

# Irrigation Policies and Irrigation Management Transfer Programs in Chile

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## PHYSICAL SETTING

CHILE IS LOCATED between parallels  $17^{\circ} 30'$  and  $56^{\circ} 30'$  of south latitude (about 4,270 km of longitude), with a continental area of 75.7 million ha with 28.7 million ha of agricultural area, of which 5.1 million are arable, divided into 3.3 millions ha of rainfed land and 1.8 millions ha under canals of which 1.2 million ha are high security irrigation and 0.6 million ha of eventual irrigation.

The great extension of the country allows the existence of a variety of ecosystems, going from desert areas in the north to humid-warm areas in the south.

Chilean topography, north-south extension and climatic and edaphic factors have created a wide variety of agricultural conditions. There is a large variety of ecosystems making it possible to cultivate a wide diversity of crops, from subtropical species in the Chilean north to native species to cold climates near the Andean foothills and in the south and far south of the country. A map of Chilean climatic zones and major agricultural crops is presented in Figure 1.

## WATER RESOURCES

River flows in Chile are mainly of pluvial origin in the winter and glacial origin during the spring and summer. In the river basins north of  $32^{\circ}$  south latitude, available run-off is generally insufficient to support irrigation development on all suitable land even with storage dams. In the central part of Chile, from the  $32^{\circ}$  south latitude to the  $38^{\circ}$  south latitude, total run-off is generally sufficient for irrigating all suitable land except for a period of acute water shortage, occurring in the high summer when the decline in water yield from snow melt coincides with peak water demand for many crops. The construction of storage dams, transfers between river basins and sub-basins, and development of groundwater resources could all be involved in solving seasonal water shortages in these valleys. In river basins south of the  $38^{\circ}$  south latitude to  $56^{\circ}$ , river flows are generally sufficient for full irrigation of suitable land without storage dams.

## HISTORICAL ASPECTS OF IRRIGATION

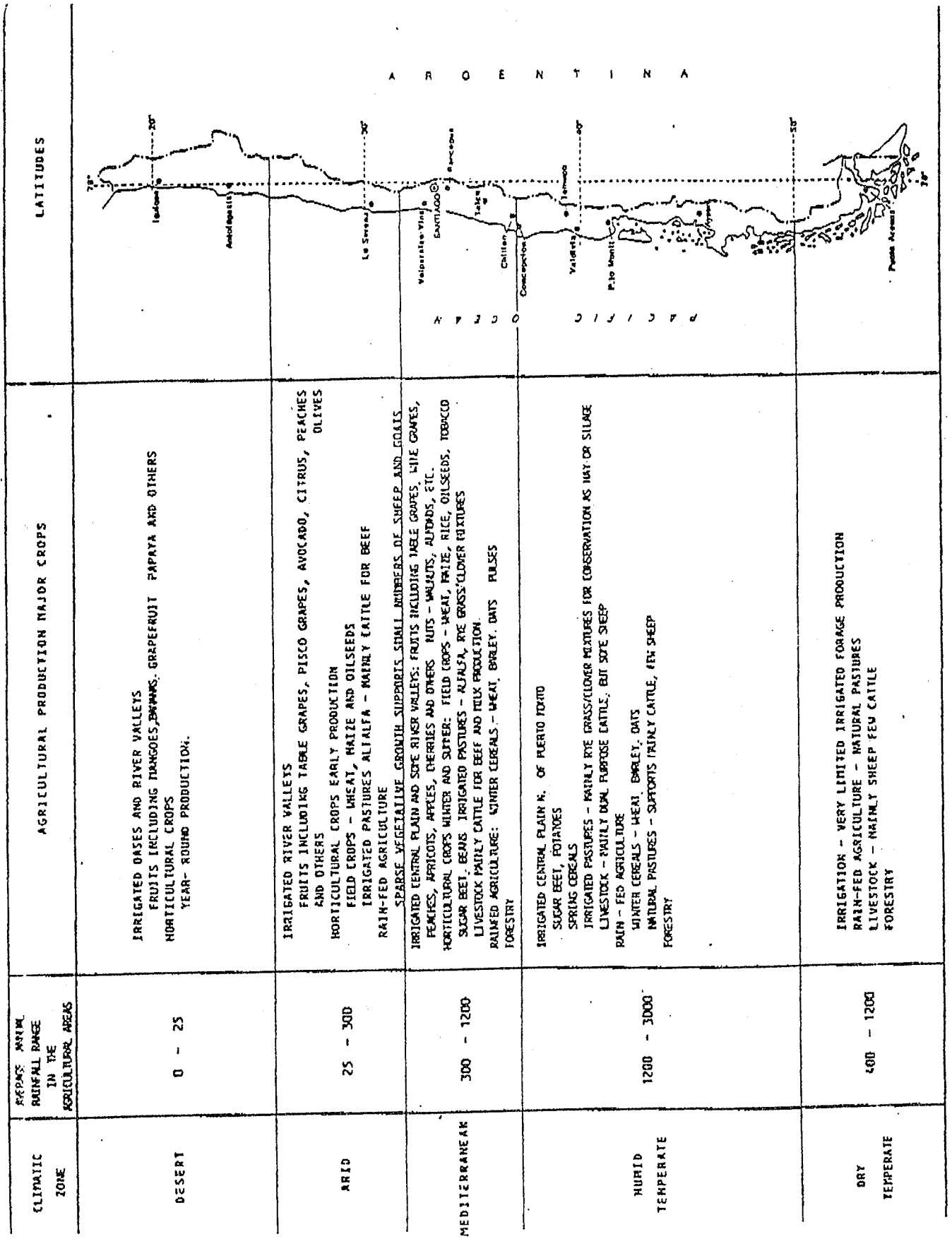
Chile has a great tradition in the construction of irrigation works. Irrigation development in Chile has been characterized historically by strong private sector involvement. From colonial times to 1915, private investment was responsible for developing irrigation capability on about one million ha. Subsequently, however, private participation declined-gradually at first, as the subdivision of landholding increased the complexity of coordinating implementation and financing, and then came to a standstill during the agrarian reform period of 1965-1973. In contrast, from 1915 until the mid-1970s, the public sector constructed more than 60 irrigation schemes benefitting 800,000 ha.

