Global Water Partnership South America

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SYSTEMIC STUDY OF WATER MANAGEMENT REGIMES

MENDOZA, ARGENTINA

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ARMANDO BERTRANOU

v. How it is applied

3. Regulator/Inspector

vi. Inspection

vii. Conflict Resolution

B. PERFORMANCE

i. Effectiveness

ii. Efficiency

iii. Social equity

iv. Environmental Quality

v. Participation

vi. Integrated management

C- Failures

a. Systemic Failures

b. Government Failures

II. ADMINISTRATIVE SYSTEM

A. REGIME

1. Director

i. Operational criteria

2. Executive
ii. Who administers?
iii. Who pays?
iv. Who decides to invest?
v. What water is delivered and by what means
vi. Development of policies to maintain and increase the level of collection

3. Regulator/Inspector
i. Inspection and control
ii. Conflict resolution
iii. Inter-Institutional Conflicts

B. PERFORMANCE

i. Effectiveness
ii. Efficiency
iii. Equity
iv. Environmental Quality
v. Participation
vi. Integrated management

C. FAILURES IN THE SYSTEM
i. Systemic Failures
ii. Government Failures
iii. Institutional Failures
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III. SYSTEM OF EXPLOITATION

A. REGIME
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v. Conflict resolution

B. PERFORMANCE
i. Effectiveness
ii. Efficiency
iii. Equity
iv. Environmental quality

C. FAILURES

INTRODUCTION

1. Objectives

The overall objective of this report is to provide a systematic analysis of the regulatory regime for water in the Province of Mendoza (Argentina).

This report is directed primarily to Governments, both provincial and federal. The intention is to make a useful contribution to improving water management and, among other things, to resolving the conflicts and limitations in the existing system of regulation.

2. Type of analysis

This report is a systematic analysis, in that it attempts to include all elements in the water resource system of the Province of Mendoza and the interrelationships among them. It provides an integrated view of the water resource, having been undertaken by an interdisciplinary team including professionals in legislation, administration, and economics, as well as in the physical aspects of the resource. Moreover, it has been structured to allow comparison with regimes in other countries.

3. Methodology and the Structure of the Report

An effort has been made to follow precisely the outlines provided at the GWP-SAMTAC meeting held in Santiago, Chile, 3 and 4 July 2003.

To facilitate the reader's understanding of the criterion applied to the study, the agreed methodological approach is given below.

The analysis applies to the management regime of water as a resource within the following sectors:

Agriculture

Households

Mining/Industrial

Electricity

The analysis of each sector concentrates on only three systems:

Allocation/Reallocation: this system focuses on the allocation and reallocation of the provincial water resource.

Distribution: this system is limited to the study of the abstraction, transportation, and storage of water, according to the allocations and reallocations made.

Water use: this system includes the activities related to the use of water made by each use sector, without going into an analysis of the regulation of the associated utilities.

In each of these Systems three aspects are looked at:
Regime,
Performance, and
Deficiencies.

For the purpose of the study the following definitions have been made:

Regime:
On the basis of the outline provided by the London School of Economics (LSE), the Regime is considered as a complex of institutions, rules, public and private agencies, strategies and regulatory tools, decision-making processes, and guiding principles involved in water management.

In each Regime the functions of the following are identified:

The Director,
The Operator, and
The Inspector.

Performance:
The evaluation is made from the perspective of predefined criteria. On the basis of objective data a scale of 1 to 5 has been created. The criteria used are:

Effectiveness
Efficiency
Social Equity
Environmental Quality
Participation
Integrated Management

Deficiencies
The causes of the resulting deficiencies in performance and consequent inconveniences will be determined.

These are:
Systemic Deficiencies: the reform is taking place within an incomplete communications and control system, shows rigidities limiting the response of the system to the reforms, and involves unstable institutions.

Government Deficiencies: include agency-principal problems, behaviour determined by rational choice and the theory of public decisions (the regulator or the politician takes decisions on the basis not of what is best for the community but of what is best for winning elections), limitations on resources, abilities, control, and accounting.

Market Deficiencies: incomplete or non-existent property rights, uncorrected environmental and social externalities, incomplete information systems, asymmetric

information, and lack of substitutes.

4. Importance

Land use in the arid western region of Argentina – where Mendoza is located – has always been related to the water resource. The low rainfall is an obstacle to agricultural, livestock, and industrial development and, in consequence, to human settlement. The creation of production centres and human settlement has only been possible with the adequate utilisation of the water resources from the streams of the snow-capped mountains or from groundwater.

This statement is corroborated by the geography and settlement history of the oases.

4.1. Geographic, economic and social characteristics

The Province of Mendoza, defined as the geographic area encompassing the water regime under analysis, is characterised as arid.

Mendoza is a province located in the west of Argentina. It has an area of 150,839 km^2, equivalent to 5.4% of the national territory. The population is 1.6 million, of which 80% lives in the Northern Oasis. Less than 3% of the area is under cultivation.

Statistics for the last 69 years show that the average annual precipitation is 196mm, giving the region an indisputably arid nature.

Mendoza is also a region of considerable solar radiation. According to existing studies, the solar reception is more than 600 g-cal/cm^2 a day, outstanding on a world scale.

To the north it borders on the Province of San Juan, to the south on Neuquén and the Pampa, and to the west the Andes Mountain Range separates it from Chile.

The province is mountainous. The foothills and the Andes Mountains form a tract of

territory whose width, in some places, extends to more than 150 kilometres. Mount Aconcagua, almost 7000 metres high, is part of this mountain chain, as are many very high volcanoes.

In the east of the province are the plains, crossed by numerous rivers, creating three oases. The rivers rise from snowmelt in the Andes Mountains to the west and the highest flows are in summer. In the Northern Oasis and the Uco valley significant amounts of groundwater are abstracted to complement surface resources. These are typical mountain rivers: shallow, fast flowing, with numerous rapids, and their beds are covered with stones and rocks.

Dams have been constructed on a number of the rivers to store water during the months of high flow to permit irrigation throughout the year and to generate hydroelectricity.

Ninety percent of the water is used in agriculture. Water for industrial use comes mainly from groundwater. In the oasis on the Mendoza River, 17% is used for domestic water supply.

In 2000, GNP per capita reached US$6,031.[1]

The economic activity that consumes most water is the production of high value temperate fruits and vegetables for both national and international markets. For many decades grapes have been the principle crop, accounting for half the cultivated area and 60% of the value of agricultural production. Other important crops include garlic, onions, olives, peaches, plums, pears, and apples.

Other significant economic activities are agro-industry, electricity generation, and oil extraction and refining. Exports amount to US$870 million and the principal exports are petroleum derivatives, wine, must, garlic, and fruit.

The three oases are: a) the Northern Oasis, formed by the basins of the Mendoza and

Lower Tunuyán Rivers, where 50% of the provincial population lives; b) to the south, the Western Oasis, Valle de Uco, which coincides with the basin of the Upper Tunuyán River and c) the Southern Oasis, formed by the basins of the Diamante and Atuel Rivers. Finally, on the Patagonian plateau, which occupies the southernmost part of the Province, is the oasis watered by the Malargüe River. The oases are used primarily for specialised agricultural production (vineyards, horticulture, olive and fruit orchards). See map.

In the study no reference is made to the Grande River, which is the most important water body of the Province of Mendoza.

The Grande River is formed from the confluence of the Tordillo and Cobre Rivers. The Tordillo River rises on the southeastern slopes of the Tinguirica Volcano (4,300 metres), between it and the Risco Plateado Mountain (4,999 meters), which act as the watershed with the Atuel River basin.

The agreement signed at the Sixth Conference of the Governors of the Provinces of the Colorado River, 26 October, 1976, between Buenos Aires, La Pampa, Mendoza, Neuquén, and Río Negro, awarded the Province of Mendoza the possibility of abstracting a flow of 34m^3/s from the Grande River at the Atuel River.

The average flows of the principal rivers of the Province are given in Table 1.

[1] Comentario Ecónomico de Datos, 2000, see statistical annex Mendoza.

Table 1 Average Flows of the Principal Rivers of the Province

River	Average Flow	
	m^3/second	m^3/year
Mendoza	50.2	1582
Lower Tunuyán	34.0	1065
Upper Tunuyán	29.9	943
Las Tunas	3.3	103
Diamante	37.0	1169
Atuel	34.7	1095
Malargüe	9.7	305
Grande	106.1	3345

Source: Day, Jorge and Valerie Mendoza, 2001, "Recursos Hídricos in Economía de Mendoza, Chapter 11, Universidad Nacional de Cuyo, Faculty of Economics, Mendoza, Argentina.

The storage capacity of the reservoirs in the Province is shown in Table 2.

Table 2. Storage Capacity by Reservoir, for the years 2001 and 2002

Reservoir	Total capacity in hm^3	October 2002 Volume stored in hm^3	October 2001 Volume stored in hm^3	Discharge m^3/second	% Discharge compared to total storage
Potrerillos (Mendoza)	450	98		31	22
Carrizal (Tunuyán)	344	259	240	50	75
A. del Toro (Diamante)	325	296	181		91
Los Reyunos (Diamante)	255	130	249	41	51
Nihuil (Atuel)	205	159	99		78
Valle Grande (Atuel)	160	78	119	60	49

Source: Mendoza, General Department of Irrigation, 1999, Plan Hídrico para la Provincia de Mendoza.

The cultivated area of the province is given in Table 3.

Table 3. Cultivated Area by River Basin, Province of Mendoza
(hectares)

River Basin	1988	2001
Rivers Mendoza and Lower Tunuyán	164,823	148,120
Upper Tunuyán	50,122	47,323
Diamente and Atuel	76,625	65,658
Malargüe	2,796	2,643
Total	294,367	263,745

Source: Mendoza, Directorate of Statistics and Economic Research, Censo Nacional Agropecuario, 2001 (preliminary figures).

The principal products of the region are based on agriculture, the most important being the vine, which gives rise to a significant wine industry in Mendoza. Table 4 gives the area by types of crop according to the Census of 1988, as this information is not yet

available from the Census of 2001.

Table 4. Cultivated Area in the Northern Mendoza River Basin, by type of crop (% of total area)

Crop	River Mendoza Basin	Lower Basin of the River Tunuyán
Vegetables	22	3
Grapes	58	79
Fruit	14	14
Feed	3	-
Wood	3	-

Source: Mendoza, Directorate of Statistics and Economic Research, Censo Nacional Agropecuario, 1988.

4.2 Selected Study Area

Due to the disparate nature of the river basins in the Province of Mendoza, it was decided to select the North Basin, formed by the Mendoza River and the Lower Tunuyán River, as the study area.

4.2.1. Principal Physical Characteristics of the Mendoza and Tunuyán River Basins[2]

Location of the Basin

The Northern Basin lies between the Mendoza River and the Tunuyán River in the north of the Province. The Mendoza River sub-basin includes the Departments Capital (54km^2), Godoy Cruz (75km^2), Guaymallén (164km^2), Las Heras (10,035km^2), Lavalle (10,244km^2), Luján de Cuyo (4,847 km^2), Maipú (717km^2), as well as a small part of the Department of San Martín, the districts of Galigniana Segura and Nueva California.

The Tunuyán River sub-basin, or the lower basin, is irrigated by water drawn from the dam of the Carrizal reservoir and includes the Departments of San Martín, Junín, Rivadavia, Santa Rosa and La Paz.

The total surface area of the Mendoza River sub-basin is 18,484 km^2, equivalent to 12.25% of the area of the province. While the area of the Tunuyán River sub-basin is 19,523 km^2, the irrigated area is 1, 128 km^2.

Hydrography

The Mendoza River rises in the Andes, flowing through the mountains for 90 km, between Mount Aconcagua to the north and Tupungato to the south. It flows 300 km until it reaches the Guanacache Lakes complex, where occasionally the flow (in the months of January and February) is sufficient to fill the depressions formed by the lakes. In rich hydrologic years, these lakes overflow and the water flows into the Desaguadero River. The altitude of the basin varies from 6,962 metres (Mount Aconcagua) to 600 metres in the lake region.

The water used in the oasis comes almost completely from a mixture of snow and glacier water from the Andes Mountains. Rain only falls in the spring and summer months and its contribution to the flow is insignificant. The Mendoza River starts at the confluence of the Cuevas, Tupungato, and Vacas Rivers at Punta de Vacas.

From Punta de Vacas, the Mendoza River flows northeast to the Uspallata valley, following an old line of fractures, and then it turns towards the southeast to flow between the Cordón del Plata and the foothills down to Alvarez and Condarco, where it enters the eastern plains to drain, in the north of the province, into Rosario and Guanacache Lakes. (See map).

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[2] General Department of Irrigation, Descripción física de la cuenca del Río Mendoza y Tunuyán Inferior, 1996.

The river has an average annual flow of 50.6 m^3/second, as measured at the Aforos Cacheuta station where the basin has an area of 9,040 km^2.

Hydrogeology of the Area around the Rivers Mendoza and Tunuyán

The northern section consists in a wide plain located approximately between latitudes 32° 20" and 34° 40" south and longitudes 67° 10" and 69° 00" west. The natural limit to the west is the Andes foothills, to the south, the tertiary outcrops of the Carrizal, La Ventana, and Vizcacheras anticlines and, to the north and east, the Rosario Lakes and the Desaguadero River (Figure 2[?]).

Within these limits is a hydro-geologic basin with an important groundwater reservoir, crossed on the surface by three water courses: the Mendoza River, the Tunayán River and Carrizal Creek, whose average flows are respectively, 50.6 m^3/second, 30 m^3/second and 1 m^3/second.

The groundwater reservoir is made up of aquifers that cover all the subsoil of the region with water levels varying from emergence at the surface to more than 200 metres depth.

The groundwater system receives an average annual recharge of approximately 600 hm^3, has a total storage of more than 270,000 hm^3 and an extractable volume, at reasonable cost, of 25,000 hm^3.[3]

The aquifer is found in the basins of both the Mendoza and Tunuyán Rivers and includes both confined and unconfined aquifers.

The aquifer has an area of 22,800 km^2 of which the western sector, covering approximately 10,000 km^2, is subject to intense extraction, principally for agriculture. The eastern section of some 12,000 km^2 has lower use, directed mainly to livestock.

[3] Hernández, Jorge and Nicolás Martinís, "Modernización del manejo de los recursos hídricos. Agua subterránea. Cuenca del Río Mendoza y Tunuyán Inferior" National Water Institute-Andean Regional Centre, 2001

The depth of the aquifer varies between 240 and less than 5 metres. In the area of transition between the confined and unconfined aquifers there is a 250km^2 area of emergence. The confined aquifer is structured into three depths for exploitation: 1, between 60 and 120 metres, 2, between 150 and 200 metres, and 3, between 240 and 350 metres.

The average depth of the saturated zone is 150 metres, with a storage coefficient of 0.08. The total reserves of the aquifer have been estimated to be 275,000hm^3, whereas the economically exploitable reserves are estimated at 8,200hm^3. The average annual extraction is 380hm^3 with a minimum of 100hm^3 in periods of high surface flow and a maximum of 600hm^3 in drought years. There are some 19,000 wells in the basin.

In the North basin there are 165,000 hectares under irrigation, 70% of which use both surface water and groundwater or only groundwater. Of the 19,000 wells registered for groundwater extraction in the Province, 11,000 are in the North basin. 27% of the water used for domestic consumption comes from groundwater, which is also the main source for industry.

Table 5. Available Water Supply in the Northern Basin,
surface and groundwater sources.
(Normal year hm^3)

Surface Flow	Available Groundwater	Total
2649	800	3449

Source: Mendoza, National Water Institute, 1999, Informe Ambiental.

Table 6. Water Allocation in the Northern Basin, by use and source: surface or groundwater (Hm^3 2003)

Use	Source	Allocation
Irrigation	Surface	2439
	Groundwater	463
	Total	2902
Drinking Water Supply	Surface	198
	Groundwater	35
	Total	233
Industry	Surface	103
	Groundwater	n.d.
Others		35

Source: Based on data in the Informe Ambiental, 1999, National Water Institute and the Censo Agropecuario 2001 (preliminary figures).

5. Historical Evolution and Water Resource Policy

A. Five stages can be defined:

a) The indigenous population: The settlement at Huantata, the centre of the Huarpe Indians was irrigated by "four canals: the Guaymaré, the Estabaleste, the Allallme and the Caubanete. Each name corresponds to that of a local chief. They grew mainly corn along with other pre-Colombian crops".[4]

These lands were at the extreme south of the Inca Empire and, undoubtedly, members of this very important American culture must have contributed to their development. As has been shown, "in the original settlement and its continuance, the canals and local crops were more significant for the people of Mendoza than the intervention of Spanish colonisation. The other settled areas, Guanacache Lake, at the mouths of the Mendoza River and the San Juan River, and the Uco and Diamante valleys were also founded on the basis of the availability of water".[5]

"The use of water for irrigation has built, little by little, a body of jurisprudence which over time has added a significant local contribution to European legislation, conditioned by the characteristics of the region. Irrigation was the lever that propelled industrial progress in Mendoza and San Juan. The Spanish found a considerable and fully functioning hydrographic network built by the indigenous people. There is no indication

[4] Draghi Lucero, Juan (1945), "Actas Capitulares de Mendoza," Vol. I, p.LXXVIII, Buenos Aires.

[5] Laría, Salvador Carlos (1961), "Contribución al conocimiento y nomenclatura de los principales ríos de Mendoza en la época de la Revolución de Mayo", in Anales de la Sociedad Argentina de Estudios Geográficos, Vol. XI, Buenos Aires: Coni, pp. 53-58.

that the colonists excavated new canals until two centuries later, which is evidence of the quality of the indigenous works."[6]

b) **The Spanish occupation:** The Spanish, with the arrival of Marshall Francisco de Villagra around 1551, the later founding of Mendoza by Don Pedro del Castillo in 1561, and the arrival of Juan Jofré in 1562, encountered a very poor region. It was separated from Chile by high mountains that were blocked by snow for several months each year, and was surrounded by an immense desert. Here, on the basis of the existing watercourses, they developed the cultivation of wheat, other cereals, and fruit. Grapes became one of the principal commercial products.

During the governorship of the Marquis of Sobremonte basic works were built for flood protection and for the rational distribution of water for irrigation. Works were planned for abstractions from the Mendoza River, the Tunuyán River, and the Guanacache Lakes.

The expansion of crops was based on both the existing canals and those that were being built.

"By the middle of the 18th century there were 83 secondary canals fed by the Mendoza and Tunuyán Rivers. The judicial and economic regime for irrigation was perfectly regulated."

"The water delivered to each irrigator was in proportion to the area to be irrigated. That is, the system of *proportional volumes* was applied. The water was measured by *water regulator* and distributed by turns. Each irrigator had to pay proportionately to maintain the service on the basis of so many reales per cuadra, which, at the end of the 18th century, was 1 real."

" In order to irrigate, each land owner had to request the opening of an intake for the diversion of water from a ditch or canal to his farm. However, as the cultivated area expanded, there was some considerable proliferation of illegal abstractions. Consequently, numerous lawsuits arose both over these and over water rights and their distribution."[7]

c) From Independence to national organisation (1810-1853)

According to Guillermo Cano, "the creation, on 15 October, 1810, of the Juez de Aguas, an administrative institution specifically charged with administering irrigation coincided with the birth of the nation."

"The first organically regulated distribution of water was in the cities (Reglamento de Policía, 5 January, 1813), undoubtedly because of their priority over the countryside due to their economic importance, a priority that was later lost."

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[6] Draghi Lucero, Juan, op.cit.

[7] Martínez, Pedro Santos (1961), "Historia Económica de Mendoza durante el Virrreinato", Universidad Nacional de Cuyo e Instituto Gozzalo Fernández de Oviedo, Madrid, p. 89.

"The first attempt to systematically regulate the administration of all water, both urban and rural, was the Reglamento de Cuerpo Capitular of 1820-25, which seems to have applied until the approval of the Reglamento General de Aguas of 1844. When the position of Juez General was created in 1833, the post was given "the authority which this activity had held before it was abolished".

"The legislation of this period was always adapted to the agricultural and economic characteristics of the various irrigation areas through the approval of specific regulations for each of them, following the outline of the general legislation, but taking into account the particularities of each agricultural region. These specific regulations came into being as the extension of the cultivated area created the necessity for regulation. The first was approved on 13 January, 1837 for San Martín."

"Also worth noting are the regulations for the "Acequia del Estado – now the Jarillar Canal – of 18 November, 1842, and for the canal "El Retamo" of August, 1852."

"As can be seen, the Retamo Regulation ruled the irrigation of almost half of the cultivated area of Mendoza from 1853 to 1884, and this has induced one author to affirm that irrigation in the whole of the Province was administered under this regulation, despite the existence of the Reglamento General de Aguas of 1844."

"The most important water law of the intermediate period is, undeniably, the Reglamento para el Juzgado de Aguas, signed by Governor José Félix Aldao, 1 October, 1844."

"Its application lasted for 40 years until the passing of the law of 1884, which is still in force. Therefore, it governed one of the most important stages in the economic history of Mendoza. During this period there was a rapid and large-scale expansion of the agricultural economy, the transformation from production only for domestic consumption to export, the evolution towards intensive cultivation of the land, and the beginning of wine production as the primary industry of Mendoza."

d) From national organisation (1853) to the end of the 19th Century

"After 1852 the State intensified activities promoting the expansion of irrigation and of the cultivated area through the construction by the government of numerous irrigation works. Previously the building of canals had been left to private interests and initiatives and their financial capacities. However, from this period on, numerous laws were passed supporting the construction of canals and of irrigation works with public funds, sometimes reimbursed, sometimes not."

"It was also at this time that irrigation management began to be decentralised, but only *in the bureaucratic sense*, through the establishment of "subdelegaciones de aguas" in nearly all the departments into which the Province of Mendoza is politically divided."

"The first Constitution of Mendoza, 17 November 1855, art.57, para.3, apparently committed the error of giving the Municipalities the right to allocate water, establishing a decentralised water management system. Fortunately, however, this decision never had

any practical effectiveness, because the municipalities only began to be regularly constituted in 1869. In 1871 the Governor of Mendoza pointed out to the Legislature that municipal institutions had not yet entered public awareness or practice, and informed it that there were only two organised municipalities, Guaymallen and San Vincente (today Godoy Cruz), remarks that he repeated the following year."

