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SYSTEMIC STUDY OF WATER MANAGEMENT REGIMES, CHILE

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1. THE ALLOCATION AND REALLOCATION SYSTEM

The 1981 Water Law profoundly modified the allocation criteria prevailing in Chile under earlier laws. Its expressed purpose was the incorporation of market criteria in all procedures for the allocation and reallocation of water.

In the words of one of its main architects (Buchi, 1993), the objective of the new water legislation was to "create sound property rights, not over water itself, but over the use of water, and to facilitate in every way the ordered working of the market. The problem [of water] will persist as long as the market is not allowed to work and it is, therefore, fundamental to first fully recognise property rights and the rule of the market in the sector. There is no doubt that this is the core of the problem, in spite of the fact that many still think that "property" is a dirty word […]. Property is by far the best system for protecting the social function and the correct allocation of resources. This is accepted in the most institutionalised sectors that have a longer tradition of private ownership. However, it is rejected in the less formal sectors where the State has more weight. Less tradition, greater statism."

Therefore, the three directing elements in the new Law are:

- The creation of "sound" use rights,
- The creation of markets, and
- The reduction of the role of the State ("statism").

The analysis presented below reflects the concrete way in which this has been put into practice. Nevertheless, it is necessary to understand that the new law only marginally influences the allocation of water actually in use in Chile, as, without any question, a high percentage (over 90% in the case of consumptive use) is the result of older allocation rules. Moreover, it must be emphasised that the relevance of any reallocation process depends on the quality of the original allocation and its concordance with present requirements.

1.1 REGIME

1.1.1 Allocation Criteria

To abstract water from a natural stream it is necessary to hold a water right, with the only exception in the legislation being the use of some minor flows. These include the abstraction of groundwater for domestic and drinking water use (art. 56)[1] (the DGA has interpreted such uses in a restricted manner, as those used within the home) and the use of springs rising and dying in the land of the user (art. 20). In all other cases the users must request a water right from the administrative authority (the General Directorate for Water).

[1] The articles refer to the 1981 Water Law, unless the contrary is expressly indicated.

The Water Law defines the current allocation criteria, establishing the following basic rules:

- There is no preference among uses.

- The administration is obliged to concede the rights requested as long as the request is proper from the legal viewpoint (this includes requirements for publicity and the opportunity to present objections) and the rights of third parties are not affected. This means that the State cannot qualify the objective or the size of the request.

- If there is more than one request for the same resources (over a period of 30 days) the flow is allocated by auction in which, in addition to the requesting parties, government agencies can participate. This procedure does not apply to groundwater.

- The requests are granted on a "first come, first served" basis.

There is no doubt that this way of allocating new water rights is a very radical attempt to leave the decision to the market. Implicit is the hypothesis that, if no more than one request is received, the social cost of the requested water is nil and therefore it makes no sense to restrict access to this good.

1.1.2 Reallocation Criteria

The reallocation of water rights is made through the simple buying and selling of rights through the market. This means that it is assumed that the rights will go to those uses that, from the perspective of the holders, provide the greatest benefits. It should be noted that this economic model assumes that the State should take social considerations into account through the explicit subsidy of demand.

If a market is to be created, water rights have the following characteristics:

- Free transfer of water rights.

- Independence of the right from a particular use.

- Water rights are protected in the same way as property rights over any good. This was first expressed in the 1980 political constitution (art. 19, N° 24, last paragraph), where it is established that "the rights of private individuals over water, recognised and constituted under the law, grant the holders property over them". Similarly, the new Law eliminates any possibility of the administration terminating a water right by deleting the regulations that could weaken property rights, such as the declaration of an area of rationalisation and the suspension of existing rights (art. 35 of the 1967 Water Law), or the restriction of more or less free use during periods of drought (art. 332).

- It is obligatory to register water rights with the Registrars of Title to Real Property (Conservadores de Bienes Raices) as a way of assuring the title to the rights (art. 309). There are rules for regularising unregistered rights (art. 1 and 2 of the transitory dispositions), criteria, and presumptions for determining the nature of previous rights (art. 309, 312, and 313).

- The users own the water distribution infrastructure (art. 202 and 212), but obligatory rights of way can be established for aqueducts to allow the use of canals by any interested party.

It is important to bear in mind that the free transfer of rights among irrigators had already been practised under earlier laws and that in a large part of the country rights were already established. In consequence, there arose an undeniable need to establish a system of reallocation to open space for supplying new demands. Both of these existing situations facilitated the success of an innovation of this nature.

1.1.3 Who decides

As has been shown, the system for allocating rights is conceived so that it is principally done through the market. However, this has hardly ever happened, because usually no more than one person has competed for the same rights. Therefore, in practice, the allocation has been by order of precedence in the requests, with no other restriction on the allocation of new rights except the evaluation made by the administration on the availability of water and its affect on third parties.

This situation has created a considerable increase in tension between the Administration, which has to decide on the technical possibility of constituting new rights, and the private parties requesting them as water becomes scarcer and increases in value. As a result, new participants have begun to be decisive. These are the General Comptroller of the Republic and the Courts, both of which have the authority to revise the decisions of the Administration.

In the situation described above, the allocation of new rights is the result of:

- The technical qualification of requests by the Administration.

- The decisions of the General Comptroller of the Republic and the Courts, as agents of second and third appeal.

- The decisions of the requesting parties themselves (see the next paragraph) in confronting the authorities above through the presentation of requests supported by technical and legal advice.

A new, if exceptional, participant in the request for rights is hydroelectricity generation. In fact, the result of an appeal by the government to the anti-monopoly bodies that was favourably accepted, was that the DGA was advised, “while no legal or regulatory means exist to guarantee the adequate use of water”, to abstain from constituting new rights for

this purpose, “unless there are specific projects of general interest”. This has been done through consultation with the National Energy Commission to verify that the case they are dealing with can be considered exceptional.

1.1.4 Who demands

It is necessary, when looking at the demand for water, to distinguish between demands for abstraction from natural streams and demands for maintaining the flow in the river (in situ use).

a) Demands to remove water from natural sources

The decision to request a right is in the exclusive competence of each user, including public services that require water to carry out their work. Therefore, it is important to emphasise who has the responsibility of satisfying the various uses, according to the prevailing overall economic model, which assigns a subsidiary role to State participation in production:

- Residential use: in the cities it is the utilities (usually with a majority of shares in private hands); in rural areas the initiative is governmental through the Rural Drinking Water Supply Programme directed by the Hydraulic Works Directorate (DOH).

- Hydroelectric use: the initiative is completely private.

- Agricultural use: the initiative is private, with the exception of major works in which there can be requests from the government through the DOH.

- Industrial and mining use: the initiative is private.

As can be appreciated, in the existing law there is no direct authority for the government to plan the use of the water resource, although there is a provision that charges the DGA “to plan water in its natural sources” for the purpose of “making recommendations” (art. 299).

The size of the flow requested is also the exclusive competence of the users. Considering that there is no restriction, obligation, or charge in this area, the users frequently request all the river flow or, in any case, flow beyond their needs. This is not applicable to requests for groundwater where the capacity to extract becomes a natural limit on the flow demanded.

The existing rules, as can be easily predicted, produce a new user: the speculator, who seeks ownership of water rights as a means of making a profit by anticipating the requests of those who really need the water for the development of new projects. This dynamic forces all the participants to take a position by making requests at those points where they may possibly have a future interest, even if this would be in an undefined or very long term.

b) Water demands for in situ use

This type of demand is not explicitly considered in the current legislation; however, it has been incorporated through the approach of the Administration to existing rights, which takes into account environmental, navigation, landscape and other demands. This is a discretional decision of the DGA or, if it is a project with an approved Environmental Impact Study, it is the result of the Evaluation of Environmental Impact System. Moreover, it should be mentioned that the National Congress is currently debating the recreational fishing bill, which defines a "minimum flow for fishing" to be determined by the DGA in the places defined in this bill.

1.1.5 What is granted

The allocation of water is made through the constitution of water rights. These rights, as has been mentioned, are real rights, granted in perpetuity, which can be freely transferred, and are protected by all the guarantees common to property. They are also considered to be primary goods, not accessory goods, as they would be if they were assigned to the land or to a specific use.

The rights are legally defined:

- At a specific point of a natural source, surface or groundwater (art. 149).
- As a flow of defined volume per unit of time (art. 149).
- As consumptive or non-consumptive rights according to whether or not they consume the water totally (art. 13 and 14).
- The exercise of the right can be permanent or eventual, depending on the right to abstract water during periods of scarcity. Permanent rights are distributed proportionally while eventual rights can be used only if there are flows to supply all the permanent rights and according to their order of precedence (art. 12, 17 and 18).
- Rights can also be continuous, discontinuous or alternate, if use can be made of them only at certain times (art. 19).

1.1.6 How they are applied

The procedure for allocating rights is regulated in detail in the Water Law and, furthermore, the agency responsible for its application has prepared a Manual for Water Resource Management in which the criteria and the technical and legal procedures to be used are regulated.

Basically it contains the following steps (Book II, Chapter I):

- Presentation and publicity: the obligatory publication of requests in the official gazette and in national and regional newspapers.

- Presentation of objections by those who could be affected.

- DGA resolution on the relevance of the objections and of the constitution of the right, which requires hydrological and legal studies, on site inspections, and measurements.

- Agreement of the General Comptroller of the Republic.

- All the resolutions of the DGA, whether they find for the objections or constitute rights, can be submitted for reconsideration by the Service itself or put before the Appeal Courts. So, the process of constitution of a right can have many variants, depending on the initiative of the users. It is also pertinent to emphasise that the actions of the Administration can, as can those of all public agencies, be appealed to the General Comptroller of the Republic.

1.1.7 Monitoring

As has been mentioned, all actions of the Administration can be appealed to the General Comptroller of the Republic, which is empowered to investigate the appropriate exercise of authority. Moreover, there are various resources before the courts for the same purpose. Special mention should be made of protection appeals, which protect against the arbitrary action of authority by public agencies and the appeal for economic protection, which is related to abusive measures that could limit economic initiatives of the private sector.

In addition, the Law of Administrative Procedures guarantees an adequate response from government agencies to the requests of citizens and establishes rules of transparency and rights of access to files.

Once an irregularity in Administration procedure is established, it can be subject to administrative sanction or taken to court. There are many means of sanctioning any improper action.

1.1.8 Conflict Resolution

Conflicts in the constitution of new water rights are resolved in one of the following institutions:

- The DGA, when it is an objection or a claim for reconsideration.

    - The Courts, when recourse is made to appeals, protection, economic protection, or annulment. It should be mentioned that, with the exception of decisions on annulment, all the rest are initiated in the Courts of Appeal.

- The General Comptroller of the Republic, if it concerns presentations during the confirmation process or resolutions that have not been registered in the Water Registry of the Registrar of Title to Real Property.

1.2 PERFORMANCE

1.2.1 Effectiveness

Allocation and reallocation must be considered separately in the evaluation of effectiveness.

c) Allocation

Allocation can be assessed as follows:

- Overall the system has allowed the accelerated development of the country, which has doubled its GNP in 10 years on the basis of the exploitation of its natural resources, particularly, access to water resources for mining companies, industries, and water utilities. For example, almost 12,000 litres per second of rights over groundwater have been granted for mining use alone.

- However, in some places, a tendency has developed to use water rights as an obstacle to the entry of competitors in certain markets. This can be seen in water utilities, property development, and hydroelectricity generation.

- There is an incentive to request rights for speculative reasons, which has resulted in an artificial (legal) scarcity in some river basins (for example, in the basin of the Imperial River).

- In some places, the hoarding of unused rights and the impossibility of satisfying other requests have become disincentives for the development of some projects, particularly because this blocks access to established benefits in favour of investment.

In summary, as was to be expected, the negative aspect of the new model has meant: the proliferation of requests to hold a strategic good such as water; the request for large volumes (why ask for only what you need when you can ask for it all!); the creation of legal (formal) but not real scarcity in many important areas; the creation of difficulties for the development of projects and; the generation of barriers to entry in some markets, discouraging competition. On the other hand, in its positive aspect, it has favoured investment in the search for new groundwater resources (for example, the hydrogeologic surveys undertaken by mining companies in the north of the country).

The above assertions have been profusely documented, starting from the practical experience of the General Directorate for Water, and throughout the debate on the modification of the Water Law. As examples, the following can be mentioned:

- Rights have been constituted for 13,000 m^3/second for non-consumptive use while barely 2,500 m^3/second are currently used. This has had a decisive influence on the development of hydroelectric generation, according to the testimony of company directors.

- In the case of consumptive use, in regions where surface water rights had not been constituted before the present Water Law, only 1% of the rights allocated under the new legislation are being used, but in numerous streams today it is possible to obtain only eventual rights.

- In some areas the disputes over groundwater, taken on occasion to court, are obviously for the purpose of controlling access to certain water utility concessions.

In synthesis, the procedures structured to favour the market have, paradoxically, in practice signified the concession of monopolies (without any payment to the government, of course) and a reduction in competition in various markets.

There is no doubt that situations like those described, in addition to being a clear discouragement to the full exploitation of the hydraulic potential of the country, are unacceptable for the common citizen who gives water a high social component. They have a negative impact from the perspective of equity and contribute strongly to the loss of prestige for the whole of the water legislation. They also demonstrate a lack of harmony between the water legislation and the nature of the problems facing society.

However, sometimes the situation turns so violent, as when the drinking water of some village is in danger, that eventually a solution is reached at the margin of the law, through political intervention. (An example was the provision of water for the fishing village of Quintay by a real estate developer). Another extreme case was the constitution of a group of more than 10 non-consumptive rights, which compromised flows of around 14,000 m^3/second and seriously affected competition in the hydroelectricity generation sector. In this case, after a judicial process initiated by the petitioner, the Administration found it necessary to deny the rights as they went against the public economic order and, in addition, to ask for a decision by the antimonopoly agency. Finally the argument lead to a recommendation to the DGA by the Central Preventive Commission to abstain from constituting new non-consumptive rights, at least in the case of a specific project of general interest, “while no legal or regulatory means exist to assure the proper use of the water.”

Paradoxically, in these cases, the extremely liberal procedures of original allocation have led, in practice, in one case, to giving the Administration very wide powers and, in the other, to direct political intervention. These solutions are certainly completely foreign to the spirit of the legislation.

Finally, a point should be indicated where the concession system appears to be inadequate to provide sufficient legal security. This is the reservation of flows for “in situ” uses, such as recreation, fishing, tourism, and others, as in reality the granting of rights that are not for the abstraction of water from its natural source is not contemplated.

d) Reallocation

There can be no doubt that reallocation through the market (done mainly on the basis of rights conceded under earlier legislation, applied from the 19th Century on), has been suitable for producing transfers to strongly growing demands with high social and economic benefits. This is so with the new residential, mining, and industrial demands at the north of Santiago. This is reflected in the fact that all the water utilities north of Santiago have open buying powers for water rights. The sellers have typically been marginal water users or even owners of unused rights, the latter due to the expansion of the cities or other reasons.

Similarly, free transfer has been shown to be an effective means of locating, even if only temporarily, the available resources in the most profitable uses in droughts, at least when there is infrastructure to reduce hydrologic uncertainty and the distribution systems are flexible. An emblematic example is given by the Paloma system in Region IV, which is a clear case of the operation of a very active market with a high sensibility of prices to scarcity conditions.

In contrast with what can be seen in the transfers from agriculture to other consumptive uses, within agriculture the cases of transfers among farmers of intensive farms, independently of the land, are very few. In general, this market activity is very small. For example, an analysis done in the Elqui valley shows that the total number of transfers included less than 3% of the rights, of which 90% corresponded to unused or only marginally used rights (Hearne and Easter, 1995).

1.2.2 Efficiency

The allocation process, although overall of low direct cost for the petitioner, has produced various problems related to the following:

- Excessive delays in the allocation due to the time needed by the Administration, because of the volume of requests,
- the possibilities offered in the legislation for dilatory action by third parties, and
- processes passing to the courts.

It is also obvious that, as allocation through the market is not operative in practice, there is simply allocation in order of precedence, which in no way guarantees an economically efficient allocation and has even stimulated speculative requests.

As has been discussed, reallocation by the market, seen in perspective, has allowed transfers of generally under-utilised water to uses with greater benefits, a process that would surely have be extraordinarily conflictive and inefficient if it had been done under a centralised system.

However, from the perspective of the efficiency of the process, it is necessary to emphasise that a particularly active system, of easy access, that effectively develops the theoretical potentiality that could be expected of a market system, has not been created. This is possibly related to the following obstacles:

- The absence in the existing legislation of any obligation or incentive to use the water resource. This creates unused rights in some areas that are not brought to market, due the speculative ideas of the holders.

- The traditional farming culture links water rights indissolubly to the land. This culture is strongly reinforced by the insecurity created by hydrological uncertainty, to the extent that the water which eventually could be held in excess is considered more as insurance for dry periods that as a marketable good that can be bought and sold. For this same reason, when favourable conditions do exist, farmers are more willing to make temporary lease contracts than to give up the rights definitively.

- The costs of trades are high, due principally to the rigidity of the distribution infrastructure. The canals of greatest length have numerous works to distribute the water in fixed proportions, according to the water rights, and the modification of these considerably increases transfer costs.

- Another factor discouraging transfers is the complex of administrative rules that must be followed to transfer the use of a right from one point to another of a stream and the objections of third parties.

- There are weaknesses in one fundamental element for the functioning of a market: the property registration system and the procedures for the proper registration of the rights. There are various rules that cover this procedure (art. 20-21, 55, 111-112, 114-121), but there is general agreement that these are not sufficiently expedient or that they have gaps preventing the creation of adequate databases.

1.2.3 Social equity

Asymmetries can occasionally be seen in the possibility of acceding to new rights or of defending points of view in the courts or before the administration (the General Comptroller of the Republic). Curiously, this can affect public utilities confronting private interests.

In effect, once the new Water Law came into effect, the sector that reacted most rapidly in requesting water rights was hydroelectricity generation, managing in the 1980s to constitute a large number of non-consumptive rights, sometimes compromising whole river basins. Something similar occurred with other well-informed groups. However, the water utilities, in the hands of the State, did not fully realise the strategic value of water rights for their development until the 1990s, when they began to create units specialised in the subject. The same happened with government requests for water rights for the construction of major hydraulic works, as the policies of the government in power in the

1980s did not consider the construction of this kind of works. Consequently, various public works have encountered problems in obtaining water rights due to earlier requests (for example, in the basins of the Cautín, Maule, Mataquito, Aconcagua and other rivers). Similarly, poorer farmers and indigenous communities, lacking in information and assistance, have frequently only realised in the last few years that they do not have permanent water rights, which are necessary to accede to government development plans as, for example, the Law to Promote Irrigation.

Asymmetry is also evident in relation to the technical analysis required to defend objections to specific water rights. In such cases, the Administration, in defence of third parties who do not have the possibility to defend their own interests, must frequently counter innumerable requests from companies with considerable resources.

In the process of reallocation through the market, there is no sign of distortions caused by monopolising of rights by buying up existing rights, as had happen in the allocation of original rights, because of the way it was done. However, it is known that there have been inequities in the value of rights transferred, due to asymmetries in information.

1.2.4 **Environmental Quality**

In the allocation process, environmental considerations are incorporated by the Administration at the time of conceding the right. Since the coming into effect of the new Water Law (1981) there has evidently been a drastic change in the level of concern for the environment, so that now there are various legally consolidated environmental requirements. Nevertheless, in the last 10 years environmental demands have been an important part of the Administration's activities. All the same, the technical difficulties in defining environmental demand are a serious limitation, particularly due to the lack of sufficiently defined strategies for the conservation of biodiversity in Chile.

As for the existence of possible environmental externalities associated with transfers, it can be emphasised that, in general, in the greater part of the country, impacts have not been detected nor have conflicts arisen in this area that can be directly attributed to the transfer of water rights. However, it is necessary to mention the social pressure that has been produced by the gradual disappearance of agriculture from the oases in the north of the country (Calama, Quillagua), which partially contradicts the historical vocation of the local communities.

1.2.5 **Participation**

The participation of possible interested parties in the allocation of rights is guaranteed through publicity and the objection procedures. There are limitations due particularly to:

- The limited possibility that interested parties or the public will be sufficiently informed on the basis of the publication in a newspaper, considering the complex and subtle ways in which the effects of an abstraction can affect other activities, both now and in the future, at the river basin level.

- The lack of capacity and preparation of some sectors of society for participation in such complicated matters with adequate technical and legal assistance.

1.2.6 **Integrated management**

The allocation and reallocation process shows certain insufficiencies originating in the absence of elements more actively incorporating more integrated perspectives of water management. The principal insufficiencies are given below:

It is important to emphasise the consequences of transfers among users for return flows, particularly because in a large part of the country water is used successively (up to 5 times) along the courses of the rivers, in what are called sections, taking advantage of the percolation and overflows from the land irrigated upstream, even when there is no legal requirement to generate these return flows.

Overall the users have shown no particular concern for this issue, perhaps because there have been few transfers, or because the effects are not immediately evident to the ordinary user, or because there have been no serious hydrological studies to evaluate the issue. However, in some northern river basins, where users have become concerned about the risk, a solution has been contrived at the margin of the water law regulations: the Watch Committees have simply introduced correction factors with the change of water rights from one point to another, which has been accepted by their members. Even so, the doubt remains about the impacts that have in fact occurred. Perhaps these have not been evaluated due the lack of hydrologic studies of the issue.

The existing regulations show serious problems in adequately incorporating the interference between the use of groundwater and surface water to the process of allocating rights. The current practice is to manage them independently, without benefit of the enormous advantages of joint use. To the north of Santiago there are examples of conflicts between the two groups of users, but complementation initiatives are not found at the user level, which means an obvious loss of opportunities.

The present definition of rights assumes independent management of the quality and the quantity of water, which is counter to the substantial interdependence of pollution loads and dilution flows. Although important progress can be seen in this issue, it can be expected that in the near future there will be numerous matters that will need integrated and participative visions, such as the definition of quality goals for water in the natural environment, and the development of plans to control pollution, such as clean production programmes, etcetera.