The construction of dams is not absent from the government's activity that started in 1930. Between 1930 and 1976 the government built a total of 28 dams that jointly provide a regulation capacity of 3,307 million  $m^3$ .

Recently, a canal was built in the Penuhue Valley with a capacity of 12  $m^3$ /second, which irrigates a surface of 12,000 ha, at a cost of twenty million dollars. A dam is being built in the country, with a capacity of 160 million cubic meters ( $m^3$ ), which will irrigate a surface of 12,000 ha, at a cost of forty million dollars. The construction of a canal of 60  $m^3$ /s., at a cost of 90 million dollars will begin early in 1995; it will irrigate a surface of 63,000 ha.

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Figure 1. Chilean Climatic Zones and Major Agricultural Crops.



## TYPE OF IRRIGATION PER CULTIVAR

Chilean agriculture is highly dependent on irrigation, as demonstrated by the relatively high percentage of arable land irrigated. About 1,8 million ha—35% of the area in crops and pasture including almost all land planted in high-value export crops—are currently under the command of existing irrigation systems. Almost 40% of this area, however, receives irrigation water intermittently due to scarcity and deficiencies of conveyance and distribution infrastructure.

The cultivated area, classified in great crop groups is 630,244 ha of pastures; 1,064,138 ha of annual crops; 126,593 hectares of fruit-tree plantations; 108,317 ha of vineyards and 118,897 ha of vegetable crops.

Regarding the irrigation systems, the major part of the areas is irrigated with superficial methods, such as furrow and wild irrigation. Furrow irrigation is used mainly in fruit-trees and vegetables and wild irrigation is used in cereals and cultivated pastures.

During the last years some irrigation methods of high efficiency have been introduced, such as drip irrigation and micro sprinkler to irrigate fruit-trees of high income-yield capacity. The major part of the area irrigated with these methods of high efficiency, 15,000 ha, is located in the northern zone of the country.

Available data do not permit estimation of water losses from infrastructural deficiencies of conveyance and application or from excess water use from improper application practices at the national level. However, efficiencies tend to be higher in areas such as the north where irrigation is required throughout the year, water is scarce and modern irrigating methods are practiced. In contrast, in the Central Valley, overall irrigation efficiencies are estimated at below 30%. A study carried out in the irrigated area near Santiago found that overall efficiency is 24% and field efficiency, less than 60%.