"The first basic law creating municipalities that was really effective was that of 28 August, 1872, which in art. 16, para. 16 evidently reverted the apparent dispositions of the Mendoza constitution of 1855. It gave the municipalities only 'the distribution and regulation of the use of water in the ditches inside the city' that is, of the urban water, the main use of which was not for irrigation but for drinking and the watering of the trees in the streets."

"Later the extension of the cultivated area and the subordination of the economy to agricultural production resulted in the appreciation that an adequate distribution of water was a matter of public interest. A logical corollary of this new idea was that general costs, that is those benefiting the whole system of irrigation (the salary of the magistrate, works in the river etc,), were to be met by the public treasury. When this happened, the contributions, which applied only to the cultivated lands that used irrigation water, became transformed into *taxes*.[8] In effect, due to the increasing extension of the cultivated area, the tax moneys collected exceeded the amount of the common costs and were invested to meet other expenses of the State.[9]. So real property, until then taxed exclusively when irrigated, and only in the amount required to pay for irrigation, began to be subject to a different tax: the tax was changed into a *general property tax*, applied only in a very minor part to the cost of irrigation, and mainly towards the general cost of government.[10] As a result of this change, irrigation services of interest only to one irrigator or one group of irrigators remained, as before, an exclusive charge on them to be met by another kind of tax or by contributions in the form of labour."

"The next step was the extension of the land tax to non-irrigated land, that is uncultivated land, which meant definitely and totally abandoning the idea that the basis of the tax was paying for irrigation."[11]

On the other hand, there was already evidence of the search for groundwater and of the first sinking of wells.

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[8] In Mendoza, no cultivation without irrigation is possible, because the average rainfall does not exceed 200 mm.

[9] ROM, 1871, p. 176. Law of 21 January 1871, art.8, under which the studies to ascertain the existing proportion between the quantity of water in the rivers and the needs of the cultivated lands should be paid with part of the product of the land tax.

[10] V. ROM, 1865, pp. 523, 527, and 529. The tax law of 1864 charged the land tax on all cultivated land, "whatever the source of water used for irrigation", that is, whether it is public or private water. The budgeted costs for water where $1,740 for all of 1865, whereas the income from the land tax in the same year was calculated to be $12,000.

[11] Cano, Guillermo (1941), Régimen Jurídico-Económico de las Aguas de Mendoza, durante el período intermedio 1810-1884, pp. 24-30.
Lorente, Faustino (1968), "Fuentes y Evolución del Derecho de Aguas de Mendoza".

"In 1872, the government of Mendoza awarded to Gregorio Guevara and Jésus María Soto 'the exclusive right – for a 10 year term – to open artesian wells in the province'. This concession would expire at the end of one year after the law came into effect if they had not begun the works."[12]

e) From the end of the 19th Century to the end of the 20th Century

Continuing the process begun in the preceding period, and now primarily based on the development of the wine industry, a set of coherent policies were adopted which allowed a significant expansion of the settlement of the irrigated oases, both for cultivation and for significant population centres.

The principal elements of the these policies, directed by a series of important politicians, led originally by Emilio Civit, were the following:

a. The passing of the Water Law

b. The adoption of the Provincial Constitution. It included a separate chapter on the water system. The basis points were: the concession of water rights under a specific law, the participation of the users in water management, the creation of a specialised, autonomous, politically stable, and financially independent institution, the principle of the inherent relationship between land and water (the water right could not be sold separately from the land), and the requirement of a law to authorise large hydraulic works. All together, this regime offered legal security, transparency in the allocation of water, self-imposed limitations on political interference, and security to the users.

c. The incorporation of masses of European immigrants into rural land-ownership, through the contracting system of vineyards and fruit farms, under which the workers received shares in the profits, which they generally used to buy land.

d. The use of the railway to supply local products to the markets on the Argentine Atlantic coast led to the development of a strong and expanding domestic market.

e. The creation of General San Martín Park, designed by the architect Thays to protect the city from the floods caused by the occasional heavy summer storms. The construction of a sewage system, proposed by Emilio Coni, was designed to prevent sewage from entering the public watercourses, putting an end to periodic epidemics.

f. River through the construction of a dam, designed by the engineer Cipolleti, and a hydroelectric generating station at Cacheuta, built by Carlos Fader, but later destroyed in a flood.

[12] Pérez, Martín (1961), "Acrecentamiento del área de cultivo en Mendoza mediante el empleo de agua subterránea", in Anales de la Sociedad Argentina de Estudios Geográficos, Vol. XI, Buenos Aires: Coni, p. 225.

a. The study of a proposal for the development of the Atuel and Diamante Rivers in the Southern Oasis for water and the generation of electricity, and the initiation of the hydrologic survey of the Grande River, the largest in the province, and which today still remains undeveloped.[13]

This was the foundation for the occupation of more than 350,000 hectares of irrigated land and a population of more than 1,000,000 in the middle of a desert with no important natural resources.

This structure, designed at the end of the 19th and the beginning of the 20th centuries, was maintained, despite various crises, by the succeeding provincial governments.

The more or less simultaneous formulation of all these policies indicates that the Province was applying systemic criteria for development, anticipating plans developed many years later. They argued for settlement on the basis of economic activities with market and transport possibilities and, on the other hand, the solution of the basic environmental problems that the region faced at this time. Undoubtedly, in formulating this proposal, advantage was taken of a set of favourable circumstances. The federal government decided to extend the railways west, in the construction of which Guillermo Villanueva was involved, one of its most important supporters. Furthermore, Emil Civit had been an outstanding Minister of Public Works under President Roca. Also, the European wine crisis caused by the destruction of the vineyards by phylloxera led many important groups of Spanish, Italian and French wine growers to move to the Cuyo region. Tiburco Benegas developed a competent enology. The local politicians, as a social group, had direct knowledge of events in Europe and the rest of the world. Proof of this last, is that they were simultaneously beginning the development of the Mendoza Oil Company to exploit the oilfields of the Province and of the North of Argentina on the basis of local capital, following within a few years the activities of Rockefeller in the USA. The overall project had difficulties in placing its products when the railway was transferred to British ownership, a move Civit opposed, since high freight rates soon became an obstacle to the sale of Mendoza wine and oil in the coastal markets.

Without doubt this project, based on the use of natural resources, gave sustainability to the Cuyo region. It was possible due to the simultaneous presence of a group of highly qualified leaders and the coincidence between their private interests and the general interests of the Province.

Awareness of the scarcity of water led to the redirection of its intensive use towards wine production, which had high economic returns per hectare. This meant a return to emphasing wine production, which had previously been the base of the socio-economic development of the region. It had entered into crisis at the beginning of the 19th century with the opening of the port of Buenos Aires and the consequent competition of European wines. This was aggravated by the loss of manpower due the massive incorporation of the population into the Army of the Andes and the later period of civil wars. These events

[13] Olascoaga, Manuel J. (1935), “Topografía andina y aguas perdidas”, in Junta de Estudios Históricos de Mendoza.
Olbrich, Jorge (1959), “El Río Grande.” Buenos Aires: Hachette.

had transformed Mendoza, converting it into an important producer of wheat, in more humid areas, and of alfalfa for fattening cattle that were then driven to Chile.

From 1855 this situation began to be reverted with the arrival of French wine producing experts, like Pouget and Lefrere, opening the possibility of once again producing quality wines.[14]

B) The Crisis in the System

The social, economic, and cultural model of the Province of Mendoza based on the intensive use of water in the Northern, Central and Southern Oases was maintained for more than one hundred years, despite numerous passing crises resulting from the nature of wine production.

The successive governments, of different political tendencies, sustained their budgets on internal taxes; the co-participation resources received from the federal government, and the oil royalties.

Agricultural production was structured on a base of medium-sized farms, with the work charged to contractors who received a proportion of the production, and salaried workers.

The domestic market, with a high per capita consumption of wine, despite periodic variations, maintained the continuity of the economic model and also of the system of water management.

Oil production and the water utilities were in the hands of state companies. In the former, there was an argument over the control of the resources, but this did not affect the availability of water.

Towards the end of the 1970s there was a serious deterioration in the national economy with a fall in wine consumption and a contraction in the wine industry, which ended in the 1980s with the collapse of one financial-industrial group. Some of the companies acquired by the group were transferred to the State, which administered them so poorly as to cause their almost total collapse.

The result was a transformation in the local situation that, together with the appearance of a number of new factors, had a decisive effect on the provincial water resources.

Below are the principal aspects of the present situation:

1. *Transformation of the productive oases.* Population growth, both natural and through domestic and foreign immigration, has led to an expansion of the urban centres, occupying lands previously under agriculture, both for high income suburbs and by people living in extreme poverty. This has caused uncertainty about the water rights attached to this land.

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[14] This entire process has been studied in detail in our work. Díaz Araujo, Edgardo, *La Vitivinicultura Argentina*, Vol. I, Idearium, University of Mendoza, Mendoza, 1989.

2. *Changes in the structure of the wine industry.* The combination of the reduction in the profitability of the land irrigated by surface water, due to the decline in consumption, and, consequently, in the price of ordinary wines, with the development of a new form of high quality wine production, based on irrigation with modern technology (pressurised drip), often provided by companies from outside Mendoza, has changed the technological, social, and economic structure of the industry.

3. *The subdivision of land.* The inheritance laws have resulted in a subdivision of the medium-sized farms giving rise to a proliferation of very small, uneconomic farms, with serious difficulties in the application of modern production and irrigation techniques. This has had a serious impact on the water resource, as approximately 80,000 hectares have been abandoned, the majority with assigned water rights, and it is not known with any certainty the use given to this water as there is no up-to-date register of irrigators.

4. *The granting of subsidies without economic justification.* In the 1970s both the Federal Government and the governments of the Cuyo provinces adopted subsidy policies based on tax allowances for the use of land without access to irrigation from surface water sources, land that is irrigated from groundwater. High yield grape varieties were planted on this land and, with the decline in the consumption of ordinary wines, the crops have been difficult to market and prices have fallen, producing fiscal and banking crises, the effects of which still persist.

   These policies did not take into account the fact that water is a production input that itself should have a market. On the contrary, not only did the policies upset public finances, but they also changed the prices of pre-existing production.

   The subsidies given to the wine industry through tax allowances in the 1970s were not economically justified, as many people who received them used the benefits to plant vines, which, due to their characteristics, were later difficult to market. The resulting over-production produced a fall in prices and financial crises. This is directly related to water resource management, as a proportion of these plantations were based on the use of groundwater.

5. *Pollution of the aquifers.* Due to the over use of the aquifer and, to a lesser degree, poor management of the wells, there has been significant salinisation of the aquifer.

6. *The appearance of groundwater discharges in the Southern Oasis.* The retention of sediments in the hydroelectric works on the Diamante and Atuel Rivers has caused the water table to rise. This has led the farmers in this area to submit a legal claim, demanding indemnification for the flooding of their land.

7. *Construction of the Potrerillos Dam on the Mendoza River:* There are doubts whether funds are available to waterproof the derivation channels, with the consequent danger of modifying the behaviour of the aquifers in the northern part of the Province. It should be added that when the decision to build the dam was made, not all the studies of

its economic viability had been completed. This was possible as there is no specific requirement to consider the social benefits of investments made or promoted by the State.

8. *Pollution of the Carrizal Reservoir.* The use of the shore for tourism and the activity of the nearby oil industry have produced changes in the water of the reservoir that regulates the lower course of the Tunuyán.

9. *Privatisation of Hydroelectric Generation.* The ownership of the generating stations on the Atuel and Diamante Rivers has been transferred to private companies. These have met all the requirements of the General Department of Irrigation (DGI) in the management of generation flows, but they have a private interest in producing the maximum energy from the reservoirs. One particular conflict resulted from the release of water due to an alarm over the structure of one of the dams, which led to the flooding of the land below.

10. *Lack of sewerage works.* These would allow the complete treatment of sewage in the south of the province. The sewage from one of the plants in the north of the province is not correctly controlled leading to the discharge of a degree of pollution in a restricted area, including some irrigation areas.

11. *Lack of control over the oil industry.* The conflict in jurisdiction between the Federal and Provincial governments has led to an inadequate regulation of the oil industry, giving rise to pollution due to the spills from the ponds of recovered water into surface streams in the producing areas. This situation has come into prominence with the possibility of exploiting the oil field under Llancanelo Lake in the south, an animal reserve of international significance. This particular issue is presently under judicial review.

12. *Concerns over provincial powers.* When Law No. 25688 came into effect the absorption by the Federal government of provincial powers began to affect water management. With the excuse of establishing an environmental management regime, a supra-provincial authority has been imposed on river basins. This has impeded regulation, particularly in the case of the pollution of aquifers.

The objections to this law are discussed below.

A similar effect has resulted from agreements the Federal government has signed on the protection of foreign investments and related agreements on submitting disputes to the International Centre for Dispute Resolution in the World Bank in Washington. These agreements apply to local governments. They have been used indiscriminately so that now there are an important number of cases before that body questioning decisions of the provincial governments. The provincial governments cannot intervene in these cases and, furthermore, the submission to the local courts included in the contracts no longer applies. This is a serious situation that impedes the provincial governments in the adequate exercise of their authority. The conflicts are currently being analysed and

discussed and, depending on the results achieved, could substantially change the division of powers and jurisdiction between the provincial and federal authorities.[15]

13. *The loss of the legitimacy of the political class*. The politicians appear to be disqualified in the eyes of the public and are subject to strong contradictory pressures as a result of their failure to resolve basic problems. This has affected the DGI, where the election of the Superintendent has become a political rather than a specialised technical affair.

14. *Lack of irrigation user participation in the Canal Inspectorates (Inspecciones de Cauces).* The absence of profitability, indebtedness in the payment of contributions, and the abandonment of land once in production has influenced the participation of the farmers in the irrigation associations.

15. *Merging of Inspectorates.* To reduce the difficulties faced by the canal authorities, it has been made legally possible to form associations with greater technical and financial management capacity. In some cases this has resulted in improvements in efficiency, but in others the inordinate increase in operational costs has been criticised.

16. *Construction in the foothills.* There has been a growing development of expensive suburbs in the foothills, with a major demand for water supply. In some cases they have been supplied with groundwater, but others have been built on the supposition that aqueducts will be built taking water directly from the Mendoza River. This raises conflicts with pre-existing rights.

Building in the foothills also requires landslide protection works. This danger was solved for the City of Mendoza by the building of collector drains and the building of General San Martín Park. Obviously, proposals for urbanisation above these works will require new protective infrastructure.

17. *Discussion on the revision of the legal regime for water management.* There is currently discussion of:

a) Should the principle of the inherent inseparability of water and land be maintained, as protected in the constitution?

b) Should a market mechanism be introduced?

c) Is the allocation of water to land excessively rigid?

d) Who owns the rights over treated effluent?

e) Can the supply of groundwater be maintained?

[15] Tawil, Guido Santiago, “Los conflictos en material de inversion, la jurisdicción del CIADI y el derecho applicable”, Rev. Per. La Ley 20/11/2002, Buenos Aires, p.1 among other sources.

f) Is the organisation of the irrigators adequate and efficient?

g) Who should finance the externalities stemming from hydroelectric works?

h) Should a land use law limit urban expansion in the irrigated oases?

i) Is it possible to legalise eventual rights?

j) Is it necessary to have obligatory models for the evaluation of public investment projects?

Some argue that the existing model no longer reflects reality and that it is necessary to formulate a new integrated project.

In the light of this discussion, there are questions whether, in the event of the elimination of the system of water concessions granted by the Legislature, which cannot be sold separately from the land, there are adequate safeguards to prevent governments discriminating in the assignment of water rights or to prevent a concentration of the use of water by large industrial and real estate companies through the purchase of rights. It is not possible to measure or evaluate these situations now, but there are indications that these situations could cause conflicts.

6. The Structure of the Regime

6.1 The General Legal Framework

The Province of Mendoza forms part of the Argentine Republic, which is governed by the Federal Constitution of 1853 as reformed in 1860, 1866, 1898, 1957 and 1994. The form of government is representative, republican, and federal.

Under the federal system, the Provinces retain all powers not delegated by the constitution to the Federal Government (art.121). Their powers are derivative and undefined. The powers delegated to the Federal Government are specific and defined. Amongst these is the authority of the Federal Congress to dictate the basic laws, the management of external affairs, the navigation of internal rivers, and domestic and foreign trade (art.75).

Both the Federal Government and the Provinces can exercise the concurrent powers for the development of the Nation. These powers are defined in the so-called Progress Clause, which refers to, among other things, the promotion of industry, immigration, railway and canal building, colonisation of public lands and the introduction of new industries (art.75 para.18 and art. 125).

In environmental matters, the Federal Government can set basic standards, but it corresponds to the Provinces to complement and apply them. The provinces can raise the minimum standards of environmental protection set by the Federal Government, but they cannot lower them (art. 41).

6.1.1. Water Resource Law

A) Federal Law

Under the Federal Constitution (art.124) the provinces have **dominion** over the natural resources found in their territories. It should be made clear that dominion is not equivalent to property, but refers to institutional power over natural resources.

Under the Civil Code, rivers, their beds, other water running in natural courses, and all water that has or acquires the ability to satisfy uses of general interest is a public good (art.2340 para.3).

Springs, which rise and die within the same property, belong to the owner for his use and pleasure. (Art.2350)

Groundwater is in the public domain, without prejudicing the regular right of the owner of the land to extract it for his own use, subject to the regulations (art.2340 para 3, under law 17711).

Although there are numerous federal laws and regulations referring to water resources, mention must be made of a recent law, Law No. 25688, which has been the cause of much discussion. This law is entitled Environmental Management of Water Resources. Its first article states that its objective is to establish minimum environmental standards for the conservation of water and its rational use. Despite this apparent aim, it allows the creation by the Federal Government of Water Basin Committees for Interjurisdictional River Basins, permitting interference in provincial affairs, which is obviously contrary to Argentine constitutional law. This situation has merited well-founded criticisms from very senior lawyers.[16] The imposition on the part of the Federal Government of supra-

[16] Pigretti, Eduardo A. (2003), *Gestión Ambiental de Aguas*, Anales de Legislación Argentina, Doctrina, Boletín Informativo No.1, La Ley, Buenos Aires, pp. 41-42. "It should not be called environmental management, but simply river basin management." "The designation we are criticising will tempt the Executive Power to issue distorting regulations to which we will return later." "Neither do we believe that it deals with minimum standards, even though the law is very short. Despite its shortness, its content is of maximum standards for water management, and yet there is nothing about the environment." "It is remarkable that, using the subterfuge of a technicality, water management and legal aspects are mixed together, with no possibility of establishing an authentic relationship between the social and the physical sciences, a theme we have always advocated in the hope of establishing an interrelationship between them, as Dr. Osvaldo Canziana, a well know Argentine authority, has frequently advocated." "We cannot but think that this type of legislation pursues no other end than to transfer powers not delegated from the Provinces to the Federal Government." "There is a kind of legal desperation to try to convert a federal country into a unitary country, without the necessity of undertaking a constitutional reform". Amílcar Moyano more generally questions the abusive use of minimum standards under article 41 of the Federal Constitution. Moyano, Amílcar (2003), "El derecho ambiental en el Estado Federal

provincial institutions for river basin management conspires against the adequate management of the resource, as it gives rise to bureaucratic structures foreign to the geographic reality of the resource, and which are impossible without the knowledge and control that come from immediacy. Further, it imposes a single criterion on all river basins, ignoring the fact that within the same basin there are provinces with quite different situations affecting the use of the water resource. In the particular case of Mendoza, its inter-provincial rivers are linked with the provinces of La Pampa, Río Negro, Neuquén, San Luis and Buenos Aires where there is no systematic irrigation, nor any organisational structure of irrigators, which means that the participation of the users in water resource management is weak. Moreover, this is complicated by very different agricultural and economic situations. Finally, the oil companies have already used the existence of federal river basin authorities in an attempt to avoid fines for pollution levied by local authorities.

This law has given rise to fierce opposition from the irrigators and the government of Mendoza. They are taking two approaches: a legal approach, with the intervention of the Provincial Prosecutor claiming that the law is unconstitutional, and a legislative approach, with the preparation by the deputies of the Province of Mendoza of a bill for the modification of the law.

B) Provincial Law

The water laws governing the Province of Mendoza include the Provincial Constitution of 1916 (art. 186 to 196), the Water Law of 1884 and its regulations of 1905, Laws 4035 and 4036 concerning groundwater, and Law 6405 on the Canal Inspectorates and their Associations.[17]

These laws have resulted in the following fundamental elements in the water law and in the administration of the water resource in Mendoza:

- *Legal Concession:* Water in the public domain of the province is given in concession under the laws of the provincial legislature (art. 194 of the Constitution of Mendoza).

Argentino", La Ley Gran Cuyo, Voces Jurídicas, Año 8, No.4, August, 2003, Buenos Aires, p.439.

[17] These laws are complemented with the following: The General Environment Law, 5961. Law 6021 Eco-Atlas. Environmental Impact Evaluation: Decrees 437/93, 691/93, 2109/94. Discharges: Law 5917 dangerous discharges and Law 5970 urban discharges. Protected Areas: Law 6045 and Law 6394. Soils: Law 4597, adhesion to Federal law 22428 soil conservation, Law 3776 and 5239 municipal zoning, Law 4341 and 4376 property subdivision, Law 5804 Land Use Plan for western Greater Mendoza, Law 4886 Land use and subdivision of western Greater Mendoza, Law 5761 Creation of and Urban Environmental Reserve and Decree 1077/95 Regulation of Law 5804. Flora, Fauna and Fish: Laws 2088, 4258, 2376, 5733, 5753,4602 and 4428.

- *The Inherence Principle:* The use of water given in concession is a right inherent to the land; water cannot be sold separately from the land, or the land without water (art. 187 of the Constitution of Mendoza).

  Termination of the Concession: If the right of water use is not exercised for more than 5 years, the administration can cancel the right granted.

- *Autonomy:* The General Department of Irrigation (DGI) enjoys autonomy derived from its nature as a decentralised and financially independent institution as established in explicit constitutional rules (art. 186 to 196 of the Constitution of Mendoza of 1916, presently in force).