Rights are constituted according to individual requests in the absence of an adequate perspective for the development of more advantageous multiple use initiatives. It is interesting to note that the principal existing multiple-use projects originated in agreements made between public agencies more than twenty years ago.

A synthesis of the evaluation of the performance of the allocation and reallocation system on a scale of 1 to 5 is given in Table 1A.

1.3 FAILURES

In the evaluation developed in paragraph B, various failures in the functioning of the system were identified.

In overall terms these failures can be classified as:

- Systemic Failures
- Market Failures and
- Government Failures

Below follows a brief commentary on the failures identified, differentiating the three categories, although it is necessary to recognise that in reality they frequently appear as combinations of these three types.

1.3.1 Systemic failures

In this category the following failures can be identified:

The definition of consumptive rights does not take into consideration that the greater part of these rights are not in reality entirely consumed and therefore produce very significant return flows for supplying water uses downstream. This failure, which potentially could be significant when there are transfers or changes in use, cannot be corrected directly, as it corresponds to practices well over a century old.

Surface water and groundwater rights are independently defined, whereas frequently both types of resource are closely related. In these cases it would be advantageous to define rights over the resource as a whole, independently of the form it takes.

The system has not designed a single obligatory means to easily register rights. In addition, the process of registration for old rights does not have defined time limits (it should be noted that to change this would require a change in the constitution), which blocks the availability of a complete and up-to-date registry of water rights.

There is no legal definition of “in situ” uses.

1.3.2 Market Failures

There is no doubt that auctions are ineffective as a decision mechanism for the allocation of original rights, as in practice it has been proved that the applications for them do not even occur in one in a thousand requests. This way of original allocation of rights, as has been discussed, has had very negative consequences, favouring restrictions on free competition and creating complete distortion in the functioning of various markets. The cause of this failure in the legislation is related basically to the problem of information. In effect, it is unrealistic and deceptive to presume that the potential users of water, who are requesting rights for themselves, will examine at least twice a month the new requests that are published in the newspapers. Moreover, it assumes that they are also competent

to determine the scarcity and the supply and demand for water – which sometimes requires evaluations of river basins thousands of square kilometres in extent – that could affect the development of their businesses in the future.

There is little activity in the market in many areas where it could be the most effective way of improving the efficiency of use. This behaviour is associated with the incapacity of the users (and their organisations) to develop flexible distribution infrastructure adequate for an active market system and with the low level of technical development. This allows the persistence of a culture of exploitation that considers excess availability as a form of insurance against drought.

Asymmetries in the information of the different participants can be seen, with obvious disadvantages for the weaker sectors of society and advantages for the informed sectors with technical and legal advisors. This affects the process of price determination in transfers, the presentation of new requests that sometimes reflect exclusively speculative interests, and the defence of their interests both before the administration and the courts.

1.3.3 Government Failures

In confronting the explosive demand for water rights facing the Government in recent years, the inability of the Administration to respond to the requests of the users within the expected time has become obvious. Similarly, ever more complex situations have arisen that require a strengthening of the Government's activities in the exploration and evaluation of the water resource, quantitatively, qualitatively, and as part of the environment.

The insufficiencies of the Courts and the General Comptroller of the Republic to assume their responsibilities in areas needing a high level of legal and technical expertise and the ability to become involved in issues of considerable complexity have become obvious.

Finally, it is important to remember that, in addition to the idea of auctioning requests presented through the initiative of the users, the Water Law allows for active participation by the Administration in offering rights in open auctions of available resources that have not been requested (art. 146). This alternative has never been used, possibly because the private dynamic in the request for rights has easily surpassed the ability of the Administration to organise an activity of this kind, since it requires a clear idea of the future development of the river basins.

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ANNEX 2A
INDICE OF REGIME PERFORMANCE
(using performance criteria)

On a scale of 1-5, where 5 is highest

ALOCATION AND REALLOCATION SYSTEM FOR WATER RESOURCES					
Criterion	Chile	5	4	3	
i. Effectiveness ALLOCATION Considering the factors generating effective demand REALLOCATION	2 There are difficulties in granting rights (much demand is motivated by spurious reasons) 3 Normally, in some cases there are problems	The allocation is always made. Given a resource meeting the demand is not affected by the system Always reallocated	Occasionally there are obstacles to allocation. Occasionally there is reallocation	Usually there are no obstacles to satisfy new demands Usually reallocation is allowed	Sometir problem to a den Frequer
ii. Efficiency ALLOCATION REALLOCATION	2 There are difficulties due to cost and delays. Dilatory actions of third parties. Process taken to the Courts. Precedence, not the market, rules 3 Usually acceptable	If the various costs make reallocation very easy.	If the various costs make reallocation easy.	If the various costs make reallocation acceptable	If the va reallocat
iii. Social Equity ALLOCATION REALLOCATION	2 General disadvantages for low income users 3 Neither advantages of disadvantages	If there is effective compensation for the difficulties of access of some sectors.	There are advantages for some sectors	No discrimination, usually neutral	There a disadva not bloc
iv. Environmental Quality ALLOCATION REALLOCATION	4 Normally considered, but it does not respond to solid formal institutions 2 User initiative Frequently environmental effects are not considered	Environmental needs are always considered	Occasionally environmental needs are not considered	Usually not considered	Frequer needs a
v. Participation ALLOCATION REALLOCATION	3 There is publicity and opposition, transparent, but unequal process 1 No participation, even lack of protection in the creation of monopolies	There is good participation and public information	There is participation with incomplete, but acceptable, information	Some participation and those who do have some limited information	Some p biased i
vi. Integrated management	2	Always	Very frequently	Usually	There a

2. ADMINISTRATIVE SYSTEM

2.1 LAWS AND REGULATIONS

2.1.1 The Water Law

Basically, the current Water Law (DFL N° 1122 of 1981) gives the responsibility for the management of the country's water resources to various user organisations, defined in the Law. The fundamental principle of the Law is that where there are two or more persons or organisations that use common works in the exercise of their rights of exploitation, a *de facto* community is formed by those involved. These communities are formalised when they are registered with the General Directorate for Water (DGA).

The Water Law also considers the existence of Drainage Communities, which include all those whose land benefits from common drainage works, and Groundwater Communities

for users abstracting water from the same aquifer, but only when the aquifer has been declared a restricted area by the DGA (using its authority).

Under the Water Law, individual or legal persons and user organisations that in any way exploit the water resources of the same river or hydrologic basin, natural stream, or section of a stream that is treated separately for purposes of distribution, can organise a Watch Committee.

The Water Law assigns, among others, the following responsibilities and functions to the Ministry of Public Works, General Directorate for Water:

- To plan the development of the water resource in its natural state, in order to propose recommendations for its exploitation.

- To monitor and control the water resource in natural streams of public use and to prevent that works are built, modified, or demolished in them without proper authorisation.

- To monitor the functioning of the Watch Committees.

- To monitor the operation of intake works on natural streams and the construction, maintenance, and operation of canals and aqueducts to prevent damages that could affect third parties through accidental overflows caused by such works.

- To promote and assist the organisation of water communities everywhere they are needed.

In periods of extreme drought, the President of the Republic, on petition or advice of the General Directorate for Water, can declare a drought area. This declaration allows the DGA to intervene in the user organisations at the river basin level and to proceed to redistribute the available water, if this is necessary, so as to reduce the damage caused by the drought (see Table 2.2).

The Water Law indicates that when water sources do not have sufficient water to entirely satisfy the permanent water rights, then the flow must be distributed in aliquot parts. During this time, eventual rights can only be used if there is surplus water in the source, once all the permanent rights have been satisfied.

The Water Law contains detailed rules about the form the organisation of the Watch Committees, User Associations, and Water Communities should take, including at least the following points:

- The rights and obligations of the members of the communities and associations
- The forms of participation and the election of directors
- Conflict resolution mechanisms, under which the members can appeal to the General Directorate for Water or to the Courts, depending on the issue.
- The ways of financing the operation of the organisation.

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In reference to the above points, the following features should be commented on in more detail to complete the study of the current situation.

- The quotas set for the costs of maintenance, construction, exploitation, cleaning, conservation, and improvement of common works must be set in proportion to the water rights of each member. Any expenses that only benefit some members must be met exclusively by those benefiting, again in proportion to their rights.

- The members of the community or association who are entered in the Registry of the Organization and up-to-date with their quotas have the right to participate in the ordinary general meetings of the organisation.

- The members of the community or association have votes corresponding to the number of water rights they possess. Both permanent and eventual rights are taken into account in voting.[2] Among other matters, the board of directors of the organisation must be elected at the ordinary general meetings. It is renewed every year (directors can be re-elected). The board of directors has all the necessary authority to administer the organisation.

- The DGA can only intervene in cases of complaints over financial problems or the distribution of water. In other matters such as elections, rules on publicity, notices, records etc., the DGA cannot act and, in practice, they are not regulated.

2.1.2 Other Laws and Regulations

Mention must be made here of the enactment in 1994 of Law N° 19,300, known as the Basic Environment Law, under which the National Environment Commission (CONAMA) was created as the public authority responsible for the co-ordination of the various agencies exercising authority in environmental matters. This Law established a general framework for environmental protection in accordance with other national objectives, such as economic growth and social equity.

Although this law only dates from 1994, there already existed a number of legal regulations relating to water quality contained in international agreements, laws, supreme decrees, resolutions, and official Chilean regulations. The superabundance, diverse origin, and accumulation over time of the regulations have resulted in an obvious lack of logic in the matter.

With the coming into effect of Law 19,300 a start was made in the Evaluation of Environmental Impact System (SEIA), applicable to the great majority of new hydraulic works, as well as to the modification of existing works. As a result of the demands of the SEIA, the concept of “ecological flows” has begun to be applied. This establishes

[2] No distinction is made between permanent consumptive or non-consumptive rights. The participation of eventual rights is fixed at a maximum of one-third of the total of permanent rights.

minimum flow requirements that must be respected in natural streams for environmental reasons. The General Comptroller of the Republic has agreed to a reinterpretation of the concept of "third party rights" to make it applicable to the ecological flow. This will oblige the Watch Committees, where relevant, to respect the required minimum flows in their distribution of water corresponding to the established rights.

It has to be remembered, in any case, that the limits of the ecological flow established for projects or modifications to specified projects, only oblige them to permit the defined flow to pass at the specific point where they are located. Downstream, the pre-existing water rights still allow the owners to take all the water from the stream if this is necessary to satisfy the existing rights in their entirety. Consequently, the decision to establish an ecological flow is not very effective, in practice, in improving the environmental state of natural streams whose flows are already totally dedicated to pre-existing uses.

Even so, as an indication to the users and the general public, the procedure that has been established should be maintained, for although it is clear that it does not guard the "passive environment", it does not worsen the existing situation. Moreover, it produces positive externalities, as it allows the conservation of the upper watersheds and the river mouths.

In surface streams where the available resources have not been totally committed and the State must constitute new rights of exploitation if they are requested, the establishment of an ecological flow has a practical effect of much greater significance from the viewpoint of environmental conservation.

It also must be considered that since the putting into effect of Law 19,300 regulations have been established for discharges of liquid effluents to surface waters, as well as to groundwater. Moreover, the study of objective flows for surface water bodies was begun. However, in principle, these ideas should not affect existing water management by the users.

2.1.3 Comments about the Application of Laws and Regulations

In practice there are, in fact, various departures from the legally regulated situation, as seen in the study by Alegría and Valdés of the situation of User Organisations in Chile.[3] Table 1, taken from this study, shows the total number of organisations in 1999, distinguishing between organisations registered with the DGA (according to the Law) and those not registered.

Table 2.1 Total Number of User Organisations in Chile

Organisation	Registered	Unregistered	Total
Watch Committees	21	30	51
User Associations	49	167	216

[3] Alegría and Valdes, "Diagnóstico de la Situación Actual de las Organizaciones de Usuarios de Agua a Nivel Nacional", II Jornadas de Derechos de Agua: Institucionalidad y Gestión de Agua: Sequia, Abundancia y Conflictos, November 1999.

Water Communities	2625	n.d.	2625
Total	2695	197	2892

Source: Alegría and Valdes, "Diagnóstico de la Situación Actual de las Organizaciones de Usuarios de Agua a Nivel Nacional", II Jornadas de Derechos de Agua: Institucionalidad y Gestión de Agua: Sequía, Abundancia y Conflictos, November 1999.

The same study indicates that the DGA's registry of the various user organisations has been produced relatively slowly over many years, with a noticeable increase in the 1990's. Alegría and Valdes also note that:

- Watch Committees exist that were constituted under regulations now annulled and that have not introduced the changes required to meet present legislation and that have not registered with the DGA.

- There are *de facto* organisations that act as Watch Committees.

- There are User Associations that are authorised to act as provisional Watch Committees under regulations now annulled. Some of these are still active and are not registered with the DGA.

Alegría and Valdes also comment that, in general, the user organisations fulfil their prime function of managing and distributing water. However, the majority of them do not fully exercise all the faculties they are given under current legislation. They attribute this to the lack of training of the administrators and directors and the limitations caused by the absence of legal organisation in many of them. Consequently, many of the conflicts end up in the ordinary courts.

Peña provides other complementary information on the present state of user organizations.[4] The results of a recent survey made in the Mataquito river basin (Table 2.2) show how the User Associations and Water Communities are operating. This evidence shows that the majority operate without an office and their means of communication are precarious. When surveyed, 50% of the users said that they were unaware of the decisions of the board of directors. Many of the boards were incomplete, and few organisations adequately kept minutes and control of the budget. On the whole, the study shows a generally precarious situation.

[4] Peña, Humberto, Desafios de las Organizaciones de Usuarios en el Siglo XXI, III Jornadas de Derecho de Agua, 2003.

Table 2.2
State of the User Associations and Water Communities
Mataquito River Basin
(Survey of Participation, April 2002)

	User Associations (20)	Water Communities (98)
Without an office	90%	100%
With no means of communication	80%	85%
Users unaware of decisions	50%	50%
Incomplete Board of Directors	90%	95%
Without minutes	35%	55%
No budgetary control	15%	71%
With gauges in good condition	50%	41%

Moreover, if other aspects of the organisation are analysed, such as the level of transparency and participation, the information collected shows a strong tendency for the same directors to remain in office for long periods, as can be seen in Table 2.3.

Table 2.3
Watch Committees
Permanence of directors and participation in the annual meeting
(last 5 years)

Watch Committee	% of Directors		Personal participation in the annual meeting % of canals
	100% of the period	80% of the period	
Huasco and tributaries	11%	44%	7%
1st Section Cachapoal	67%	78%	95%
Claro de Rengo	57%	71%	-
1st Section Tinguiririca	71%	100%	37%
Chimbarongo	20%	40%	78%

2.2 PUBLIC PARTICIPANTS

Institutional Structure

Figure 2.1 shows the institutional structure of the government agencies involved in water management, emphasising those services most directly involved in the Water Management System.

Within the Chilean public administration there are two agencies that are involved in the management of water as a resource, the General Directorate for Water, Ministry of Public Works (DGA) and the National Environment Commission (CONAMA).

The former has a number of responsibilities (principally at the Director and Regulator level) related to the formulation of water resource policies, planning the development of the resource, constituting water rights, and overseeing water bodies and the use of water.

CONAMA coordinates the actions derived from the policies and strategies defined by the government in environmental matters. Specifically, it must fulfil, among others, the following functions: (1) to propose the government's environmental policies, (2) to administer the Evaluation of Environmental Impact System (SEIA), (3) to coordinate the process of drafting environmental quality regulations and of programmes to meet them. In this sense, CONAMA operates mainly at the Director level.

The DGA is a regionalised institution; that is, there are regional offices of the DGA in all the regional capitals, at least, and in some regions there are offices in other cities. The Regional Directors are the highest authority in each region and report to the National Director for Water at the headquarters in Santiago.

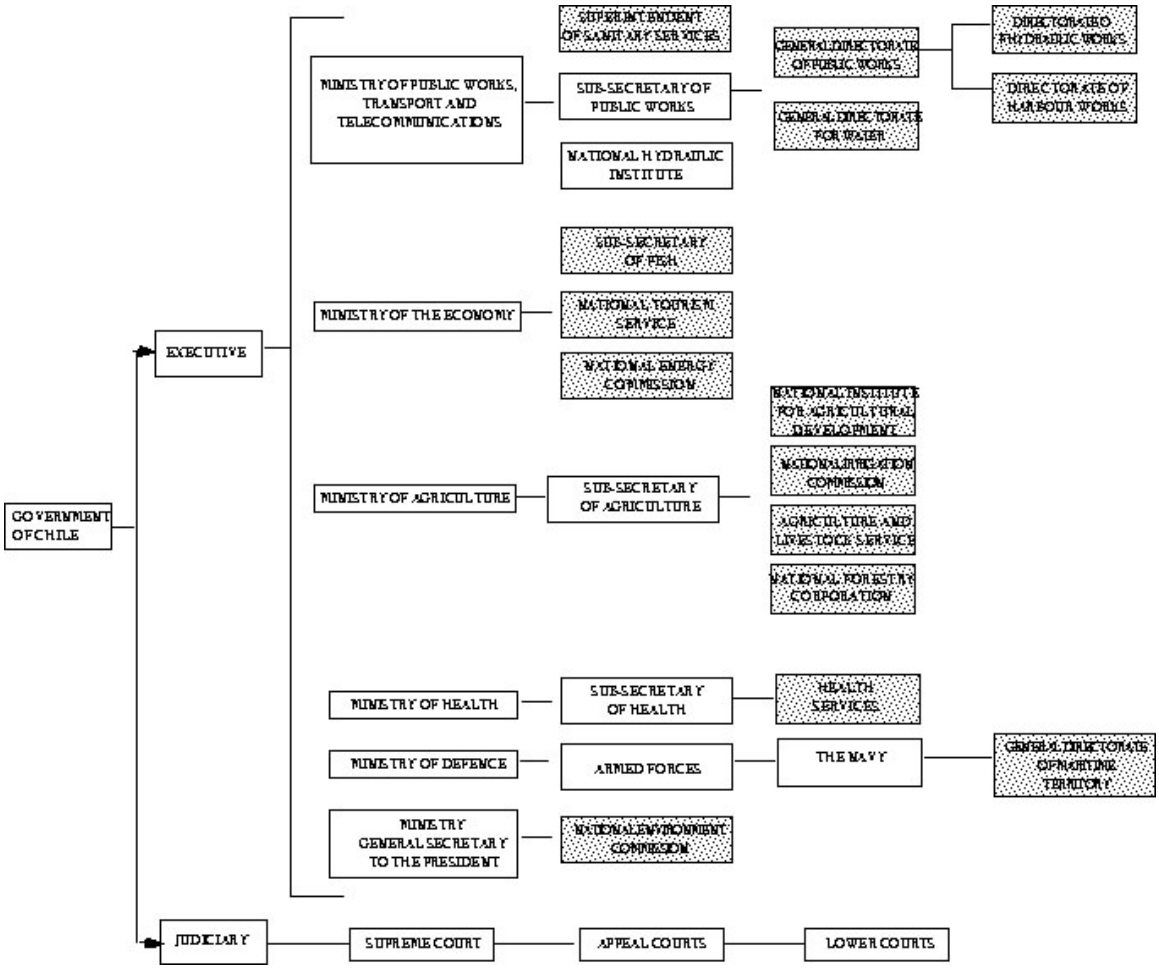
CONAMA also has its headquarters in Santiago, under the National Director, and in its turn has Regional Directors. In the regions, actions related to environmental matters are complemented by the Regional Commissions (COREMA), which are inter-agency commissions presided over by the Regional Intendente (representative of the President), with the Regional Director of CONAMA as secretary. Its membership usually includes all the relevant agencies of the Regional Government. The responsibilities of the COREMAs are to coordinate regional environmental management, to establish arrangements for municipal and citizen participation, to coordinate and oversee the implementation of prevention and treatment plans, and to undertake studies of the environmental impact of projects and activities in the Region.

At the level of Control and Regulation, from the viewpoint of water as a resource, the following institutions have responsibilities: the DGA, the Ministry of Health (Environmental Health Services), and the General Directorate for Maritime Territory and the Merchant Marine (DIRECTEMAR) of the Chilean Navy. The DGA must monitor and measure all the hydrometeorological and water quality variables in rivers, lakes, and aquifers and also demand that the private sector establish means to measure the use of groundwater and can request information on the use of surface water. In addition, the DGA must oversee and inspect surface streams, regulate the user organisations, and bring before the courts any infractions it detects within its area of competence so that the appropriate sanctions can be applied.

At the level of Control and Regulation the Ministry of Health measures and monitors water quality and identifies the effects that any deterioration in quality might have on public health. It also must adopt the appropriate corrective measures when dangerous situations are identified.

DIRECTEMAR has authority to control water quality in coastal seas, river mouths, and navigable freshwater lakes. This includes the supervision and approval of projects for disposal of liquid effluents in these water bodies and the monitoring of these activities.

Figure 2.1
Water Administration in Chile
General Structure of the Public Administration involved in Water Management



The other government agencies involved in water management are largely sectoral; that is to say, they are concerned with the resource only to the extent that it affects their particular economic sector. These agencies include: the Superintendent of Sanitation Services (SISS), the regulating agency for water utilities; a number of agencies active in irrigation in various roles (Hydraulic Works Directorate of the Ministry of Public Works, the National Irrigation Commission, the Agricultural Development Institute, the Agriculture and Livestock Service); the National Electricity Commission (CNE), which regulates hydroelectricity generation; the National Tourism Service (SERNATUR), which oversees recreational use of water and; the National Fisheries Service (SERNAPESCA), which regulates aquiculture.

In the Regions, the following regional institutions participate with the following responsibilities:

- THE REGIONAL GOVERNMENT establishes priorities in the allocation of regional investment funds (FNDR)

  - The Intendente formulates and proposes strategies and budgets to the Regional Council.
  - The Regional Council approves plans, policies and budgets.
  - The Governor is the provincial administrator.
  - The Economic and Social Council advises on provincial development and citizen participation.