## IRRIGATION INSTITUTIONAL STRUCTURE

In 1975, the National Irrigation Commission (CNR) was created to coordinate the activities of public institutions and private organizations in irrigation. The CNR's Council is chaired by the Minister of Economy and includes the Ministers of Finance, Public Works, Agriculture, and Planning, as well as the executive secretary of the CNR. Its main responsibilities include planning, evaluating, and approving investment projects and coordinating their implementation.

The CNR was established to expand and improve irrigation. It is responsible for the coordination of all public and private entities involved in construction and implementation of irrigation and drainage works. The CNR's technical secretariat carries out water resource and agricultural surveys and river basin studies, evaluates investments identified in these studies and makes recommendations to its Council for approval. Its role is implementing the Irrigation Promotion Law 18.450.

Through its Directorate of Irrigation, the Ministry of Public Works is responsible for design, construction and Operation and Maintenance (O&M) of irrigation infrastructure. The General Directorate of Water has overall responsibility for water development planning and the development and exploitation of natural water resources. It operates the National Hydrometric Service and publishes data gathered; funds and supervises studies of water resources; controls and supervises natural inland waterways and activities of vigilance committees. Its main activity is regulating the distribution of water rights and resolving conflicts among users. It is also involved in the systematic collection of water samples for analysis of water quality and it gives technical assistance on Irrigation System Management.

## IRRIGATION WATER LAWS AND POLICIES

The Water Code of 1981 specifies that all waters are national property, but recognizes the right of individuals and entities to use them in line with the tenets of the Code. A water right involves the use and possession of water. It is an asset, a civil right which can be alienated and mortgaged by itself independently of land. Historically, water rights were assigned by the State and these rights continue today. However, new rights now generally must be allocated through competitive bidding. All transfers or transactions must follow the regulations of the Civil Code. Consequently, water users are free to buy and sell water rights, and the rational allocation of water among interested parties is left to market forces. Prevailing regulations reflect overall government policy to reduce the public sector's role in allocation and management of water resources.

The Water Code distinguishes between the following rights to water use: (a) consumptive and non-consumptive; (b) permanent and temporary; (c) continuous and discontinuous; and (d) alternating rights among several users. A consumptive right entitles its owner to consume totally the water in any activity. A non-consumptive right allows the use of water but requires its return under specified conditions. A permanent right is only granted if non-claimed

water resources are available. A permanent right permits the owner to use the corresponding amount of water except in those cases where its supply is insufficient to satisfy the needs of other permanent owners. In such cases, the available flow is divided proportionally among the entitled users. A temporary water right only allows water use in periods of surplus after requirements of permanent holders are met. A continuous right entails uninterrupted water use for 24 hours a day, while a discontinuous right limits use to certain time periods. Alternating rights are distributed on a rotating basis among two or more users.

The organization and performance of the irrigation subsector in Chile is based on active participation by and responsibility of private water users. The judicial/administrative framework for this subsector organization differs from other Latin American countries, where the State plans, builds, operates and controls water resources at river basin- or regional levels and offers technical support, training and financing to private irrigators. In Chile, in contrast, the State limits its participation to: (a) general subsector policy development; (b) implementation of irrigation activities which otherwise, because of their nature, complexity and financial requirements, cannot be implemented solely by the private sector; (c) intervention to resolve conflicts between water users; (d) gathering of statistical data and provision of technical information to water users; and (e) incentives for establishment of water user organizations and associations of users.

The current government, being aware of the significance of the irrigation works to develop a modern agriculture allowing to increase the life level of the rural population of the country, is encouraging a national policy on irrigation based on three large programs: Major Works, Intermediate and Rehabilitation Works, and Minor Works.

### **Programs of Major Works**

A major work of irrigation shall mean that represented by an investment over 20 million US dollars.

The construction of these works shall be ruled by the Law 1,123 in force from 1981. According to this Law, the Government builds and funds the works outside the lands involved in the projects. Later, the Government recovers a part of the costs of such works through a long-term line of credit for the beneficiaries.

### **Program of Intermediate and Rehabilitation Works**

This program corresponds to those representing an investment between US\$ 600,000 and US\$12 million. The significance of this program lies in the fact that being by themselves interesting projects, they can be undertaken as a stage of a bigger project. To carry out this program, the Chilean Government has assigned US\$118,7 million, with a partial financing of the World Bank (40%).