- *User Participation:* users of the canals, ditches, and drains have the right to elect their authorities and administer their respective revenues, without prejudice to the control of the higher irrigation authorities (DGI) (art. 187 of the Constitution of Mendoza).

- *Independent Management of the Rivers:* The water laws allow independent management for each river, without prejudicing their dependence on the DGI.

- *Stability and Financial Independence of the Water Management Authority:* The higher authorities of the General Department of Irrigation, the Superintendent and the Counsellors representing the Provincial Rivers who form the Honourable Administrative Tribunal and the Council of Appeal, are elected and confirmed by the Governor with the agreement of the Senate. The General Department of Irrigation applies the water law, manages the resource and the revenues for rivers, dams and the main canals.

- *Financial Independence of the Canal Inspectorates:* The management, use, control, conservation, maintenance, and preservation of the canals, ditches, and irrigation drains of the province, as well as of the water transported by them, is the responsibility of the Canal Inspectorates, under the dispositions of Special Chapter Section Six, General Department of Irrigation of the Provincial Constitution (art 1 of Law 6045). Secondary canals, their laterals, ditches, and drains are managed through the users by the Canal Inspectorates, which are financially independent and the inspectors are elected by the users, without submission to higher authority, although the legitimacy of their decisions is subject to the administrative control of the General Department of Irrigation.[18]

- *Canal Inspectorate Associations:* The first major reform in the institutional structure for water management in the province at the user level was initiated in 1985. It resulted in the merging of Canal Inspectorates[19] (organisations of the users of surface water), a process promoted by the General Department of Irrigation with the objective of achieving administrative, financial, and technical efficiency through economies of scale.

[18] This condition has been confirmed by the Supreme Court of the Province of Mendoza in the case Troncoso, Carmelo R. v. the General Department of Irrigation.
[19] Resolution No. 6393, Honourable Administrative Tribunal, DGI.

In the case of agricultural use, the absorption of inspectorates serving areas smaller than 1,000 hectares produced an increase in the area under each Canal Inspectorate. Water management was left in the hands of 27 Inspectorates, which covered a total of 200,000 hectares. There were 750 Inspectorates in 1984 and now there are only 164. Each Inspectorate can contract a technician to manage the network, undertake and oversee the construction of works, and optimise water management. In 2000, following principles similar to those applied in 1985, Resolution No 163/93 was issued, establishing a procedure to allow the grouping of Canal Inspectorates into Canal Inspectorate Associations.[20] Today there are 17 of these. These new organisations stem, with the approval of the Honourable Administrative Tribunal of the DGI, from agreements among Inspectorates that have merged because they are in the same area and share a common problem. In contrast with the reform of 1985, these Inspectorates maintain their autonomy.[21]

The users of the associations are the participants in the subsystem (farmers, domestic consumers of drinking water, industrialists, street trees, mining, oil etc.).

- *Groundwater:* When works are required, the survey, use, control, recharge, conservation, development, and utilisation of groundwater is governed by Law 4035 and administered by the General Department of Irrigation under Law 4036. The DGI also has authority to issue all the regulations and rules required for the exercise of its powers of control. These include the declaration of areas of temporary prohibition or restriction, the measurement of flows, and the designation of areas of ecological protection. Since 1977 it is obligatory to install a flow meter or similar device for each new well.[22]

6.2 The Institutional System

6.2.1. Public institutions – General Department of Irrigation

The General Department of Waters was founded in 1884. In 1894 its name was changed to the Department of Irrigation. Later, in the Constitution of the Province of Mendoza of 1916, art. 188, Section VI established that "all matters related to irrigation in the Province, lying outside the competence of ordinary justice, will be exclusively the responsibility of a General Department of Irrigation".

Characteristics of the Agency:

[20] Law 6405, Law of Canal Inspectorates, Art.14.
[21] Law 6405, Art 15: "CONSTITUTION". To form an association of Inspectorates the express consent is required of the Canal Inspectorates with interest in the merger, manifested through their respective General User Assemblies and without affecting their autonomy. The General Department of Irrigation will issue the respective act of approval."
[22] Boris, Rubén, "Panorama actual del agua subterránea a veinticinco años de la sanción de las leyes 4035 and 4036", La Ley Gran Cuyo, Year 6, No.3, June 2001, Sec. Doctrina, pp.424-426.

The principal characteristic of the DGI is its constitutional rank, which gives it special status and support, assuring, among other things, its institutional and managerial continuity within the province.

It should also be noted that it is a financially independent and decentralised institution, which means that it elaborates and executes its own budget on the basis of its own resources raised from water users, and is guaranteed independence from the provincial executive power.

Both surface water and groundwater (confined in aquifers or not) are managed by the DGI. The long-existing tradition in the management of surface water has sustained the organisation of the institution for many years.

Although the DGI has authority over all the water resources of the Province of Mendoza, it has principally concentrated on the management of surface and groundwater for irrigation. This use is the most important in volume and in number of users. In some areas one source is used exclusively, in others there is joint use, and in some areas groundwater is used to supplement surface water during droughts. The reuse of effluents has recently been added to these sources for irrigation.

The province has elected to decentralise water management. The government owns the resource, because it is considered to be a public good, and generates the policies, but leaves the management at the secondary and tertiary levels to water user organisations. This has produced a system of double decentralisation in water management, as the province delegates responsibility for water to the General Department of Irrigation and this, in turn, to organised user communities. The result has been the formation of a culture of user participation in water management that is reflected in the institutions and, as has already been mentioned, that is recognised in the existing legal system.

The General Department of Irrigation shows a further particularity in the conformation of its overall structure. It consists of three organs with responsibilities mirroring those of the organs of the Provincial Government: an Executive Organ headed by the Superintendent and his representatives for each river basin (River Sub-delegations); a Judicial Organ in the Council of Appeal, constituted of representatives of the users of the provincial rivers; and a Legislative Organ, the Honourable Administrative Tribune, formed by the Superintendent and the members of the Council of Appeal.

To create smaller water management units, the province has been divided into jurisdictions based on river basins to which the Superintendent’s functions are delegated, applying a criterion of geographic departmentalisation.

Finally, it should be mentioned that the scheme for decentralisation of water management includes the Canal Inspectorates, which will be discussed below. They include all the irrigators from a given canal, who elect their own authorities, manage their own finances, and can associate to achieve more efficient management.

6.2.2. Other public institutions

- **The Provincial Legislature:** The Senate together with the Provincial Executive confirms the election of the authorities of the General Department of Irrigation. Questions related to surface water and groundwater are studied by commissions for handling provincial water resource matters.

- **Ministry of Economics:** The Ministry has the authority to set policies for the protection, fomenting, development, and regulation of agriculture, mining, industry, commerce, tourism, and services, promoting the establishment of an economic environment that provides conditions that are an incentive to private investment and the generation of new jobs.

- **Public Utility Regulators**

Provincial Electricity Regulator (EPRE): Under the Provincial Ministry of Environment and Public Works, this body regulates the provincial electricity service. Created under Law 6497 and approved in May 1997 by the legislature, it is decentralised and financially independent, establishing the Electricity Regulatory Framework of the Province of Mendoza. Its authority is limited to the province, covering all the operators holding concessions in the provincial hydroelectric energy system.

Provincial Drinking Water Supply and Sanitation Regulator (EPAS): This body, under the Provincial Ministry of Environment and Public Works, regulates drinking water supply and sanitation. It was created under Law 6044/93 and began to function in July 1996 as part of the transformation of the sector. Its function is to regulate the provision of drinking water and sanitation in the province, to protect the rights of the users, and to resolve conflicts between those involved in the sector so as to ensure the quality of the service and its expansion.

- **Federal Institutions**

Under-secretariat of Water Resources: This body is responsible for the preparation of the national water policy, as well as for the formulation and implementation of a master plan for water resource management, both with the agreement the provinces. It supervises the activities of the federal regulators of privatised areas, such as the Regulator of Dam Safety (ORSEP) and the Federal Sanitation Works Authority (ENOHSA). Among other responsibilities, it facilitates and mediates in inter-jurisdictional water disputes.

Federal Electricity Regulator (ENRE): This body is a financially independent agency under the Energy Secretariat of the Ministry of Economics. As the agency created to apply the new electricity regulatory framework established under Law 24,065, 19 December 1991, it has complete legal powers in both public and private law. . It has jurisdiction over the concession area of the former electricity service company for Greater Buenos Aires and, nationally, over the wholesale electricity market and over the infrastructure for the generation and transport of electricity.

Regulator of Dam Safety (ORSEP): This federal agency, created under Decree 239, 17 December 1999, is responsible for both the structural and operational safety of the dams under its jurisdiction to prevent risk to the population and infrastructure located below them. The dams in Mendoza under its jurisdiction are Nihuil I, Tierras Blancas, Aisol, Los Reyunos, Valle Grande, Agua del Toro and El Tigre.

Inter-jurisdictional Committee for the Colorado River (COIRCO): Under the agreement of 26 October 1976, signed by the provinces of Mendoza, Neuquén, La Pampa, Río Negro, and Buenos Aires and the Federal Government its function is to apply the mathematical model approved for the distribution of the water in the river.

Federal Sanitation Works Authority (ENOHSA): Created by Law 24,583, this is a decentralised agency under the President's Office, within the jurisdiction of the Secretary of Public Works. It is responsible for the continuance of policies developed for basic sanitation under the Federal Water Supply Service (SNAP) and the Federal Council for Water Supply and Sanitation (COFAPyS). Its principal purpose is to find concrete solutions to the problems of the sector, in both large cities and in medium-sized and small communities, through policies of technical and financial assistance and social support to all the authorities of the sector so as to promote expansion and rehabilitation of services, assuring their quality and universal availability. Among the programmes under its responsibility are those financed through external loans from the World Bank and the Inter-American Development Bank and those financed from its own resources. It has authority over the whole country.

- **Scientific and Technical Bodies:** These are both federal and local institutions that provide technical assistance and training, and carry out research into water resources through various thematic approaches and scientific and technical disciplines. The most important are the Cuyo National University, the National Technological University, the Regional Centre for Scientific and Technical Research (CRICYT), the Federal Water Institute (under the Sub-secretariat of Water Resources) with the Centre for the Andean Region (CRA) and the Centre for Economics, Legislation and Management of Water (CELA).

- **Municipalities:** Municipalities are responsible for the management of local interests and services, with direct incidence in local water management. Under municipal law they have authority over public works.[23] They are also water users in that they irrigate public parks. In some municipalities (Tupungato, Maipú and Luján) they provide drinking water supply. All municipalities manage irrigation of street trees and participate in the regulation of water pollution.

6.2.3. Water Utilities

These are private companies, whose principle input is the water resource. This group includes:

[23] Municipal Law. Public Works, Art.75.

- **The Mendoza Sanitation Company (OSM SA)**: This is a private company that produces, distributes, and sells drinking water and sewerage services and supplies some industries. Its service area includes approximately 80% of the population of the province. It was privatised on 16 June 1998.

- **Mendoza Electricity Distribution Company (EDEMSA)**: This is a private company responsible for the distribution and sale of energy. The operation of the hydroelectric plants, Cacheuta, Alvarez Condarco, and Carrizal, were transferred to CEMPSA, the builder and operator of the Potrerillos dam.

- **The Nihuiles Hydroelectric Company (HINISA):** This is a private electricity generation company holding the concession for the Los Nihuiles Plants.

- **The Diamante Hydroelectric Company (HIDISA):** This is a private electricity generation company holding the concession for the generation of hydroelectricity at the Los Reyunos and Agua del Toro dams.

- **Consortium of Companies for the Construction of the Potrerillos Dam (CEMPSA):** The provincial government put up US$162 million, and the private sector the rest, to build the dam (total cost US$320 million). It was awarded the contract for hydroelectricity generation (from the dam and from the Alvarez Condarco and Cacheuta plants).

- **Cooperatives:** Within the province there are various cooperatives for both electricity and water supply.

6.2.4. Non-governmental Organisations

- **Professional Societies:** These are professional associations, such as the association of geologists and engineers, which at times are asked by the DGI to provide advice on groundwater.

- **Federal Council of Sanitary Service Companies (COFES):** This body brings together provincial, municipal, state, private, and cooperative companies providing and regulating water supply and sewerage in Argentina. Its principal role is to be a permanent forum for the analysis, discussion, study, evaluation, and horizontal cooperation in the general integral problems of the agencies and companies that provide and regulate the provision of water supply and sewerage. OSM SA is a member of the council and presided in 1999 and 2001.

- **Consumer Defence:** These are non-governmental, non-profit organisations whose objective is to protect the interests of the consumers and users of public utilities. Today they are important because of the role they play in the User Committee formed for the renegotiation of the water supply and energy concessions.

- **Community Water Resource Organisations:** There are none in the province relating to water resources. There are, however, environmental organisations.

- **Federal Institute for Agriculture and Livestock Technology (INTA):** This organisation has organised farmer councils made up of local representative advisors. Today it is interested in the water resource problems that affect them and are undertaking actions to resolve them independently of the DGI and the Canal Inspectorates. This is the case with the councils for Lavalle and Luján de Cuyo: the INTA Extension Agency, representatives of the Municipality of Lavalle, the Head of Extension of the Lavalle Agency, and other farmers.

- **Other Organisations:** There are various business organisations, such as the Association of Small and Medium-Size Industries (APYME), the Stock Exchange, the Commercial and Industrial Union of Mendoza (UCIM), the Mendoza Council of Businessmen (CEM), the Economic Federation of Mendoza (FEM), and the Chamber of Foreign Trade. The Mendoza Council of Businessmen represents a substantial membership and in recent years has been of political significance, generating opinion on public policies and demanding reform and action from the government.

7. Comments

In recent years, the public impression in Argentina of those involved, both public and private, of the level of efficiency and transparency in the public administration, and its relationship with economic interest groups has been negative. The loss of prestige has not been specific to any particular political group, but to the political class as a whole. This disqualification of the political function has accentuated the presence of private interests, domestic and international, in public decisions.

Obviously, the local situation cannot remain entirely aloof from this panorama. However, there has been a very strong public reaction to this type of behaviour. The relationship among those involved in water management has not been sufficiently substantive to allow integrated management. The relationships have rather been formal, typifying a culture where water management is considered to be separate from the rest of the administration, to the extent that the Superintendent of the DGI was referred to as “the Water Governor”. Furthermore, the transformation of the users organisations has been affected by critical ups and downs. The traditional irrigators have lost power, due both to their diminished economic importance, resulting from the subdivision of farms, and to their lack of participation. At the same time the participation of residential, industrial, and oil users has increased. The significant growth of these new sectors has created informal relationships and pressures not properly institutionalised because the system was designed basically for agricultural uses; there is no system for regulating their representation. This is an indisputable failure in the system, as, by its very nature, it obscures transparency in the relationship.

The province continues to manage water by use, and not by resource, and the General Department of Irrigation has centred its water management efforts on water for irrigation, while its use for energy, industry, and human consumption remains outside the system.

Finally, it should be made clear that the Federal centralisation of river basin management is not a solution to the problem caused by the lack of integrated management in the provinces, on the contrary it worsens it. It impedes the necessary local coordination among the different uses, by mixing them with water uses in the other provinces within a basin. The reform that is needed is the integration of the uses under a single provincial authority or, at least, a coordination of the various agencies that manage the use of water. Once this has been achieved, inter-provincial agreements can be negotiated to define the limits of the jurisdiction of the river basin authorities created under these agreements.

8. Limitations

This paper has been prepared on the basis of available information and within a limited time restraint.

The fact that it is limited to the Province of Mendoza means that its conclusions cannot be applied to the rest of the country, as there are geographic, economic, legal, and cultural differences of real significance.

Finally, on some of the points discussed personal opinions are expressed that are debatable by their very nature, depending on the philosophical and political conceptions of the person making the evaluation.

I. SYSTEM FOR THE ALLOCATION AND REALLOCATION OF WATER

A. REGIME

1. Director

i. Criteria for allocation, reallocation, and objectives

a) Criteria for allocation

Article 115 of the provincial water law establishes a criterion for the order of preferences to be taken into account in granting surface water concessions:

1. Supplying the population
2. Supplying the railways
3. Irrigation
4. Mills and other factories
5. Tanks for nurseries and fish farms

Groundwater concessions are awarded by the DGI through the Honourable Administrative Tribunal. The order of priorities for these concessions is established in art.4 of Law 4035/74.

1. Domestic water supply
2. Agriculture and livestock
3. Industry
4. Mining
5. Recreation and tourism
6. Spas and medicinal use

The criterion for priority of use, if there exist concurrent requests for concession for the same use, are modified in the following order:

- Public bodies, including the Canal Inspectorates
- Consortiums, associations or cooperatives of users
- Private individuals or companies, whose land possesses a use concession for surface water and when the amount requested is to complement the area or the volume conceded or to maintain crops.
- Private individuals or companies farming lands without a surface water right or for any purpose. In the case of similar conditions the first request has priority (art. 7 Law No.4035).

Explicit objective: the system of allocation by priorities has as its explicit objective the establishment of a balance between social and commercial demands. Agriculture, both for surface water and for groundwater, is always second to domestic supply.[24]

Implicit objective: for groundwater, as well as following the objective mentioned above, the order given in the groundwater law for concurrent requests is intended to promote joint use of both kinds of water and to complement amounts, giving preference within agriculture to large farms.

It should be mentioned that in the existing legislation there are no criteria for allocation or reallocation based on the benefits stemming from water use (for example, the value of production).

[24] The reference in the Water Law to the supply of railways has no practical effect, as there are no public or private railways in the province with the exception of one federal freight concession that is little used and has no need for water.

b) Criteria for reallocation

Surface Water

The right to surface water for agriculture is considered to be permanent in contrast to other uses (excepting domestic supply), where the use is considered indefinite only as long as the industry or activity continues.

Nevertheless, rights to surface water can be renounced, can expire, and can be revoked or terminated.

The law does not anticipate the reallocation of water used for agriculture, but, on the contrary, establishes the principle that water is tied to land *in solidum* (art. 25 and 24). To appreciate the real nature of the concession, it must be understood that all transfers of water rights separately from the land are considered to be null and void.

The inherence principle in the constitution (Art.186), established originally to guarantee and provide legal security to water rights granted to a property, is now acting as an impediment to the reallocation of rights from one area to another.

The principle is a restriction on efficiency, considering that within the province there are areas of different soil quality and crops and that assigned water rights might be scarce in some cases and excessive in others.

The lack of the consideration of reallocation in the water law also blocks the owner of a right from using the right for other property, whether his or belonging to others.

Consequently, the owner of a right can use or not use the right, but does not have a third alternative of using the right more efficiently.

Similarly, this way of perceiving the inherence to land produces a lack of stimulus to water users to utilize water efficiently and to increase the capacity of the amount by buying or leasing properties without rights.

The inherence principle, originally conceived in the water law and incorporated in the Provincial Constitution in 1894 and still included in the present form of the Carta Magna, has been interpreted by the DGI in a very restricted sense. This interpretation has been imposed both conceptually and in law, through Resolution 71/68 of the Honourable Administrative Tribunal. This resolution blocks relocating crops even within the same property, except in the case of silting, as envisaged in art. 123 of the water law.

The order of priorities, as has already been mentioned, is very strict. The water law only allows the expropriation of any particular use of water for reasons of public utility, subject to indemnification, in favour of a use with higher priority, but not for any use of the same or lower priority, except through a special law (art.118).

In the case of the silting of land – as the law provides – the owner of affected, previously cultivated land, if he has not renounced his right to irrigation and has paid all the taxes and other costs involved in his irrigation, can request a concession for another piece of land. This can only be given if his first right is completely given up and with the consent of the other users of the canal from which the irrigation water must be taken. If the land can be irrigated from the same canal, as that on which he already held rights the consent of other users is not required (art.123).

Later the exceptional cases were widened to include expropriation, the existence of sand dunes, poor soil quality, etc.

This criterion of priorities is qualified by the considerations in art. 116, which allow, within each class, that larger more profitable businesses will be given preference. In equal circumstances, the first applicant is preferred.

Groundwater

Reallocation is not considered either, but there is a system allowing the complementation of a groundwater right and administrative authorisation for the irrigation of properties different from those for which the right was allocated, provided they are in the same ownership, but not for third parties.

Although it is established that any attempt to use more water than that conceded is subject to a new grant, in the case that the intention is to use water destined for one use for another, of lower priority, partially or complementarily, a new concession is not required, only permission. When the use cannot be considered complementary, then a new concession is necessary.

- Termination of the Right

For a right to be reallocated it must previously have been terminated.

A water right can be terminated in two ways: by decision of the DGI to revoke it when the conditions established in the laws, decrees or resolutions of the DGI are not being met, or by resignation, at the petition of the holder of the right.

- Revocation

Before the termination of a right can be carried out a series of conditions must be met. The inherence principle blocks the transfer by the user of the right from one property to another, whether he owns it or not, and neither can the use for which it was conceded be changed (art. 123). In either case such action will result in the immediate revocation of the right.

The DGI can also revoke the right, according to the Water Law, when no use is made of the right for 5 years or more. If the activity for which the right was granted is inactive for more than 5 years, the Administration can remove the concession. The loss of the right is not automatic; the DGI must act (art.133).

Similarly, a concession will expire if the time periods and conditions under which it was granted are not met (art. 125).

In order to protect the health of the population, the DGI can declare the termination of a concession without any indemnity, if the water becomes dangerous to health or to the environment due to the activities of the industry using the concession (art.134).

Temporary rights can be terminated for the following reasons (Law 508, art.7): because the time expires, for failure to meet the conditions set by the DGI for this water use, for failure to pay financial charges, because the water loses its suitability for the use made of it, because of the drying up of the source, for using the water entirely or partially for a use different from that promised, for reasons of public interest, or by decision of the permit holder.

For groundwater, the revocation of permission to drill comes into effect when causes arise that prevent either the construction or the regular operation of the well.

Other causes for the termination of concessions are the end of the period granted, revoking, expiring, drying up of the source, or loss of suitability of the water for the use conceded (Groundwater policy, DGI, 1999, p.17). In every case the wells must be sealed.