- MUNICIPALITIES

  - The Mayor administers property and coordinates with government agencies.
  - The Municipal Council approves zoning ordinances, development plans, and the budget
  - The Economic and Social Council advises on municipal development and citizen participation.

These institutions have no direct responsibility for the water resources, but many of their actions have indirect effects and, given the position of authority that they have, as the decentralisation of the country proceeds these actions could become very important for the sustainability and conservation of the water resource.

2.3 NON-GOVERNMENT PARTICIPANTS

2.3.1 Identities and Activities

2.3.1.1. User Organisations in the Water Law

The principle non-government participants in water resource management are the user organisations that, according to the Water Law, are responsible for the distribution of

water according to the rights at the different sources and exploitation works. As has been described in Chapter 1, these are the Watch Committees, the User Organisations, and the Water and Drainage Works Communities.

In practice the way in which the responsibilities of the users are fulfilled in the various river basins or "sections" of a river in each basin varies throughout the country due to a number of factors, amongst which the principle ones are:

- The greater or lesser relative shortage of water at the source.

- The greater or lesser economic prosperity of the water users, which affects the possibility of providing better or lower quality infrastructure for water distribution among the users.

- The presence or not of trained personnel for the work of distribution, and the existence or not of directors with greater knowledge and dynamism to manage the organisation.

In surface streams water distribution is usually based on partitioning the available flow in aliquot parts, according to the "shares" of the water rights corresponding to each canal. Also generally, the total flow of the river is distributed in the corresponding section or portion of the river, limited by the maximum capacities of the main canals. The User Association or the Water Community distributes the flows entering each canal; in many cases this is done with the use of special critical flow hydraulic structures (marcos partidores) that automatically divide the flow in aliquot parts.

In the use of water for irrigation, the flows transported in the canals are often not entirely used (especially in years without droughts), leading to overflows and discharges that finally return to the surface water streams and are available to be distributed again downstream.

To distribute water in the surface streams, the responsible organisations usually "pre-calibrate" the necessary opening of the gates to divert a defined flow into each intake. In very special cases the intakes have a hydraulic mechanism to measure the diverted flows, as well as, in a very few cases, to maintain statistics on the flows diverted.

In the majority of the river basins of central and north-central Chile, water is distributed by turns in drought periods; this means that all the river flow is distributed by time of diversion to the various groups of intakes located in defined sections of the river. Once the time corresponding to a section has been completed, then the total flow is assigned to another section and so successively until all the groups of canals have had their turn. This is done so as to limit losses in both the river and the canals, as these increase substantially when very small flows are distributed to each user according to the corresponding aliquot shares allocated on the basis of the rights of each user. The Watch Committee, or the User Organisation charged with the administration of the corresponding stream, takes the decision on when the distribution of flows in the river should be based on turns. There are examples of rivers in very arid areas where the flows are always very small and in which the distribution of water is always by turns.

It also should be noted that in most river basins in Chile there are very few intakes for the use of water for irrigation with permanent diversion works. The majority of the intakes have temporary structures that are destroyed after the period of irrigation by the high flows during the following rainy period. In some cases, the canals are simple lateral diversions that are modified every year and have no intake structure whatsoever.

The above is due in part to the geomorphological characteristics of the rivers of the Central Valley (winding, braided, and rambling) that make it difficult and expensive to install permanent works. According to information available from surveys of intakes contracted by the DGA, on the basis of more than 8,000 intakes surveyed, only 13% have permanent barriers, while the other 87% have temporary ones.[5]

In most river basins the great majority of artificial canals (primary, secondary, or tertiary) that transport water from the river intakes to the farms served are unlined. Moreover, it is frequently the case that the main canals are very long (various dozens of kilometres). In such conditions it is easy to understand that the losses from seepage in the transport of irrigation water can be very high.

In those rivers (or sections of rivers) that are not fully exploited, or even where the water is usually sufficient, user organisations have not been constituted and there is no distribution of water, and each canal simply takes the water it requires.

Usually, groundwater communities bringing together the users of the same aquifer have not been established either. There is little control over groundwater extraction or of whether this reflects the existing water rights. There are practically no statistics on the amount of groundwater really used.

In contrast, the users of water for hydroelectricity generation, drinking water supply, or for economically important industrial uses, such as mining or pulp production, all have permanent hydraulic works for their water intakes.

The reservoirs are generally operated and managed by their owners. This is the case for reservoirs built for hydroelectricity generation, irrigation reservoirs built by the private sector, and irrigation reservoirs built by the government whose management has been transferred to the users. The tendency has been to transfer irrigation works built by the government to the users for their management and operation. However, this has not been done for various reasons in the case of some irrigation reservoirs, although they are relatively old (examples are La Paloma, Region IV and Conchi, Region II). Some more recently built reservoirs, such as Santa Juana (Region III) and Puclaro (Region IV), are also still operated by the Hydraulic Works Directorate of the Ministry of Public Works, in agreement with the users.

[5] Leventamiento y Catastro de Bocatomas en Cauces Naturales, I Etapa (AC Ingenieros Consultores, 2000, II y III Etapa (Conic-BF Ingenieros Civiles Consultores, 2000 and 2002, respectively.

There are also multiple-use reservoirs for Electricity Generation and Irrigation, such as Maule and Laja Lakes. In these cases, there are operation and management protocols agreed between the government (Hydraulic Works Directorate) and ENDESA in which the respective procedures are laid down and the institution responsible for the operation of the work is indicated.[6]

Finally, it should be mentioned that Concessions are the latest method used for building reservoirs by the Government. A private company, following a call for bids, finances the construction of the works and then has the right to operate the reservoir for an agreed number of years, charging the users for the water provided (without counting any agreed government subsidies). Once the operating period has expired the works must be passed to the Hydraulic Works Directorate of the Ministry of Public Works. The El Bato reservoir in Region IV is being built under this system and it is expected that, among others, the future Convento Viejo reservoir (Region VI) will be built this way.

2.3.1.2 Economic Centres for Load Dispatch (Electricity Sector)

Chilean law provides for the organisation of agencies to coordinate the operations of the electricity generation and transmission systems when the systems are interconnected or there are various generation or transmission companies. These agencies must be created and financed by the companies involved. In Chile, the whole sector was privatised in the 1980's so that these agencies are of a private nature.

The creation of Economic Centres for Load Dispatch (CDEC) is defined in the General Electricity Services Law of 1982 and regulated by Supreme Decree N° 327, 1997, both of the Ministry of Mining. These laws establish the obligation to create these agencies for the coordination of the operation of the electricity installations of concessionaires who operate in an interconnected way, so as to ensure the security of the electricity system service and to guarantee the most economical operation of all the installations in the electricity system.

Each CDEC is made up of a Board of Directors with a representative of each company involved, an Operations Directorate, and a Toll Directorate. The last two are eminently technical and operational and fulfil their assignments in accordance with general criteria set by the Board of Directors.

The basic responsibilities of the CDEC include the following:

- To plan the short-run operation of the electricity system, considering the actual situation and the expected situation in the medium and long term.
- To calculate the instant marginal costs of electricity.
- To coordinate major preventive maintenance of the generating units.

[6] ENDESA is the National Electricity Company S.A., an institution originally founded by the Government of Chile in the 1940s to develop and operate the electricity generation and transmission system in the country. It was privatised at the end of the 1980s.

- To verify the fulfilment of the operation and major preventive maintenance programmes.

- To determine and cost the transfer of electricity between generating companies.

- To prepare the procedures required at each level of generation and transport to meet the service quality standards established in Supreme Decree N° 327.

- To establish, coordinate, and verify the reserve capacity of the system, so as to instantaneously regulate frequency.

- To coordinate the disconnection of loads in consumption groups, as well as other measures that might be required by the members of the electricity system under coordination to preserve the overall security of the electricity system.

- To guarantee the right of way in transmission systems built under concession.

- To collect and have available information on the new replacement values, operation and maintenance costs, and other matters applicable to the calculation of basic and additional tolls in the various sections of the system.

- To inform the National Energy Commission and the Superintendent of Electricity and Fuels of failures and other situations that affect or could affect the normal operation of generating stations and transmission lines.

In 1985 the CDEC-SIC was established to coordinate installations in the Central Interconnected System. This covers the area located between Paposo in the north (in Region II) and Quellón in the south, on the Island of Chiloé (Region X) and serves around 93% of the population of Chile.

By 30 June, 2003, the CDEC-SIC was managing a generating plant of 6,996 MW installed capacity (composed of 58% hydroelectric and 42% thermal) equivalent to 65.2% of the total installed capacity in Chile as well as more than 11,200 kilometres of transmission lines ranging from 66,000 V to 500,000V.

Given the responsibilities of the CDEC-SIC and the large proportion of hydroelectric generation in the system, the decisions it takes are very important in the operation of hydraulic systems, especially in the operation of the reservoirs.

2.3.1.3. Other organisations

Other user organisations (non-public) that might have influence on water management are briefly described below.

Mention must first be made of the Confederation of Water Users of Chile, founded in 1949, and remaining active today. Article 1 of its statues states that, “it is founded […]

for the purpose of protecting the Water Users of Chile, procuring a just distribution and exploitation of water and increasing the irrigation of cultivable lands". According to Bauer, "the Confederation of Water Users was and is the association that represents the medium and large farmers in water matters".[7] In practice, the Confederation has not acted in the water management system, although it has expressed views in matters related to water management policies, the allocation of water rights, and the development of government investment in irrigation works.

There have been other initiatives in the creation of organisations at the river basin level that advocate more integrated water resource management than now exists. One example of such initiatives is the formation in 2001 of the Regional Water Resource Committee in Region I with the participation of public agencies, representatives of user organisations in the area, and representatives of regional development corporations.

This Regional Committee defines as its essential objective "the promotion of integrated water resource management to achieve the best use of the resource in terms of producing the greatest social and economic benefits for the Region, within the context of environmental sustainability". The practical role that a Committee of this type may have in the future in the management of the water resource in the region is difficult to forecast and it is too soon to evaluate it.

Another initiative, of a rather different character, but also for integrated water management at the river basin level, is the recent creation of the Aconcagua River Confederation that brings together the Watch Committees for the different sections of the basin and the Farmers Associations existing in the basin.[8] In this case, the organisation only includes water users; it does not include representatives of public agencies. It also is a very new organisation (strictly speaking it is still being formed),[9] whose effectiveness is still to be seen. However, it is to be hoped that, in the future, it will be capable of appropriately managing water in drought periods without Government intervention, as has been necessary in recent drought periods in this basin. (See Table 2.4, which describes the interventions of the DGA in the distribution of water.)

Table 2.4
DGA Interventions in the Distribution of Water during Periods of Extreme Drought

The Water Law allows the establishment of special powers, given certain conditions, for government intervention of rivers. Below an extract is quoted from the Law in which the authority of the Government to intervene in a river is described.
Art.314 "The President of the Republic on the petition or advice of the General

[7] Bauer, C. (2002), "Contra la Corriente. Privatización, mercados de agua y el Estado de Chile," Lom Ediciones/Fundación Terram, Santiago, Chile.
[8] Including the Watch Committee being created for the second section of the river.
[9] Recently received information shows that the Watch Committee for the 1st Section has decided to leave the Confederation. This is just one example of the difficulties of reaching agreement among private associations in direct negotiations when there are questions that require compromise solutions.

> Directorate for Water can, in periods of extraordinary drought, declare areas of shortage for a maximum period of six months, not extendable. The General Directorate of Water will previously define, through a resolution, the periods of drought of an extraordinary nature.
>
> If an area of shortage is declared and if there is no agreement among the users on the redistribution of water, the General Directorate of Water can distribute the water available in natural streams of public use among the canals that extract water from the stream so as to reduce to a minimum the overall damage resulting from the drought. It can, for this purpose, suspend the authority of the Watch Committees as well as the sectional divisions of the natural flows within the area of shortage.
>
> The supreme decrees and the resolutions of the General Directorate of Water emitted in virtue of the powers conferred under the previous paragraphs are of immediate effect, subject to later confirmation by the General Comptroller of the Republic.
>
> Any holder of title to a water right who receives a smaller proportion of water than that corresponding to the existing availability has the right to compensation from the State.
>
> The declaration of an area of shortage is not applicable to water stored in private reservoirs."

The act of "intervention" in a river must be preceded by a declaration of "area of shortage". Usually, the "intervention" obeys the need to distribute and redistribute water so as to limit the damage caused by the drought.

At the beginning of the process an "intervener" is appointed, who, as the representative of the government, has all the authority required to maximize the optimum use of water.

Just as the law indicates, <u>any holder of a water right who receives a smaller proportion of the water than that which corresponds has the right to be and can be eventually compensated.</u>

Since the approval of this current legislation, two important interventions in rivers have taken place:

Aconcagua River, 1996/97.
Mapocho River, 1996/97.

The following is a brief description of these two episodes:

Intervention of the Aconcagua River, 1996/97

The second, third and fourth sections of the Aconcagua River were intervened to ensure and control the transfer of water from the first to the third section so as to improve, as far

as possible, the supply of water for the areas around La Calera and Quillota.

The declaration of an area of shortage was made on 30 September 1996 and included, among others, Region V.

Once the declaration of shortage was made, the idea of intervening in the river gathered momentum. Various sectors, including the Regional Government, the Watch Committees, and some companies involved in the local market for water, such as the water utility Esval, requested and supported this move in letters directed to the General Director of Water.

The intervention became definite on 7 December 1996 when the government designated Cesar Videla as intervener.

The initial declaration of an area of shortage was originally set for six months, but was later extended by three months. The end of the intervention was declared on 30 May 1997, without there being noted any great problems. Only two minor problems arose among some of the people involved, but none of those who suffered damages asked for indemnification.

Intervention of the Mapocho River, 1996/97

The first section of the Mapocho River was intervened to improve the supply of drinking water to the eastern part of Santiago, served, at that time, by the Lo Castillo Water Utility (EAPLOC).

The declaration of a water shortage area was made on 30 September 1996 and included, among others, the Metropolitan Region.

The intervention of the river was strongly requested by EAPLOC, which had had to take exceptional measures due to the drought. Among other measures, the company undertook water-rationing campaigns and reached the extreme of putting into effect programmed cuts in the supply of water.

The problems created had a huge impact on the media, as on this occasion the affected population was from the highest income levels in the country, living in the municipalities of Vitacura, Las Condes and, Lo Barnechea.

The intervention took place on 5 December 1996, when the government designated María Angélica Alegría as the intervener.

During the intervention there was speculation about the capacity of the company responsible for the drinking water supply services of the affected sector. It did have a certain amount of responsibility, as it had not taken measures to reduce the impact of the drought, hiding behind the government, which, by intervening the river, increased the availability of water. It must be mentioned that EAPLOC was always prepared to pay for the additional volume of water obtained by the intervention.

The additional resources corresponded to water rights for irrigation belonging to 50 clubs, parks, and sports grounds.

The intervener managed the conflict well and there were no serious complaints or requests for compensation, which would have had to be met by EAPLOC.

Finally, due to this problem, some modifications were made to the law, affecting the authority of the SISS over the functioning of the water supply and sanitation companies.

Other cases
In addition to the two cases described, there are others that had less repercussion and impact on the functioning of the systems and on public opinion.

On example was the intervention of the Maule River, due the national energy crisis during 1998/99. This intervention was coordinated among the government, the generating companies, and the involved Watch Committees. In this case an agreement was reached satisfactory to all parties.

2.3.2 Identification of Winners and Losers

In general, the users manage the water resource management system in Chile, and try to achieve a distribution of water according to the water rights of each user. Given that the participation of the users in the election of directors and in the voting in the meetings is directly proportional to the amount of rights held, it is easy for the larger users to dominate the administration and the taking of decisions in these organisations.

Peña says, with respect to the development of a democratic culture inside the organisations, that frequently there are problems of legitimacy due to proceedings that do not work in the way in which they were conceived.[10] For example, is the voting system today an incentive to participation or, on the contrary, a deterrent, favouring the manipulation of the less informed users? Are the rights of minorities sufficiently guaranteed? In addition, there have been conflicts between the new agricultural companies and traditional farmers over the modernisation (both administrative and physical) of the use of the water resource.

The Water Law permits any holder of a water right to present a judicial complaint if he feels damaged in his water use by any recent action. According to Peña, “on those occasions when a user has entered into conflict with the board of directors of his organisation, even with support from the DGA and from the courts, it has been impossible in practice to reverse the situations soon enough, given the nature of the

[10] Peña, Humberto, “Desafios de las Organizaciones de Usuarios en el Siglo XXI”, III Jornadas de Derecho de Aguas, 2003.

problem".[11] Consequently, the users (especially the poorest) tend to avoid using the courts, given that legal proceedings are slow and costly.

Another point worth comment is that, given that the Water Law does not make any distinction at all for participation in the Watch Committees between permanent consumptive use rights and permanent non-consumptive use rights, in river basins with significant hydroelectric development, the generating companies with various plants in series (non-consumptive rights) that also use the same water later destined for consumptive use, can multiply their voting power in the user organisations by various times. Thus, if they form part of the Watch Committees, they can dominate the administration and management decision-making. In fact, the Hydroelectric Generating Companies usually have not participated in the Watch Committees, primarily because the situation is uncomfortable for the users with consumptive rights and, therefore, they have not taken the initiative to include the companies. The situation created is also uncomfortable for the companies, because, although according to the law they could assume a major influence in water management, this could also mean heavy financial responsibilities for operation and maintenance, as well assuming a responsibility for conflict resolution. Consequently, in practice, the main hydroelectric companies have remained outside the user organisations.

Under the conditions described, the conflicts between non-consumptive and consumptive users arising in water management in some river basins have reached the courts for resolution.[12] In general, the courts have avoided making fundamental definitions in water management in their decisions and have tended more to reach compromise solutions among the litigating bodies, resolving the differences on a case-by-case basis. This shows, on the one hand, that the issues are complex and that the existing laws and regulations are not sufficiently precise. On the other hand, it shows a praiseworthy attitude by the courts in reaching solutions in technical areas where they do not have sufficient knowledge. In any case, it must be taken into account that the action of the courts has always been rather slow, moving at a pace at variance with the urgency of many water management problems.

A further source of conflicts in water management has been the operation of multiple use reservoirs for energy and irrigation in the headwaters of the Maule and Laja Rivers. Bauer also discusses this issue (2002). It must be understood that the Maule Lake and Laja Lake reservoirs were built more than 40 years ago under an agreement between two organisations that were at that time public agencies, ENDESA and the Irrigation Directorate of the Ministry of Public Works, for the purpose of regulating the natural hydrology of the basins to improve the possibilities for hydroelectric generation and irrigation. These agreements are still fully in force, although ENDESA was privatised in the 1980s and despite the two substantial modifications to the laws applied to water since they were signed. The operation of the dams is still a responsibility shared by ENDESA

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[11] Peña H., "20 años de Código de Aguas. Visión desde la Administración", IV Jornadas de Derechos de Aguas, Universidad Católoca de Chile, November, 2001.

[12] Examples include cases in the basins of the Maule, Laja, and Bío-Bío Rivers. See Bauer, C.J. (2002), *Contra la Corriente. Privatización, Mercados de Agua y el Estado de Chile*, Lom Edicones/Fundción Terrum, Santiago de Chile.

and the present Hydraulic Works Directorate of the Ministry of Public Works. The irrigation users, who today are the owners of their water rights, have complained more than once (especially in dry periods) that the operation of these dams violates the exercise of their use rights. These complaints in some cases have been through the courts, but in any case they have not been successful. It has to be taken into account that the users have no influence at all, from the legal point of view, over the management of the reservoirs under discussion, although they do have responsibility and authority to manage the waters of the whole river. They do not do this adequately for lack for of technical and organisational ability. Also, in relation to the management of the reservoirs, it must remembered that the operations of the Central Electricity Grid (SIC), of which these generating stations, using the water discharged by these dams, form a part, looks for an optimisation of the management of the reservoirs with the explicit goal of supplying the electricity demands of the SIC, but it does not attempt to optimise water use for irrigation, a sector where only the minimum restrictions established for the current irrigation season are taken into account and there is no consideration of a multi-year horizon. It has been argued that, given the important changes that have occurred in the water legislation and in the demand for water in the basins concerned, the existing agreements for the operation of the dams should be reconsidered and accommodated to the new situation.

The problems illustrated above could also occur with a new work soon to be put into use for irrigation, the Convento Viejo reservoir located on the Chimbarongo creek, tributary to the Rapel reservoir. It is also used for hydroelectric generation. This new reservoir (which really is a significant increase in the capacity of a small existing reservoir) will be supplied with water principally from a canal that transfers water from the Teno River (Teno Canal-Chimbarongo) that was also designed and constructed in the 1960s for combined irrigation and energy use (Rapel Generating Station). However, in this case the problems should be much fewer, given that the operational rules of the reservoir are in accordance with the provisions of the actual rules governing water rights. Moreover, any future multiple use works must take into account the actual legal and administrative situation and, therefore, must contemplate operational rules in agreement with the new system, minimising future conflicts.

2.3.3 Communications between Non-Government Participants and Government Participants

In Chile the non-government participants communicate within the user organisations according the proceedings outlined in the Water Law, at least formally, and wherever these organisations exist. The Annual General Meetings take place once a year and there are Extraordinary Meetings when they correspond under the Law. The Law also governs the meetings of the Boards of Directors and the Statutes of each organisation. However, as Alegría and Valdés point out, the direct participation of the users in the Annual and Extraordinary General Meetings is sparse, although the necessary quorums are usually assembled to function and take decisions through the request for simple proxies.[13]

[13] Alegría and Valdes (1999), op.cit.

As has already been discussed, the surveys that have been made throughout the country suggest that a large proportion of users is still not organised according to the present legal provisions. Consequently, in these cases there are no formal channels of communication among users. Although there are no systematic studies analysing these circumstances, making it difficult to quantify the degree of lack of communication, the authorities are aware of innumerable situations created by the absence of communication over time. For this reason the DGA has dedicated much systematic effort over the last decade to bring together the users of many canals to form Water Communities to permit organised functioning and better communication among the participants.