### **Program of Minor Works**

The minor work of irrigation corresponds to those having a cost of up to US\$ 600,000. This program is founded on Law 18,450 of promotion to the private investment in irrigation works of 1985. This law was promulgated to encourage private investment in irrigation and drainage works. The Law stipulates that the State may subsidize up to 75% of the investment costs for construction of and repairs to irrigation and drainage works and related pumping equipment. Eligible investments must increase the irrigated area, improve water availability in an area of short supply or reclaim poorly drained or waterlogged land for agricultural production.

The application of the program of minor works through Law 18,450 in the areas benefited by the great works and intermediate works shall enable the farmer to implement his farm irrigation.

The program of minor works represents an investment of US\$ 20 millions per year.

## **IRRIGATION MANAGEMENT TRANSFER PROGRAMS AND TECHNICAL ASSISTANCE**

### **Government Action and Institutional Frame**

The transfer of technology and technical assistance shall be under the responsibility of the Ministry of Agriculture through the corresponding agencies: the Institute of Agriculture and Livestock Research (INIA) and the Institute of Agriculture and Livestock Development (INDAP).

INIA's objectives are as follows:

- \* To help increase the agricultural and livestock production of the country through the creation, adaptation and transfer of technology.

- \* To foster and support the development of processes of industrial transformation and incorporation of added value to the livestock and agricultural producers through the execution of any kind of research, study or services.
- \* INIA's action has a national cover, having 5 experimental stations and 8 sub-stations between Region IV and XII. A new experimental sub-station shall be created in the Huasco River Valley due to the construction of the reservoir.
- \* INDAP's purpose is to promote the economic and technological development of the small agricultural producers thus helping to raise their managerial ability, to make as effective as possible the use of the productive resources and its integration to the rural development.

In order to develop this objective, INDAP develops the following actions:

- \* To grant loan assistance to the small agricultural producers and to organizations of small producers with legal capacity developing productive activities.
- \* To provide technical assistance and training both as regards the productive aspect and the home economic aspect. For these purposes, it shall manage subsidies or line of credits for the beneficiaries to directly hire these services in the private sector.
- \* The action of transfer shall be oriented to the management of irrigation water according to the special conditions of each area and to the agricultural management of crops under the irrigation situation.
- \* Program of irrigation transfer for extension agents and agricultural producers.
- \* INDAP shall subsidize the irrigation management extension for small owners who shall hire the extension services from private enterprises of technical assistance.
- \* The program shall be essentially based on INIA's action and oriented to the entrepreneurial and small producers, and to the extension agents of the area affected by the irrigation projects.

For this purpose, INIA would have two operative units:

#### ***Communication Unit***

This unit would centralize the technical information and coordinate the transfer in the different sectors to be developed in the [irrigation agriculture.] Likewise, it would be directly related to INDAP's Agricultural Extension programs.

#### ***Technological Transfer Unit***

This unit would be in charge of creating the Groups of Technological Transfer (GTT) and the Technological Transfer and Adjustment Centers (CATT). The GTTs and CATTs shall be made up by farmers having common interests. INIA's experience with these Groups and Centers has proven to be effective to date, since it is interesting to continue with them in the future.

The GTTs shall be made up by entrepreneurial farmers. The actions shall be carried out through courses, field days and publications.

The CATTs shall be made up by groups of peasants, the production system of which is representative of the agroclimatic and socioeconomic conditions of the different irrigation areas benefitted. The CATT's objective shall be that of adjusting and making valid technologies under the circumstances of the peasant; training the professionals and technicians of extension and technical assistance programs. The actions shall be courses which are basically practical and especially oriented to the irrigation technology; field days and manuals to spread information.

The transfer program proposed by INIA would have a duration of 4 years from the beginning of the irrigation project, renewable according to the results. It has been estimated that after 4 years, the need of having an office of technical assistance would become evident, which is to be made up by the professionals involved in the program, if possible, and under the responsibility of the users or associations of irrigators.

## **Action of the Private Sector**

An irrigation work from the perspective of the Chilean Government goes beyond the construction of a civil work. The irrigation projects are development projects which by creating new work sources improve the living standards of the beneficiaries in the rural sector in general. They also increase the contribution of the agricultural and livestock sector to the Gross Domestic Product.