- Resignation

In resigning a right to surface water there are two alternatives: complete resignation or partial resignation. In both cases it is necessary to register no debt with the DGI, to have title to the right and, finally, to have a plan of the area renounced.

To resign a groundwater right, it is necessary not to have any debt at the date of application. The well must be out of use and properly sealed, as a measure against any possibility of pollution.

Water Use Registry

In 1995, the DGI created a Water Use Registry, which was brought up to date under Resolution 323/99 of the Honourable Administrative Tribunal.

The Registry allows the temporary reallocation of excess water. Requests by users for suspension of their concessions when they will not be used for a defined period (three to twelve months) are placed in a bank. Use of these volumes of water can then be requested.[25]

The holder of the right receives no payment, but there is a tax incentive, as the cost of service is reduced pro rata, as well as, partially, the charge for the right. The beneficiary

[25] Pinto, Mauricio, “Los Mercados de agua y su possible desarrollo el régimen jurídico vigente en la Provincia de Mendoza”, in Revista Foro de Cuyo, Editorial Dike.

has to pay a tax equivalent to the charges not paid by the holder of the right, plus 20% of this amount to meet administrative costs.

c) Objectives of the regime for allocation and reallocation

Explicit

The legal and institutional regime is based on five principles:

1. Legal Security: water rights are granted under a special law. They are inherent to the land, conceded in perpetuity, and cannot be sold, embargoed, or mortgaged separately. The concession is a perfect right, which allows the holder of title of the concession to use the water and protects this use before third parties and the administration.

2. The public character of the allocation: by the involvement of the provincial legislature, the State establishes a self-limitation on the discretionary power of any government and allows political control, as the minority can intervene. It should be added that, to get access to a concession awarded by the legislature, there must be a prior report by the DGI that explicitly takes account of the integrated plan for water resources.

3. Proof of the prior occupation of the land: the granting of all previous rights is ratified. The rights acquired before the Water Law came into effect are registered and respected, subject only to proof of the effective use of the right.

4. Independence in water management: the water authority is autonomous and financially independent. The higher authorities are nominated with the agreement of the Senate and the users participate in the water management structure.

5. Groundwater rights for agriculture are not inherent, or attached to the land, but are subject to administrative limitations both for their modification in respect of the land for which they were originally granted and in the prohibition of moving them to the property, works, or activities of third parties, without previous authorisation.

Implicit

1. The system is used to encourage long-term investment taking into account that, in an arid environment, water is a good with a greater economic value than land.

2. The establishment of restrictions on the concentration of water rights, through the inherence regime, which blocks the use of the right separate from the land it was granted for, attempts to prevent the monopolisation of rights through their purchase separate from the land.

The law defines action that can be taken when concessions are requested for the same use, based on the type of person requesting the right. Independently of this order of priorities, if it is indisputably proved that the social benefit of one request is greater, the

law decrees that this must be approved over any opposition. For each use the law stipulates the definition of a coefficient for water delivery and for charging.

Groundwater is conceded through a title of concession or a drilling permit.

Similarly, a rule has been established for deciding preference when two businesses in the same activity present a request for a water right on the same canal. In this case the business of greater importance and utility is to be preferred: in equal circumstances it is to be granted to the business that first asked for the right.[26]

2. Executive

ii. Who decides?

Under the Provincial Constitution all water concessions are granted through a law passed by the Provincial Legislature with the agreement of the General Department of Irrigation. The request must be made first to the DGI who will determine whether it is technically viable, does not affect third parties, and has met the administrative and technical requirements demanded by the law. From there it goes to the Legislature, where the different political parties are represented in the Chamber of Deputies and in the Senate, both elected by all the citizens of the Province. This means that allocation and reallocation decisions are subject to the influence of technicians, politicians and economic interests. The intervention of the Legislature ensures the public character of the debate and, consequently, the control of the whole of society over the decisions. Nevertheless, it is possible to influence behaviour through the communications media, which can be sensitive to external pressure.

Under Law 4035/78 concessions for groundwater are granted by the General Department of Irrigation.

Nevertheless, there are interest groups that put pressure on the authorities making the decisions. One clear example is the real estate sector, which has promoted projects that directly affect the availability of water.

iii. Who demands?

The table below gives the allocation of water by river basin, use, and source.

[26] Water Law, art. 116

Table 7. Water Demand, by river basin, according to use and source, surface water or groundwater (Hm^3, 1998)

Use	Source	River Basin			
		Mendoza and Lower Tunuyán	Upper Tunuyán	Diamante Atuel	Total
Irrigation	Surface	2439	569	1185	4193
	Groundwater	463	224	18	706
	Total	2902	793	1204	4899
Drinking Water	Surface	198	1	21	220
	Groundwater	35	22	8	65
	Total	233	23	29	285
Industry	Surface	103	Insignificant	1	103
	Groundwater	n.d.	32	7	39
	Total	103	32	8	143
Total		3238	848	1241	5327

Source: Authors on the basis of data in the "Informe Ambiental", 1999, National Water Institute and the "Compilation of Municipal Statistics, 1991-2002", Mendoza, Statistics and Economic Research Directorate

60% of provincial water demand is in the Northern Basin, 85% from surface water and 15% from groundwater.

The demand for drinking water is equivalent to 7%, more than 95% of which is provided by the main drinking water utility in the province, Mendoza Sanitation Works. About 85% of this water is returned to the system for irrigation use.

The demand for agricultural use is estimated on the basis of the cultivated area (provisional data, Census, 2001), the water needs of the crops, and, for surface water, application and transport efficiency.

Industrial use in the Mendoza basin is divided into two types, consumptive and non-consumptive. Among, the second is the use of cooling water in the one thermal generating plant and in minor industries. An important part of this water is returned to the canals and reused for irrigation.

Energy use in the Northern Basin is for hydroelectric generation and, therefore, non-consumptive. The stations are Porterillos, Alvarez Condarco, and Cacheuta, all on the Mendoza River, and José de San Martín on the Grand Master Canal.

iv. What is allocated? Characteristics of the concession

The concession has the following characteristics:

- It is legal: water in the public domain of the province is conceded by a law passed by the Provincial Legislature with the approval of the DGI. The concession is definitive when it

is on a river with known flow, and otherwise is considered to be eventual. It has not yet been possible to measure all the rivers so that the concessions awarded since the law was passed are not considered to be definitive (art. 194, Constitution of Mendoza).

- It is inherent to the land: The water law widens and ratifies the inherence principle defined in the Provincial Constitution, under which the embargo or sale of the water right independently from the land is prohibited. The water right is joined to the land no matter what its destiny. Water cannot be sold without the land or the land without the water.

- There cannot be any impact on third parties: no concession or special use permit of public waters can prejudice or affect rights already conceded.

- The law recognises various classes of rights:

    - Precarious right: rights registered as precarious by administrative act of the Superintendent can be revoked by a justified resolution of the Superintendent.

    - Definitive right: is the generic name for all the rights registered at the time of the promulgation of the Water Law.

    - Eventual right: refers to all the rights registered after the promulgation of the Water Law. A large number of these correspond to illegal crops, regularised under Law 1920.

    - Drainage right: corresponds to properties that use surplus water, or water returned from properties located upstream.

    - Private domain: water that rises and dies within a property. Registration is voluntary. Much water formerly considered in the private domain has lost this character as a result of property subdivision.

    - Surplus: corresponds to the water surplus to the needs of the holders of definitive or eventual rights.

    - Motor force: the water used to generate hydroelectricity.

    - Public irrigation use: the water used to irrigate public parks and street trees.

    - Industrial use: corresponds to concessions granted for cooling or for steam generation.

    - Summer reinforcement: the water diverted from a river to maintain a stable flow in smaller streams.

    - Drinking water: rights granted for public drinking water.

    - Provisional: transfers of water during the period of the completion of the conditions of transfer.

- Drainage: permits granted for the use of surplus water diverted to the collector drains.

- Temporary permits: Permits granted under Law 5081, for a specific period and for individual use. They cannot be transferred to third parties even if the property is transferred. The law establishes that these can be used for irrigation from wells and for the irrigation of annual crops.

Content of the concession

Surface water:

The Water Law provides that every concession for irrigation must determine the maximum amount to be used; this can be up to one and a half litres per second, per hectare, per year (art. 122).

When the flow is not sufficient to provide a permanent amount of 1 litre per second, per hectare, use by turns will be established (art. 162).

Later, Law 430 provided that the quantity of water corresponding to each hectare should be determined on the basis of the nature of the land and the types of crops. Neither these studies nor the measurement of river flow have been done, as will be discussed below.

In this way, each irrigator has the right to a maximum amount of water – generally, not yet fixed. This amount should be defined on the basis of needs and the availability of water.

Formally, the area of the property determines the amount. Without substantially changing the area basis, each user's right is expressed in terms of a right to a specific volume of water. For example, a water concession to irrigate 10 hectares gives the right to receive a maximum of 1.5 litres a second. In the case of shortage, the amount will be proportional to availability.

As the maximum volume has not been defined, it has been proposed that those making more efficient use of water should be allowed to irrigate a larger area than that registered, but this remains unrecognised by the law and subject to sanctions.

Additionally, the system of distribution, as will be discussed below, is pro rata on the basis of the area given in the title. It is not possible to "legally" cultivate more land if the volume of water provided is more efficiently used.

Groundwater:

The concession is on the basis of a defined volume for a specific use. Any modification in either has to be authorised by the DGI.

The Groundwater Law permits that when the holder of a groundwater concession can, through improvements or the application of special techniques, irrigate a greater area, then an increase in the concession can be requested.

It must be understood that the quantity that can be distributed is determined by the existing infrastructure.

v. How it is applied

Surface water

For surface water, the DGI uses a decentralised administrative system through the River Sub-delegations,[27], or Heads of Irrigation[28] and the Canal Inspectorates[29].

The steps in these procedures, decentralised to the River Sub-delegations or the Heads of Irrigation, are begun with:

- A request for a precarious permit for surface water
- A request for a temporary permit for surface water
- A request for a drilling permit for groundwater (unless it is for drinking water when the process has to go through EPAS).

In the case of groundwater the process begins in the sub-delegation but is then immediately transferred to Headquarters for control by the Water Police Directorate, then to the Superintendent, and finally it is passed to the Honourable Administrative Tribunal, which grants the concession and informs the Executive.

Groundwater

The Water Police Directorate has formalised all administrative procedures, including giving a title for a drilling concession and a drilling permit.

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[27] River sub-delegations result from the application of an administrative criterion of geographical subdivisions. They are river basin organisations dependent on the General Department of Irrigation and their heads exercise the functions of the Superintendent in their areas of jurisdiction, assuring the equable and efficient distribution of water, for all uses, in accordance with the existing legal framework.

[28] Heads of Irrigation is an organisation under a Head of Zone reporting to the Superintendent, with the same functions but for a smaller jurisdiction.

[29] Canal Inspectorates are organisations formed by the users of an irrigation canal. Traditional in the water culture of the province, they are responsible for the management of the Irrigation Network, are non-profit organisations, financially independent, and with competence to act under both public and private law.

The interested party requests a drilling permit for groundwater, whether for common use (exclusively for his own domestic needs) or for special use (public drinking water supply, agriculture, livestock, industry, mining, recreation, tourism, thermal or medicinal).

In both cases, the procedure is initiated with the Water Police Directorate or the River Sub-delegations, but the title is given by the General Department of Irrigation by resolution, copies of which are sent to the Executive and to the Legislature (both chambers).

The user must meet a number of requirements before obtaining a permit or concession. The technical director of the work must be a professional listed in the register maintained by the DGI. He must present a Final Technical Report, a copy of the profile of the well, results of the analysis of the water, edicts, etc; this documentation must be complete.

A technical inspection is made by the Police Directorate to ensure that the well meets all technical requirements.

- **The eventual concession, subject to the existence of a flow and the constitutional obligation to measure river flows.**
  Surface water

  As has been mentioned above, a distinction is made between definitive or undefined rights and eventual rights.

  The Water Law requires that eventual rights be considered in order of their antiquity and that they can never prejudice users who have or may have definitive rights.

  Where there are existing rights of a known and valid use, other concessions can only be given when the measurement of flows in ordinary years shows that the volume requested is surplus after all existing rights have been met (art.128).

  When the measurement does not show a surplus in ordinary years, then only an eventual right can be conceded.

  This conditionality on measurement of the flow established in the Constitution of 1916 fixed the criterion that, until the measurement was made, all concessions would be eventual and require a report by the DGI and the vote of two-thirds of both legislative chambers (art. 194, Constitution of Mendoza).

  The measurement of flows is a technical operation consisting in the measurement of historic flows to allow the creation of a hydrologic balance and determine the volume of each concession.

  Earlier, in 1907, through Laws Nos. 386 and 402, it was recommended that the water authority plan irrigation works with the end of “avoiding the inconvenience of subjecting

whole areas to an inflexible maximum and minimum, when it is not yet known what crops will be grown".[30]

Law No.430 of 1907 established that cultivated land should keep the character of eventual right until the quantity of water corresponding to each hectare according to the quality of the land and the crops produced was established.

The purpose of these regulations was to value water as an economic good and to search for an element of conditionality so as to permit efficiency in its management.

The purpose of the measurement of flow was to establish that the quantity of water assigned per hectare should depend on the quality of the land and the type of crop.

Neither the Constitution nor the laws have defined the technical requirements of the flow measurement needed to change an eventual right into a definitive right and, although the DGI measures daily flows in the principle rivers of the province, it has never undertaken the technical operation required to define the volume of water corresponding to each concession. Consequently, there has been no legislative or administrative pronouncement declaring this measurement completed, so that in reality there cannot exist any definitive rights.[31]

- **Concession without affecting third parties**

The water law establishes that every concession of eventual rights must have no impact on third parties and leave all private rights protected. For this purpose, in all grants of concession, anyone, if they are known, whose rights might be affected must be informed . If not, then the request and the relevant administrative resolutions must be published for 15 days. The concession must also be published if it will affect, or might affect, collective interests whether these have legal representation or not.

Art. 162 of the Water Law establishes that in periods of extraordinary water shortage, when the water in a river and its tributaries is not sufficient to meet the ordinary demand, then a system of use by turns should be adopted.

Explicit objective: The clause dealing with "without prejudice to third parties" must be understood in relationship to the principle of eventual rights, having the explicit objective that, should these become definitive, they cannot affect the volume of water assigned to pre-existing definitive rights.

In the case of groundwater, Laws 4035 and 4036 strengthen the power of the Administration to establish restrictions and to guarantee proceedings when third parties are affected.

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[30] Message of the Governor to the Legislature accompanying the presentation of Law 386.
[31] Pinto, Mauricio, "Transformación de derechos de uso de agua eventuales en definitivos en el regimen jurídico Mendocino", LL. Gran Cuyo, 2001, p.575.

The Water Authority reserves for itself the right to establish turns, restrict, limit, or regulate by justified resolution the use or withdrawal of water; to establish protection zones around wells; to limit, condition or prohibit activities which could affect the well; to request the Executive to declare a well dry (art.23).

Such requests must be published in the Official Bulletin and one local newspaper and brought to the attention of interested parties to allow for opposition. Everyone with a legitimate interest can oppose a request with well-founded arguments and the Authority will decide on the basis of the interests presented by the two parties (art.12).

3. Regulator/Inspector

vi. Inspection

Surface water

Inspection and regulation are very important in detecting problems not only in the allocation of water, but also in its distribution and use. Generally speaking, inspection procedures in the federal and provincial public administration are not very rigorous. The DGI is no different. This is somewhat contradictory, and it is very difficult to explain why it is that in a situation of a degree of water scarcity, there are not stricter controls on its allocation, distribution and use. Inspection and regulation of the administrative system will be discussed in Chapter II A 3 i.

For surface water there is no real regulation of the use of water and, consequently, no verification of whether use has been abandoned for more than five years. This verification could result in the loss of the right, according to art. 16 of the Water Law, but in practice this does not happen.

Groundwater

Regulation of the impact of human activities on the aquifer

There is technical regulation to analyse the degree to which any new well affects the aquifer. Additional regulations include the declaration of areas of temporary prohibition or restriction on new wells.[32] These regulations allow the Superintendent to accept or reject a request for a drilling permit that falls within a prohibited area, when it replaces an existing well which has the same diameter of outlet pipe and the same flow. The existing well must be previously sealed. In the case of a restricted area, the well to be sealed may or may not have been in use.

[32] Groundwater Law, 4035, art.23 and Resolution of the Honourable Administrative Tribunal 673/97.

Location	Foothills, in the departments of Las Heras, Capital, Godoy Cruz and Luján de Cuyo	Right bank of the Mendoza River in Luján de Cuyo and Tupungato	Eastern area, in the districts of Montecaseros, Chapanay and the three Porteñas
Problem	Lack of water and salinity	Water deficit on average 34hm^3 a year, with a lowering, since 1992, of 3 to 4 metres and with extremes of up to 33 metres	Decreasing groundwater quality

Information systems to support decision-making

The DGI has invested in the development of a strategic information system directed towards decision-making to gather up-to-date information on provincial water resources. The system, called the Survey and Register System (SICAR), brings up to date and rationalises the data in the user registers so as to have more accurate information on the use of the right requested.

This information, as has been said, is strategic to decisions on the reallocation of rights (see Chapter 7, Problems, p.78). The system includes physical, economic and institutional data.

Manuals

The DGI constantly revises and reformulates technical and administrative regulations for water management. Among the manuals prepared to facilitate regulation can be mentioned:

- Guide for the User of Groundwater. This manual explains the obligations and rights of the user, the requirements to obtain a permit or concession, and the sanctions applied.

- Administrative Procedures for the granting of permits and concessions for groundwater, including the relevant administrative resolutions. It is published on the DGI web page.[33]

- Technical Regulations for Drilling.[34]

[33] Resolution 895/20, Superintendent, 20 October 1999.
[34] Resolution 299, Honourable Administrative Tribunal, 17 June 1994.

- Register of Directors and Drilling Companies, an obligatory register in which engineers and drilling companies must be entered in order to undertake drilling.

vii. Conflict resolution

General Department of Irrigation

The Water Law establishes that questions arising from water management and distribution will be resolved by the General Department of Irrigation with appeal to the Executive.

For water allocation and reallocation the Superintendent has authority to be the first to be informed of:

Every request for a definitive or eventual water concession for agriculture or for industrial generation of energy;

All complaints made against the Inspectorates, delegates, and other officials; and

All complaints of fraud or abuse in the use of water.

The Honourable Appeal Council decides on all appeals against resolutions issued by the Superintendent. This body is made up of the representatives of the Rivers in the Honourable Administrative Tribunal, but without the Superintendent.

Ordinary courts

The Water Law provides that the ordinary courts will decide on appeals made against the decisions of the Administration in the allocation of water in the following areas:

- When a concession made to an individual or company is declared void.

- When Administrative decisions negatively affect acquired rights (art.183).

Also within the competence of the ordinary courts is the resolution of conflicts between private individuals:

- Preference in the right of water use when the preference is based on titles in civil law and rainwater (art.187).

- Questions of damages and prejudices caused to third parties (by the drilling of ordinary wells, carrying out other underground works, and all types of use in favour of private parties).

The conflicts that can arise in the process of water allocation of can be:

Conflicts between users

Conflicts between users arise out of conflicting interests. Water in a semi-arid province like Mendoza is always a potential source of conflict. For this reason, the procedure for granting water, both surface and groundwater, demands publicity. The decisions must be published in a local newspaper and in the Official Bulletin for 2 days. The purpose of this is to allow those who feel affected by the requested concession to object during the 10 days following publication. The objections are revised, both technically (for groundwater), and legally, and the presenter is informed of the decision reached. If the objection is accepted, then the request for concession stops there.

B. PERFORMANCE

i. Effectiveness

a. Distribution of water allocation

Water in the Northern Oasis of the province is distributed among sectors as shown in Table 8.

Table 8 Distribution of water allocation by use, Northern Oasis, Mendoza, by volume and percentage

Use	Volume (hm^3)	Percentage
Agriculture	2902	90
Drinking Water Supply	233	7
Industry	103	3
Total	3238	100

Source: Based on information in the National Water Institute, Informe Ambiental, 1999, and the Mendoza Directorate of Statistics and Economic Research, Compilación de Estadisticas Municipales 1991-2002.

For the whole province, the proportion of water allocated to agricultural use, 92%, is somewhat higher, because this use is higher in the Upper Tunuyán and Diamante/Atuel River basins, and industrial and drinking water use lower.

15% of the water comes from groundwater and the rest from surface water.

Table 9 shows the availability of water from river flows and from groundwater.

Table 9 Useable water supply in Mendoza by source, average year, in hm^3

Source	Surface flow	Groundwater	Total
Mendoza River and Lower Tunuyán	2649	800	3449
Upper Tunuyán	542	221	763
Diamante/Atuel	2273	130	2403
Total	5464	1151	6615

Source: Based on data in the Plan Hídrico para La Provincia de Mendoza, 1999, General Department of Irrigation.

The water balance in the north, in an average year, shows an excess of supply over demand of only 6%. In the Upper Tunuyán basin there is no excess even in average years. In the south the excess supply is 48%.

The flow values for the rivers are equal to annual average flows, which show a 33% variation coefficient. This gives an idea of the unsatisfied demand in years of low flow. It means that, on average, 15% of the time flows on the Mendoza River can be less than 1000 hm^3 and on the Lower Tunuyán less than 700 hm^3, meaning values for the Northern Oasis of less than 900 hm^3, creating a water deficit in these years. The deficit is met by pumping groundwater, which varies between 150 and 600 hm^3 a year.

One measure of unsatisfied water rights is the area of land irrigated only by groundwater, which is about 26% in the Northern Basin, and 36% in the Upper Tunuyán River. The farmer facing a shortage of surface water resorts to groundwater to which there has been direct access since the beginning of cultivation. Recently, restrictions have been placed on the allocation of groundwater. This point is discussed further in Use, environmental quality.

A further measure of the unsatisfied demand for surface water is the use of precarious permits for marginal water (domestic effluent). In the Northern Basin almost 5000 hectares are irrigated with treated domestic wastewaters, equivalent to 4% of the irrigated land in the basin.

In summary, there is an unsatisfied demand for surface water rights due to the fact that it is 4 times cheaper than groundwater. This indicates the necessity to more thoroughly pursue the study of the value of water, to introduce into the management system information on the costs and prices of water in different uses.