The formation of Watch Committees for superficial streams has been left more directly to the participants themselves, as the Law does not provide any authority to the General Directorate of Water (or any Government agency) to invest public funds in efforts to favour their formation. The result is that in those rivers or sections of rivers in which water shortage is very infrequent, Watch Committees have not been formed and, consequently, there are no established channels of communication among the participants.

Moreover, in river basins with large hydroelectric generators that must live with and share the water resource with irrigation users with no formal communication channels (see section 2.3.2 above), critical periods of shortage tend to create conflicts whose only solution is through recourse to the courts. This, as has already been said, has not been effective.

In summary, it can be said that the channels of communication among the interested non-government participants (principally the users) in matters related to surface streams are good in those river basins with permanent water shortage, as is the case between the 1st and IVth Administrative Regions in which Chilean territory is divided.

In contrast, communications are much more imperfect (allowing for exceptions) between the Vth and VIIIth Regions, where problems arise during the relatively more infrequent periods of drought.

In the river basins of this area, user organisations are more imperfect (or there are none) and they do not have long-term traditions or cultures of confronting this kind of problem. This is partially because such problems have become important only in the last few decades, as the demand for water has placed greater pressure on its availability. In this part of the country, conflicts during droughts tend to arise over the distribution of water, such as water theft through illegal diversions, and on many occasions the existing user organisations are incapable of managing the problems. Consequently, calls are made for the intervention of the General Directorate of Water or recourse is made directly to the courts (Allegría and Valdes, 1999).

Further south (Regions IX to XII) communications among non-government participants are non-existent, given that not only are there very few user organisations, but also water needs are very small compared with its availability. Consequently, there is no system for water resource management in this part of the country.

In the case of groundwater, although the Water Law takes it into consideration, Groundwater Communities associating users of the same aquifer have not been constituted. For the management of groundwater the Water Law provides that when the use of groundwater by some users causes damages to other holders of rights (art. 62) the General Directorate for Water can temporarily reduce the use of rights, proportionally, at the request of one or more holders,[14]. The Water Law also defines "restricted areas" as "those hydrogeologic sectors of common use in which there exists the risk of a serious reduction in a specific aquifer with consequent damage to the already established rights of third parties" (art. 65). The same article 65 continues: "The General Directorate of Water will declare a restricted area at the request of any user of the respective sector, on the basis of historical evidence of the use of his well that shows the convenience of restricting access to the sector. The declaration of an area of restriction will initiate a water community formed by all the users of groundwater included in it".

In practice, neither of these two articles of the Water Law has been used, because there have been no initiatives by users to request it of the DGA.[15] The DGA does not have the legal authority to take the initiative in this matter, even though there are various aquifers (for example, aquifers in the Azapa Valley, in the Copiapo Valley and in the Chacabuco-Polpaico Valley) where it has become evident in recent decades that actions of this sort should have been taken. It would seem to be very difficult for a user (or users) of an aquifer to persist in a request of this type, which will mean some restriction in the use of his rights. It seems to him to be a better solution to deepen his well and to continue to use the total volume even though this means higher costs. Since Groundwater Communities have not been constituted there are no formal communications among the users of the same aquifer. Again, the activities of a public institution such as the DGA remain outside the management of groundwater in an aquifer. Thus, the DGA is prevented from requiring the users of groundwater to install periodic measurement of the condition of the groundwater and the volumes used, or from demanding the respective information (see art. 29, Resolution N° 186, 1996 of the DGA on the Exploitation of Groundwater).

2.4 Other Indirect Influences on the System

In general, in Chile, there do not appear to be other forces or influences, social or political, that could indirectly influence the Water Management System, except changes introduced by new development works in a river basin (either works for water development or works that interfere with the existing distribution systems) or, perhaps, the reallocation of use rights due to transactions among the holders of these. Both of the situations mentioned are usually accompanied by the need to introduce modifications in the water distribution systems, which can mean the adaptation of physical distribution works, as well as the adjustment of user organisations or the creation of new ones.

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[14] In this paragraph the author has underlined passages to indicate the importance of the concepts.

[15] Strictly speaking, users have made such requests, but they have rapidly withdrawn before they could be processed, probably due a reconsideration of the situation or, perhaps, at the request of other users of the same aquifer.

The new developments that interfere with water distribution systems are principally from the expansion of urban areas, which changes land use from agricultural to urban and obliges changes in the routes of irrigation canals and in the distribution structures. In these cases, the result is that after a few years the canal networks are enclosed in the urban development, creating serious problems for the maintenance and operation of the systems as well as problems for the urban population.

The most significant water development works in a river basin are the union of canals and intakes to improve efficiency in diverting and transporting water. This should also lead to the union of existing user organisations. On the other hand, the building of new very large regulation reservoirs also requires the adjustment of canal networks and distribution works and, again, the modification of user organisations. In some cases, the large reservoirs introduced into the system significantly change the use of the existing canal networks, introducing inefficiencies in their operation that are not easily resolved.[16]

Transfers of water use rights, when these are among users of the same canal, can require the modification of all the distribution works located between the new and old points of use, especially if these are permanent critical flow divider works. Trades involving the transfer of rights from one primary canal to another have more serious implications, as the receiving canal must be adjusted to transport and distribute a larger flow. At the same time the canal from which the rights are taken remains oversized, which means it will be less efficient and, in addition, the maintenance costs will now be distributed over a smaller number of users. This means that the users of a canal often strongly oppose the sale of rights to outside of the same canal. This last is an additional factor tending to reduce the efficiency of the market in the reallocation of water.

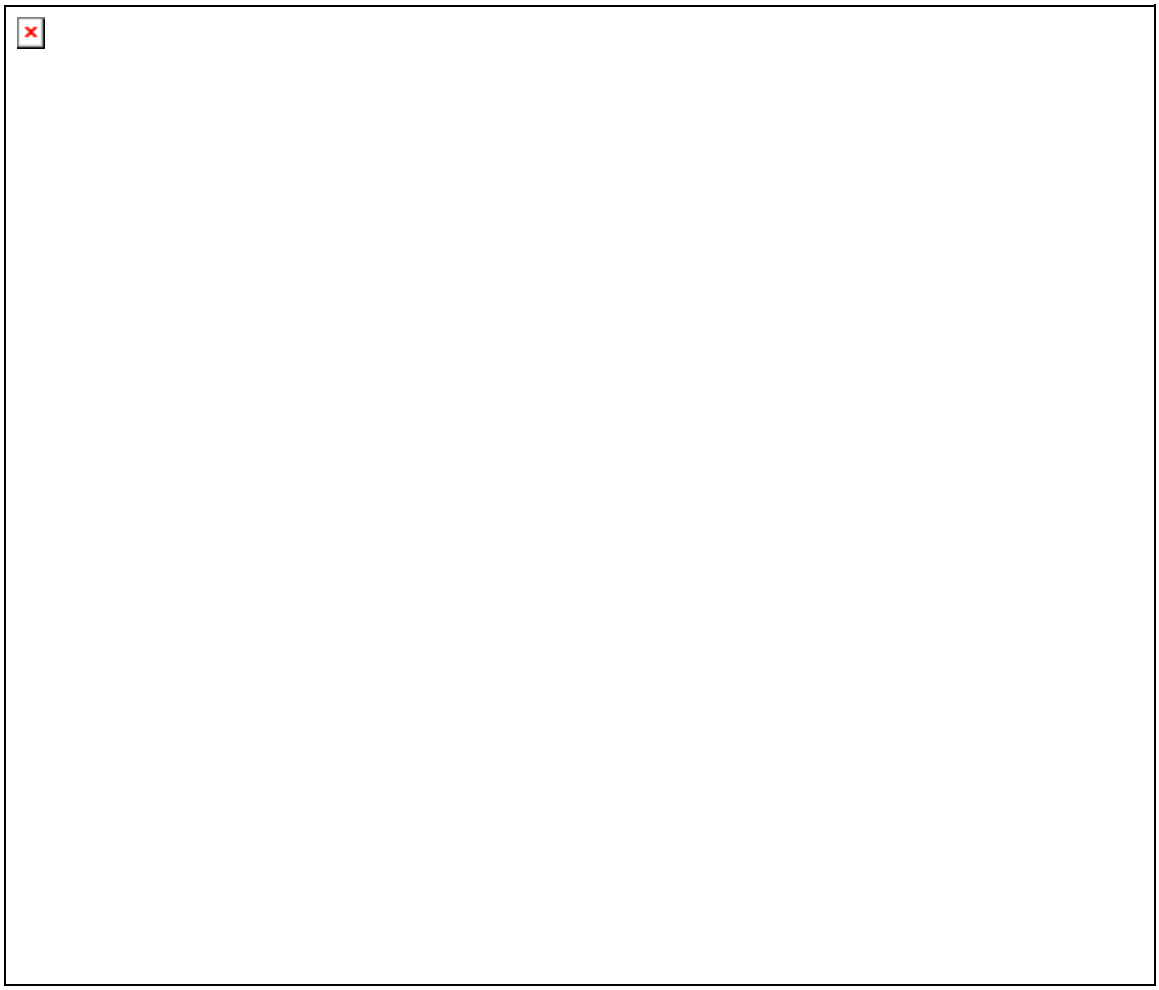
Finally, it is necessary to mention that the Health Services of the Ministry of Health have authority to prohibit the delivery of water to certain users from a source known to be seriously contaminated, when this could seriously affect the health of the population. For this reason, the Health Services in the Administrative Regions must monitor water quality at the source and must also refer to the controls made by other agencies such as the General Water Directorate and the Agriculture and Livestock Service (see Figure 2.1). The water utilities supplying urban centres are themselves responsible for the quality controls as part of their normal operations. However, for irrigation, especially the irrigation of vegetables eaten raw, there are no rules which demand self control, making the controls of the Health Services important for this sector. The last emblematic example of the intervention by the Health Services happened some 10 years ago, when the cholera virus was detected in the streams receiving sewage from the city of Santiago. On this occasion the Santiago Metropolitan Health Service issued a resolution prohibiting irrigation from these water sources and also proceeded to physically destroy on site all the vegetable production that could have been contaminated.

2.5 Structure of the Water Management Regime in Chile

[16] For instance, the irrigation canals on the south bank of the River Maule that supply an irrigation area located between the Colbún Reservoir and the return canal from the Macicura Generation Station are now too large for the very much lower flows that they transport. This causes significant operational difficulties.

The structure of the public sector has already been explained in section 2.2 and of the non-government participants in section 2.3. Figure 2.2 gives a diagram of the Public Institutions and the Non-Government Institutions involved in the System of Water Management in Chile,[17] showing the kinds of interrelationships that occur among these different participants.

Figure 2.2
The Structure of the Administrative System



2.6 ANALYSIS OF THE REGIME (ADMINISTRATIVE SYSTEM)

2.6.1 Introduction

[17] A diagram of the place of the public agencies in the Structure of the Public Administration can be seen in Figure 2.1

This section will emphasise and qualify the strengths and weaknesses of the water resource management system in Chile on the basis of the description provided in earlier chapters.

The chapter is arranged so as to give separate consideration to the administration of surface waters and groundwater, given that, as has been described, there are considerable differences in the administration in these two systems, both in the form provided in the present Water Law and in practice.

2.6.2 Administration of Surface Water Systems

2.6.2.1 Strengths

- The present Water Law defines specific procedures for the constitution and operation of user organisations at the level of natural surface streams (sources), as well as for artificial surface streams (canals and aqueducts).

- The Water law precisely defines how the users themselves should finance the administration of their systems for obtaining and delivering water. The Government does not spend funds in this matter, except for paying for the work of control, monitoring, and conflict resolution.

- In practice, in those parts of the country that suffer an almost permanent shortage of water, and particularly where irrigation is an important contribution to economic productivity, user organisations have been constituted and work reasonably well (examples are the Rivers Copiapo, Elqui, Limarí, and the first section of the Maipo River).

- In the rest of the country the frequency and the levels of conflicts over water have been only moderate. They happen in periods of drought and mainly in the river basins in which the economic productivity of water is very high (Examples are the basins of the Aconcagua, the Mapocho, and the Maule Rivers).

2.6.2.2 Weaknesses

- User organisations have only been constituted in some river basins (or sections of river basins), since the law does not oblige the users to form them. The consequence is that there are large parts of the country in which water management is very weak, both because the intake, control, transport, and distribution works are precarious, and because either there are no user organisations or these are deficient in their operations and resources.

- The organisations that do exist fulfil only a limited role in the administration of extractive water rights. There are no suitable rules and no culture or desire for these organisations to adopt a more integrated approach towards water management.

- There is no evidence that the failure of the user organisations to exercise some of their prerogatives is due to ignorance. An example of these prerogatives is the undertaking of extension activities among their members to introduce techniques and systems for better water use (Alegría and Valdés, 1999, op.cit.).

- On many occasions the means for conflict resolution are not used with the result that many problems that should be resolved within the organisations, with the means the law provides, are taken to the Regional Offices of the General Directorate for Water or even to the courts (Alegría and Valdés, 1999, op.cit.).

- The means provided in the Law for the participation of the users in the management of the organisations favours management by "cliques". For example, the boards of directors of the organisations tend to perpetuate themselves, while effective participation by the users in the general meetings is on the whole limited. Moreover, the legal regulations on the management of the organisations do not allow an adequate level of transparency in their management (personal communication of the Director General of Water, Humberto Peña).

- On the whole, the holders of non-consumptive water rights have not participated in the Watch Committees of the corresponding river basins or sections. This is particularly the case with the large Electricity Generating Companies. In river basins with considerable hydroelectric development, the other water users do not want the Companies to participate, since under the Law they will have a major influence on the administration of the organisation. At the same time, the Companies, being non-consumptive users, do not appreciate the need to participate; rather they perceive a threat of having to assume financial responsibilities in the organisation, which they can avoid.

- In many parts of the country the level of investment in infrastructure for intakes, transport, control, and distribution can be considered to be insufficient to achieve a better level of efficiency and modernisation of the management of the water resource.

- In the 1981 Water Law, the authority of the General Directorate for Water to monitor the operations of the user organisations or to promote the formation of these organisations is very limited. (It can only intervene in the case of complaints about problems in financial management or in the distribution of water.)

- The authority of the DGA to intervene user organisations to redistribute water in periods of extreme drought is very restricted in the Water Law with respect to the payment of compensation for those who feel their rights have been infringed.

- Water uses of a more public nature, in general uses that can be described as "in situ", are not considered in the existing legislation and regulations. Therefore, the authority cannot either "reserve" flows for these purposes or concede rights "in situ" to private persons for such purposes as tourism, landscape preservation, sport fishing, and recreational use.

2.6.3 Administration of Groundwater Systems

2.6.3.1 Strengths

- The present Water Law and Resolution N° 186 (1996) of the General Directorate for Water provide obligatory procedures for exploring for or using groundwater. The latter can only be legally done once a right to use groundwater has been granted.

- Under certain circumstances the Water law provides for the formation of Water Communities bringing together all the users of a common aquifer.

- Once a groundwater right has been granted by the competent authority (DGA), an area of restriction prohibiting new wells must be defined around the point for which the right has been granted.

2.6.3.2 Weaknesses

- The rights for the use of groundwater have been granted historically and still are granted on the basis of a maximum volume, normally expressed in litres per second. Neither the maximum number of hours of use nor the maximum annual volume of extraction is specified. In this way, wells destined for different uses with rights to equal maximum flows can be used at very different annual rates. For example a well used for irrigation is used at its maximum flow for only a couple of months a year (or even only in some years), whereas a well destined for industrial use or drinking water is exploited at its maximum flow continuously. When there is a trade of a well between users of different natures, the effect on the volumes extracted from the aquifer can be dramatically different (for example, trading in groundwater between irrigation and drinking water, as has occurred in the past in the Azapa Valley).

- The authority of the DGA to declare areas of restriction for the exploitation of groundwater has to be based on the request of a user who sees his rights to be threatened. In practice this authority provided by the Water Law cannot be exercised, as the users prefer that the Public Sector authority does not interfere. Consequently they do not request the declaration of restricted areas or the reduction of volumes of use in proportion to the rights, even when it is seen that the aquifer is descending and the flows are decreasing.

- In many river basins there are groundwater wells that are used without rights. Neither monitoring nor the policies of the DGA are fully carried out, probably because of the lack of resources.

- Groundwater Communities have not been constituted to bring together the users of the same aquifer, although the Water Law permits it, because the only case in

which such an organisation is obligatory under the Water Law is when an area of restriction has been declared.

- The existing Water Law considers groundwater to be independent of surface flows. It does not recognise the physical and natural interrelationships between the two systems. This means that communications between users of surface water and groundwater have not been established. It also means that in various river basins the historical emergence of groundwater, which gives rise to surface flows downstream, has been modified.

- In general, the Water Law is not directed to conserve long-term sustainable levels of exploitation of an aquifer, but rather only to intervene once obvious impairment of the aquifer has been detected, either in piezometric terms or in water quality. The Water Law also significantly limits the intervention of the government authority (the General Directorate for Water), which could have a longer-term perception of sustainability for groundwater.

2.7 THE REGIME OF THE WATER MANAGEMENT SYSTEM IN CHILE

2.7.1 Introduction

In this chapter, the roles of the different participants in the Water Management System in Chile are summarised in the table presented below, in terms of Director, Inspector or Executive.

To assemble the matrix, the different activities or responsibilities in the system have been disaggregated following the analysis presented in the first six sections of this chapter. It identifies the participants under whose responsibility or supervision the activities are carried out or, in other words, defines who has the pertinent authority.

2.7.2 Matrix of the Management System

Table 2.5
Matrix of Roles in the Management System

Role	Area	Description of Participants and Responsibilities
Director	Definition of the criteria of Administration/Technical, Economic and Financial Operation, Resolution of Conflicts	• Government of Chile: Proposes the Laws with the Technical back up of the General Directorate for Water. • General Directorate for Water: Emits resolutions establishing criteria in the areas in which the Law gives it competence. • CONAMA: Establishes regulations in the areas where the Law gives it authority. • User organisations: Through their statutes
Inspector/Regulator	• Monitoring and control	• Ministry of Public Works, General Directorate for Water: - Supervises the Watch Committees

		- Supervises the operations of intakes in natural streams, canals and aqueducts to avoid damage to third parties - Intervenes in user organisations in situations of extreme drought, as permitted by the Law. - Monitors and measures hydrometeorological variables and water quality in rivers, lakes and aquifers. - Monitors and inspects surface streams - Declares areas of restriction in the exploitation of groundwater at the request of one or more users and reduces the use of rights when the exploitation produces demonstrated damages to some users.
Inspector/Regulator	• Inspection and regulation	• User organisations: - Ensure that the distribution of water is made in conformity with the rights and the instructions of the Board of Directors (Watch Committees for the rivers, User Associations of Water communities for the canals). This is done by those charged with the distribution of water who also correct any anomalies. • Ministry of Agriculture, Agriculture and Livestock Service: Monitors water quality in the irrigation canals. • Ministry of Health, Environmental Health Services: Monitor water quality to protect public health. Emits resolutions to correct problems. • Directemar: Monitors water quality in coastal waters
	• Conflict resolution	• User organisations: are the first level for conflict resolution in water distribution among their members: they have the authority in the role of inspectors to call for a meeting of the Board of Directors • General Directorate for Water: intervenes in those conflicts among users under the authority conferred by the Law (only in economic and distribution matters). In practice it is asked to intervene in many types of conflicts among the users, which should have been resolved within the user organisations. • Lower Courts: Resolve the conflicts brought before them.
Executive	• Effective management • Participation • Financing • Investment decisions	In general, all these matters, according to the Law, lie in the area of competence of the user organisations. The description of how these responsibilities are carried out is given in the

	• Subsidies • Physical deliveries • Others	text of the report. The only point at which the General Directorate for Water can assume an Executive role is when it intervenes a Watch Committee during extreme droughts.

2.8 PERFORMANCE OF THE MANAGEMENT SYSTEM

In this section the performance of the Management System is judged in the light of various concepts: effectiveness; efficiency; social equity; environmental quality; participation and integrated management. For each of these, the different responsibilities are examined to permit an appropriate evaluation of the concept. However, in most cases there is no dependable quantitative information covering all the systems in Chile. Therefore, to make an evaluation it is necessary to resort to the expert opinion of the consultants, partial information for some sample cases, and the personal familiarity of the consultants with many of the systems.

Distribution of the Allocation of Water

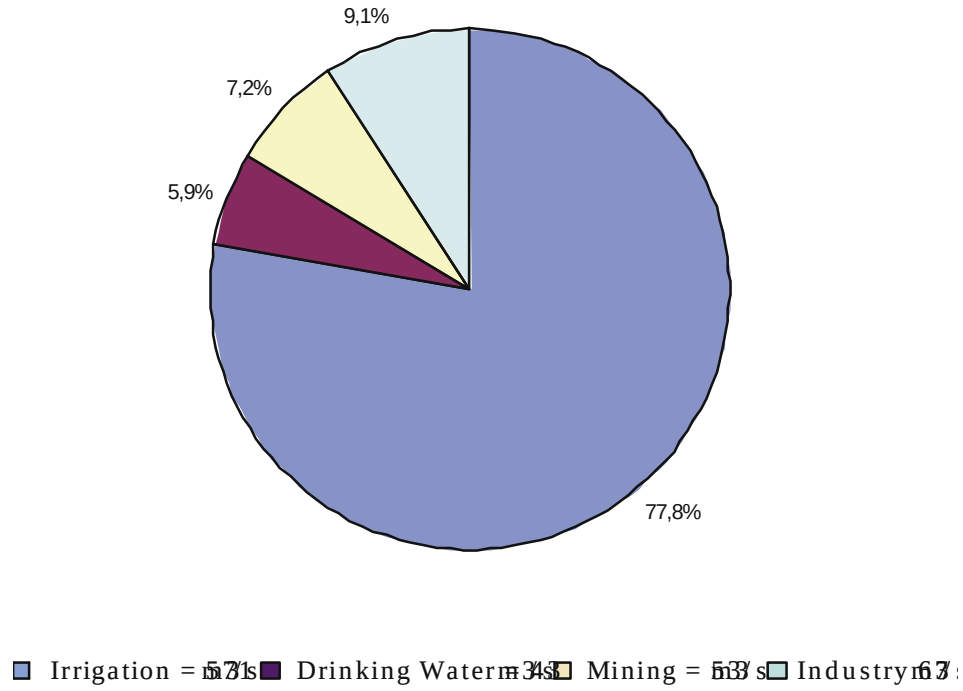
According to the information available, the consumptive use of water is equal on average to 743m^3 a second.