The Transfer of Technology, the access to credit sources and marketing ways for the new products are basic stages leading to achieve the final objective of the irrigation work.

In this respect, and related to the above, the participation of the private sector, the agroindustrial sector and export sector in particular, is essential. Hence, the National Irrigation Commission is engaged in looking for the agreements and mechanisms able to foster the active participation of this sector in the areas benefitted by the irrigation projects to be implemented.

Additionally, the Irrigation National Commission sets up demonstrative plots on the area with irrigation projects, with the purpose of teaching the farmers the necessary techniques for the management of irrigation on the crops which adapt themselves to the conditions of local climate and soil.

## **OPERATION AND MAINTENANCE PLAN**

### **Legal Frame**

According to the Law of Work Construction by the Government, Law 1,123 of August 1981, when a new irrigation work is constructed, the Government shall manage the works through the Irrigation Directorate, in a temporary way for a maximum period of four years.

During this period, the irrigators benefitted with the new irrigation works shall be organized with the help of the Irrigation Directorate and the General Directorate of Waters of the Ministry of Public Works, in Vigilance Committees, Irrigation Associations or Water Communities, according to the rules set forth by the Water Code.

A water community consists of two or more holders of water rights in a common system (irrigation or drainage). Communities are established through public deeds which identify members and specify their rights as members. Such deeds also specify the by-laws of community operation, including administrative and judicial aspects to ensure reasonable distribution of water and O&M of common works. All matters of interest to a community need to be discussed and resolved in a general assembly, which also elects a board.

An irrigation association functions similarly to a water community, but has a collective, legal status (i.e., which enables its members to take out loans collectively).

A vigilance committee is a water user organization depending on a common natural stream. Its members are individuals, public entities, irrigation associations, water communities or any other entity which uses water from the same river basin. These organizations administer and distribute water among members, exploit and maintain common infrastructure and construct new works to improve water distribution and conservation. Establishment of a vigilance committee requires a public deed signed by all interested parties. Aggregate water rights controlled by a committee are divided among the members in proportion to their individual rights. Internal organization is similar to that of a water community.

In 1949 the Government officially recognized the Chilean Confederation of Canal Operators as a legal entity, which incorporates legally constituted water communities, canal associations, vigilance committees, and other individuals and entities which extract water from their own canals. The Confederation represents its members to ensure fair distribution and exploitation of water resources, and works for the improvement and expansion of irrigation. It represents the majority of water user organizations, covering most of the national canal system.

The number of water user organizations increased significantly as a result of the sub-division and re-arrangement of land-holdings during the last two decades. At present, Chile has about 4,000 water user organizations of which only about one-half are legally established. The Water Code only applies statutory norms to legally established organizations. Consequently, some 2,000 user organizations lack the necessary legal status to carry out their administrative and judicial functions needed for water distribution and O&M of their common infrastructure.

### **Financial Sources**

The Operation and Maintenance of the irrigation systems have been given to the private sector. In this situation, this same sector is the one giving the corresponding financial contributions for its O&M. In the case of the works operated and maintained by the Government, the legal provisions set forth that it shall submit the collections to the users for the expenses incurred in.

Information from the Chilean Confederation of Canal operators suggests that the private sector currently spends about US\$ 40 million per year for investment and O&M.

## **POLICY OF COST RECOVERY BY THE STATE**

### **Construction**

The system of cost recovery by the State is ruled by the Statutory Decree 1,123 as of August 13, 1981.

Such decree reestablishes the principle that the irrigation works are private property, the Government acting just as performer of them, the transfer of them having to be completed within the terms set forth. Notwithstanding, it forbids the beginning of studies or construction should there not be a previous agreement of the sector favored as to undertake its costs according to the terms set forth by regulations.

The Government, bearing in mind the strategic nature of this kind of infrastructure, has considered that the State as a whole is also benefitted and, therefore, the Government now accepts to partially take part in the funding costs of the irrigation works.

The water rights generated by the works shall be offered on sale to the farmers in the first place, and, then, to other parties interested in them. The sales conditions set by the Government, consider a grace period up to 4 years, valid from the start-up of the system. The option of time payment with a preferential rate of interest and terms of about 25 years shall also exist. In the case of a loan, the corresponding water rights shall be established as pledge. The ownership of water in Chile is separated from the ownership of land.