Using such information it should be possible to increase the benefits generated by water with its reallocation to sectors where its value is higher.

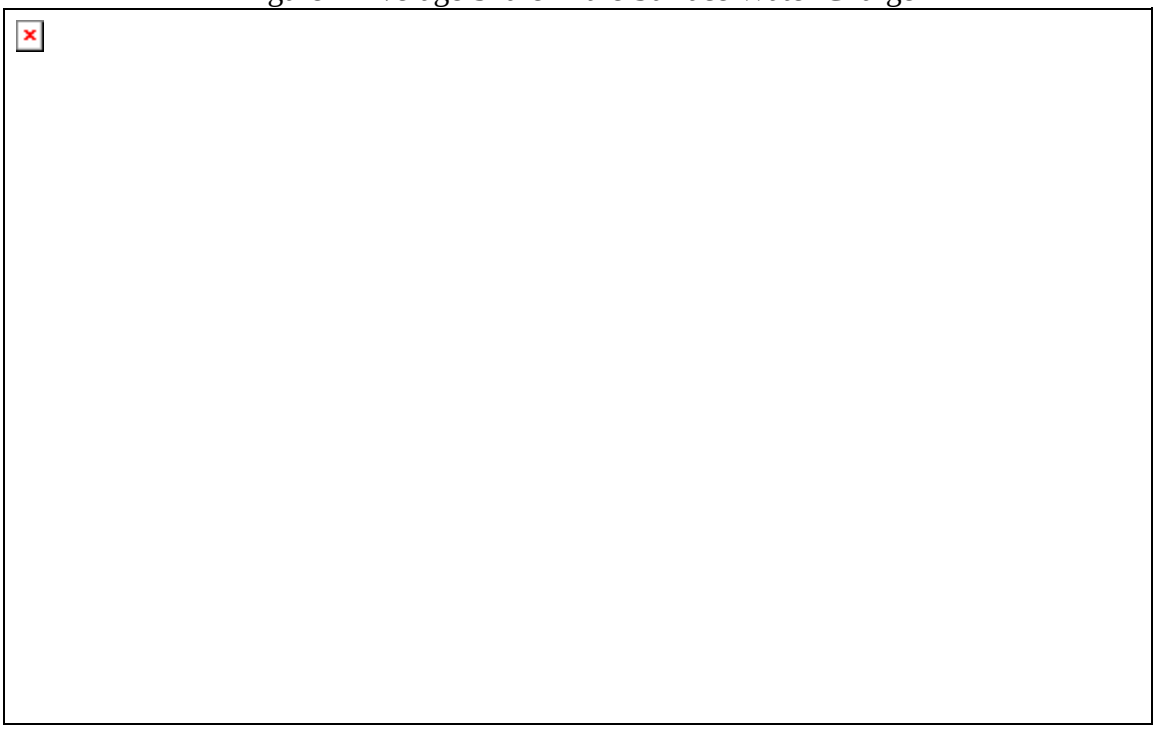
ii. Efficiency

a. In administration

Part of the charge paid by the irrigator is destined for the DGI, part for the repayment of works, and the rest to the Canal Inspectorate (see figure 2). The General Department of

Irrigation concentrates primarily on administrative tasks while the Inspectorates (and/or User Associations) are more dedicated to operational tasks. It is possible, therefore, to estimate the average participation of the administration in total costs.

Figure 1 Average Share in the Surface Water Charge



Source: Abihagle, Carlos and Jorge Day, “Agua y Sociedad”, 2002, unpublished.

The Inspectorates on the Mendoza and Tunuyán Rivers (the first four in the figure) receive between 40% and 60% of the charge, so the DGI receives about half of the charge for central administration from these areas. On the other hand, the share of the Inspectorates in the south only reaches an average of 20-25%, so that the costs of the central administration represent 75% of the total.

The changes adopted over the last 15 years, first the integration of Inspectorates and later the coming into force of Law 6105, introduced managers and technical personnel to the Associations. This led to better technical advice in system operation, but it also led to an increase in the costs of the Associations. There has been no evaluation of the benefits and costs of this incorporation of technical personnel. There has been no evaluation of efficiencies to justify the introduction of new costs.

b. Levels of conflict

The principle conflict in the Northern Basin in the near future (20 years) will be the continuing increase in population, which means increased demand for drinking water.

If the present efficiencies in the transport of water are not improved both for agriculture and for drinking water (see Administrative System), which are causing important losses,

it is obvious that there will be conflict between the two uses, as any increase in demand for drinking water must be met by greater efficiency in agricultural use.

There exists, of course, the possibility of improving transport efficiency through waterproofing the irrigation canals.

The conflict could be aggravated by those interests pushing the growth of the city towards the west, presently beyond the reach of water supply services. It has been argued that real estate speculation lies behind this expansion of the city into areas not served by drinking water: buying land today at very low prices that, once water supply is provided, will rise in value tremendously. Obviously this situation can be corrected through state intervention to prevent unjustified private advantage.

c. Economic efficiency

The present allocation of water shows that the system is too rigid, blocking the reallocation of water to more economically beneficial uses. There is no criterion for the allocation of water based on the economic benefit to the total economy. The allocation to drinking water supply has priority in law.

The economic efficiency of the effective allocation of water could be evaluated through the contribution to the economy of the sectors using water (industry and agriculture). However, it must be taken into account that the two sectors are interdependent as the majority of the industries of Mendoza are agriculturally based food processing industries.

Table 10 shows the relationship between the regional gross product and the allocation of cubic metres by sector, over time.

Table 10 Relationship between regional gross product per cubic metre, Northern and Central Oases, in pesos

River Basin	1997	1998	1999	2000
Northern	3.07	3.15	3.23	3.22
Central	0.71	0.59	0.99	1.25
Province	1.86	1.76	1.92	1.95

Source: Based on data in National Water Institute, Informe Ambiental, 1999 and Mendoza Directorate of Statistics and Economic Research, Compilado de Estadísticas Municipales, 1991-2002.

The productivity index for 2000 was A$1.95 per cubic metre representing an increase of almost A$0.10 compared with three years earlier. Most notable is the increase in productivity shown in the Central basin (almost 100% between 1998 and 2000). This is explained by the strong acceleration in the change over to the production of high value crops. Over the same period the growth in productivity in the Northern Basin was only 2%.

iii. Social equity

Under the present system of water allocation the following situations occur:

- Irrigators with surface water rights who receive water and pay for it.

- Irrigators with surface water rights who receive water and do not pay for it.

- Irrigators with surface water rights who do not receive water and whose rights have expired.

- Potential users.

This situation is the result of the lack of an up-to-date and operational survey of surface and groundwater rights. This blocks the development of a policy for the reallocation of water within the existing law, which would be a move in the direction of greater social equity, and make the entry of new users into the system possible.

Some feel that the introduction of water markets could be a means of producing greater equity. Undeniably, knowledge of the costs, externalities, benefits and value in water use would permit allocation, taking principles of equity into account.

As for water markets, their impact on the concentration of wealth has to be demonstrated with concrete examples.

iv. Environmental Quality

There are areas protected environmentally, for the quality of their water, their ecosystems and biodiversity. Decree Law 9/80 created the Llancanelo Lake reserve. Under this decree, the General Department of Irrigation must assure the necessary flows to protect the environmental sustainability of the lake and of the 40,000-hectare reserve around it.

The prohibition on drilling new wells in aquifers on the right bank of the Mendoza River, because of the risk of over use, is considered to be an allocation of water for environmental quality. The protected area covers 15,000 hectares.

There are claims that the deep aquifers could be polluted with oil, but hydrogeologic studies have not convincingly proved the existence of such pollution.

The oil company has compensated irrigators whose crops have been polluted by the overflows from containing ponds for residual water from the secondary recovery of oil.

Environmental demands are widely discussed among the public. This has a positive effect on the allocation of water for environmental purposes and on environmental controls in general.

v. Participation

As has been described, irrigators participate in the DGI at all levels. However, there is no participation by other users. Nevertheless, they pay for the water they use.

Users of water for uses other than irrigation participate in sector organisations: the drinking water users in the Regulator for Water Supply and Sanitation (EPAS); the energy users in their Regulator (EPRE). Those affected by pollution must make their complaints under Law 5961 on the Preservation, Conservation, Defence and Improvement of the Environment, through the Provincial Council of the Environment created under this law. This council, the secretary of which is the Secretary of the Environment in the government, has not been very active.

User participation is in full evolution. Law 6105 has active user participation in decisions on improving water management as one of its objectives. The Users Association does not play a role in the granting of rights, but does have in its hands the possibility of improving the irrigation survey, by establishing who are the irrigators who really use and pay for water.

The unified Inspectorates and the Associations have redistributed rights as the registers have been revised. However, as yet, there has been no study evaluating these activities.

vi. Integrated management

Multiple use

The multiple use of water is decided within the central organisation, the General Department of Irrigation. As has already been described, the first priority is for drinking water. The private company that provides the service pays for the water conceded. The private electricity generation companies come to an agreement with the DGI on the use of water for generation, taking into account that irrigation has priority. The companies pay for the use of water for generation.

Finally, treated domestic wastes are allocated to irrigation (see Performance of the Administrative System).

The privatisation of the public utilities has allowed the DGI to charge for the water conceded and this has made a large contribution to its self-financing. Conflicts with the private utilities, in a situation where agriculture is depressed, have not been of any significance. Only one conflict is worthy of mention. Due to the instability of a dam it was necessary to make an unusual release of water, which led to the flooding of lands that are not intensively cultivated.

b. Interactions between surface and groundwater

The DGI has not actively participated in the joint use of surface and groundwater, although it has had all the legal and administrative means to do so since 1974.

Little has been done in the reallocation of groundwater and surface water rights in order to reduce the major problem in the region: the constant salinisation of the aquifers.

C. FAILURES

a. Systemic Failures

Rigidity in achieving more efficient management

One of the principle characteristics of the system for the allocation of water rights is the inherence principle. This principle was given important weight at the beginning of the use of water for irrigation (at the end of 19th and beginning of the 20th centuries), when water rights were first distributed, giving security and stability to the system. At that time, of course, water did not act as a serious limitation to agricultural and social development.

The principle was complicated in its application, because excessive restrictions were established through administrative rules. These led to the prohibition, within the same property, of allocating water to other parts of the property with higher productivity, but which did not appear in the register. This situation conspired against the more efficient use of water and achieving a higher yield from the resource. In reality, it was a denaturalisation of the purpose of the inherence principle and has led to serious criticism of the principle itself, when the problem is not the principle, but its incorrect application. Some of these administrative restrictions have become more flexible, giving greater rationality to the system.

Such operational practices, mentioned again below, allow reallocations taking account of economic rationality. Such practices are not considered in the legislation.

b. Government Failures

Although the law expressly states a number of causes for revoking water rights, which would allow the reallocation of the water, in practice these have not been applied, making the system rigid and, in consequence, inefficient in the allocation of water.

However, in some cases criteria have been applied in the allocation of rights that are not stated in the law. This has occurred when excess water is available in the spring (when the river flows are higher) or in years of abundant water. The existence of such flows, which go through some areas with severe problems of over-exploitation of groundwater (when it has been advised to limit pumping), has provided a means to allocate temporary rights to the holders of groundwater rights to prevent pumping and the continued salinisation of the aquifer.

User organisations have also developed informal practices for the distribution of surplus water. These arrangements involve the integrated use of surface and groundwater.

Finally, it is important to mention the existence of the so-called water banks implemented by some inspectorates and sub-delegations.

In conclusion, it can be said that although the laws allow flexibility in the reallocation of water, the means chosen (the failure to implement the proceedings to declare closure)

continue to impose rigidity in the system of reallocation. There are, however, a number of means by which the users, in their organisations, can in fact reallocate water, taking principles of economic rationality into account.

II. ADMINISTRATIVE SYSTEM

A. REGIME

1. Director

i. Operational criteria

The system begins with the diversion of water from the rivers, by weirs or by direct intakes, into the main canals under the responsibility of each River Sub-delegation. The water is then delivered through intakes into the secondary canal network distributing the water to the areas of irrigation administered by the Canal Inspectorates. These divert the water manually into the small canals and ditches that carry the water to the farms. There are also direct intakes of water from the rivers feeding the main canals and following the same route to the farm. The quantity assigned to each Inspectorate depends on its area of land with paid-up water rights and on the system of turns, which has been established.

The main operational criterion followed is to give priority to those with definitive rights, and only then are eventual rights supplied in the proportion the flow allows. Finally, and if there are surplus flows in the months of high flow, the summer reinforcements are provided.

The operational management of water distribution from the secondary canals to the farms is the responsibility of the User Associations and Canal Inspectorates, which distribute the water in consensus with their members.

For groundwater, each user decides operational criteria in accordance with his needs.

2. Executive

ii. Who administers?

The authority responsible for the application of the Water Law is the General Department of Irrigation, which manages water resources in the province. The River Sub-delegations and the Irrigation Areas share in this responsibility in each river basin. Finally, the Associations and Canal Inspectorates have the operational responsibilities. It must be emphasised that although the Law covers all uses, the DGI only manages water used for irrigation.

User participation in surface water management

a. Higher management levels

The highest deliberating body for water management is the Honourable Administrative Tribunal. This consists of five councillors, one for each river, except the Tunuyán, which has two. The users elect the councillors. They also make up the Appeal council, which reviews the decisions of the Superintendent.

The functions of the Administrative Tribunal include the nomination of the DGI personnel, the approval of the elections and of the budget for the Canal Inspectorates. It decides on regulations and resolutions. It fixes the date on which water will be stopped. It is participatory in that its members are elected from among their peers.

b. Management at the River basin level – River Sub-delegation (first level of decentralisation)

The participation of irrigators is also guaranteed in the basin management organisations. When a Sub-delegate deems it necessary, given the significance of an issue, he convenes the Honourable Committee of Canal Inspectorates, formed from elected delegates, to act as a deliberative body to accompany the Inspector in his administration.

Recently River Basin Councils presided over by the Sub-delegate have been created. These represent all interests involved in water management, not only irrigators. They have sometimes been successful, sometimes not.

These bodies make up the administration by the State, while the following are bodies completely administered by the users. Users have a very specific role in water resource management, which the General Department of Irrigation has recently been deliberately strengthening.

While the participation of irrigators is assured, this is not true for other users of water: drinking water, industrial, environmental, and urban uses.

c. Small basins: Canal Inspectorates

The Canal Inspectorates participate actively in the exercise of their responsibility for water management in their areas of jurisdiction.

The authorities within the inspectorates are:

- GENERAL ASSEMBLY OF THE USERS: These can be ordinary (approval of the annual budget, calculation of resources and rendition of accounts) or extraordinary (called by the Inspector, either on his own account, or at the request of the DGI or of the users, for urgent or important reasons).

- CANAL INSPECTOR: He is democratically elected by all the users within an inspectorate to manage the inspectorate with the assistance of the delegates.

- DELEGATES: Three users are elected to assist the Inspector.

- WATCH COMMISSION: This is formed annually at the Ordinary General Assembly for the purpose of inspecting the inspectorate.

Delimitation: An inspectorate manages the area delimited by the canal, ditch, drain or aquifer under its jurisdiction, including all activities affecting the distribution of water, the integrity of the canal, and the quantity and quality of the water. The area is defined by the DGI.

iii. Who pays?

Water resource management is financed through the income generated by the tariff charged to users and from investment funds for water infrastructure, which sometimes must be reimbursed, at others not.

Both the DGI and the Canal inspectorates have an annual budget cycle.

a. The Budget

The Honourable Administrative Tribunal approves the budget for each year. It contains a summary of expenses and an estimate of expected income and, within the general and specific regulations, it regulates everything carried out that year. The resources and the proportion of income are calculated according to the conditions in each basin and over successive years the structure has increased tariff differentiation according to water use.

b. The water charge

The value of water depends on the value given to it by the users, which, in turn, comes from their estimate of the benefits they believe they obtain from it.

There are two different concepts to be considered: first, there is the **charge or tariff**; the price paid by the user to the DGI and the Canal inspectorates; second, there is the delivery cost, the costs involved in ensuring that the DGI and the inspectorates get water to the user in the appropriate time, form, quality, quantity, and opportunity. In the province the tariff is included within these costs.

By law, the DGI is responsible for setting and collecting the water charge. The users are obliged to pay the financial charges related to the concession of surface water, including reimbursement for capital works, of a groundwater concession, and for polluting. The charge includes these three tariffs: surface water, groundwater, and pollution. Figure 3 shows the components of each part.

Figure 3: Water Charge

Surface	Groundwater	Pollution
General Department of Irrigation	General Department of Irrigation	General Department of Irrigation
Headquarters costs Maintenance of telemetric network Climatic emergencies Permanent works fund Dams Heavy equipment **Reimbursements** Minor and major works **Canal inspectorates** Canal;branch;ditch		

Surface water:

For irrigation, the charge is based on land area, independent of the volume of water used. For the oil industry a volumetric charge is made varying according to whether the water is used for exploration, exploitation, secondary recovery, or treatment plants. For hydroelectricity the charge is a proportion of the value of the energy.

The costs entering the tariff are:

- **The quota to meet administrative costs** of regulating the provincial water resources: the DGI, Sub-delegations (basin organisations) and the user associations.

It includes all the costs of maintaining infrastructure: technical, accounting, and administrative. It is a charge inherent in the right and must be paid. It includes the Central Headquarters, the Sub-delegations and Irrigation Areas. The cost of the headquarters is prorated among all the registered hectares. For Sub-delegations, it is prorated among the hectares in each basin. The two together make up the cost of maintaining the General Department of Irrigation.

- **Maintenance of the Telemetric Network:**

  The network has different components, depending on physical location, type of hardware and software, instruments, etc. For practical reasons this cost is differentiated from the cost of administration, but legally it is treated in the same way. As a first step, the cost is prorated over all registered hectares.

- **Dam**

  This charge includes all the costs derived from the maintenance and repair of the dams located on each river. The costs are prorated among the registered hectares downstream. If there is a physical obstacle to the reception of water, “beyond the responsibility of the user”, there is exemption (the service was not rendered).

- **Heavy equipment:**

  This charge is for the estimated costs of the maintenance and repair of the heavy equipment. This is used for opening drains and cleaning canals. The costs are prorated among the benefiting hectares. If there is a physical obstacle to the reception of water, "beyond the responsibility of the user", there is exemption (the service was not rendered).

- **Climatic emergency fund:**

  This fund was established to help areas affected by climatic phenomena, "frosts, hail, wind", which cause a drop in the income of the Canal inspectorates until the following agricultural year. These are autonomous bodies with budgetary independence and do not receive any kind of subsidy for the payment of the water charge. When they do not receive income they can use resources from the fund, which must be repaid once the emergency is over. Consequently, in the case of maintenance, there is no exemption.

- **Canal inspectorate:**

  This is the amount calculated by the Canal inspectorates and the User consortiums in their budgets, as approved by the Assemblies. It represents the amount the irrigators in the area benefiting from each inspectorate must pay to meet the costs of an efficient and effective water delivery. If there is a physical obstacle to the reception of water, "beyond the responsibility of the user", there is exemption (the service was not rendered).

The following table shows the composition of the water charge for surface water from the Mendoza River.[35]

Table 11 Water Charge for Surface Water, Mendoza River

Administrative costs		Others DGI (a)	Canal inspectorate	Total (A$/ha. Per year)
Headquarters	Sub-delegation, dams and telemetry			
4.51	10.79	4.96	23.4	433.66

Source: Based on General Department of Irrigation, Plan Hídrico para la Provincía de Mendoza, 1999.

For other uses, various costs are multiplied by a coefficient defined in the DGI budget and applied to the charge for irrigation, that is, so many times the charge applied for irrigation.

[35] General Department of Irrigation, "Plan Hídrico para la Provincía de Mendoza", 1999, p.11

Drinking water supply has a coefficient of 3.125, recreational use of 3 and industrial use of 1.5.

Groundwater:

If groundwater is used for agriculture, the yearly charge is determined by the diameter of the well without considering the effective consumption of water. For other uses, the basis corresponds to that used for agriculture multiplied by a determined factor. Only water for mining is charged by volume.

The charge is fixed on the basis of the diameter of the well in inches: (1”-4”), (5”-8”), (9”-12”), (more than 12”). This charge is for the maintenance of the entire infrastructure, for control of the reserve volume and the quality of water in the aquifer, to allow the periodic revision of the drilling permit, or to demand the repair of the pipes or the sealing of the well.

Income received from the sealing of wells is used to effectively seal wells definitively, since, due to their high level of pollution, they are a danger to the aquifers.

Consolidated Register of discharging Companies. The case of polluting effluents

This is the tariff charged to companies for the discharge of effluents into irrigation channels, according to the corresponding category and annual volume discharged. If the discharges exceed established quality limits, fines are levied.

The percentage of the charge varies according to irrigation areas, although in general it is low, affected by the overall economic situation.

Annual contribution:

The “Charge for the Control of Pollution and the Conservation of the Water Resource of the Province” is applied to all businesses registered in the “Consolidated Business Register” that have registered voluntarily or are included by the nature of their activity, until the General Regulation for the Control of Pollution is approved.

There are various categories:

- First category: businesses discharging annually up to 1,000 m3.
- Second category: businesses discharging annually between 1,001 and 10,000 m3.
- Third category: businesses discharging annually between 10,001 and 50,000 m3.
- Fourth category: businesses discharging annually over 50,000 m3.

Pollution charges:

a. Registration
b. Registration by nature of the business
c. Fines

Table 12. Tariffs by water use

Water use	Method of calculation
Electricity Generation	Average cost energy-kW generated- % royalty 2.5 law 6088
Oil and others	m3/extracted – superficial or groundwater
Agriculture	Base of calculation1 – on which all these others are differentiated
Drinking Water Supply	Coefficient 3.125
Industry	Coefficient 1.5
Public	Coefficient 1.5
Recreation	Coefficient 3
Fish farming	Coefficient yet to be determined
Brick making	Coefficient 6
Mineral water	m^3 extracted

Source: Based on General Department of Irrigation, Plan Hídrico para la Provincia de Mendoza, 1999.