Of this amount, the major part corresponds to irrigation, with a total consumption of around 571m^3 a second, all of which is in the area north of Region X. This is equivalent to 77.8% of the total consumption.

The remaining uses are in drinking water supply (residential) and in industry and mining with an estimated consumption of 43.67m^3 a second and 53m^3 a second respectively.

Figure 2.3 shows the percentage distribution of the different levels of consumption. The percentages in this figure are close to the monthly averages (Global Report on Water Resource Development, UNESCO, 2003).

Figure 2.3
Distribution of Water Use in Chile



Effectiveness

For this concept replies will be attempted to the following question:

- Are there unsatisfied rights or demands in droughts due to the lack of infrastructure, organisation, or opportunities?

a) Infrastructure

- Overall the existing infrastructure is sufficient to satisfy the existing rights and demands (when there is sufficient supply). Nevertheless, there is an important quantity of non-consumptive rights that are not used and there is no infrastructure for exploiting them. The latter has occurred because, in the 1980s, after the 1981 Water Law came into effect, the electricity generating companies requested non- consumptive rights for all the hydroelectric development that might be built. As the Water Law does not oblige the use of the rights granted and as the Government granted them free of charge and there is no charge to maintain them, the companies can keep them in case at some future moment it becomes economically attractive to construct a project. This is an important debility in the system of allocation and reallocation of water in Chile, since the existence of these rights prevents the realisation of other projects that use water for

other ends. It also obstructs the entry into the electricity generation market of other generating companies.

- In the north and central parts of Chile there are numerous unsatisfied demands for water, principally in irrigation, which cannot be met given the present supply. In some cases, regulation works (reservoirs) or wells could improve the supply of water.

b) Organisation

- In many river basins in Chile the organisation of water management is divided by stretches of river that, for the purpose of water distribution, are treated as flows independent one from the other. This means that, in the same river, the security of delivery of the water rights, in times of water shortage, can vary considerably in the different sections of the river. This causes inequities and potential conflicts. A typical example is the Aconcagua River, where the principal stream is divided into 4 sections. The 3rd and 4th sections are clearly at a disadvantage in available water compared with the two sections located upstream.

- Also, even within the same section, there are canals with more water rights than reflect the real demand. This happens because the proportion of rights of some canals is greater than their effective demand or because some canals have only eventual rights that, by definition, can only be met once the permanent rights have been fully satisfied. This situation produces inequities among the irrigators in the same river basin.

- Is the water applied effectively used?

This question is analysed for residential use and irrigation.

Industrial use and mining use together account for only a small percentage of the total national use (16%) and water is considered to be simply another input and, in general, does not limit production objectives, when efficient use is made of it. Therefore, more efficient technologies are used, less water is consumed, or new, economically more convenient sources are developed, depending on the availability of water.

a) Domestic Use

The water utilities are very effective. The coverage of the urban population is around 99.7%. In the rural communities, a similar proportion is supplied in concentrated communities (those with a population between 150 and 3,000 and a density of not fewer than 15 houses for each kilometre of road).

The residential consumption of water includes drinking, food preparation, cleaning, and toilet flushing. Additionally, particularly in the summer, there is consumption for garden irrigation and swimming pools. This consumption is significant in high and middle-income households.

The effectiveness of the Rural Water Supply programme, in terms of its benefits, is measured basically on its extent. By December 2001, the National Rural Water Supply Programme for concentrated rural communities reached 99.3% of the population, benefiting 1, 261,000 people. By the end of 2002, almost 100% of the rural concentrated population had been supplied. In the six years that the Ministry of Public Works, Direction of Planning, has been responsible for the National Rural Water Supply Programme 360 services have been created equivalent to 31% of the total number of new services in the country.

The direct and indirect social benefits of the National Rural Water Supply Programme are various, including the reduction in the levels of morbidity and mortality due to waterborne disease, principally among children, greater social development, increases in productivity, better knowledge of sanitation, and improvements in the quality of life.

The indirect benefits go beyond the simple supply of water, as the social policy in which this programme is included aims to consolidate models of management and participation that bring together public policies on basic infrastructure, public health, overcoming poverty, decentralisation and regionalisation, conservation of the environment, and housing.

b) Irrigation

As has already been shown, irrigation is the principal user of water, requiring some 78% of the total water consumed in the country. The average annual consumption is approximately 571m^3/second applied with a low level of efficiency (around 39%).

It is not possible to speak about the effective use of water for irrigation, as a large part is lost or used unprofitably.

An example is given in Table 2.6, which shows the area under different irrigation methods by region and the respective average efficiencies.

Table 2.6
Estimated Water Demand for Irrigation and Efficiencies, by region

Region	Area by Irrigation Method (ha)			Area	Demand	Irrigation efficiency %
	Gravitational	Mechanical	Micro-irrigation	Total (ha)	m^3/s	
I	6474	9	1556	8039	6.1	44.7
II	2897	19	46	2962	0.5	36.0
III	6845	180	7239	14264	5.4	60.8
IV	35018	470	14038	49526	32.5	49.5
V	50258	3524	15180	68962	32.4	47.8
RM	128436	5957	10964	145357	120.8	40.2

VI	199200	3015	6436	208651	115.1	37.0
VII	311409	3283	3634	318326	153.8	35.9
VIII	177827	2299	682	180808	82.5	35.6
IX	44080	6255	558	50893	18.1	39.8
X	569	5638	853	7060	2.5	69.0
XI	3485	0	0	3485	1.2	35.0
XII	1792	0	0	1792	0.1	35.0
National	968290	30649	61186	1060125	570.9	38.9

According to the Agricultural Census of 1997, there are 2,297,277 hectares of cultivated land, of which approximately 1,000,000 hectares have secure irrigation. Consequently, to the extent that there is technological change in methods of irrigation and the systems of distribution and regulation of the water resources are improved and increased, it should be possible to achieve a noticeable improvement in irrigation effectiveness.

Efficiency

Efficiency is evaluated considering the principal consumptive uses of water: irrigation, residential (drinking water), and industry and mining.

- **Irrigation**

Irrigation efficiency is measured by the combination of the efficiency of various procedures. These include the transport and distribution of water, storage, and irrigation technique. It can be evaluated in two ways: at the field level, through the efficiency of each type of irrigation, or from a river basin perspective evaluating the gross and net demands for agricultural use. In this last case, efficiency is considered to represent the overall management system of the river basin, as this allows the internalisation of the effects of overflows and recoveries.

Table 2.7 shows the efficiencies of irrigation water use in Chile.[18] As can be seen from the table, the efficiencies of the use of water for irrigation at the river basin level in Chile are relatively low. This is due to the fact that the transport systems/distribution and application of water on the fields are generally relatively inefficient. There are significant losses due to unlined canals and in the river sections used to transport water and the irrigation methods are generally primitive. This last factor has improved gradually in recent years due to the application of the Law to Promote Irrigation, which subsidises with public funds the undertaking of projects to improve irrigation, principally at the field level.

Table 2.7
Efficiency in the Use of Water for Irrigation in Chile

Region	River Basin	Gross Demand	Net Demand	Efficiency

[18] Brown E. and J.E.Saldivia, (2000), "Informe Nacional sobre la Gestión del Agua en Chile", SAMTAC, Global Water Partnership.

		Hm^3/year	m^3/s	Hm^3/year	m^3/s	%
I	Lluta	46,047	1.5	18,007	0.6	39.1
	San José	36,276	1.2	20,106	0.6	72.0
	Camarones	24,100	0.8	8,405	0.3	34.9
	Region	106,423	3.4	62,918	1.0	49.3
II	Loa	16,801	0.5	10,097	0.3	60.1
	Region	16,801	0.5	10,097	0.3	60.1
III	Copiapo	74,501	2.4	52,910	1.7	71.0
	Huasco	100,274	3.2	64,211	1.7	54.1
	Region	174,775	5.5	107,171	3.4	61.3
IV	Elqui	164,756	5.2	77,291	2.9	46.9
	Limarí	790,847	25.1	274,707	6.7	34.7
	Choapa	318,181	11.0	124,314	3.9	35.7
	Other basins	13,513	0.4	4,067	0.2	36.0
	Region	1,317,92	41.8	481,174	15,3	36.5
V	Petorca	71,255	2.3	38,121	1.2	53.5
	La Ligua	116,059	3.7	60,032	1.9	52.2
	Aconcagua	1,023,585	32.5	429,175	13.6	41.9
	Region	1,210,899	38.4	527,928	16.7	43.6
RM	Maipo	3,460,790	109.7	1,201,310	38.1	34.7
	Region	3,460,790	109.7	1,201,310	38.1	34.7
VI	Rapel	4,176,791	132.4	1,754,453	55.6	42.0
	Region	4,176,791	132.4	1,754,453	55.6	42.0
VII	Matequito	1,321,795	41.9	680,161	21.6	51.5
	Maule	3,049,730	96.7	1,120,076	35.5	36.7
	Region	4,371,525	138.5	1,800,237	57.1	41.2
VIII	Itata	952,713	30.2	360,632	11.7	38.7
	BíoBío	1,289,077	96.7	420,937	13.6	33.3
	Region	2,241,790	138.6	797,569	57.1	35.6
IX	Imperial	195,508	6.2	97, 252	3.1	49.7
	Region	195,508	6.2	97,252	3.1	49.7
XII	Natales	1,346	0.0	743	0.0	55.2
	Las Minas	801	0.0	360	0.0	44.9
	Region	2,147	0.1	1,103	0.0	51.4
Country		17,274,745	547.6	6,830,762	216.6	39.5

Source: Based on DGA Análisis uso actual y futuro de los recursos hídricos en Chile, 1996.

As can be seen in the table, the national efficiencies are quite low (39.5% on average); the highest values are in Regions I and III and associated with the shortage of water.

Residential (Drinking Water)

According to an analysis based on the statistics of the Superintendent of Sanitation Services, the national average is 31.7%, higher, in most regions, than the limit set by the SISS in the "model company" used in the tariff setting process (20%).

The losses indicated above could originate in operational problems, such a broken pipes or seepages, as well as from commercial causes. These would include thefts and problems arising in the processes of metering and control of drinking water consumption in the household.

There are other factors, such as the geographical location and density of population, that influence efficiency in the use of water in that they condition the size of the network.

Table 2.8 summarises the production and billing values and the losses in the systems, by region and for the country as a whole.

Table 2.8
Summary of Water Supply Losses by region

Region	Production (000s m^3)	Billing (000s m^3)	Losses (%)	Network Km	Cost Ch$/$m^3$	Billing Ch$/$m^3$	Per capita supply (l/per capita/day
I	35,461	23,704	33.2	926	378	720.4	159
II	35,543	25,944	27.0	947	275	937.1	157
III	21,547	13,502	37.3	744	236	481.0	155
IV	35,943	27,991	22.1	1,506	207	463.4	150
V	145,759	88,920	39.0	3,997	212	539.9	173
VI	50,716	31,727	37.4	1,892	165	383.5	152
VII	53,810	33,633	37.5	1,679	188	345.1	149
VIII	133,374	84,833	36.4	3,678	145	349.8	152
IX	48,326	31,009	35.8	1,701	201	436.5	146
X	51,641	35,894	30.5	1,793	205	450.6	149
XI	6,304	3,992	36.7	281	241	659.0	160
XII	11,114	9,628	13.4	514	235	571.1	179
RM	728,469	516,186	29.1	12,547	91	270.9	214
Total	1,358,007	926,963	31.7	50,542	170	368	184

As can be seen in the table, it is noteworthy that, despite the scarcity of water, Regions I, II, and III have a high level of losses (31.8% on average). This zone also has the highest costs for m^3 billed in the country (Ch$305.2), which to a large extent is due, among other factors, to the scarcity of water, the low density of population, and problems associated with the high losses in the systems.

- **Industry and Mining**

Industrial and mining use of water represents a small percentage of total national use (approximately 16%) and in this kind of use water is considered as one input more and generally is not limiting for the achievement of production goals.

Depending on the availability of water, use is made of more efficient technologies, those requiring less water consumption, or new sources of supply are developed, if this is economically more convenient. For example, in the case of mining there is a tendency to recirculate water approximately 3.7 times (see details in the following chapter).

Social Equity

The Water Management System in Chile distributes the available flow in conformity with rights. Consequently, if a person owns recognised rights in his user association, he must receive the corresponding amount of water, independently of his social and economic or ethnic condition, always provided that he is up to date in the payment of his membership quotas in the community or association. According to the existing evidence in respect of

this matter, the user associations fulfil the legal requirements to the letter. Moreover, according to the existing legal regulations, all uses of water that have been exercised without interruption by a user, even if he has not registered his rights, must be recognised. With this rule the Water Law includes an attempt to protect the rights of small farmers who, due to ignorance of the law, lack of education, or lack of ability to pay, have not been able to register their rights.

In any case, it is well known that there are examples of economically powerful farmers who buy water rights from small poorer farmers with economic problems, who must liquidate their rights when they are in urgent need of money.[19] Mining companies have also bought the rights of small farmers in several places (for example, in the Loa and Choapa river basins). In some cases these purchases of water rights also include the land.

The situations described can be very inequitable for small farmers in some cases. However, in other cases the trades might have been made at values very advantageous for the farmers.

Environmental Quality

This issue has already been discussed in some detail in earlier sections of this report. In summary it can be said that the Water Management System in Chile does not put much emphasis on environmental water demands in the various river basins. The issue became relevant with the definition of ecological flows after 1994, with the coming into effect of the Environmental Bases Law.

Even so, the application of the concept of ecological flows is very restricted, as in the majority of the river basins of the centre and north of the country, the river flows were totally committed many years ago. However, today, in the granting of water rights for surface streams in river basins that have not been declared exhausted (mainly to the south of the IX region), the Ministry of Public Works, Directorate General for Water, requires that a minimum ecological flow be left to pass at the point of extraction. This decision obliges the corresponding user or the organisation of users to respect the minimum flow established in the river.

The idea is of such recent application that it is not possible to evaluate whether the demand is respected or not in water management practice.

In that part of the country where surface water rights have been granted in their totality, it is not possible to establish requirements for ecological flows, unless the Government expropriates the necessary water rights or opens a buying power through a call for bids. Otherwise, the government would be violating the right to property consecrated in the Constitution of Chile. At present, it does not seem likely that the government would take any action in the direction mentioned.

[19] There has been no systematic study of the extent of these practices, but these consultants came across situations of this kind in the Azapa Valley (Arica).

The only steps that the Government is taking at the moment to establish requirements or limitations on the use of existing water rights is when there are special situations, such as:

- When a user requests an authorisation to change the point of intake for his rights. In this case, the environmental impact analysis of the new intake (Law 19,300 of 1994) allows the establishment of mitigation measures, consisting in letting a minimum ecological flow pass by at the new intake point. From the point of view of the river this is relatively ineffective, as the holders of rights located below do not have any requirement to let this water by, in using their own rights. However, it can be significant in the headwaters of the rivers and at river mouths.

- When a user requests additional rights in a different source. In this case, the way in which the user is using the rights he already owns can be evaluated to see whether these are producing undesired environmental impacts. If this is the case, CONAMA can negotiate with the user a modification (reduction) of the flows used in one of the existing sources so as to reduce the environmental impact observed in this use. One example of such a situation is the agreement with Codelco Norte to gradually reduce the use of its source in Ojos de San Pedro (Region II) to improve the estimated natural recharge for this area, at the same time as replacement sources are developed for Codelco.

Participation

There is no evidence of interest groups trying to influence the Chilean Water Management System. This has occurred in the project and construction phases of some works (recent examples are the Pangue and Ralco hydroelectric plants on the Bío Bío River and the Laja-Diguillin Canal), but in the operational phases there has not yet been any pressure.

The participation of the users in water management has been discussed in section 2.6.2.2 of the report where it is shown that it is more formal than real.

Integrated Management

As has already been discussed, in Chile there are no organisations or regulations that encourage integrated river basin management. Attempts to do this by government agencies (particularly the General Directorate for Water) have not been successful, probably because they have not convinced the Congress or the general public of the advantages of integrated management for long-term sustainability of the water resource.

However, there are multiple use works in Chile (the Maule and Laja Lake reservoirs constructed in the middle of last century for shared use for irrigation and the generation of hydroelectricity) and there are projects under consideration of the same type (the Convento Viejo and Punilla reservoirs). In addition, now the projects analysed by the Ministry of Public Works (Hydraulic Works Directorate) are always evaluated considering irrigation (the traditional objective), hydroelectric generation, and tourism.

There are no projects in Chile for shared use of surface and groundwater, or projects conceived for the improvement of the artificial recharge of aquifers. It is probable that the absolute legal separation established in the Water Law between exploitation of surface water and exploitation of groundwater has been decisive.

2.9 IDENTIFICATION OF THE PRINCIPLE FAILURES IN THE REGIME

2.9.1 Introduction

This chapter presents a summary of the failures of the Regime that have been described in more detail above.

The failures are divided into two main groups: Systemic Failures and Government Failures.

2.9.2 Systemic Failures

a) Failures in the System as such

- The water management system does not consider integrated water resource management in each river basin.
- The System does not consider the conservation of the quality of the environment.
- The System does not consider the possibility of “in situ” use of water, but rather considers only extractive use.
- The System does not demand the obligatory organisation of the users of surface water in a river basin. Neither does it demand it for the users of an aquifer. (In practice there are no Groundwater Communities.)
- The System is not directed to the sustainable long-term exploitation of groundwater.
- The System does not encourage users to invest in intake, transport, or water distribution works to improve efficiency.
- The System provides no incentive for administrative and transparent management of the user organisations.
- The System does not consider the physical interrelationships existing between surface water and groundwater. In fact, they are considered to be independent of each other for all legal and management purposes.

- The System allows “sections” or stretches in river basins to be managed independently from each other for the purpose of water distribution. This gives rise to inequities among the users in the same river basin, especially in droughts.

b) Failures in the User Organisations

- These organisations (where they exist) do not fully use their authority. In particular they do not solve many conflicts and should do so using their authority.

- These organisations do not encourage the effective participation of the users in their management.

- In particular, the users holding non-consumptive rights generally do not participate in the user organisations.

- The decisions of the agencies responsible for the management of the electricity generation system do not take into account the water requirements of other sectors, but only the requirements for the supply of electricity. This produces conflicts.

c) Other Failures in the System

- In groundwater management the authority (General Directorate for Water) can only intervene at the request of the users. In practice, this means that intervention is impossible.

- Groundwater rights are expressed only in terms of maximum extractive flow (litres per second) and do not include a maximum annual volume.

- In the interventions of the General Directorate for Water during periods of drought, the government must compensate those users who might suffer injury with the redistribution of water. This limits the actions of the authority.

- The lack of communication among users and of these with the authorities results in many conflicts being passed to the courts.

2.9.3 Government Failures

- The General Directorate for Water cannot fully carry out its responsibility for monitoring and control. This is, in part, because the authority does not have sufficient powers in some areas, but also because of the lack of government financial resources.

- The courts, which must hear and decide in numerous cases of conflicts generated in the Water Management System, are very slow. Moreover, the judges lack knowledge and specialisation in the subject. This means that this method of

conflict resolution is particularly ineffective in solving issues concerning the Water Management System.

ANNEX 2A
INDICE OF REGIME PERFORMANCE
(using performance criteria)
On a scale of 1-5, where 5 is highest.

WATER MANAGEMENT SYSTEM

Criterion	Chile	Performance				
		5	4	3	2	
i. Effectiveness	3 Inequalities due to the division of the rivers into sections; lack of effective use of rights; faults in the infrastructure for irrigation.	There are no unsatisfied demands and water is effectively used	Only exceptionally are there no unsatisfied demands and water is used effectively.	Occasionally there are unsatisfied demands and water is not effectively used.	In some cases there are unsatisfied demands and water is not effectively used.	D s
ii. Management efficiency Economic Efficiency	3 4	There are no management, economic, or physical obstacles in the way of reaching goals.	Only exceptionally are there obstacles to effective management.	Occasionally, there are obstacles in the way of reaching goals.	In some cases the obstacles are resolved for the achievement of goals.	T p o w a
iii. Social equity	2 Cultural problems result in negative discrimination.	The system favours the less protected.	There are some cases of positive discrimination in favour of the least protected sectors.	There is no discrimination or privileges.	In some cases there is negative discrimination and monopolies.	T n d a n
iv. Environmental quality	2 The system is concentrated on management needs.	The management system always takes account of environmental variables.	Only exceptionally are environmental variables not taken into account.	Usually they are considered.	Frequently they are not considered.	M d e n
v. Participation	2 There is only participation in the user organisations and there are problems of representation.	There is very good participation with full representation (society + users and a good level of public information)	There is an acceptable level of participation, representation and information, but it is incomplete	There is some participation and limited information, but only for the direct users.	There is imperfect participation of the users due to lack of representation.	T p re a p u
vi. Integrated management	2	There is always integrated water management.	Very frequently there is integrated management.	Usually there is integrated management.	There are incipient signs of integrated management.	T o n

3. EXPLOITATION SYSTEMS

3.1 INTRODUCTION

This chapter presents an analysis of the activities of the water users in Chile, concentrating the analysis on the water resource itself, without making a serious study of market factors (either of national or international origin) or of the regulatory agencies that could affect the decisions of the participants (users).

The analysis is limited to agriculture, residential, mining, and industrial use, which are the principal consumptive users of water in Chile.

It must be borne in mind that in Chile the initiative in decisions over water needs, investment, maintenance, equipment replacement, and how the resource is used are freely taken by the users. These, for their part, make their decisions in the light of the expected economic return associated with the use and on the basis of their economic capacity and access to the financing needed to make any investment. Access of the various users to the water resource is governed by the granting of water rights by the competent authority (General Directorate for Water) or by the purchase, borrowing, or renting from third parties of specific amounts or flows.