The Government, based on the principle of development with equity, shall favor the peasant sector with direct subsidies, which may reach 100% so that this sector funds that portion of the work corresponding to it.

The participation commitment in the cost of the works shall be undersigned at least by 50% of the water rights generated before the beginning of the civil works construction.

The policy for recuperation of costs considers the following:

- \* The amount used as a basis of contracts is the investment estimated by the National Directorate of Irrigation and approved by the CNR for the project, capitalized to the date of handing over of the works with rates equivalent to the financing cost of the program.
- \* The State is well-disposed to subsidize the estimated investment for the project, up to such an amount that makes it profitable to the private investor, considering an internal rate of return (IRR) of 15%, which is the reasonable minimum for this type of investments, providing the project presents a social profitability of at least 12%.
- \* If the project does not yield a profitability of 12% it is not advisable to carry it out.
- \* The annual payment of the project is calculated in readjustment units or in quintals of wheat corresponding to the subsidized investment according to the above, for a horizon of 25 years. To calculate the cost per hectare the annual payment is divided by the number of hectares to process. Thus, there is a different subsidy for each project.
- \* The annual payment for farmers considers additional subsidies, which are bigger for the smaller properties and vice versa.
- \* The payment is done over a maximum period of 25 years, including a period of up to four years during which only interests will be paid.
- \* The amount of annual payment is established in an equivalent of quintals of wheat, price established in January of every year, placed in Santiago, with an annual interest of 6%, or else in readjustment units with an annual interest of 4.5%.
- \* Notwithstanding, the full recuperation of investment which results from the collection of the payments, cannot exceed the real recuperation, calculated on the basis of the financial flows that the State has to pay.
- \* The payments agreements are made with the organizations of Water Users or through individual agreements.

- \* To guarantee the repayments, the State mortgages the new water rights that the user subscribes. In Chile, water is an asset independent from land.
- \* The cost of operation and maintenance of the works is financed 100% by the users of the water.

### **Operation and Maintenance**

The costs of O&M are borne by the irrigation subscribers themselves through their own organizations, and the payments of each user are proportional to the number of shares. The Government does not subsidize the O&M once the Work is delivered to the users. The Users' Organization is authorized to cut the water supply to the individual users who do not pay their dues to the O&M.

New projects, after completion, start operating under a temporary system for 4 years, during which period work is operated by the Government.

### **PROBLEMS AND OBSTACLES**

#### **Water Resources**

To develop each irrigation project, the Government shall previously submit the request for the corresponding water rights, according to the procedures of the Water Code.

In this respect, the Code makes no difference between the Public and the Private Sector. Therefore, the general provisions for the acquisition of a water right applications, are included in the abovementioned legal body.

#### **Water Pollution**

##### ***Urban Sewage***

The country has not developed yet the treatment of urban sewage water before being used in agricultural processes. Thus, this is a serious problem for the irrigation area of Mapocho River, Santiago's final collector of sewage water. In the medium term, this is becoming a serious conflict in other areas of the country.

##### ***Water from Copper Mining Processes***

In general, the copper mines located in the Northern zone of Chile do not compete with irrigation, basically due to the geography.

This situation changes in the Central Zone where there has been some water pollution in the upper part of some rivers, coming from industrial liquid [tailines].

#### **Water Rights**

##### ***Arrangements with Other Sectors***

The Water Code provides two ways of using the right in water consumption; when used in agriculture water returns to its natural bed, as in the case of hydroelectric power stations.

The great irrigation projects consider both uses in general, which are unfortunately competitive. The hydroelectricity uses water in Winter when agriculture is interested in storing it to be used in Summer.

In this conflicting situation of competitive interests with the energy sector, the legislation allows the market to regulate this situation. The Public sector takes part in it as another individual.

### **PURCHASE OF THE LAND - COMPENSATION**

The irrigation projects built by the public sector refer just to the development of the water resource, its storage or derivation with the construction of canals up to the farm gate. The land is a resource belonging to the private sector and the State does not buy it, but it just assigns the water rights for irrigation.

The lands occupied by the construction of civil works are purchased by the State from the owners through direct purchase at commercial values.