The determination of the amount corresponding to the tariff depends essentially on the type of water use, the effective delivery, the analysis of the use, and its comparison with similar uses in "semi-desert" areas. This allows the tariff to be administered with equity and equality.

Electricity Generation:

The registrations under this use are at the equivalence of 1 ha. = 1Kw. The registration has value in the Evaluation of the Water Balance of the Basin, and its payment is set under Law No.6088 as "the average value of electricity generated by % of co-participation".

Drinking water supply:

Water is delivered 24 hours a day and 365 days of the year. The registration must correspond to the effective delivery of the specified amount. The General Department of Irrigation determines its equivalence in hectares and, since 1998 the coefficient applied over the "agricultural use base" is 3.125.

Industrial:

For registration the same criterion of "average delivery" is used at its equivalence in hectares. The coefficient for the tariff is 1.5 times over "agricultural use base".

Public:

This category corresponds to the registration for watering street trees, “Municipalities”. For each lot laid out (10 hectares) it is estimated that 35% is used for streets, green areas, etc. Consequently, this right, which originally covered buildings, is reduced to 3.5 hectares. The coefficient is 1.5 times “agricultural use base”.

Agriculture

Agricultural provides the base of the calculations for the application of the different tariffs. The coefficient is 1.

Recreation:

This use defines the maintenance of lawns, clubs, weekend houses, parks, etc. The coefficient is 3.

Fish farming:

The coefficient is still under study.

Brick making:

The coefficient is 6.

Mineral water:

The mineral water tariff consists of a fixed amount up to 500m^3 and beyond that a fee per cubic metre. The companies must present a notarised declaration of the amount consumed and possess flow metres for periodic control. If illicit use is discovered the Sub-delegates or the Chiefs of Area are authorised to charge a fine of up to 50 times the established amount.

Oil and others

The charge is determined by volume for both surface water and groundwater used in pumping, drilling, or repairing oil wells.

Under a precarious right for each cubic metre used in refining and in the secondary or tertiary recuperation of wells a differential tariff is paid.

c. Development of policies to maintain and increase the level of debt collection

Facilitating payment

Recognising the problems of the users, it has been deemed necessary to find a means of assisting the debtors in bringing their accounts up–to-date, but in such a way as not to prejudice users who pay their bills.

Examples include the bringing back into cultivation of uncultivated and abandoned lands.

- Low income, “only source of income”, small areas.
- Property affected repeatedly by “climate emergencies”.
- Those in a position to pay equal or higher charges than those fixed for the present period.
- Cash payment

These are very different situations and must be resolved in such a way that over the whole of the Province they are given equality of treatment with charges sufficient to prevent affecting the budgets needed for maintenance and operations.

Compulsory payments

There are two methods, totally compatible and approved under the Water Law and the Civil Code.

They are based on the concept that the use of water is a privilege, “not everyone has the right”, and consequently the user must pay.

Restricting supply

Under art. 27 of the Water Law, non-payment of the charge permits the water authority – the Superintendent, the Sub-delegate or the Canal Inspector – to restrict delivery of water. This is effective for 90% of the farms under cultivation and “there must be periodic controls and fines applied to those who violate the established rules”.

Further causes of restricting supply are the failure to take the share, the lack of systematic irrigation, the abandonment of the intake, or the lack of a gate.

Force

The authority cannot allow the writing off of debt, but must apply the tax law. Abandoned lands or those that do not respond to the restriction of supply must be legally charged and, if necessary, the property can be auctioned.

Stimuli for those who maintain their accounts up to date

There are different ways of providing incentives and stimuli to farmers who regularly pay:

Scaled discounts of 5%, 10% and 15% for those who keep their accounts up to date over time.

It is important to repeat that the tariff system of the General Department of Irrigation is not designed to encourage efficient use of water.

iv. Who decides to invest?

Irrigation works are self-funded. The decision to raise resources is in the hands of the irrigators, in co-ordination with the General Department of Irrigation and the provincial government.

The resources of the DGI correspond to funds raised by the quota of the Permanent Fund (Decree law 55/75) for the reimbursement of previous works and others. The quota of A$2.75 a hectare is paid within the bill for the water charge,. Where this money has been used for minor works, the users directly benefited repay 80% of the cost and the other 20% is paid from the Permanent Fund. For major works the user only repays 60% of the total cost of the investment and 40% is paid by the provincial government, on the argument that these works benefit the whole population (see point two).

Sources of finance outside the General Department of Irrigation are also used:

1. The Provincial Government programme for public works.

2. The Federal Government programmes, including the emergency work programmes.

3. International financial organisations, such as PROSAP, the programme for public works in the agricultural sector. PROSAP finances 80% of the investment and the province finances the other 20%. The decision to invest in these cases is taken by the provincial government with advice from the organised irrigators.

v. What water is delivered and by what means[36]

The Northern Basin is formed by two of the five rivers in the provincial hydrologic network, the Mendoza River and the Lower Tunuyán River.

The Mendoza River has as tributaries the Cuevas River, which rises in the glaciers close to the Volcán pass, the Tupungato River, which rises in the Tupungato glacier and then joins the Plomo River, and the Las Vacas River, which rises on the eastern slope of Mount Aconcagua. (Annex II Maps)

The Tunuyán River rises in the cordillera of Mount Tupungato and Mount Tupungatito and also carries the meltwater from the San Juan, Negro and Mesón San Juan glaciers. Its

[36] General Department of Irrigation, “Plan Hídrico para la Provincia de Mendoza”, 1999, pp. 17-18.

principle tributaries are the Palomares, Salinillas and Colorado Rivers. The San Carlos, Pircas, Salas Coaca, Claro, Grande, Olmos and Villegas Creeks are also tributary.

In the province two sources of water are used, surface water (rivers) and groundwater. Recently, treated effluents have been added, which can be considered a third source.

To use groundwater all that is needed is to dig a well. For surface water, in contrast, it is necessary to build a hydraulic infrastructure to transport the water to the user, consisting of canals, weirs, reservoirs, dividing works, hydrological stations and other works. According to the General Department of Irrigation, in 2001 the existing hydraulic infrastructure was valued, at US $1,908 millions.

Table 13. Estimated value of the hydraulic infrastructure, by basin, Mendoza

Infrastructure[37]	Estimated value (US$)
Lined canals	347,000,000
Unlined canals	287,000,000
Specific works	30,000,000
Drains	34,000,000
Weirs	83,000,000
Dams	1,127,000,000
Total	1,908,000,000

Source: Mendoza, General Department Irrigation, Research and Water Planning Directorate, “Obras y Proyectos, 1997-2001”, 2002.[38]

The existing basic infrastructure in the Northern Basin is shown in Table 14.

Table 14. Existing basic infrastructure in the Northern Basin of Mendoza

River	Weirs		Reservoir		Annual Flow hm3	Canal		Drain Km
	Name	Derivation capacity m3/s	Name	Capacity in hm3		Km	% lined	
Mendoza	Cipolletti	80	Potrerillos	420	1,585	4,910	2	350
	G. Andre	6						
Lower Tunuyán	Tiburcio Venegas	60	El Carrizal	385	1,065	1,570	10	484

Source: Mendoza, General Department of Irrigation, Research and Water Planning Directorate, Obras y Proyectos, 1997-2001, 2002.[39]

[37] This information is for the whole of the province.
[38] Mendoza, General Department of Irrigation, Research and Water Planning Directorate, “Obras y Proyectos, 1997-2001”, 2002, p.3
[39] Mendoza, General Departmentof Irrigation, Research and Water Planning Directorate, “Obras y Proyectos, 1997-2001”, 2002, p.4

The distribution of water depends, primarily, on whether it is a regulated system or not, and the criterion applied is the number of hectares under concession.

The Canal inspectorates operate the system for the distribution and delivery of water through the employment of gate operators. Therefore, complete decentralisation to the user organisations has been achieved in the operation of the surface water network.

The operation of groundwater is on an individual basis, each user establishing his requirements at the time of pumping water. However, an important factor influencing this decision is the system of low tariff periods for well operation offered by the electricity utility.

Nevertheless, in recent years, a policy of decentralisation of water resource management to the user inspectorates has been introduced in order to improve efficiency in the use of groundwater and the conservation of its quality.

As has been mentioned, the irrigation canals are a part of the water infrastructure for the Mendoza River. These are described below:

The First Association has 83.626 kilometres of canal, of which 12.131 kilometres are lined and 71.495 kilometres are unlined. The Second Association has 202.52 kilometres of canal, of which 31.06 are lined and 171.16 unlined. The Third Association has 168.8 kilometres of canals, of which 20.23 are lined and 145.57 are unlined. The Fourth Association has 150.00 kilometres of canals, all of which are unlined. The Fifth Association has 356 kilometres of canals, entirely unlined.

The lack of regulation of the Mendoza River, solved by the Potrerillos dam, led to water being diverted to flow immediately into the canal. Due to significant daily and seasonal variations and the use of permanent adjustments at the first level, both the increases and the decreases in flow were divided proportionally among all the canals integrating the system. Generally, the supply of water between April and November is less than the demand. Consequently, the water was distributed by turns, dividing the system into the necessary number of sections to ensure a delivery coefficient of not less than 0.5 litres/second/hectare.

Before the Potrerillos Dam was built, starting in December when river flow began to exceed 45-50m^3/second, in conjunction with the delivery of water to the canals of the lower reaches (without sand), it was necessary to clean the sand and gravel traps of the Cipolletti Dam, because of the large amount of sediment carried by the river, a job which took 48 hours every week.

In years of high flow, when the sustained flow exceeded 200 m^3/second, it was necessary to make an additional 24-hour sand clearing in the middle of the week. Consequently, the delivery of water had to be suspended for the upper and middle reaches and all the flow was returned to the natural bed below Cipolletti.

The building and coming into operation of the Potrerillos Dam has solved this problem through the derivation of clear water.

During June and July, the annual closure of distribution is made. This lasts30-45 days and is to allow the cleaning and the conservation of the canals and carrying out work on the dams and the distribution network. Generally, the canals in the lower reaches are closed first, so that when the work is done in the upper reaches, they can receive all the water.

As the Mendoza River is now regulated, a distribution plan is drawn up on the basis of crop needs, reducing supply to lower priority crops.

The distribution is made taking account of those who have paid the water charge, information provided by the DGI. The programming of the distribution of water to the canals is the responsibility of the DGI and it is the Canal inspectorates who manage the water through a manual system of gates in charge of their employees, called “tomeros”.

The delivery of water takes into account its availability and the area registered, as the law establishes.

The basic requirements of the DGI for delivering water to the users are: that it is made use of; that the payments of the water charge are up to date; that the intake is in good condition; and that the cleaning of the irrigation ditches and drains ordered by the Inspectorate has been completed.

The Tunuyán River is regulated in its lower basin by the El Carrizal dam.

A system of distribution by turns in proportion to the number of hectares with water rights has been established for the distribution of water.

The Water Law establishes that the holder of a concession will receive a litre and half per second per hectare as a maximum (art. 122). However, in periods of drought and whenever the supply is not sufficient to satisfy all the concessions in any canal, a system of turns will be established. At present, however, this practice is always applied.

3. REGULATOR/INSPECTOR

i. Inspection and control

Among the controls during the distribution and transport of water is the control of water quality.

The DGI is responsible for the police power for water quality control in rivers and canals. It is also responsible for groundwater quality.

The DGI uses the following groups of controls:

a. Legal

b. Economic

c. Institutional

a. Legal controls

Over the last decade, the DGI has followed a policy of the centralisation of regulation and the decentralisation of operations. In keeping with this, a pollution regulation has been designed whose application is to be decentralised. The DGI, within the General Water Law and Laws 4035, 4036, 5961, 6044 and 6405, the provincial water law, has established a general regulation for the control of water pollution under Resolution 778 of 1996 of the Honourable Administrative Tribunal of the DGI.

The objectives of this regulation are:[40]

a. To conserve and improve water quality according to the uses assigned legally or through administrative authority, or in order to protect the environment.

b. To stop pollution or degradation of both surface and groundwater, whether caused by natural causes or events or provoked by human action.

c. To conserve, preserve, and recuperate aquatic ecosystems, in coordination with the pertinent authority.

d. To regulate and definitively improve existing discharges through concrete projects for their treatment.

e. To regulate the procedures for the control of discharges and the granting of authorisations and permits.

The principles behind this Regulation are the following:[41]

a. Respect for the Unity of the Hydrological Cycle and of the Unity of the River Basin;

b. Conservation and protection of the environment and its ecosystems;

c. Prevention to avoid pollution or degradation of the water resource;

d. Repair of the damage caused and indemnity where it corresponds;

e. User participation;

f. Precaution, or the imposing of restrictions and control measures, where there is potential or presumed pollution;

[40] Resolution 778/96, Honourable Administrative Tribunal, Art.2
[41] Resolution 778/96, Honourable Administrative Tribunal, Art.3

g. Coordination;

h. Information;

i. Objective responsibility.

Under the law, pollution, or water degradation, is defined as " any human or natural action or activity that implies change in the quality of water. This is in relationship either to the uses assigned or to the protection of the environment and occurs both within the public water domain and in its surroundings."[42]

To monitor companies that discharge into irrigation canals, the Consolidated Registry of Companies (RUE) has been created. In principle, inscription is voluntary, but in reality it is obligatory for those companies falling under the requirements established in the regulation.[43]

In some areas, to reduce the level of groundwater degradation Resolution 673/97 of the Honourable Administrative Tribunal has been applied, which allows the Superintendent to declare areas of temporary prohibition or restrictions on drilling.

b. Economic controls

The DGI applies two different economic criteria: incentive and coercion. The incentives are directed at animating polluters to takes measures to reduce the pollution they produce. The coercive measures correspond to drastic sanctions with the same objective, such as charges and fines for discharges. However, in the use of fines the prime objective is the commitment of the polluter to reduce the pollution load, not to increase the collection of fines.[44]

The charges that have been established for the companies incorporated in the RUE are, by category, as follows:[45]

- First category: Companies discharging up to 1000 m^3 per year, an annual charge of A$150.

- Second category: Companies discharging between 1001 and 10,000 m^3 per year, an annual charge of A$250

- Third category: Companies discharging between 10,001 and 50,000 m^3 a year, an annual charge of A$500

[42] Resolution 778/96, Honourable Administrative Tribunal, Art.4
[43] Resolution 429/93, Honourable Administrative Tribunal
[44] Resolution 311/95, Honourable Administrative Tribunal
[45] Resolution 173/95, Honourable Administrative Tribunal

- Fourth category: Companies discharging over 50,000 m^3 a year, an annual charge of A$2,000.

All the money collected under this item is incorporated into the "Pollution Fund", used to meet the costs of the prevention and control of pollution in the irrigation canals, drains, and collectors under the jurisdiction of the DGI. The fund also receives resources from fines, registrations, and other incomes originating as a consequence of this activity.[46]

c. Institutional controls

- Warning system for the control of emergencies

A system of permanent fixed guards has been set up to detect any event that might pollute the Mendoza River. They are on duty 24 hours a day, 365 days a year. They are under the Sub-delegation of the Mendoza River and the person on duty at the time the event occurs is responsible for the appropriate visual inspection. The areas covered are the mountains, the irrigation area, and the oil producing areas where human life or material goods can be compromised and are beyond the operative capacity of the Sub-delegation, which is limited to reports of routine discharges.

- **Areas of restriction or temporary prohibition of the use of groundwater**[47]

The declaring of areas of restriction and the temporary prohibition of the sinking of new wells result from evidence of the degradation of the groundwater appearing in the technical studies. The intention of the implementation of areas of restriction is to reduce overuse in areas where severe processes of salinisation have been detected. The affected areas and the measures applied are:

Area	Measure
Foothills: In the departments of Capital, Las Heras, Godoy Cruz, and Luján de Cuyo	Problem: water scarcity and salt taste. Measure: Declaration of restricted area.[48]
El Carrizal basin: Right bank of the Mendoza River in the districts of Agrelo, Blanco Encalada, Perdriel, Ugarteche, Carrizal, and Anchoris	Problem: Annual water scarcity of 34 hm^3, fall in the water level of 3 or 4 metres since 1992, in some places reaching 33 metres. Measure: Declaration of area of restriction.[49]
The districts of Alto Salvador, Montecaseros, Chapanay, and Tres Porteñas	Problem: Increasing decline in water quality. Measure: Restricted area.

- Information system for snow and hydrometeorology

[46] Resolution 253/92, Honourable Administrative Tribunal
[47] Mendoza, General Department of Irrigation, "Política de Agua Subterránea", p.19
[48] Resolution 331, Superintendent, DGI.
[49] Resolution 220/99, Superintendent, DGI.

The information system for snow and hydrometeorology has been built by the General Department of Irrigation to measure, in real time, the flows in the basic distribution system, the rivers, and meteorological parameters in the high mountains (forming what is called the Telemetric Network). This system of information allows the control of river flow, which improves the management of water distribution.

- Decentralisation of operational pollution control and centralisation of the analysis of the results.

The DGI, pursuing its policy of administrative decentralisation, delegated the monitoring of water quality and effluent control of the big industrial establishments in the river basins to the River sub-delegations.

Through agreements signed with the Canal inspectorates, they have more actively participated in the planning and coordination of the annual hydro-chemical monitoring of wells, reporting contaminated and illegal wells, and sealing wells.

- Quality levels

The DGI has also defined acceptable discharge levels for industrial and sanitary discharges.

Industrial and urban discharges

These are regulated by the standards established in Resolution No. 634/87 of the Superintendent and 413/87 of the Honourable Administrative Tribunal.

Oil industry discharges

Due to the nature of the products generated in the industry, there are no discharge standards for this industry.

Agricultural discharges

This matter requires urgent study and the application of controls, as the province has no legislation in this area.

Sanitary discharges

Zero discharge into irrigation canals is recommended, with agricultural reuse in restricted areas for special or specific crops (A.C.R.E.).

For effective control of the level of these discharges, the DGI has established controls over industrial and sanitary discharges. The first is under the Water Police Directorate. Such control is not limited just to discharges, but also to other kinds of depositions to prevent water pollution.

The Consolidated Business Registry has been created, in which every person, company, or business that actually or potentially discharges into waters in the public domain of the province is obliged to register. If they do not they can be fined and formally registered. Once this requirement is met, the quality and quantity of discharges are controlled. They must be within the limits set.

1. Information basis for decision-making

The DGI has invested in the development of a strategic information system for making decisions with the intention of having up-to-date information on the provincial water resources.

- River Basin monitoring

There are 60 monitoring points on the river from the source, on the reservoirs, and on the first, second and third canal networks.

- Control of oil fields

The DGI, under the Water Law and Resolution 778/96 of the Honourable Administrative Tribunal, has the authority to regulate all the areas that are potentially hazardous and could cause water pollution.

ii. Conflict resolution

Conflicts in information management

There are conflicts between the Sub-delegations and the Inspectorates about, among other things, the management of information and water use. This is a result of the administrative decentralisation that has been put into effect. There is a general rejection of control by the Inspectorates. The inspectorates must bring the registration of users and uses, which is provided by the Sub-delegations, up to date and, once finished, this must be returned to the Sub-delegation. This has not been done in every case.[50]

iii. Inter-Institutional Conflicts

There are various types of conflicts generated and resolved. These must be identified if they are to be discussed in detail:

a. Conflicts between users:

[50] Llop, Armando, "Diagnóstico de las Subdelegaciones de río del Departmento General de Irrigación", National Water Institute – Centre for Economics, Legislation and Administration, 1999.

These are conflicts among the various users of water, in which the DGI behaves as "judge", and provides administrative resolution.

Law 322 defines a procedure for obtaining administrative resolution to this kind of problem before it reaches the courts.

Two stage procedure:

- **Administrative level:** the system consists of two stages and guarantees the user that the original decisions taken by the Canal Inspectorates can be appealed before the corresponding Sub-delegation, those of the Sub-delegation before the Superintendent, and finally before the Honourable Administrative Tribunal. The administrative procedure is exhausted, in every case, at the second stage.

- **Judicial level:** once the administrative procedure has been exhausted, the decisions of the water authorities can be appealed before the Supreme Court of the Province, through an administrative procedure complaint.

River Basin Committees have been created as a means to resolve the problems among the various users.

b. Inter-Institutional conflicts

In the event of inter-institutional conflicts between agencies of the provincial government, the law establishes that the Ministry of Environment and Public Works should intervene.

In some cases conflicts between institutions arise as a result of the ambiguity of the laws.

There are no defined mechanisms for the resolution of this type of conflict. In practice, most have been solved by mutual agreement between the parties involved.

c. Interstate conflicts

The Federal Constitution establishes that the water resource is in the jurisdiction of the Provinces, when the waters rise and die in the province. If this is not the case then they are considered to be interstate waters and are governed by inter-provincial agreements.

Recently, the Federal Undersecretary of Water Resources has moved towards a definition, jointly with all the provinces, of the "basic principles of water policy", which is meant to form the basis for water management at the federal level.

The Federal Water Council (COHIFE) has been created to work in agreement with all the provinces to coordinate actions in water management.

Federal Law 25.688/03 on water, dealing with this matter, has recently been passed. This has caused conflicts between the federal government and the provinces and between the provinces and some important water users.

B. PERFORMANCE

i. Effectiveness

The urban population supplied with drinking water and sewerage in the Northern Basin is shown in Table 15. There is an unsatisfied population (without service), not due to a lack of water, but due to the lack of investment in the distribution systems. (This should improve with the goals proposed for drinking water concessions.)

Table 15. Proportion of the population with drinking water and sewerage services, by basin, 2000

River Basin	Percentage of the total population with service*	
	Drinking water	Sewerage
North Basin	93	65
Central Basin	82	35
Southern Basin	78	30
Total Mendoza	83	57

Source, Mendoza, Directorate of Statistics and Economic Research, 2003

* The overall data for the Province of Mendoza show that 95.9% of the urban population has access to drinking water and 59.2% has access to sewerage services (According to the National Report on Water Management in Argentina).

The rights conceded for drinking water are easily supplied in normal years, but they are affected in dry years.