3.2 REGULATIONS AND RULES

3.2.1 Description of the regulations

All users, who legitimately use water that corresponds to a consumptive right under the Water Law, have the right to consume all the corresponding flow within their farm or in their process. The regulations, normative or legal, do not, consequently, refer to how the user should use water, and refer to only a few considerations about the water that, once used, returns through surface flow, discharge, or overflow to the neighbouring farm or to a superficial drainage channel (natural or artificial).

The present Water Law carefully defines overflows and drainage of water in such a way that this water is presumed to be abandoned by the owner of the water right once it has left his property and he cannot use it again. Similarly, the Law allows the neighbours to use this overflow without needing to obtain a water right. However, the law indicates that the use by third parties of overflows or drainage does not in any way oblige the originator to produce these permanently, even when water rights granted over this overflow may exist.

The powers given under the Indigenous Law (N° 19,253) to the National Corporation for Indigenous Development (CONADI) in respect of the water of Indigenous Communities should also be noted. This Law created the Indigenous Land and Water Fund which can be used specifically in the financing of the constitution, regularising, or purchase of water rights, or to finance works for obtaining water (art. 20).

Under art. 63, the Law also indicates that water found in the land of an Indigenous Community will be considered the property and for the use of the indigenous community. In art.64 it is indicated that new rights over lakes, ponds, springs, and rivers, among others, rising from water belonging to several indigenous communities will only be granted once the normal supply of water to these communities has been assured.

The 1981 Water Law refers to the quality conditions of water returned to natural streams from non-consumptive uses and indicates that the devolution cannot damage the constituted rights of third parties over the same water, in respect of quantity, quality etc. (art. 14). The Water Law provides no standards at all for the quality conditions of overflow, drainage or discharge water to natural streams from consumptive uses.

However, Law 19,300, the General Bases of the Environment Law (1994), consecrates some means that directly or indirectly set (or will in the future set) quality standards. Table 3.1 shows the regulations referring to water that have been issued (or are being drafted).

Table 3.1
Regulatory Situation

Regulation	State of advance
Emission Regulation for the Control of Pollutants associated with the Discharge of Liquid Industrial Wastes to Sewage Systems	Published in the Official Gazette (D.S. N° 609/98). Modified by D.S. N° 3592/00 (Published in D.O. 26/9/00). There is a second modification in draft.
Emission Regulation for the Control of Pollutants associated with the Discharge of Liquid Wastes to Surface Waters	Published in the Official Gazette 7/3/01 (D.S. N° 90/00)
Quality Regulation to protect the Use of Freshwater	D.S. N° 145/02 waiting for approval of the General Comptroller of the Republic
Emission Regulation for Groundwater	Published in the Official Gazette 17/1/03 (D.S. N° 46/02)
Regulation of the Environmental Quality in Marine Waters at the National Level	Final draft to be presented the Council of Directors of CONAMA
Secondary Regulations for the Protection of Freshwater in various river basins	Under study

The Bases Law defines pollution in terms of the existence of primary and secondary environmental quality regulations and analogously defines an “environment free from pollution” as one in which the pollutants are at concentrations and periods lower than those likely to constitute a risk to public health, to the quality of life of the population, to nature preservation, or to the conservation of the environmental inheritance.

It establishes that quality goals are defined by primary environmental quality regulations, which protect both public health and welfare and the quality of life, and by secondary regulations, which are for the protection and conservation of the environment, or nature preservation.

A further type of environmental regulation established in the Bases Law applies to emission, which it defines as “the maximum permitted quantity of a pollutant as measured in the discharge of the emitting source”.

The Emission Regulation for the Discharge of Liquid Wastes into Surface Waters defines the maximum permitted concentrations for the discharge of industrial wastes and domestic sewage to fresh and marine waters in accordance with the dilution capacity and natural quality of the receiving water. The monitoring of the regulation is the responsibility of the Superintendent of Sanitary Services (SISS) and the definition of the dilution capacity of the receiving waters is determined by the DGA. The Emission Regulation for Groundwater is similar.

The implementation of the Quality Regulation for the Protection of Freshwater requires the DGA and/or DIRECTEMAR to define the actual quality and nature of surface water bodies and streams. Next, a quality objective is set for river basins with priority, taking into account the actual priority water uses and potential future uses. The competent authorities carry out this process under the coordination of CONAMA. This process begins the procedures that lead to the definition of Objective Quality Regulations. Once these have been defined, special areas in streams or water bodies can be declared saturated or latent, which, in turn, allows the preparation of clean up or prevention plans, respectively. At the same time, this makes it possible to prepare scientific studies or other means of environmental management as an aid to maintaining the chosen quality goal for areas that cannot be classified as saturated or latent areas.

3.2.2 Comments on the Application of Regulations and Rules

From the discussion above it could be thought that the Water Law makes very little reference to the conditions under which the holders of water rights can use water. That is so, as in the strict sense there is only the obligation of the holders of non-consumptive rights to return the flow in such a way as not to affect the rights of third parties over the same water, in quantity and in "quality, sediment, opportunity of use, and other respects". In contrast, no conditions are set for overflows, drainage, or return water from consumptive rights. This means that the law does not consider issues such as efficiency of use of the water rights, loss in quality or pollutants carried by water used for various purposes, loss in quality of receiving waters, or damaging environmental effects to receiving waters caused by overuse above the real need for water or by the discharge of water polluted through use, etc.

Undeniably, this shows that in 1981 when the Water Law came into force in Chile, the government of the period showed no concern at all about these issues. Now environmental issues and water quality are being tackled by the legal instruments and regulations of Law 19,300 (1994). These, to the extent that they are monitored and the various standards that have been defined are enforced, can bring change in the behaviour patterns of water users.

In fact, in the last decade, in accordance with the above, important improvements have been introduced in the treatment of waste waters before they are discharged to streams and water bodies, both by industrial and mining users and in domestic use. Table 3.2 indicates the coverage of sewerage services and sewage treatment in the country.

Table 3.2
Sewerage Service and Sewage Treatment

Region	Estimated Urban Population in 000s	Sewerage (31 December 2002)		Sewage Treatment (31 October 2002)	
		Population served in 000s	Provision %	Population served in 000s	Provision %

I	409	400.4	97.9	373.8	91.4
II	453.7	448.5	98.8	447.8	98.7
III	241.3	225.6	93.5	183.4	76
IV	511.5	485	94.8	484.9	94.8
V	1,420.9	1,279.8	90.1	1,165.2	82
RM	6,593.6	6,464.8	98	4,918.8	74.6
VI	531.8	433.7	81.6	424.3	79.8
VII	618.7	579.7	93.7	152.8	24.7
VIII	1,586.3	1,412.1	89	1,162.8	73.3
IX	581.2	529.2	91	84.9	14.6
X	658.3	585	88.9	337.1	51.2
XI	68.6	62.4	90.9	48.2	70.2
XII	147.4	145.8	98.9	15.6	10.6
Total	13,822.1	13,052	91.1	9,799.6	70.9

Source: Superintendent of Sanitary Services.

There is a regulation defining the quality of water for different uses (N.Ch. N° 1333, 1978, modified in 1987) that applies to water used in irrigation. This regulation refers to the physical, chemical and bacteriological standards to be met for water used in irrigation, for aesthetic purposes, in recreation, and for aquatic life. In practice the only part of this regulation that is used at all is that referring to standards for irrigation, although the work of monitoring and control to see if they are met is at best sporadic.

3.3 PUBLIC PARTICIPANTS

3.3.1 Introduction

Figure 2.1 (Chapter 2) is a diagram of the Institutional Structure of the Water Regime in Chile. The following government agencies intervene in the System of Water Use and particularly in those uses considered in this report: irrigation, industry, mining, and residential:

- The Superintendent of Sanitation Services (under the Ministry of Public Works [MOP])
- The National Institute for Agricultural and Livestock Development (INDAP)
- The National Irrigation Commission (CNR)
- The Agriculture and Livestock Service (SAG)
- Health Services (under the Ministry of Health)
- The Planning Ministry (MIDEPLAN)
- The National Corporation for Indigenous Development (CONADI)

Each of these institutions has specific responsibilities for some use of water, as will be described below.

3.3.2 Description of Responsibilities

a) The Superintendent of Sanitation Services (SISS)

The SISS is a government agency whose task is to guarantee the quality and quantity of drinking water supply and sewerage services to the public in the urban areas of the country at a price that is just and sustainable in the long term. It is also responsible for ensuring to the community the treatment and return to nature of the used water in a form compatible with sustainable development. This responsibility is fulfilled by fomenting transparency in the market, the self-control of the companies, and developing efficiency in the provision of the services.

Its area of responsibility includes the following:

- The granting and control of the concessions under which the companies provide drinking water and sewerage.
- The periodic control of tariffs and revision of development plans
- The control and monitoring of all aspects of the services.
- The control of the adherence to environmental regulations for the discharge of industrial liquid wastes.

b) The National Institute for Agricultural and Livestock Development

INDAP was founded in November 1962 with the principal goal of promoting and fortifying the development of small farms. It is a decentralised autonomous public agency of indefinite duration with its own capital and full capacity to acquire, exercise rights, and control obligations under the supervision of the President of the Republic through the Ministry of Agriculture.

The range of services of this agency includes the “Small Farmer Irrigation Programme”. An Irrigation Bond is allocated as a means of promoting production. It includes economic incentives to invest in minor irrigation and drainage works realised by clients of INDAP and by the formal and informal organisations composed largely of these clients.

The Irrigation Bond is an economic incentive that can be used to build new irrigation and drainage works, to improve or augment existing irrigation and drainage works, to install advanced irrigation systems, and to replace irrigation equipment and inputs. Its objective is to aid in the incorporation of new areas of irrigation and drainage to agricultural production and to improve or augment irrigation security in areas already irrigated.

c) Agriculture and Livestock Service

The SAG contributes to productive development and to the improvement in the competitiveness of national agriculture, livestock, and forestry through policies on plant health, animal health, renewable natural resources, and food quality.

Through the Department of Renewable Natural Resources Protection, it is responsible for the promotion of the sustainable development of agriculture through the protection and conservation of renewable natural resources involved in agricultural production as well as the prevention of environmental impacts that could affect the quality and quantity of these resources or the biodiversity of natural ecosystems.

Article 3, Paragraph L of the Founding Law of the SAG assigns it the following responsibility:

"To promote measures to secure the conservation of soil and water in order to prevent erosion and to improve their fertility and drainage. In addition, to promote incentives for the conservation of water and improvements in its abstraction, transport, and use in agriculture. At the same time, it will regulate and administer the provision of incentives to the incorporation of conservation practices in the use of land, water, and vegetation."

d) National Irrigation Commission

The National Irrigation Commission is an autonomous public agency dependent on the Ministry of Agriculture. Its mission is the "coordination of the framing and putting into practice of the national irrigation policy for the optimum exploitation of the water resource of the country with emphasis on irrigation and drainage".

Its principal management objectives are:

- To contribute to the framing of the national policy on irrigation.
- To improve the efficiency of irrigation through development projects and changes in production.
- To focus efforts directed towards the development of the isolated regions of the country and of farmers in vulnerable circumstances.
- To promote private investment in irrigation infrastructure through optimising investment and providing irrigation and drainage subsidies.
- To evaluate the technical and economic feasibility of investment in profitable irrigation infrastructure in the river basins of the country.

Through the Department of Irrigation Studies and Policies, the CNR develops studies and policies in the area of irrigation and drainage and on the impact of the policies implemented. It prepares and systematises the information gathered in order to assist the work of the Executive Secretary in the Cabinet.

Through the Department of Irrigation Promotion, it promotes private investment in irrigation infrastructure and contributes to the better use of available irrigation technology in areas that have benefited from these works, coordinating and supervising design, the functioning of Law N°18,450, as well as the transfer and evaluation of technology.

The CNR is a centralised agency that delegates responsibilities for the application of the Promotion Law to the Hydraulic Works Directorate of the Ministry of Public Works and to the Agriculture and Livestock Service of the Ministry of Agriculture.

e) Hydraulic Works Directorate

The DOH is responsible for the development of hydraulic works within the context of integrated river basin management, proposing efficient use of the available resources in benefit of community development.

- Objectives

    - To improve the quality of life of the urban and rural population through the development of hydraulic infrastructure.

    - To provide the population with access to the water resources in both a timely fashion and in the necessary quantity and quality.

    - To improve administration, procedures, and technology for providing a better service to the community.

- Responsibilities

    - The study, project design, construction, repair, and exploitation of the irrigation works financed from public funds, according the provisions of DFL N°1,123/81.

    - The recovery and improvement of land, financed from public funds.

    - The study, project design, construction, and repair of the vaulting of irrigation canals in urban areas, provided that these canals were in use before the area they cross was declared to be within the urban area and that the works were built with public or municipal funds.

    - To propose the total or partial pardoning of debts for the recovery and improvement of indigenous lands. The pardon must be conceded by a Supreme Decree justifying it.

Law N°19,525 of 1997 further gives the following responsibilities to the Hydraulic Works Directorate:

    - The planning, study, project design, construction, repair, maintenance, and improvement of the primary network for systems of storm water drains.

- The development of Master Plans that allow the definition of the structure of the primary network of storm water drains. The Ministers of Public Works and Housing and Urban Affairs are to sign these plans.

- The storm water networks are to be separated from the sewage networks, with the possibility of connecting them if the competent authority so determines.

- The plans must take the river basin into account and contain measures to avoid erosion and deforestation.

f) Ministry of Planning and Cooperation

MIDEPLAN is responsible for the design and application of policies, plans, and programmes for national and regional development, the proposal of public investment goals and the evaluation of investment projects financed by the government, the harmonisation and coordination of the various initiatives of the public sector directed to the eradication of poverty, and the orientation of international cooperation received and given by the country.

It is also responsible for the implementation and execution through the related services of policies and programmes (such as the Subsidy for Drinking Water Consumption and/or Sewerage Service) directed towards priority groups (children, young people, old people, invalids, women and indigenous people).

g) National Corporation for Indigenous Development

This is an autonomous public agency under the Ministry of Planning and Cooperation with the following responsibilities:

- To promote recognition and respect for the indigenous peoples, their communities, and the persons that form part of them.

- To promote indigenous culture and languages and bilingual education.

- To encourage the participation and integral development of indigenous women.

- To assume the legal defence of indigenous persons and their communities in conflicts over land and water and to act as arbitrator.

- To assure the protection of indigenous lands and to assist indigenous persons and their communities in increasing their landholdings and access to water through a special fund.

- To promote the suitable use of indigenous lands and assure their ecological equilibrium.

- To maintain a register of indigenous communities and associations and a public register of indigenous lands.

- To act as arbitrator in conflicts among the members of any indigenous association.

- To assure the preservation and diffusion of the archaeological, historical, and cultural inheritance of the indigenous peoples.

- To propose to the President projects for legal and administrative reforms required for protecting indigenous rights.

h) Ministry of Health

The Ministry of Health formulates and sets health policies and issues regulations and general plans, in accordance with the instructions of the government.

It has the following responsibilities affecting the water resources:

- Drinking Water Supply

    - To prevent illnesses and poisonings and to minimise the risks associated with sanitary deficiencies in water supply.

    - To assure the population served by drinking water the consumption of water meeting the required microbiological, physical, and chemical quality standards and that it is treated and fluorinated.

    - To assure the population supplied with drinking water a continuous and sufficient supply.

    - To promote and support increased coverage of drinking water systems in the urban and concentrated and dispersed rural population.

- Disaster Preparation

    - Design action plans for confronting disasters in coordination with the agencies responsible for drinking water supply, sanitary disposal of excreta, and garbage collection so as to minimise damages and reduce as much as possible the interruption in these basic services.

- Treatment and sanitary disposal of excreta

    - To detect and eliminate sources of pollution of streams and water bodies used for drinking water, irrigation, recreation, aquiculture, and any other use affecting public health.

- To promote and support increased coverage of sewage treatment and the sanitary disposition of excreta.

3.3.3 Analysis of the Impact on the Conservation of the Water Resource

The analysis developed shows that within the responsibilities of these agencies, with the exception of the SAG, there is no explicit mention of the conservation of the water resource. They are concerned with its distribution or quality.

In the following section, the activities of those agencies are described that directly or indirectly influence the conservation of the resource.

a) Superintendent of Sanitation Services

In general, this agency is concerned with tariff procedures, the allocation of concessions, and the regulation of drinking water and sewerage companies, including the quality of discharges to receiving waters.

Its area of action is restricted to ensuring the satisfaction of the public demand for drinking water, virtually without interfering in the regulation of the growth in this demand.

Despite the above, the process of setting tariffs indirectly internalises the concept of efficiency by using the “Model Company” arrangement. This conceptual model functions efficiently at minimum costs. Following this model, the SISS accepts (ideally) a maximum 5% of leakages in water production and 15% in distribution.

This is then converted into an economic incentive for the drinking water and sewerage companies to reduce their drinking water losses so as to get closer to the standards of the “Model Company”, given that this will maximise the profit on each m^3 billed.

There are differentiated drinking water supply tariffs for the peak period (summer) and the non-peak period, intended to discourage excessive consumption of drinking water by consumers. Between December 1 and March 1, the clients who exceed a pre-established volume are billed for excessive consumption. The tariff charged is twice that of the non-peak period.

b) National Institute for Agricultural and Livestock Development

This agency is principally concerned with agricultural and irrigation development for small farmers. Its field of activities is not directed towards the conservation of water resources.

Nevertheless, it has an indirect influence as it finances the use of technology in irrigation systems, collaborating in the efficient use of water.

c) Agriculture and Livestock Service

According to the basic law of the SAG, it is charged with promoting initiatives to conserve the water resource and to improve the abstraction, transport, and use of water for agricultural and livestock purposes. However, in practice, the influence of the SAG is concentrated mainly on issues of water quality.

d) National Irrigation Commission

This agency is mainly concerned with the administration of the Law to Promote Irrigation (18,450). It has, therefore, an influence similar to that of INDAP in the conservation of the water resource, through the granting of subsidies to individual users for the development of the use of technology in irrigation and for projects for relining and leakage reduction in irrigation canals.

e) Directorate of Hydraulic Works

This directorate is concerned with the development of projects for irrigation, storm water, stream protection, flood protection, rural drinking water, and rural sanitation. Therefore, its activities are directed to the construction of works for the abstraction, regulation, and use of the water resource.

f) Ministry of Planning and Cooperation

This Ministry has practically no responsibility in the issue of water resource conservation. It intervenes indirectly through its policies of subsidising drinking water.

This subsidy is assigned to priority groups through the Municipalities and pays a proportion (between 50% and 85%) of the drinking water bill up to a maximum consumption of $15m^3$. In this way the benefited consumers are encouraged not to exceed the maximum permitted volume. This restricts consumption, which indirectly influences the conservation of the resource.

g) Ministry of Health

Overall, the area of competence of this Ministry lies in the control of water quality, pollution processes, and the discharge or disposition of wastes. Therefore, it does not influence the conservation of the water resource.

3.4 NON-GOVERNMENT PARTICIPANTS

3.4.1 Introduction

In Chile, the non-government participants are mainly water users. Here, the water exploitation systems of the residential, irrigation, industry, and mining sectors will be described, as far as the limits that have been fixed allow.

It is undeniably true that it is the individual users who undertake the exploitation of water in agriculture. As has been discussed in section 2.3.1.1, it is the user associations or the water communities proposed in the Water Law that distribute water in the case of surface water. The exception is the case of a single user who owns his canal and abstracts the water directly from a natural surface stream and transports and distributes it within his land.

In industry (excluding mining) there can be very different situations depending on the type of industry. Industries that have large water needs for their processes, such as the pulp and paper industry, have their own sources (largely abstractions from surface water) and independent systems for the transport and treatment of liquid wastes to be discharged to receiving waters. In mining, all the mines and mineral processing plants have their own sources of water, while their discharges are to surface drains or to tailing ponds from which the water is recycled and reused. The sources are both surface water and groundwater.

3.4.2 Factors leading to greater efficiency

a) Irrigation

There are both government and private projects for irrigation that contribute to the improvement of efficiency in the use of water. The following should be mentioned:

The National Irrigation Commission applies the Law to Promote Irrigation (N° 18,450). These are funds open to competition for irrigation projects on the farm (usually) in which the Government subsidises up to 75% of the value of the project. The principal objective of these projects is the improvement of production dynamics, although indirectly they contribute to improve efficiency in water use. In effect, the CNR calls for various competitions for different groups of farmers or contributes to the financing, among others, of projects that have important effects on the improvement of the efficiency of water use in irrigation. Among these are the construction and rehabilitation of night ponds, the use of technology for irrigation on the farm, and canal lining, etc.

Irrigation projects promoted and financed by the Hydraulic Works Directorate of the Ministry of Public Works are very large irrigation projects directed to improve the security of irrigation in already irrigated areas and to provide irrigation to new areas. These projects must be partially paid for, over the long term, by the benefiting farmers. Among the projects undertaken by the MOP are the regulatory structures built in the past and particularly those built in the last decade, the Santa Juana reservoir (Huasco river basin), the Puclaro reservoir (Elquí river basin) and the Corrales reservoir (Choapa river basin). These reservoirs improve water use efficiency for irrigation, allowing a reduction in the variability of the supply as well as more profitable exploitation of the irrigated farms. The MOP also undertakes projects of canal relining, unification of intakes, etc., directed towards reducing losses in the transport and distribution of water.

b) Drinking Water Supply

The following activities influence efficiency of water use in this sector:

The tariffs charged to the consumers of drinking water supply services include a charge for each m^3 consumed, together with an excess consumption tariff in periods of peak demand. The original objective of this measure was to try to reduce peak demands (spring and summer in Central Chile) and thereby reduce the need for investment by the companies to satisfy peak demands. Obviously, this measure tends to reduce demand and contribute, therefore, to the conservation of the water resource.

The setting of tariffs for the water utilities includes a maximum loss for the "Model Company" that, in practice, the real companies do not generally meet. This encourages the Companies to reduce their losses in the transport and distribution systems, as they cannot transfer real losses superior to the accepted maximum (today this value is set at 20% of the volume of water produced) to higher tariffs.[20] This manner of tariff setting is in the right direction: to improve efficiency in water use and, therefore, conserve the water resource.