In poor years, the irrigation system has problems satisfying rights in the lower reaches of the river basins. The Department of Lavalle with 20,000 hectares under cultivation (13.5% of the Northern Basin) and almost 2000 farms (15% of the farms in the basin) is the most vulnerable area, due to its location in the northern (the lowest) part of the basin. Some recent works have alleviated the problem (Fourth and Fifth section of the Mendoza River network). The construction of the Potrerillos Dam, together with the El Carrizal Dam, improved the annual distribution (opportunity), although problems persist in the supply of surface water to agriculture in dry years (as drinking water has priority by law). The difference between the quantity of water required by the crops and the quantity received by the irrigators is met from groundwater. In the Northern Basin, complementary groundwater is used for 41% of the irrigated area (DGI, 2000). When a farmer does not have a well, he generally irrigates a smaller area.

There is a lack of waterproofed infrastructure (see the following section, Physical Efficiency). There is no lack of irrigation organisations, but failures within them (see the chapter, Failures).

ii. Efficiency

a. Physical

The efficiency of the drinking water supply system is considered to be low. Although production is estimated to be 614 l/pc/d, it has been shown that domestic consumption is only 410 l/pc/d, implying an efficiency in distribution of only 67%, which means that 33% of the water is not accounted for (Provincial Water Plan, 1999).

In the distribution network for water (irrigation, drinking water, and industrial), which is done through open canals, the efficiency in transport and distribution is of the order of 46% in the Mendoza River (Morábito et al, 2003) and of 61% in the River Tunuyán (Chambouleyron et al, 1999).

Some of the inefficiency in transport is due to the low proportion of waterproofed canals, which is only around 5% (DGI, 1996).

b. Administrative efficiency

Administrative efficiency is analysed by two different indicators:

- First, the administrative achievement is measured using a parameter of the relationship between the budget spent and that projected. The correct reading of this indicator of Budgetary Execution (BE) establishes how much of what was projected to be done, was actually done in practice. Given the present organisational structure of the system, for a correct interpretation of the results it is necessary to disaggregate this measure into three categories: the User Organisations (UO), the Sub-delegation (Sub) and finally, the General Department of Irrigation (DGI).

$$BE_{(UO)} = (\text{Budget spent}_{(UO)}) / (\text{Budget projected}_{(UO)}) = 74\%$$

$$BE_{(Sub)} = (\text{Budget spent}_{(Sub)}) / (\text{Budget projected}_{(Sub)}) = 98\%$$

$$BE_{(DGI)} = (\text{Budget spent}_{(DGI)}) / (\text{Budget projected}_{(DGI)}) = 90\%$$

$$BE_{(GLOBAL)} = (\text{Budget spent}_{(GLOBAL)}) / (\text{Budget projected}_{(GLOBAL)}) = 87\%$$

Reading the disaggregated indicators, it becomes clear that it is at the Sub-delegation where the major part of the programmed budget is spent, while the opposite is the case with the User organisations.

- A further indicator of administrative efficiency to be analysed is the proportion really spent on operation and maintenance compared with the amount proposed. This provides a measure of the future impact of present expenditures on maintenance and efficiencies in water distribution, on the understanding that greater expenditures today are indicative of more efficient distribution in the

future. Again, a disaggregated calculation is made in the same three categories (UO, Sub, and DGI). This indicator is called “Administrative Efficiency” (AE).

$$AE_{(UO)} = (\text{Spent on O\&M}_{(UO)}) / (\text{Total projected budget}_{(UO)}) = 31\%$$

$$AE_{(Sub)} = (\text{Spent on O\&M}_{(Sub)}) / (\text{Total projected budget}_{(Sub)}) = 36\%$$

$$AE_{(DGI)} = (\text{Spent on O\&M}_{(DGI)}) / (\text{Total projected budget}_{(DGI)}) = 16\%$$

$$AE_{(GLOBAL)} = (\text{Spent on O\&M}_{(GLOBAL)}) / (\text{Total projected budget}_{(GLOBAL)}) = 28\%$$

The results above show that the Sub-delegation dedicates the greatest part of its resources to operation and maintenance. Overall, administrative efficiency is around 28%, which shows that little more than a quarter of the total projected budget is effectively spent on operation and maintenance.

Table 16. Administrative efficiency in the Irrigation System of the Northern Basin

Indicator	User organisations	Sub-delegation	DGI	Overall
Budgetary Execution (BE)	74%	98%	90%	87%
Administrative efficiency (AE)	31%	36%	16%	28%

Source: based on data taken from Chambouleyron, Jorge, “Evaluación del uso del agua en Mendoza a través de parámetros de desempeño”, National Water Institute – Andean Regional Centre, 1999.

Another indicator of administrative efficiency is the level of tariff collection by the Associations of canal inspectorates. This is very low in the Southern Basin, 19%, while in the Northern Basin it is 56%. This is indicative of the difficulties in the Southern Basin of in collecting the resources necessary to support an Inspectorate (Abihagle C. and J. Day, 2002). It can also be seen that medium-sized Associations of Inspectorates are those with the highest rate of collection (those from 3000 to 6000 hectares), as is shown in Table 17.

Table 17. Percentage rate of collection by size of Inspectorate

Size of Inspectorate (hectares)	Average percentage of collection
Fewer than 1000	55
1000–3000	62
3000-6000	71
6000-9000	60
9000-12000	54
Over 12000	54

Source: Based on data taken from Chambouleyron, Jorge, "Evaluación del uso del agua en Mendoza a través de parámetros de desempeño", National Water Institute, 1999.

Again it must be emphasised that there are not enough studies to indicate how efficiently the problems confronting the administration are solved.

c. Level of conflict

One measure of conflict is the number of complaints made by users and the community in general. A free telephone line has been set up as a means of facilitating community participation and to solve in this way some of the current conflicts and problems.

Table 18. Distribution of complaints by type, 1997-2001

State of the complaints made	Number	Percentage of total complaints
Complaints resolved	5586	84.4
Complaints pending	646	9.75
Complaints under consideration	387	5.85
Total complaints	6619	100

Source: Based on data of the General Department of Irrigation, March 2002[51]

It is estimated that 115 complaints of various types are received each month.

There are various kinds of complaints, including reports of irregularities, suggestions, enquiries, thanks, management control, enquiries on line, and others.

[51] Mendoza, DGI, Memoria 2001, March 2002, p.27

Table 19. Distribution of complaints by type, 1997-2001[52]

Type of complaint	Quantity	Percentage
Complaint	4445	67.16
Reports of irregularities	994	15.02
Suggestion	53	0.8
Enquiry	356	5.38
Thanks	43	0.65
Management control	214	3.23
Enquiry on line and others	514	7.77
Total	6619	100

Source: Based on data of the General Department of Irrigation, March 2002[53]

iii. Equity

a. Exclusion due to lack of means

The most evident serious failure in equity is the lack of participation by the other users of water – not just the farmers – in its administration. This undeniably results in imbalances in decisions, but basically it is negative for the irrigators themselves, who must put up with a parallel system of water concessions that are directed towards industrial or oil industry activities, which are not subject to the reciprocal controls of the irrigators over their canals. Without doubt, if a means existed for a wider management of water, with elements of economic value and assignment, such inequities could be considered.

In the case of irrigation with surface water, the irrigator only pays the cost of water distribution and the repayment for minor infrastructure works, through the agreed budgets of the assemblies of the sub-delegations. For major works only a low proportion is paid. The average value of the charge for surface water in the Province is A$35 a year, per hectare: A$44 on the Mendoza River and A$29 on the Lower Tunuyán River. The user also pays the cost of cleaning the intake. The user of groundwater pays the tariff that the DGI charges annually for each well, the cost of digging the well and of the energy to pump, as well as maintenance costs. The tariff charged by the DGI depends on the diameter of the well, varying between A$50 and A$135 a year. Operation and maintenance costs depend on the depth of pumping (DGI, 2000).

As already mentioned, the average cost of surface water for an irrigator is lower than that for groundwater. Groundwater costs four times as much. This is a measure of inequity among irrigation users.

- The rate of collection indicated in the previous section (Administrative Efficiency) and in Table 17 is a measure of inequity, as the user who does not pay continues to receive his share of water. The average percentage of tariffs not collected is around 40%. There is a gradual move towards distribution according

[52] Mendoza, DGI, Memoria 2001, March 2002, p.27
[53] Mendoza, DGI, Memoria 2001, March 2002, p.27

to the area paid up. Consequently, the principle of exclusion due to failure to pay has begun to be applied.

- The physical inefficiencies in water transport produce inequity in water distribution between users at the beginning and users at the end of the distribution system. See Physical Efficiency in Administration.

- The various water users produce externalities at different moments and places and these are not included in their costs. This obviously produces inequity. Industrial use and residential use discharge contaminated effluents into canals. These matters are discussed in detail in Administration and Use.

- Major works such as the reservoirs improve the total efficiency of the system, as has already been mentioned. Within the area of influence of the Mendoza River, the Potrerillos reservoir allows an improvement in the distribution of water over the year. The excess flows in summer and autumn can be used the following spring. Obviously, there are other very important benefits, such as the reduction of the damages from major floods and tourism.

b. Distribution of costs

One measure of inequity among different uses is the electricity tariff subsidy for agriculture.

The subsidy results from the difference between the tariff charged for the electricity used for pumping, and that charged to all other users. The tariff for irrigators is 0.0863 pesos a KW/h during the peak period (10am to 2pm and from 6pm to 11pm) and 0.0285 pesos a KW/h during the off period (2pm to 6pm and 11pm to 10am). For the rest of the users in the Small Demand category the average tariff is 0.101 pesos a KW/h.[54]

Taking into account that the electricity consumption of the agricultural sector was 268,200 MW/h in 2000 and taking an average tariff for the sector of A$0.045 KW/h, the expenditure made by the farmers was A$12,060,000. If for the same consumption the average tariff had been applied, the expenditure would have been A$27,088,200: the difference between the two values, A$15,028,200, is an amount approximately equal to the annual subsidy. Under art.59 of the Budget Law No.7091, 2003, the subsidy assigned to irrigation was A$8,350,000.

c. **Applying the Water Law**

The law provides that the authority should apply a declaration of termination of the water right when it has not been used for 5 years. However, this article has never been applied by any DGI administration, which makes it impossible to introduce new users to the system when the actual users are not using their rights. This generates a clearly inequitable situation, illustrating the legal rigidity that has resulted from the existence of

[54]Data taken from the EDEMSA tariff table, May 2001.

the inherence principle. This is not correct, as the law itself establishes situations in which a granted right can be taken away and reallocated to new users. It is also inequitable for the other users who meet the requirements of the DGI.

iv. Environmental Quality

The distribution system for surface water through the canal network receives diverse types of pollution, the most important of which are domestic and industrial effluents and domestic solid waste. This occurs over the entire Northern Basin network, but the 20,000 hectares in the north of the basin are the most affected.

Industrial pollution. The industrial area in the departments of Maipú and Guaymallén discharges effluents from wineries, canning factories, and others into the Pescara Drain, from which the Sánchez and Starace ditches irrigate 3,300 hectares of Guaymallén, and into the drains of the Colonias and Tulumaya canals, which water 7,000 hectares in the department of Lavalle (in total 7% of the Northern Basin). The high levels of salinity (3,000 to 6,000 microomhos) damage crops to the point of killing them. The government of Mendoza has studied a sanitation project consisting in building a 15km.long pipeline to receive the treated effluent from each factory. This would then be mixed with the water from a group of 14 wells producing a level of salinity low enough for the irrigation of the areas of Guaymallén and Lavalle.

Sanitary pollution. The two treatment plants in the city of Mendoza (720,000 population) discharge into the irrigation canals of the Northern Basin. The treated discharge is about $2m^3$/second from one and $1.5m^3$/second from the other. Although the discharges are treated, the volume has surpassed the treatment capacity of the plants and the discharges do not always have less than 1000 nmp of fecal coliforms for each 100ml. Even though this water is used in restricted areas (areas of specially limited crops), it is a delicate environmental situation involving 4% of the Northern Basin, as it requires special treatment. However, zero discharge to the canals has not proved possible.

Pollution from domestic solid wastes. The irrigation canals receive solid wastes, blocking the canals and producing overflows that flood streets, highways, and agricultural land. In the most affected areas, it has been estimated that the elimination of these blockages would increase operational costs in the low areas (north of the basin in Lavalle) by 40% of the budgets of the Canal inspectorates.

Landslides. The landslides produced in the urban areas (surface flow in the urban and suburban areas) during periods of very intense rains of short duration, are channelled into the irrigation network of the Mendoza River. They surpass the transport capacity of the network and produce flooding of property and even loss of the harvest. They also damage the infrastructure. The urban basin of the city of Mendoza has an area of 70 km2 (35 of buildings and 35 of streets and highways).

Rising water table. This environmental phenomenon is found in the north of the Northern Oasis where water accumulates due to permeable zones close to the surface. The water comes, in part, from river and canal infiltration, but it all brings soil salts from the saline aquifer (10,000 micromhos of electrical conductivity), a problem aggravated by the

"clear water" distributed by the Potrerillos Dam. One measure of the damage is the cost of waterproofing the Guaymallén Canal and secondary canals in the 4th and 5th irrigation areas (130km) and the rehabilitation and maintenance of the whole drainage network, 340 km.

v. Participation

a. Effective presence of the users in the administration

As has been seen in the description of the regime, the participation of the irrigators in the administration occurs: a) in the definition of policies, in the maximum organ of the DGI, the Honourable Administrative Tribunal, and in the resolution of appeals in the Honourable Appeal Council; b) in advising the Canal Inspectorates and the Sub-delegations through the Irrigator Committees; and c) in the direct management of the resource through the Canal Inspectorates.

However, in practice, effective irrigator participation in the elections called to elect representatives to the Canal Inspectorates only amounts to 5% for the Mendoza River. A study directed by Chambouleyron indicates that the participation of irrigators in meetings called by the Canal Inspectorates averages only about 50% of the active irrigators in the different Inspectorates.[55]

The Water Law establishes that voting in inspectorate elections is obligatory and the failure of the user to vote must be sanctioned, but only since 1998 has a fine been imposed for not voting. The fine is equivalent to 3 times the sustaining quota corresponding to a hectare under irrigation in the year of the date of the election.[56] See conflict levels in Administration.

The reasons for the low level of participation have not been well studied. The constant subdivision of land, which continues in the entire region, is probably one of the causes of decreasing participation.

b. Participants in the basin

Formal River Basin Committees do not exist. Within the DGI, the River Sub-delegations only partially fulfil the role of River Basin Committees.

However, in the 1997-2002 Administration, an attempt was made to create river basin committees. They had no autonomy and became an arena for discussing problems of the most varied types between the users in the river basin, and were very different from what such committees are in other countries. In the case of the Mendoza River no committee was formed.

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[55] Bustos, Rosa, "Medio socio-económico cultural", in Conflictos Ambientales en tierras regadías – Evaluación de Impactos en la Cuenca Río Tunuyán, Ed. Cuyo, FONCYT-INA, Mendoza, 2002, p.107

[56] General Department of Irrigation, "Política de Descentralizacion", Mendoza, 2000, p. 6.

vi. Integrated management

a. Levels of management

This subject has recently begun to be discussed among water management professionals due to the diffusion of these ideas through the various world bodies and the activities of the Global Water Partnership. Thoughts are being given to action in this area, beginning with the Canal Inspectorates (the Montecaseros and Associated Canals Inspectorate).

Integrated management is known but not effectively practised.

Provincial Water Policy recognises this lack and supports the need to change the General Department of Irrigation into a General Department of Water as it was originally conceived.

Sustainability of the River Basin

This is closely related to the environmental question. There is no danger, in the short term, of water shortage in the Northern Basin, even less so, if the efficiency of water use is improved in the agricultural sector, which will increase the availability of water. The issue in the short term is the salinisation of the aquifers. In the long term, the most serious issue is the contracting of the Andean glaciers feeding the rivers of the province, which is the result of global warming. This could bring unpredictable risks and impacts in the near future. In dry years, 70% of the flows in the Mendoza River come from the glaciers (Leiva, J.C., 2002).

These matters are discussed scientifically, but always in partial terms. There is no adequate discussion from the overall view of the water resource at the political and institutional levels.

C. FAILURES IN THE SYSTEM

i. Systemic Failures

a. Fragmented administration of the water resource

The administration of the provincial water system is fragmented according to use. There is, as we have seen, a subsystem for agricultural use administered by the General Department of Irrigation. There is a subsystem for residential use administered by Mendoza Sanitary Works, which holds the service concession for drinking water supply and sewerage in the province. There is a subsystem related with hydroelectric use administered by the companies holding concessions for hydroelectricity generation.[57]

[57] There are also institutions dedicated to water pollution and hydraulic works.

The water resources system suffers, in the first instance, from the lack of an institutionally established body to coordinate the whole system and carry out a strategy for integrated water management.

The provincial water plan explicitly recognises this lack and proposes some solutions. Fundamentally, it is proposed to change the General Department of Irrigation into the General Department of Water with various alternatives for its relationship with the other institutions.

ii. Government Failures

Institutional weaknesses of public organisations

Public institutions suffer institutional weakness due to obsolete or inefficient management practices, lack of clarity and the superimposition of functions in the responsibilities of agencies, as well as gaps and grey areas. This must be considered within the framework of the changes operating in the reformulation of the role of the State over the last decade and more. A redefinition of this role will define the limits of the operation of the water management system, as its activity is not independent of general propositions. Specifically in the water management system, as has already been pointed out, as a failure in the system, there is a perception of the absence of a directing organisation to define polices for the whole system. This agency should have decision-making responsibilities and legal authority over the different public and private agencies. The deficiencies that have been described in public institutions and the interests created where the private mixes with the public result in asymmetries in decision-making that favour particular groups or sectors at the cost of the common good.

Weakness is also apparent in regulation and inspection. There are procedures to apply, but these are not used. The most relevant example is the termination of water rights when they are not used, which has already been mentioned.

b. The capture or influence on decision-making by power and interest groups

It is important to emphasise the existence of power groups (interest groups) that influence decision-making in water resources.

This is a subject that must be treated carefully, because frequently a group takes advantage for its own private interests of the genuine concern in Mendoza for water questions.

A recent example is the enormous political and public support for the construction of the Potrerillos dam, even though economic analyses made by staff at the Economics Faculty

suggested doubts about its economic viability,[58] particularly about the continuing investments required for efficient stream flow regulation.[59]

What is clear is that the dam was built with the total support of the legislature without any prior serious environmental study.

The direct beneficiary of the investment has been the agricultural sector, which enjoys better water distribution. The construction companies built the dam under a contract where payments were made on time and correctly as the Province established a specific fiduciary fund to meet the costs. The fund was formed from the income obtained from the sale of the concessions for drinking water supply and electricity distribution.

This case illustrates a failure of the State in the sense that, although there was political conviction in the Legislative and Executive authority, it is necessary to strengthen public agencies and their proceedings. The efficiency of public investment must be analysed and protected so that decisions are taken with more information and wider diffusion of the positive and negative effects. We shall return to this subject in the following point.

A further example, with a different result, was the question of investment in water supply and sewerage for Greater Mendoza. The economic analyses indicated that the investment was not profitable. However, in this case the investment to build a new aqueduct and drinking water treatment plant did not receive support either from the Executive or the Legislature. The project was discarded.

c. Obligatory guidelines for public decisions on investments

The Province has laws providing formal requirements for the approval of investment projects of a certain magnitude. For example, the Law on Public Works establishes that no work can be undertaken if it is not included in the budget approved by the Legislature (the Potrerillos Dam was an exception). The Environment Law also provides for a series of procedures that must be carried out for an investment to be accepted (again the Potrerillos Dam was an exception). Outside these two laws, there are only some regulations or procedures in the ambit of particular agencies, which do not necessarily involve the economic evaluation or the study of the social impact of an investment project.

The major part of the investments undertaken by the DGI respond to demands made by groups of irrigators and not to any ordered plan or structuring of the investments to be made over time.

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[58] Llop, Armando et al, Evaluación socio-económica del Proyecto de Aprovechamiento Integral del Río Mendoza en Potrerillos, 1995.

[59] The rational sequence should have been to waterproof the distribution canals first and only then build the dam, thus avoiding the tremendous losses in the distribution system as well as the problem of potential flooding resulting from having decided to build the dam first and leave the water proofing for the future.

In recent years, many projects have been financed with funds coming from multilateral organisations, as with the investments of the Provincial Agricultural Services Programme (PROSAP), financed by the Inter American Development Bank loan to the province.[60] In

[60] http://www.irrigacion.gov.ar/proyectodgifao/enttext/prosap.html: PROSAP is a programme of the Federal Ministry of Agriculture, Livestock and Fish, through which the principal needs of the provinces for public agricultural services are identified.
The objective of PROSAP is to sustainably improve the efficiency of services for agricultural and livestock production in the Provinces, in the context of a strategy for the development of competitive products.
The Federal Government, the Inter American Development Bank (IDB), and the World Bank finances the Programme under contracts signed respectively on 26 March 1996 and on 20 January 1998 with the government of Argentina.
In the Province of Mendoza, the agency responsible for the execution of PROSAP projects is the Agency for the Agricultural Development Programme (EPDA) created under Provincial Decree No.271, 5 March 1997.
MENDOZA IRRIGATION PROGRAMME
The FAO-World Bank investment centre developed an Irrigation and Drainage Programme for the Province of Mendoza (PRM) as an integral part of the activities to be financed by the Provincial Agricultural Services Programme (PROSAP), with the active participation of the General Department of Irrigation, in collaboration with the Central Executive Unit of PROSAP and institutions involved in agricultural matters in the province. The PRM was approved by the IDB in September 1995 and by the World Bank in 1996.

Objectives

Overall

- To modernise and strengthen provincial public services to assist agriculture and livestock production
- To provide the financial resources required to undertake the public investment to rehabilitate and modernise the use of land and water in the province

Specific

- To propose a set of policies necessary for the future development of the sector
- To modernise water management in the province
- To undertake in the short run the priority investments for the rehabilitation of the irrigation and drainage systems.

Strategies

- Active user participation in project execution.
- Modification of water distribution and application systems, strengthening the management capabilities of the Canal Inspectorates and of the User Associations, intensifying the policies of decentralisation and the transfer of systems.
- The introduction of volumetric pricing for water according to the cultivation plan.
- The construction of irrigation and drainage works and the inclusion of Technology Generation and Transfer in all parts of the project.
- Proposals for progressive technological change on the farm according to the technical, economic, and financial capabilities of the farmers.
- Undertaking activities complementing other provincial projects.

this work guidelines and procedures related to the economic and social evaluation of projects have been used. In these cases projects have been set up with interdisciplinary groups of well-qualified professionals. This analytical culture should spread to all levels of the public administration.

In sum, only in some cases are public investments subjected to formal requirements, but there is no obligatory standard requiring for project evaluation based on economic criteria establishing the rate of return and who benefits.

A basic principle for all social investment is that the cost, who benefits, and who loses should be previously defined and, finally, who should pay. This is not legally regulated for hydraulic works in Mendoza, and, consequently, decisions lacking in equity are often taken in ignorance.

iii. Institutional Failures

Components

I. Development projects for lands under irrigation

- Rehabilitation of irrigation and drainage networks in priority areas of the province, together with the generation and transfer of technology to the farmers

II. Minor works

- Strengthening the Minor Works Fund of the General Department of Irrigation, favouring an increase in both the number and the size of works

III. Modernising water management

- Planning and rectifying water rights
- Preparing projects for carrying out under the Programme

IV. Water and soil quality

- Strengthening the administrative capacity of the DGI both in determining quality standards and in control and follow-up

V. Follow-up and evaluation

- Creation of a Unit for Follow-up and Evaluation of the PRM in the DGI

Benefits

- Increasing the efficiency of the existing irrigation systems in the Province
- Increasing average productivity in the farms benefited by the area projects
- Decentralisation to the users of the operation of the irrigation systems
- The possibility of planning investments according to priorities based on detailed knowledge of the demand for and the supply of the provincial water resource, from the overall level of the Province down to the Canal inspectorates.
- Reduction in the costs of operation and maintenance of canals. Incentives for the optimum use of irrigation water through tariff systems based on actual consumption.
- Increased control of water quality
- Stopping the deterioration of lands, housing, roads and other installations in the areas bordering the irrigation canals. Recuperation of lands affected by flooding caused by leaks in the canals.

Information systems for management and control

There are various facets of public information on water. First, it is common to find in the different media information on water and opinions on water issues in the region, such as the expectation of a year of high flows when there is a lot of snow, warnings when it is expected that river flows are below average, etc. Some newspapers also publish regular information on river flows. This kind of information is considerably more abundant in years of abnormal flows, whether low or high.

There is also widespread diffusion of information on the tariffs users must pay for drinking water and sewerage. It is important to note that these tariffs must be approved by the provincial legislature. However, since the service was privatised in 1998 the tariffs have not been considered by the legislature. The main reason for this delay is the serious concern about equity in a system now privately managed. The well-known problems of the Argentine economy in 2001-2002 have produced serious distortions in relative prices due to asymmetric peso conversion – bank debtors had their debts converted into pesos at the relation 1 peso=1US$. The depositors called for conversion at the actual value of the dollar. Those who benefited most were the large depositors who cashed in their dollars from the banks before the conversion and demanded that their debts be converted at the 1 to 1 ratio. This devaluation and asymmetric conversion has produced a notable transfer of income and distortion in relative prices. All these events continue to hold back the final decision on tariffs for this sector.

It is curious that there is little public information available in the case of who should pay for the construction of emblematic works for the province, such as the Potrerillos dam. There has been no clarification of who receives the benefits from the work and who should pay the costs. The evaluation of the environmental impact of the work was made after the decision was taken to build it.

The need to establish a means of broadcasting the necessary information for analysing the benefits, costs, and redistributions of income produced by hydraulic works must be emphasised.

The insufficient availability of information is recognised in the Water Plan,[61] which proposes putting the information at the disposition of all parties in water management so that they all know about the availability, distribution, cost of services, and pollution of the resource. This should allow for more participation and control over what is done.

The progress that can be seen has to do with the development of a geographical information system, with assistance from FAO. It is included in the curriculum for the Master in Irrigation and Drainage in the Agricultural Sciences Faculty of the Universidad Nacional de Cuyo. The PROSAP programme, funded by the IDB and used to build minor irrigation works, basically waterproofing canals, has made the introduction of the necessary analysis of profitability obligatory for the investments made.

[61] The Water Plan recognises a lag in the survey of uses and users and insufficient reliable information both hydrological and on crop requirements.

With the consolidation of new User Associations (Law 6105) there is a parallel decentralisation of information to the user associations. The irrigators demand the decentralisation of information and of resources, with the objective of a better water distribution from the intake in the river to the farm.

There are some User Associations, which are capable of achieving this. Others are not, so it is important to tailor the process with the necessary training of those who will be responsible.

The Sub-delegation of the Mendoza River is not prepared, nor does it have adequate administrative means, to manage groundwater.

There is opposition from the Canal inspectorates to summer reinforcement with surface water to reduce the use of groundwater so as to slow its degradation.[62]

b. Infrastructure

The surveys undertaken with the Sub-delegations of the Mendoza River show the *need to have better knowledge of the supply of water*. There are infrastructure problems: there is a general lack of water gauges, gauges in the river, gauges in the Cipolleti dam, gauges on the primary canal network, and on the secondary and tertiary networks.[63]

iv. Market Failures

a. Subsidies and their relationship to sustainability and efficiency in the use of groundwater

From end of the 1960s and through the 1970s the Province had a tax rebate scheme directed towards encouraging investment in groundwater. This led to a considerable increase in the number of wells. At the same time the tariff for the electricity used for pumping was also subsidised.

These subsidies were provided within the context of a large expansion in irrigation agriculture in the Province based on the planting of vineyards for low quality wine. This produced, as has been discussed, a structural crisis in the wine industry with the accumulation of excess common wine that could not be placed either on the local or on international markets. This ended with the bankruptcy of the productive system.

The consequences of this policy were basically two. The vineyards for high quality wines were eliminated (low yield per hectare) and low quality highly productive grapes were planted instead (20,000/30,000 kilos a hectare).

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[62] Llop, Armando, "Diagnóstico de las Subdelegaciones del río del Departamento General de Irrigación", National Water Institute – Centre for Economics, Legislation and Administration, p.1

[63] Llop, Armando, ibid.

The overexploitation of the aquifers led to salinisation and deterioration in the upper water table (30 to 200 metres).

Today only the subsidy of the electricity tariff for pumping groundwater remains. The tariff for pumping is similar to the residential tariff. The total annual amount of the subsidy in 2003 was A$8,350,000.

For this kind of subsidy there are two important considerations. First, maintaining a subsidy where there is an overexploitation of groundwater is decidedly incongruent. Minimally, the subsidy should be removed in those areas where overexploitation can be seen. This produces important social costs. Otherwise, a future strategic water resource is being put at risk.

Second, the subsidy has an important distributive effect. This is because the subsidy is greater for smaller pumps and less use, and declines as the use of the pump increases. This means to say that the small farmers with small areas of production are subsidised, while the large farmers with large water needs and who maintain a constant rate of use of a pump are not subsidised.

The size of the environmental loss has not yet been valued at its true magnitude.

b. Failures in the tariff

In the opinion of the DGI, "it is necessary to establish rules and tariffs in accord with efficiency and equity, and also to balance the finances of the sector. These arguments arise from a critical analysis of the present system, which consists in the payment of a fixed amount annually per hectare. The advantages of a system of volumetric delivery are obvious".[64]

c. Failures in efficiency

The distribution network needs a policy of improvements as the standards of efficiency are low and a strategy is required to improve them.[65]

III. SYSTEM OF EXPLOITATION

A. REGIME

i. Who defines needs?

As we have seen in the discussion of the administrative regime the needs for each use are defined under existing law. The users – irrigators, drinking water companies, industries, municipalities, recreational users, public and private – receive a predetermined quantity of water according to the available flow. The Central Administrator of Irrigation, the DGI is, as yet, unable to meet the needs of the different users volumetrically. Progress is being made in improving volumetric delivery now that the Potrerillos reservoir (on the

[64] General Department of Irrigation, "Plan Hídrico de la Provincia de Mendoza", 1999.
[65] Ibid, Chapter 9.

Mendoza River) has been incorporated into the system. Together with the El Carrizal (on the Tunuyán River) it helps regulate the rivers. The main inconvenience in meeting the needs defined by the users comes from the lack of an up-to-date and reliable user registry (register of irrigators and users).

In the opinion of Pinto, a decision to apply a system of volumetric shares, although the irrigators have opposed this, does not contradict the inherence principle.[66]

ii. Who determines how water is used?

The law requires the DGI to guarantee the beneficial use of water and, to do this, it should regulate the use of water by the user on the farm. However, in reality, the DGI does not exercise this authority. Only a beginning has been made in revising the registration and survey of users to ensure better water availability and to be able to reallocate it, and attend to the volumetric needs of the different uses.

It must be made clear that it is the user who decides how water should be used.

The farmer makes the decisions on water management for irrigation on the farm. No criteria are applied based on the type of crop or area cultivated. The share of water received is a function of the registered area for which the water charge has been paid.

One of the long-term objectives of the DGI is to deliver water in function of real needs, but today this is not the case.

The irrigation methods used can be classified as:

a. Surface irrigation methods, which are influenced by the type of soil, the topography, limits, and ponds.

b. Irrigation from above the soil, which is not directly affected by the soil: aspersion or drip.

Decisions about the amount of water needed and how this water is to be used on the farm are determined by the legal dispositions of the right that is granted. These constitute – together with the actual availability of water for distribution among rights holders who share a canal – the "external restrictions" on the irrigator or user. They have been described in the chapter on Water Allocation. Given these restrictions, it is the user who decides on investments in different methods of irrigation, how to irrigate, and how much to spend on irrigation works and infrastructure on the farm. Included in this is the decision whether to use surface water or groundwater, following, for the latter, the indications of the law when a decision is made to invest in a well.

iii. Who decides when to invest?

[66] Pinto, Mauricio, "Consideraciones jurídicas para el aumento de la eficiencia hídrica: la dotación volumétrica", La Ley Gran Cuyo, year 4, No,4, 1999, p.492.

Surface water

The Inspectorate, or sometimes the Association of Users, makes the decisions over investments in the distribution network. On the farm, the farmer makes decisions.

Attempts have been made to impose the use of drip irrigation, for example in the joint DGI-FAO project, but this has been ineffective due to user rejection in the Assembly.

Groundwater

Until recently, the decision to invest in groundwater was exclusive to the user, according to his needs and economic situation. Today, the DGI intervenes in the decision as the result of the appearance of levels of salinity that threaten the sustainability of the resource and, in some areas, regulations have been defined restricting the drilling of wells or demanding the sealing of wells.

Subsidies

See electricity subsidy for groundwater.

iv. Regulation

The DGI has very little control at the level of the farm in respect of how the farmer uses water. The first measures taken have been directed towards creating an information base, including surveying information for each farm.

v. Conflict resolution

For details see Administrative System: conflict resolution

B. PERFORMANCE

i. Effectiveness

The water distributed to each sector is mainly used in the sector. However, there are allocations for agriculture, through water rights, which are not. In other words, the water is not being used for the assigned use. This happens principally in the green belts around the major urban centres, which have been displaced by the growth of cities such as Greater Mendoza in the Northern Basin. This urban area expanded by almost 40% between 1986 and 1999, mainly over agricultural land. In many cases, the water rights have not been lost and are used for garden irrigation.

Because the water tariff is a charge per hectare, and the water available is insufficient in volume for the area, the following situation exists: although the theoretical area with water rights is 500,000 hectares, the maximum cultivated area, reached in the 1970s, was only 350,000 hectares, and is now only 261,000 hectares (Agricultural Census, 2001,

preliminary results). At the same time, 48% of the irrigation rights are not being used (Water Plan, 1999). The DGI does not have available an up-to-date registry of concession holders corresponding to the use of water in each canal. There are also large areas with water concessions that have never been used. A plan to revise the registry carried out by the Canal Inspectorates allowed the recovery of an excess volume of water equivalent to 25%. The DGI has a plan to revise the registry, to be carried out under Law 6105.

ii. Efficiency

a. Physical efficiency

The drinking water tariff is not by volume, but by the "open tap" system, implying a logical inefficiency in its use. It is estimated that the consumption of water per person is around 400 l/pc/d. In arid areas with a volumetric tariff this is less than 300 l/pc/d. After secondary treatment, in most cases, more than 80% of the water allocated for residential use returns to the system. In the Northern Oasis this means, for the Northern Basin, 125 Hm^3 a year, which are used in areas of special restricted crops.

There is also inefficiency in the use of water for industry and agriculture, because the tariff is not volumetric. The water that is not consumed in industry (generally over 90%) is returned and in some cases reused, approximately 90 Hm^3 a year in the Northern Basin.

The internal efficiency of the irrigation system is set through the efficiency of farm application, which is around 59% for the Mendoza River (Morbita et al, 2003) and 67% for the Lower Tunuyán River (Chamboulyeron et al, 1999). According to the study by Miller and Satlari, the cost at the farm level of increasing the overall efficiency of the Mendoza River system is A$10,749,762 for each 1%. The same improvement would demand A$19,971,906 at the primary distribution level and A$61,931,608 at the secondary to fourth levels. Therefore, it is obviously more practical to improve efficiency on the farm.[67] The low efficiency is principally due to the excess flows at the end of the irrigation unit. However, when this efficiency is evaluated, the potential efficiency should be taken into account, allowing for the maintenance of the initial salt level in the soil and considering the salt content of the irrigation water in the area. The potential application efficiencies for the Mendoza River to obtain maximum crop productivity are between 61% and 71%.

The overall efficiency in irrigation is derived from both external efficiency (transport and distribution)(as was mentioned in Performance in Administration, physical efficiency) and internal or application efficiency, which is that referred to here. In the case of the Mendoza River both efficiencies together give a total value of 0.30% efficiency. In the Lower Tunuyán River the value is much higher, being around 0.41%.

b. Economic efficiency

[67] Miller, Juan Carlos and Gustavo Satlari, "La eficiencia del riego", Diario Los Andes, Mendoza, 17 January, 1999, 3rd Section, p.13.

The economic parameters indicate the degree of efficiency of the use of the water resources, based on the quantity of production from $1m^3$ of water.

Efficiency parameters:[68]

Gross value of production (GVP)

This measure indicates the gross income obtained from the sale of the product for each peso paid for irrigation water.

GVP = ((Value of production per hectare a year)/(cost of irrigation water per hectare a year))*100 in $/$

Gross margin per unit of volume applied (GMm^3)

Indicates the gross margin of production per volume of irrigation water applied per hectare, where gross margin is income less costs.

GMm^3 = ((Gross margin per hectare per year)/(volume of water applied per hectare per year))*100 in $/m^3$.

The values obtained for these efficiency indicators show a large variation depending on the crops to which they are applied. For this reason, it was decided to apply them taking into account, on the one hand, the size of the farm, classifying them into small and large, and on the other, the type of crop, differentiating between vineyards and fruit and vegetables. The results are shown in the following table:

Table 20 Indicators of economic efficiency, by crop and size of farm, Northern Basin

Measures of efficiency	Vineyards		Fruit	
	Small farms	Large farms	Small farms	Large farms
GVP (A$)	22.5	37.9	23	37.9
GMm^3 ($/$m^3$)	0.08	0.16	0.05	0.16

Source: Chambouleyron, Jorge, "Evaluación del uso del agua en Mendoza a través de parametros de desempeño", Mendoza, 1999.

Interpretation

GVP: each peso paid for irrigation water produces between A$22 and A$38 per hectare in terms of production, depending on the type of crop and the size of farm. Maximum economic efficiency is found in the farms of larger relative size, where each peso spent on the payment of irrigation water generates almost 40 pesos in production. On smaller farms, each peso spent on the payment of irrigation water produces in terms of production barely half that seen for larger farms.

[68] Chambouleyron, Jorge, "Evaluación del uso del agua en Mendoza a través de parámetros de desempeño", Mendoza, 1999.

GMm^3: each cubic metre applied per hectare produces between A$0.05 and A$0.16 in terms of gross marginal profit, depending on the type of crop and the size of the farm. Again, the farms of larger relative size duplicate the efficiency of the smaller farms.

Another indicator of efficiency of exploitation is the relationship between the volume of water allocated to each crop and productivity. If it is in the right direction, it is to be hoped that the larger allocation of water corresponds to those crops of greater relative profitability.

To calculate the productivity of each crop, average producer prices, average yields and average water needs are used. It should be added that if the inefficiencies in application, transport, and distribution were taken into account, the values summarised in Table 21 would be lower.

Table 21 Indicators of productivity by crop

Crop	Price A$/kg	Yield Kg/ha	Gross Income A$/ha	Water Requirement m3/ha	Productivity A$/ha
Grapes	0.26	20,000	5,200	6453	0.80
Vegetables*	0.20	23,000	4,600	5984	0.76
Fruit*	0.23	20,000	4,600	8468	0.55

* Values are averaged according to the varieties grown.
Source: Based on data in Mendoza, Directorate of Statistics and Economic Research "Compilado de Estadísticas Municipales, 1991-2002", and General Department of Irrigation , "Plan Hídrico para la Provincia de Mendoza", 2000.

Maximum productivity is in the production of grapes, with A$0.80 per cubic metre used. The lowest productivity is in fruit growing.

A requirement for achieving greater efficiency is to ensure that scarce resources go to those sectors where they have the highest value: so it is legitimate to suppose that the greatest proportional amount of water should go to relatively more productive activities. The following table summarises the proportion of water delivered to each productive sector.

Table 22 Proportion of water delivered by crop

Vegetables	Grapes	Fruit	Fodder	Forest
12%	44%	27%	10%	7%

Source: Based on data provided by DEIE and DGI

A comparison of the two tables shows that the most productive crop, grapes, receives the largest proportion of water. However, for the other crops this relationship does not hold. Fruit, for example, has a lower yield than vegetables, but receives more water.

In conclusion, the rationality that should exist on the farm in respect of water is to try to achieve the highest possible value of production per unit of water. This is what the indicators are intended to show. The highest productivity in this sense is in grapes. It is also the crop grown on the greatest irrigated area. Obviously, this is not the only rationale that enters into the decision to choose this crop. Many more variables intervene, such as cultural factors (there are families that have a long tradition in what they do and are not likely to change). The tables definitely show that grapes are one of the crops with the highest yield per unit of water. It is also, as we know, the crop that occupies the largest area.

iii. Equity

a. Is there a productivity deficit due to a lack of resources?

As has been explained, one of the problems confronting the region is the subdivision of land and a parallel lack of cooperative activities directed above all to business and technological management.

The intensive crops of the region are directed to obtaining high quality production. The achievement of this level of quality in production is labour intensive and is not impaired by the subdivision of land. However, it is important to generate cooperation in the commercialisation of large volumes. It is here that there are serious problems, creating significant inequalities in agriculture.

b. Distribution of Costs

1. Subsidies

Mention has been made of the groundwater subsidies in Distribution. Those with sufficient economic power to drill or who have already drilled a well receive these subsidies. Small farmers who cannot afford a well or do not have the capacity to cooperate are excluded from the subsidy.

2. Externalities

See environmental quality, below.

iv. Environmental quality

First, some externalities in exploitation will be discussed. The user of irrigation by groundwater overexploits the aquifer, polluting, and lowering levels of use, as becomes apparent in dry years.

These externalities have been estimated as percentages of pumping costs and according to the depth of the aquifer. The percentage value of the irrigation tariff over variable costs is an economic measure of the externality and has a value of between 21% and 71% of the

variable electricity cost depending on the depth of pumping and the change in the water reservoir.

On the other hand, the user of surface water with low levels of efficiency in application produces overflows and soil salinisation, the costs of which have not been calculated.

Inefficiencies in irrigation also produce flooding to which can be added inefficiencies in transport. The rescue of the affected land requires investment in improving the drainage network. These costs should be assigned not only to inefficiencies in application, but also to inefficiencies in transport and the impact of clear waters.

The question of water pollution by liquid and solid wastes, discussed in Performance of the Administrative System, sub-heading Environment, is also relevant to exploitation as this pollution is produced by the users of drinking water and by industry, but the impact is on the water distribution network.

It is necessary to repeat, as was said in the discussion on industrial pollution, that industries discharge effluents into irrigation canals transferring these externalities to users downstream with undeniable damage to health and crops. In the case of the oil industry the poor control of water used for cleaning has produced obvious losses in some irrigated areas, through the pollution of the upper aquifers. Finally, there has not been a strict and effective control over oil wells to provide detailed knowledge of the extent of the interruptions these have caused in the aquifers they cross, especially over the system for lining them and, in the case of abandoned wells, whether they have been sealed correctly so as to prevent later pollution.

C. FAILURES

In water distribution no account is taken of real needs, as neither the type of crop nor the area irrigated is considered. This allows a large margin of inefficiency in the use of water.

The DGI has no way of providing incentives encouraging the user to manage water more efficiently, as the delivery of water to the user is a function of the quantity of hectares registered that are paying the charge and not in relationship to the needs of the crops grown.

The economic factor does influence individual investment decisions, as in the example of the FAO-DGI project, when an attempt was made to install an area of spray irrigation in order to achieve greater efficiency in water use. It was rejected in the user assembly, leaving the project at a dead end.

It is apparent that there are undeniable failures in the Exploitation Regime, the lack of environmental regulation to allow an adequate control over the negative effects on soils and aquifers of the use of water for irrigation, for industry and by the oil industry. This leads to externalities difficult to reverse and could in the end affect the whole productive system of the Province.

On the other hand, the conflicts among agricultural, domestic, industrial and oil industry use of a limited and scarce resource, in the absence of a means of establishing their economic value and social benefit, create doubts about the general efficiency of the system.

The failure to make explicit the ways in which the different alternatives for the use of water are weighed, in terms of general benefits, has led to the over-exploitation of the Northern Oasis without adequate planning of land use, with urban expansion over good agricultural land, excessive subdivision of farms with marginal individual profitability and with industrial activities that do not include in their costs the investments required to supply them. The absence of an up-to-date register blocks control by the authorities, as the system of exploitation prevents an optimum allocation by the users.

In overall terms, it is a regime with serious weaknesses in terms of long run environmental and economic sustainability, which will worsen if effective legal and administrative reforms are not made to reverse the situation.