In Chile, the monthly drinking water bill is subsidised for those users with incomes under a minimum level. This subsidy is applied to all consumption from zero to a maximum. If a user exceeds the fixed maximum value in his consumption then he pays for the excess. This way of applying the subsidy also tends to regulate demand and, therefore, conserves the water resource.

Now, due to environmental requirements, a large proportion of wastewater is being treated prior to being returned to receiving waters. This allows later reuse of these resources, favouring conservation of the resource.

However, wastewater treatment means a considerable increase in costs, which is then finally passed on the users or consumers. Therefore, wastewater treatment is converted into an incentive to reduce drinking water demand and to use it more efficiently.

In the coastal cities of the north of the country (for example, Antofagasta) there are plants for the desalinisation of seawater to provide a secure supply to the population. This frees freshwater sources by replacing them with seawater.

c) Electricity sector

In this sector tariffs are also applied in periods of peak demand (autumn and winter with fewer hours of sunlight), setting a maximum limit above which the consumers are charged a higher tariff for excess consumption. The maximum limit is defined by the average consumption of each user in the non-peak period of the year. This system acts as an incentive for the user to consume more electricity in non-peak periods and as a punishment for excess consumption in peak periods, with the objective of getting the users to smooth out the seasonal variations in their demand curve. Given that the electricity system of the country depends over 50% on hydroelectricity generation and

[20] In any case, the definition of loss used here is in reality under-billing and only a part is effectively due to physical losses, while the remainder could be due to under-metering of the water used or even to illegal connections.

that there are several regulatory works in the system, this manner of charging should have an influence on the possibilities of using river flows in other uses.

d) Industrial and Mining Sectors

Overall, in these sectors decisions to improve efficiency in water use are based on saving production costs. That it to say that companies will invest in systems to reduce losses and recirculate water to the extent that these are more economical than developing new sources.

The actual situation in these sectors shows that, generally, mining companies located in areas of extreme natural water scarcity tend to have relatively high rates of recirculation.

Similarly, some industries with large water needs for production, such as the pulp and paper industry, have been gradually developing changes in technology that have significantly reduced water needs per unit of production. However, there is not sufficient information to allow a complete evaluation of the efficiency of water use in industry in Chile.

3.4.3 Identification of Winners and Losers

In section 2.3.2 on the Administration of Water Management Regimes in Chile, winners and losers were identified and the issue was discussed even at the level of individual users. It was indicated in that section that, since the participation of individual users in the meetings of the communities and user associations, as contemplated in the Water Law, is in proportion to the water rights each one holds, it is to be expected that the larger users will tend to dominate the administration of the organisations, to the detriment of the smaller users. Moreover, it is the boards of directors of these organisations that (in conformity with the Water Law) must resolve conflicts among the members. However, Chilean legislation considers that anyone feeling unjustly affected can have recourse to the courts, but these tend to be slow in deciding and can also be costly for small farmers if they need to contract lawyers.

The Superintendent of Sanitation Services, as the regulatory agency, supervises the Drinking Water and Sewerage Companies that produce and distribute drinking water and collect and treat sewage in the cities. The SISS has rules and regulations that the companies must meet and that protect the quality of service for individual users. If a company does not meet the standards demanded, the SISS has the authority to punish the company through fines.

However, the individual users do not receive compensation for the damages caused by service failures, even though they can resort to the courts in these cases. This is not simple for the users to do.

3.5 THE STRUCTURE OF THE WATER EXPLOITATION REGIME IN CHILE

This subject has already been described for the public sector in section 3.3 and in section 3.4 for the non-government sector, which in Chile is essentially the sector that actually exploits water.

Figure 3.1 is a diagram of the public sector and user institutions in the country. In this diagram the Water Administration System has been added. The specific characteristics of the system were presented and discussed in Chapter 2. Figure 3.1 shows the interrelationships between the Public Administration and the User Sectors, which, as can be seen, come about in some cases through the Administrative System and, in others, directly among user sectors, as has been explained in sections 3.3 and 3.4.

3.6 EVALUATION OF THE REGIME (exploitation system)

3.6.1 Introduction

In this section the strengths and weaknesses of the exploitation system in Chile will be identified and qualified on the basis of the description in the earlier chapters.

The organisation of this chapter considers separate subsystems:

- Municipal and residential use
- Irrigation use
- Industrial use
- Mining use
- Other uses

3.6.2 Municipal and Residential Use[21]

3.6.2.1 Strengths

- The drinking water supply services in Chile reach 99.8% of the urban population and 96.5% of the concentrated rural population.

- The quality indices for drinking water in the country meet the bacteriological, disinfection, physical, and chemical standards in 98.4% of the cases.

- Sewerage networks serve 94.4% of the population in urban areas.

- The treatment of wastewater in urban areas has grown strongly in the last five years, now treating 42.4% of the wastes, and plants are being constructed that will allow coverage to reach 75% in the next few years.

- The drinking water supply, sewage collection, and wastewater treatment services are paid by the users through a tariff system based on m^3 of drinking water consumed. This is calculated separately for each system throughout the country.

- The Government directly subsidies the basic consumption of drinking water of the lowest income population in the cities.

- The tariff system includes tariffs that differentiate between a base value and a value for excess consumption. The latter is applied in the seasons of water shortage, when consumption exceeds a fixed level. The tariff system is regulated by pre-established and known methods by the regulatory authority.

[21] Stranger S. and A. Chechilnitzky (2002), "Informe sobre el Abastecimiento de Agua Potable y Saneamiento y la Gestión de los Servicios Sanitarios en Chile", National Workshop, "Hacia un Plan de Gestión de Recursos Hídricos", Santiago, December 2002.

- The Government awards a geographic area in concession to a specific company that is committed to provide service to whomsoever requests it in this area. In addition, any company can request of the government the award of concessions in new service areas. Within the service areas under concession the companies become monopoly suppliers.

- There is a public agency, the Superintendent of Sanitation Services, whose principal responsibilities are to supervise the fulfilment of the service standards by each company and to approve the tariff setting procedures for the services as well as their development plans.

- The Government is responsible for the supply of drinking water to rural areas (not belonging to the geographical area of concession of some company). These services are built by the government and handed over to the communities to operate in various ways.

3.6.2.2 Weaknesses

- The losses in the drinking water services in urban areas continue to be relatively high (averaging 31.7% for the country), in spite of the strong incentives for the companies to reduce them. These losses include physical and billing losses (illegal connections and metering problems).

- In rural areas the dispersed population, approximately 4.5 of the total population (some 700,000) does not have access to drinking water.

- In rural areas the systems for the disposition of domestic wastewater are precarious and there is little waste treatment.

- There remain problems related to maintenance, repair, and technical assistance for rural drinking water.

3.6.3 Irrigation Use

3.6.3.1 Strengths

- The dominion over water rights consecrated in the Chilean Water Law makes it possible for agricultural businesses to invest in the improvement of on-farm irrigation systems and in the development of agricultural production systems with high investment costs and high profitability, directed towards export products.

- The government subsidy programmes (through Law 18,450) that are awarded through competition and administered by the National Irrigation Commission have made it possible to undertake projects for improving efficiency and the incorporation of technology in irrigation on the farm.

- The government investments in large irrigation projects, undertaken by the Ministry of Public Works, Hydraulic Works Directorate, include works such as regulation reservoirs, union of canals, lining of canals, etc. These have made it possible to improve the supply of water and the efficiency of water use in river basins.

- The programmes of the National Institute for the Development of Agriculture and Livestock aiding irrigation by small farmers has led to an improvement in the situation of the lower income rural population. This is complemented by the subsidy funds of the CNR granted in competitions focussed on this same population.

- The programmes of the Agriculture and Livestock Service and the Ministry of Health, Environmental Health Services controlling irrigation water quality have led to the adoption of remediation and preventive measures during emergencies that could put public health at risk.

3.6.3.2 Weaknesses

- Despite the programmes described in 3.5.3.1, the efficiencies in water use in irrigation continue to be very low. In the river basins to the north of Santiago, with occasional exceptions, the efficiencies at the river basin level are between 40% and 50%. In the river basins to the south of Santiago (where there is relatively more water available) the efficiencies are between 30% and 40%.

- There is a particular lack of investment by the users (and the user organisations) in the improvement of efficiency in the common works for the abstraction and transport of water and in the control works for distribution and measuring the water used. This is especially difficult to understand in areas using modern technology for irrigation directed towards very high value agricultural production.

- In many cases, there is a lack of training of the users in irrigation methods, which would permit a more efficient management of water by the users. Here, the user organisations do not fulfil the role assigned to them in the Water Law.

- There are recognised inconveniences in the operation of water distribution systems based on rigid automatic installations for the division of flows. These make impossible the temporary transfers of water among users (through the market) that would also lead to improvement in the efficiency of water use. This is particularly notable when seen in contrast with the operation of systems with great flexibility in water distribution (for example, the Paloma system in the Limarí river basin, Region IV).

3.6.4 Mining Use

3.6.4.1 Strengths

- This sector needs large quantities of water. It is mainly located in the most arid part of the country and has achieved reasonable levels of efficiency in water use with significant amounts of recirculation (but improvable between Regions I and IV), principally a response to the high cost of development and operation of their sources of water. The quality standards for discharge of effluent to natural drainage systems that are being implemented create an additional incentive for mining to improve its recirculation systems and consequently improve efficiency of use.

3.6.4.2 Weaknesses

- In mining companies located south of Region IV, it can still be seen that the efficiencies in use and amounts of recirculation are low given the standards that the industry can reach.

3.6.5 Industrial Use

There is not enough information to make a thorough analysis of this sector. However, what can be said is that, in those industries that are large water consumers, such as pulp and paper, the technological development of the processes makes it possible today to reach efficiencies very much better than those of 10 or 20 years ago.

The quality requirements for effluents and discharges to natural streams in the regulations being put in place in Chile require industry to invest heavily in treatment plants and/or substantial improvements in the efficiency of water use.

3.6.6 Other Uses

This discussion covers a group of other uses, mainly non-extractive, that usually are not considered in the country's water laws and regulations and therefore show weaknesses and problems. They include in situ recreation, landscape, navigation, wild life conservation, and dilution.

3.6.6.1 Strengths

- Where possible, the General Directorate for Water has begun in the last few years to set minimum flows in the rivers, known as ecological flows, directed towards the conservation of the environment. For example, this is done when water rights are constituted in surface waters with available supply or when a request has to be approved for changing the point of abstraction of an existing right.

- The environmental regulations require the General Directorate for Water to set dilution flows where necessary. This has been done on numerous occasions.

3.6.6.2 Weaknesses

- The uses mentioned are not specifically considered in the laws and regulations for water existing in Chile, which means that they are left open to the criteria and desires of the government in power.

- There are no formal requirements for public participation or explicit requirements to oblige the government to consider public opinion when making decisions and resolutions.

3.7 REGIME OF THE WATER EXPLOITATION SYSTEM IN CHILE

3.7.1 Introduction

The roles of the various participants in the Water Exploitation System in Chile are summarised below in a matrix,[22] denominating these roles as Director, Inspector (Regulator) and Executor.

To build the matrix, the various activities and responsibilities carried out in the System were disaggregated, following the analysis presented in earlier sections of this chapter. Those responsible for the supervision of the activities carried out have been indicated.

3.7.2 Matrix of the Exploitation System

Table 3.3
Matrix of Roles in the Exploitation System

Role	Issues	Description of participants and responsibilities
DIRECTOR	Definition of policies for water exploitation, the financing of investments and the costs of maintenance, operation and replacement, the granting of subsidies for user sectors, conflict resolution	• Government of Chile: prepares bills with the technical and administrative support of: - General Directorate for Water, Ministry of Public Works - Superintendent of Sanitation Services - Ministry of Planning and Cooperation - Ministry of Health - Ministry of Agriculture - Ministry of the Economy • General Water Directorate: Emits resolutions setting criteria for issues in which the Law gives it competence. • Superintendent of Sanitation Services: Emits resolutions on the granting and control of sanitation concessions, the periodic setting of tariffs, and the development plans of the Sanitation Companies. • National Institute for Agricultural and Livestock Development: sets criteria within the Small Farmer Irrigation Programme for the allocation of

[22] The users of water have been restricted to irrigation, municipal and residential use, industrial use, and mining use.

		Irrigation Bonds (subsidies for minor irrigation and drainage works for low income farmers). • National Irrigation Commission: sets criteria and priorities and directs the competitions for irrigation projects under Law N°18,450. • Hydraulic Works Directorate: Studies, proposes and builds hydraulic works for irrigation built with public funds, under DFL N°1123/81 Ministry of Planning: Designs policies and programmes of the Drinking Water and Sewerage Subsidy for the priority groups of the population. CONAMA: sets regulations and standards for water quality in discharges and other matters according to its responsibilities.
INSPECTOR/REGULATOR	• Inspection – Control • Conflict Resolution	• Superintendent of Sanitation Services: - Supervises the functioning of the Sanitation Companies - Controls and monitors the quality of services of the Sanitation Companies - Monitors the fulfilment of the environment regulation of discharge of liquid industrial wastes. • Agriculture and Livestock Service: Control the quality of irrigation water. Ministry of Health (Environmental Health Services): controls water quality for drinking water and quality controls to detect pollution in watercourses and bodies. The objective is the safeguarding of public health. Emits resolutions on the restriction and prohibition of the use of water sources when necessary. Sanitation Companies control their own production water quality and the quality of discharges from waste treatment plants. User Organizations: can convoke their boards of directors if anomalies are found. • User organisations: the first level for conflict resolution among users. The users can request it. • CONADI intervenes in conflicts related to conflicts over water belonging to indigenous people or communities. • General Directorate for Water: intervenes in those conflicts among users corresponding to its legal authority. This intervention must be requested by a user and does not include all conflicts, but only those related to financial management and water distribution. • Courts: must decide on conflicts brought before them.
EXECUTOR	• Water use • Finance • Investment Decisions • Others	• The users are totally responsible

3.8 PERFORMANCE OF THE EXPLOITATION SYSTEM

The performance of the Exploitation System is assessed in the light of various criteria: effectiveness, efficiency, social equity, environmental quality, participation, and

integrated management. For each of these criteria various attributes are examined that allow an adequate assessment.

Effectiveness

For reasons similar to those given in section 2.8 on the effectiveness of the systems of exploitation, performance is analysed considering only drinking water and irrigation.

a) Drinking Water

Considering the user to be the company, in general a large quantity of water is lost due to leakages or in metering and/or thefts or illegal connections. Nationally it averages 31.7% (see Table 3.4 (2.8)

Table 3.4 (2.8)
Information on Billings, Supply and Production of Drinking Water, by region

Region	Production (000s m^3)	Billing (000s m^3)	Losses (%)	Network Km	Cost Ch$/$m^3$	Billing Ch$/$m^3$	Per capita supply (l/per capita/day
I	35,461	23,704	33.2	926	378	720.4	159
II	35,543	25,944	27.0	947	275	937.1	157
III	21,547	13,502	37.3	744	236	461.0	155
IV	35,943	27,991	22.1	1506	207	463.4	150
V	145,759	88,920	39.0	3997	212	539.9	173
VI	50,716	31,727	37.4	1892	165	383.5	152
VII	53,810	33,633	37.5	1679	188	345.1	149
VIII	133,374	84,833	36.4	3678	145	349.8	152
IX	48,326	31,009	35.8	1701	201	436.5	146
X	51,641	35,894	30.5	1793	205	450.6	149
XI	6,304	3,992	36.7	281	241	659.0	160
XII	11,114	9,628	13.4	514	235	571.1	179
RM	728,469	516,186	29.1	12,547	91	270.9	214
Total	1,358,007	926,186	31.7	50,452	170	368	184

According to the table above it is possible to make the following comments:

Overall, when the tariff is higher than Ch$350/$m^3$ the demand for drinking water is more or less inelastic, converging to a daily consumption of 155 litres per capita.

The consumption in the extreme south and north of the country is quite similar, also around 155 litres per capita a day. This is probably because in these regions gardens are not irrigated, which from the viewpoint of using the resource as drinking water results in greater effectiveness.

It should be noted that, in the north of the country, the population probably uses drinking water more efficiently because of its higher cost, practically double the national average. In the south drinking water is not used for irrigation because of the natural rainfall.

In the central part of the country (Regions V to VI) the average supply is 207 litres per capita a day, of which around 50 litres corresponds to irrigation.

For the final user of drinking water, in practical terms there are no policies directed to making a more effective use of drinking water, which could be improved by using measures of the following kind:

- Treatment of domestic wastewater for use in garden irrigation.
- Replacing toilet tanks for others of less volume to restrict water consumption. (This can also be done by placing objects in the tank to restrict the volume.)
- Incorporate air diffusion systems in taps and showers.
- Adding automatic valves.
- Home maintenance programme for plumbing.

b) Irrigation

The effectiveness in the application of water in irrigation can be analysed in economic terms of the increases in profitability and income or in physical terms of the changes in crop patterns, increases in productivity and/or cultivated area.

For this analysis reference is made to the study of the National Irrigation Commission called “Study of the Follow-up Evaluation of the Results of Law 18,450, 1986-1996” (1999).

In this report the changes experienced on the land favoured under the irrigation law were evaluated and the results presented in economic and physical terms.

Over this period 3,225 projects were approved, of which 239 were abandoned. Of the remaining projects, the study only looked at 1,923 with more than one year of operation at the time the information was examined. Among these, the impact of the implementation of the project was evaluated, finding that in 244 cases there was no impact at all.

Approximately 15% of the projects approved had no positive impact, either because they were abandoned or because after the works were completed the situation of the farm showed no improvement compared with its original condition.

However, the following impacts of the Law for the Promotion of Irrigation have been identified over the period analysed:

- Improvement in the irrigation of 186,000 hectares and the incorporation to irrigation of 19,700 additional hectares, with an investment of 172.8 million US dollars.

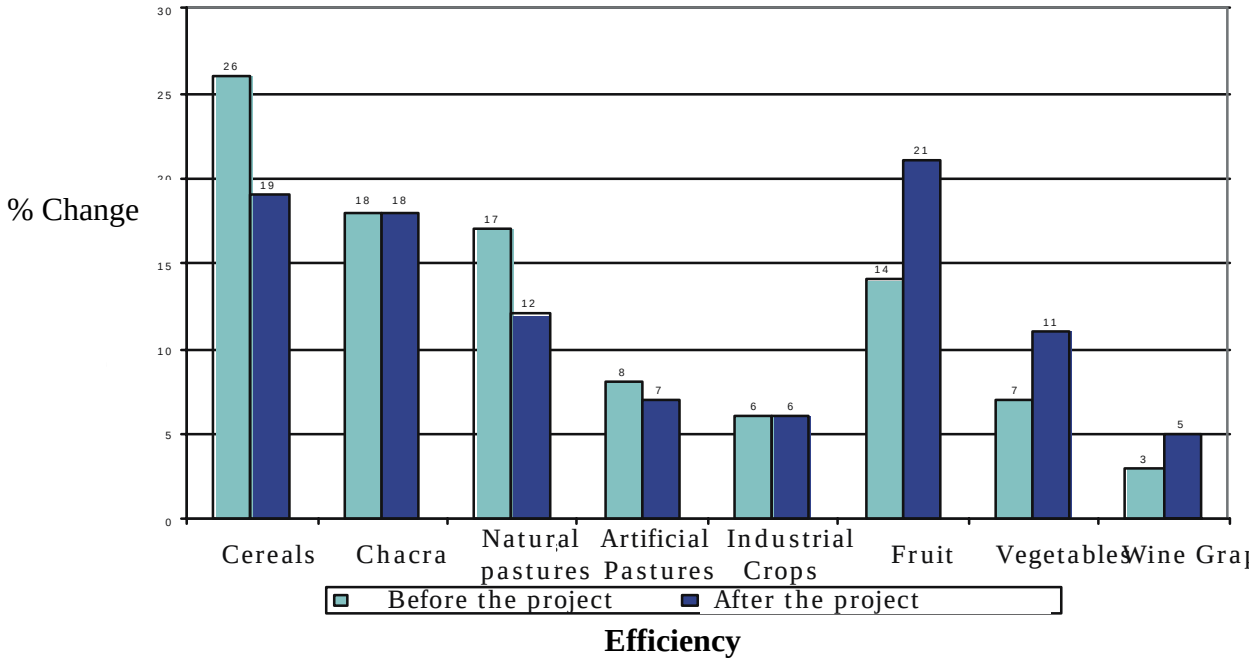
- Conversion of land use, with an increase in aggregate production. The area under fruit trees increased by 15,500 hectares, vegetables by 7,600 hectares, grapes (wine and pisco) by 4,700 hectares. An important decrease in less intensive land use such as cereals (7,500 hectares) and natural pasture (5,800 hectares) was also registered.

The bar graph in Figure 3.2 indicates the percentage changes in land use in areas covered under Law 18,450 from 1986 to 1996.

- In addition to the benefits indicated above, important advances have been made in average yields in the assisted irrigation areas, with increases of the order of 40% to 50% in fruit.

- Despite the above, the magnitude of the changes and the extent of the substitution of lower value crops (annuals and pasture) by those of higher value (fruit, vegetables, and grapes) has been much greater in the following cases: business farmers rather than poor farmers, individual projects, and new works rather than repairs.

Figure 3.2
Changes in Land Use in the Area Covered by Law 18,450, 1986-1996



a) Domestic Use (Drinking Water)

Table 3.5 shows the details of the estimated losses for the different drinking water supply companies which on average is 37.1% in most regions, above the level accepted by SISS in the "Model Company" used in the tariff setting process (20%).

Table 3.5
Summary Table of Drinking Water Losses in the Drinking Water Supply Companies

Company	Region	Production (000s m^3)	Billing (000s m^3)	Losses (%)	Network Km	Cost Ch$/$m^3$
ESSAT	I	35,461	23,704	33.2	926	378
ESSAN	II	35,543	25,944	27.0	947	275
EMSSAT	III	21,547	13,502	37.3	744	236
ESSCO	IV	35,943	27,991	22.1	1,506	207
ESVAL	V	144,414	87,617	39.3	3,930	212
COOPAGUA	V	1,345	1,303	3.1	67	205
ESSBIO VI	VI	50,716	31,727	37.4	1,892	165
A. NUEVO SUR MAULE	VII	53,810	33,633	37.5	1,679	188
ESSVBIO VIII	VIII	133,374	84,833	36.4	3,678	145
ESSAR	IX	48,326	31,009	35.8	1,701	201
ESSAL	X	42,002	28,666	31.8	1,488	204
AGUAS DECIMA	X	9630	7228	25.0	325	200
EMSSA	XI	6,304	3,992	36.7	281	241
ESMAG	XII	11,114	9,628	13.4	514	235
AGUAS ANDINAS	RM	554,772	398,494	28.2	10,321	83
SMAPA	RM	81,431	46,464	42.9	975	98
AGUAS CORDILLERA	RM	69,215	56,810	17.9	908	120
SERVICOMUNAL	RM	7,037	4,773	32.2	176	141
AGUAS LOS DOMINICOS	RM	9,409	4068	56.8	54	181
AGUAS MANQUEHUE	RM	6,605	5,577	15.6	113	184
NATIONAL TOTAL		1,358,007	926,963	31.7	32,205	170

The following comments can be made about this table:

- Only Region XII shows losses below the standard accepted in the model company (13.4%), although the volume of production and the length of the network is only a small part of the national total.

- The company with the lowest losses is COOPAGUA (3.1%). This is principally because it is relatively new company with a low volume of production.

- Despite the scarcity of water, the companies located in the extreme north of the country have a high level of losses, as well as the highest costs of production and billing.

- The above point indicates that, given the costs of exploitation in economic terms, there are strong incentives to increase the levels of efficiency in the most northern regions (I, II, and III).

b) Irrigation

This analysis is based on a bibliographic search, including the following reports:

- "Diagnóstico Actual del Riego y Drenaje en Chile y su Proyección", AC Ingenieros Consultores, 2002.
- "Riego Superficial Tecnificado", Luis Gurovich, PUC, 2001.
- "Informe Nacional Sobre la Gestión del Agua en Chile", Ernesto Brown y Juan Saldivia, 2000.
- "Política Nacional de los Recursos Hídricos", DGA, 1999
- "Uso Actual y Futuro de los Recursos de Agua en Chile", DGA, 1996.

Economic Efficiency

The concept of economic efficiency is evaluated on the basis of two factors:

- The contribution of agriculture to GDP
- The amount of water needed to produce a given crop

Table 3.6 shows production in detail in terms of the product of each region associated with each m^3 of water used. Table 3.7 shows the quantity of water required by ton produced.

As can be seen in these tables, in general the most profitable crops are associated with a more efficient use of water.

Table 3.6
Agricultural Internal Gross Regional Product, 1997

Region	Quantity of Irrigation (Millions m^3/year)	Regional GNP (000s $)	Yield ($/$m^3$ water)
I	192.1	13,112	68.3
II	14.4	2,597	180.0
III	169.0	117,130	693.0
IV	1,023.9	176,513	172.4
V	1,020.7	251,936	246.8
RM	3,808.6	369,403	97.0
VI	3,629.3	438,496	120.8
VII	4,850.6	438,062	90.3
VIII	2,601.3	213,701	93.7
IX	571.8	159,151	278.3
X	79.3	201,455	
XI	39.2	18,150	

XII	2.8	27,192	
Country	18,003.1	2,456,901	136.5

Source: ODEPA

Table 3.7
Water Requirements and Average Yields for Various Crops, by region

Water Volume (m^3/ha/year

Region	Cereals	Chacras	Industrial Crops	Vegetables		Fruit	Grapes
				Annual	Permanent		
III	11,814	11,753		17,096	17,096	9,621	9,622
IV	24,758	24,758	12,526	25,051	25,051	17,144	17,143
V	15,902	15,901	8,863	17,726	17,726	13,465	13,165
RM	26,033	26,032	14,362	28,723	28,723	25,080	25,080
VI	18,307	18,307	9,401	18,307	18,307	17,319	17,319
VII	15,577	15,577	14,308	15,577	15,577	15,066	15,066
VIII	14,599	14,599	13,785	14,599	14,599	14,395	14,395
Country	16,485	16,520	13,067	20,799	19,916	17,719	16,230

Production (tons)

Region	Cereals	Chacras	Industrial Crops	Vegetables	
				Annual	Permanent
III	746	1,173	0	138,202	17,522
IV	6,944	124,137	126	252,560	188,376
V	43,584	25,776	744	551,145	38,096
RM	186,765	73,424	9	692,675	125,900
VI	746,631	46,122	91,088	902,562	236,409
VII	461,444	104,703	1,014,521	557,675	555,547
VIII	487,819	143,082	1,015,473	142,452	367,717
Country	1,933,932	518,416	2,121,961	3,237,271	1,529,567

Yields (m^3 water/ton)

Region	Cereals	Chacras	Industrial Crops	Vegetables	
				Annual	Permanent
III	3,487	706		613	515
IV	12,558	1,498		1,092	917
V	4,418	2,147		858	720
RM	3,670	1,928		1,597	1,341
VI	2,402	3,098	320	1,103	926
VII	3,697	3,828	284	960	806
VIII	3,062	2,011	280	917	770
Country	3,082	2,344	284	1,112	868

Source: Author based on the Agricultural Census, 1996/1997 (ODEPA)

Physical Efficiency

The efficiency of water used in irrigation is obtained from the combination of various processes: transport and distribution, storage, and irrigation technique.

For this analysis, the efficiency in water use was evaluated at the farm level, through the efficiency of each irrigation technique.

Table 3.8 shows the different irrigation efficiencies by irrigation technique. The values accepted by existing legislation for the estimate of demands, are included only as a guide for the estimation of farm efficiencies.

Table 3.8
Efficiency of Different Irrigation Techniques

Irrigation Technique	Efficiency of Application (%)	
	Normal	With California Type Piping
Sheet	30	35
Furrows	45	50
Contour furrows	50	60
Contour borders	50	65
Straight Borders	60	65
Dike	60	65
Basin	65	70
Sprinkler	75	
Microjet and Microsprinkler	85	
Drip	90	

For the purposes of this study, the irrigation techniques have been grouped in three big categories: gravity (sheet, furrows, border, dikes and basins): major mechanical (sprinkler, microjet and microsprinkler and; micro-irrigation (drip), with average efficiencies of 35%, 70%, and 85%. This classification corresponds to that made by ODEPA in the 1997 Census, the information from which has been used as reference for the development of this study.

Table 3.9 gives a summary of the overall situation in the country by province and region, in terms of cultivated area, type of irrigation, and efficiency.

According to the results of the analysis developed, the following comments can me made. (Region X was not considered as it is thought that the quality of the information is doubtful):

- On average, the country shows a high level of water losses in irrigation that is reflected in a low efficiency in the use of the water resource.

- Considering the information at the farm level, the average efficiency in the country is 38.9%, which is slightly higher than that calculated considering the average demands at the river basin level. This is because in the latter case overflow and recovery is not taken into account.

- Basically the low efficiency is generally caused by the irrigation techniques used, as is confirmed by the low use of advanced irrigation techniques, only 9% of the total cultivated area.

- The regions presenting the highest efficiencies are concentrated to the north of the metropolitan region with an average efficiency of 49.3%, in contrast to the rest of the country where it only reaches 37.3%.

- It should be noted that the irrigated area to the north of the metropolitan region is only 13.6% of the country total. Moreover, in this part of the country advanced irrigation techniques are used in 29.5% of the area.

- However, despite the scarcity of water in the northern part of the country, the use of advanced irrigation techniques is low with the exception of the San José River and Region III. (The latter is the area with proportionately the highest efficiency and use of advanced irrigation techniques.)

- It also should be noted that, in the application of irrigation, crop requirements are usually not analysed and neither is the relationship with the physical characteristics of the soil or the agro-climatological conditions. Basically, irrigation is applied according to topographic characteristics and geometric dimensions, as well as the traditions transferred from generation to generation.

- In addition it should be considered that there are various sectors where there is practically no cost associated with water use and there are no incentives to increase efficiency in irrigation.

Table 3.9
Estimate of the Area, Efficiency and Irrigation Technique
(ODEPA Census 1997)

Region	Province	Irrigation Technique			Total	% Area Under advanced irrigation	Efficiency of irrigation %
		Gravity	Major mechanical	Micro-irrigation			

c) Mining

This section is mainly based on information on copper mining contained in various studies, including the following:

- Estudio de Política Nacional para el Sector Minero. Comisión Chilena del Cobre (2001)

- Análisis de Sensibilidad del Valor del EDRC, G. Lagos y M. Andía, PUC, 2000

- Informe Nacional Sobre la Gestión del Agua en Chile

According to this information, the average consumption of water in mineral processes is approximately 14.3 m^3/second, used primarily in copper mining.

In copper mining, the main use of water is in the traditional process of concentration by flotation, followed by fusion and electrolysis, or in the metallurgical process of leaching-extraction by solvents-electrolysis.

In the former (concentration-fusion-electric refining) the typical use of water varies between 40m^3 and 175m^3 per ton of refined copper, while in the second (leaching) a typical value is 32m^3 per ton of refined copper.

The leaching-extraction by solvents-electrolysis has been used since the 1960s to recover copper from copper oxides and since the 1980s for the recovery of copper from some secondary sulphate ores, principally chalcocite. During the 1990s this process has been applied in an increasing number of mines due to the low cost of operation compared with the traditional process.

The main sources of water loss in mineral processing are:

- Transport and storage losses, mainly through the cleaning and maintenance of tanks.

- Watering of roads to reduce dust.

- Inefficiencies in water recovery in the process of concentration-fusion-electrolysis.

- Evaporation during storage, concentration, and from tailing ponds.

In addition, there are some indirect uses such as drinking water, electricity generation and for the production of inputs.

Table 3.10 summarises the fresh water requirements of the principal mining companies of the country. Figure 3.3, giving the same information in graphic form, complements the table.

From this information the following comments can be made:

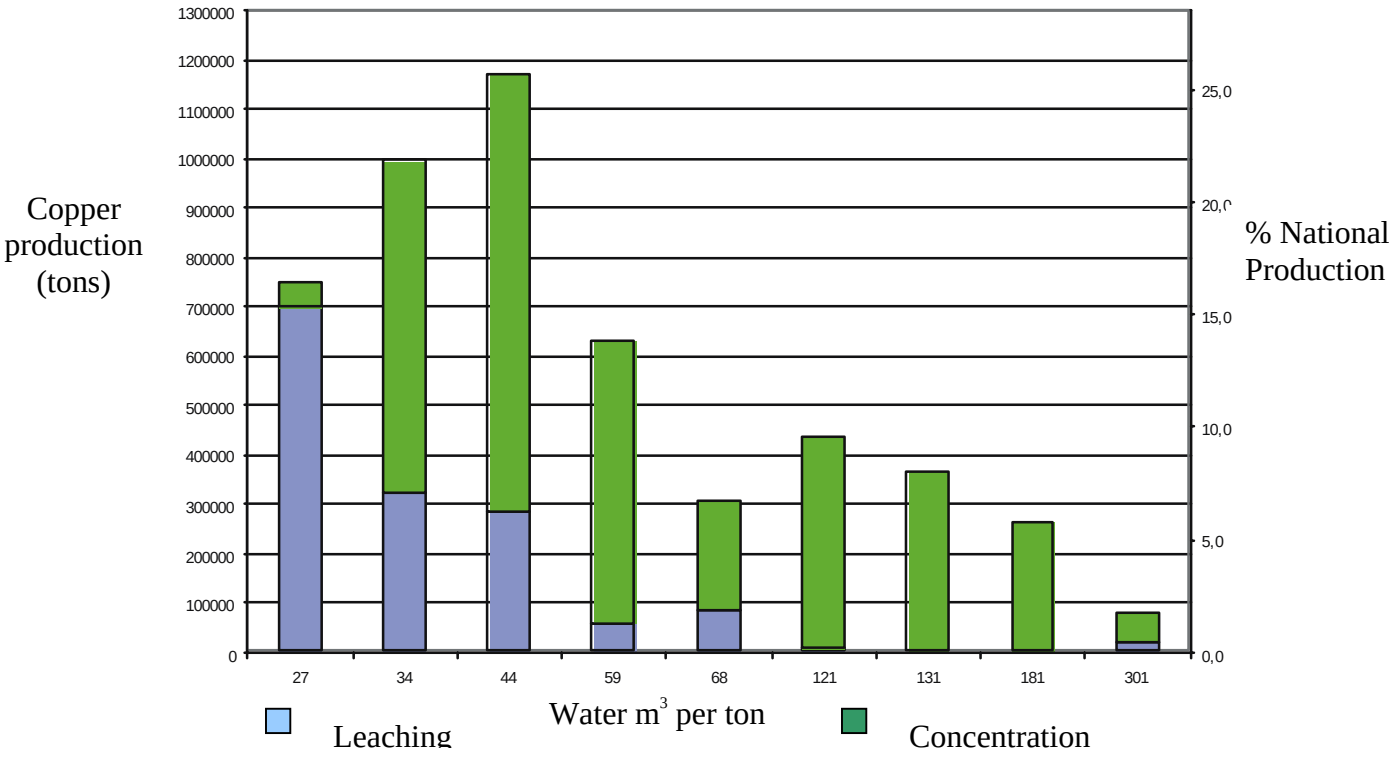
- In mines using only leaching, the average water consumption is 33.2 m^3 per ton of refined copper, while when concentration is used consumption is 104.5 m^3 per ton of refined copper. Where both processes are used the average consumption is 54.3m^3 per ton of refined copper.

- The water recirculation indices fluctuate between 38% and 85% (rates of recirculation of 1.6 and 6.7, respectively), with an average of 73.2% (recirculation rate of 3.7)

- Generally, in the biggest mines the percentage of recirculation is high, between 70% and 85%, (rates of recirculation of 3.3 and 6.7, respectively). Thus they have the lowest average consumption of water.

- Generally, the mines with the lowest water requirements are located in the north of the country (Regions I to IV), with an average consumption of 47m^3 per ton of refined copper. In the rest of the country, the average consumption is 128 litres a second. This is consistent with the scarcity of water in the north.

Figure 3.3
Copper Production in terms of the Consumption of Water per ton



d) Industrial Use

Overall, the main consumption in industrial use is of three principal kinds: domestic use (sanitary installations and drinking water), industrial processes (in the processes themselves and in the washing of equipment and buildings) and “clean water” (in cooling and boilers, etc.).

Table 3.10
Water Requirements in the Mining of Copper

Region	Mine	Mineral	Production Tons/year	Flotation Tons/day	Leaching Tons/day	Source of Water
Type	New water flotation M3/ton	New water leaching M3/ton	Total new water m3/ton	Recirculation (%)	Rate of recirculation	Water required (litres/ second

In Chile, the principal production processes requiring water are pulp and paper, metallurgy, and chemicals, which, according to the information of the DGA, consume 75% of the total industrial water demand (30%, 30%, and 15% respectively).

The rest of industry (textiles, lubricants, food, and fuels, etc.) consumes the other 25%.

Table 3.11 summarises the estimates of the main uses of water in industry, by region. The information comes from the Liquid Waste Discharge Survey of the Superintendent of Sanitation Services.

Table 3.11
Estimated Industrial Water Consumption,
based on the discharge of liquid wastes

Region	**Discharge (m^3/s)**
I	0.41
II	0.07
III	0.96
IV	0.30
V	1.32
RM	2.68
VI	2.08
VII	0.96
VIII	7.44
IX	0.93
X	0.81
XI	0.02
XII	0.04
Total	18.02

Given the great variety of products, it is difficult to identify efficiencies and consumption in the various processes, particularly as there is a tendency to confuse the water used in domestic uses, cooling, and processing.

One way of analysing efficiency is through technological changes. These lead to a decrease in water demand, either through an increase in recirculation or through requiring less water.

It is noteworthy that in the pulp industry the consumption of water in production processes has declined significantly as a result of technological improvements. Today the industry consumes only $40m^3$ of water for every ton of pulp produced, whereas in the 1980s consumption was between $120m^3$ and $140m^3$. Similarly improvements in efficiency have allowed the closing of the circuit, which means greater reuse of the water consumed. This means that today about 95% of the water used in production processes is treated and used again and it is also treated before being returned to the rivers. Only 5% is lost through evaporation.

Social Equity

The appreciation of social equity is made with reference to the use of water in the municipal and domestic sectors and in irrigation, which are those uses where social equity has most relevance.

a) Municipal and Domestic Use

As has been discussed in earlier parts of this chapter, the drinking water, sewerage, and wastewater treatment services are charged to the users by a tariff for each m^3 of drinking water consumed. Also, there is a direct subsidy from the Government for lower income users that pays the monthly bill for these services up to a maximum consumption. This system has resulted in two important achievements: first, the investments and costs of the operation of these services are financed and, second, no one is excluded from these services among the urban population. In addition, the provision of service is individual to every house.

Moreover, due to the monopoly character of these services, the Superintendent of Sanitation Services regulates them. This agency sets the tariffs in direct negotiations with the companies on the basis of a “model” company for each locality. This ensures that the companies take steps to achieve standards of service with the highest possible economic efficiency.

It is also worth noting that the value of the m^3 consumed is maintained up to a predetermined maximum. If the consumer exceeds this maximum in the seasons of greater scarcity, a substantially higher tariff is charged (excessive consumption tariff) for the m^3 above the maximum.

The main facts presented in the preceding paragraphs show that in Chile there is a reasonably efficient system for the exploitation of drinking water, which means a much more equitable quality of life for the majority of the population.

b) Irrigation use

There are Government programmes directed towards the poorer farmers that are especially dedicated to improving irrigation and providing technical assistance to the poorest farmers.

The specific details of these programmes have been described above. The main programmes are:

- INDAP's programme to improve irrigation for poor farmers.
- The National Irrigation Commission's competitive funding for poor farmers.

Both these programmes finance and strongly subsidise irrigation projects benefiting the low-income rural population. The available information on the effectiveness of these programmes has been presented in earlier sections of this report. A qualitative appreciation suggests that the programmes are effective, but, if the country could provide more funds and manage them more efficiently, the achievements could be greater.

Environmental Quality

In the last few years, the country has been advancing rapidly in various aspects, following a long period in which very little was done.

Only since 1994, with the coming into force of the Basic Environmental Law did a sustained effort begin to find solutions to the many problems of the serious deterioration of the environment that had been accumulating historically. The advance in these matters has been gradual, and there are many issues still to tackle and correct. A brief report on the state of the situation is presented below, by water use.

a) Municipal and Domestic Use

In the last decade important projects have been developed for wastewater treatment so that the 16.7% of treatment in 1998 reached 42.3% treatment in 2002, and is expected to reach 100% in 2009[23].

A regulation has been issued on the discharge of treated wastes to surface streams and to the ocean.

A regulation has been issued on the deposit of treated wastes to the sub-soil.

b) Industrial Use

A regulation is applied on the quality conditions of liquid industrial wastes that can be discharged into sewers.

[23] Stranger S. and A. Chechilnitzky, op. cit.

The regulations on discharges to surface streams and to the sub-soil are also applied to this sector and also specifically to mining.

c) Irrigation Use

Regulations on objective quality for surface waters are under study. These will oblige irrigation users to apply agricultural land management practices that will reduce the "diffuse" pollutants that these produce, to the extent that controls are put in place to this effect and that they complement the existing rules of the SAG on fertiliser and pesticide use.

There are no other general regulations on the management by the users of irrigation water directed towards the conservation of the environment.

A synthesis of the appreciation of the performance of the exploitation system has been prepared on a scale of 1 to 5 in the Table in Annex 3A of this chapter.

3.9 IDENTIFICATION OF THE PRINCIPAL FAILURES OF THE REGIME

3.9.1 Systemic Failures

The System for the Exploitation of Water in Irrigation, particularly for surface water, does not directly encourage the users to conserve water or to use it efficiently.

The System for the Exploitation of Water in Irrigation does not encourage the users to conserve environmental quality.

The System does not directly encourage the industrial and mining users using surface water to use water efficiently. Through the regulations on discharges, there is an indirect incentive in this direction.

3.9.2 Government Failures

The procedures of the courts in hearing and ruling on many conflicts in the System for the Exploitation of Water are slow and the judges are not specialists in the issues. Therefore this method of conflict resolution is not very effective.

Annex 3A
Indices of the Use of the Regime
(using a Performance Criterion)

WATER RESOURCE MANAGEMENT SYSTEM							
Criterion		**Chile**	**Exploitation System (within the property)**				
			5	**4**	**3**	**2**	**1**
i	Economic efficiency	4	Water is used, exploited to the maximum with optimum results compared with international productivity standards in kilos per hectare.	Overall productivity is close to international standards (kilos per hectare)	The indices are within the range of international standards	They barely reach the average of international standards	Close to the lowest of internationa standards
ii	Physical efficiency	4	For each user the use of water is within international standards.	In some uses exploitation reaches international standards.	The uses and the exploitation is at the average of international standards	Exceptionally adequate use is made of water	Water is no used efficiently
iii	Social equity	4 The provision of drinking water and the subsidy to irrigation promotes a general reduction in inequalities.	The whole population exploits water efficiently independent of financial capacity, operates within a homogeneous system or is compensated (thanks to explicit actions to help overcome the initial differences)	The use of water serves in some case to reduce inequalities.	The inequalities among the sectors are maintained and water does not help reduce them	Only sometimes does the use of water contribute to reduce inequalities.	Water managemen accentuates poverty
iv	Environmental quality	Industrial Use 3 (mining 4)					
		Drinking water 4					
		Agricultural use, (erosion and fertilisers) 3	Control of environmental impacts is always considered within the farm. There is concern about potential environmental deterioration (pollution, drainage and salinisation)	Exceptionally control is not considered and the management of environmental impact is negative on the farm	Usually the negative environmental impacts are considered	Frequently not considered	Never considered