CHAPTER 2

NATIONAL BACKGROUND

2 NATIONAL BACKGROUND

2.1 Land and Population

The Republic of Chile is located along with the Pacific shore, and stretches about 4,300 km from south to north. The Andes mountains are the east borders. Land area is 756,000 km^2 and divided into 13 Regions including the Metropolitan Region. According to the Census in 1992, total population of Chile is about 13.5 million. The population growth rate is 1.64% in national annual average from the last census in 1982 to the current census in 1992. Estimated population in 1997 from the census in 1992 is 14.6 million. The area and population of each Region are shown in the table below.

	Region	Area (km^2)	Population (1,000 persons)	
			1992	1997
I	Tarapacá	58,698.1	339.6	379.7
II	Antofagasta	126,443.9	410.7	449.8
III	Atacama	75,573.3	230.9	259.8
IV	Coquimbo	40,656.3	504.4	553.4
V	Valparaíso	16,396.1	1,384.3	1,507.1
VI	Libertador General Bernardo O´Higgins	16,341.4	696.4	758.4
VII	Maule	30,325.3	836.1	889.8
VIII	Biobío	36,929.3	1,734.3	1,874.1
IX	La Araucanía	31,842.3	781.2	846.0
X	Los Lagos	67,013.1	948.8	1,028.2
XI	Aisén del General Carlos Ibáñez del Campo	108,494.9	80.5	90.8
XII	Magallanes y de la Antártica Chilena	132,033.5	143.2	154.0
R. M.	Región Metropolitana de Santiago	15,348.8	5,257.9	5,831.3
	Total	756,096.3	13,348.4	14,622.4

The 1992 population census resulted in a total population of 13,348,401, of which 6,553,254 male and 6,795,147 female. Women of childbearing age (14 to 49 years) had an average of 4.09 children in 1967, but dropped to 2.39 in 1992. With the declining birthrate and no significant increase in immigration, much of the growth in the Chilean population resulted from a decline in infant mortality (119.5 per 1,000 live births in 1960 to 11.8 per 1,000 in 1995). Infant mortality rate in Chile is one of the lowest in Latin America, reflecting the success of health-care programs for expectant mothers and infants implemented since the late 1960s. Slightly less than half of Chileans are estimated to be under 21 years old, indicating a young population structure.

In racial structures, Mestizo (native American mixed with European), European ancestry, Native American, and other ethnic groups occupies 66%, 25%, 7%, and 2% respectively. Official language is Spanish.

2.2 Current Situation of Socio-economy

2.2.1 Social Aspects

(1) Education and Literacy

Primary education lasts 8 years and secondary education 4 years, the school year being from March to December. According to MIDEPLAN-CASEN96, gross school enrollment was 98.2% at the primary level, 85.9% at the secondary level, and 26.3% at the tertiary level. Adult literacy rate was estimated at 95.1%, with an average schooling of 6.7 years in population over 15 years old.

(2) Health

Heavy investments in social programs helped lower infant mortality rates and raise life expectancy, giving Chile a relatively high human development index (HDI) used by the United Nations.

		Chile	Latin America
Crude birth rate per 1,000 (1995)	:	19.8	26.0
Crude mortality rate per 1,000 (1995)	:	5.7	8.0
Total fertility rate per woman (1995)	:	2.3	3.3
Life expectancy at birth (1995)	:	74.8 years	69 years
Infant mortality rate per 1,000 live births (1995)	:	11.8	38.0

2.2.2 Outline of the Politics

(1) Government

The 1980 Constitution, amended in 1989, establishes Chile as a democratic republic with three branches of government: Executive, Legislative, and Judicial.

The Executive power is vested on the President of the Republic, who is directly elected, having to win a majority or face a runoff election. The President is elected for a six-year term, and successive reelection is not allowed. President Eduardo Frei Ruiz-Tagle was elected on December 11, 1993 and took power on March 11, 1994.

The Legislative branch, a bicameral National Congress located in Valparaíso, consists of the Senate where 2 members are elected for each "senatorial circumscriptions" in addition to non-elected members who serve eight-year terms, and the Chamber of Deputies with 120 members who serve four-year terms.

The Judicial branch consists of the Courts, including the Supreme Court (21 ministers), appellate courts, and military courts.

(2) Administrative Subdivision

Administratively, the country is divided into Regions, consisting of the Metropolitan Region and 12 Regions numbered from North to South. The 13 Regions are subdivided into 51 Provinces, and these Provinces into 541 Communes. Each Region is headed by an Intendant, each Province by a Governor, and each Commune by a Mayor.

According to the 1980 Constitution, Intendants and Mayors would be appointed directly by the President of the Republic, although Mayors of smaller towns would be designated by Regional Councils created to advise the Intendants. Members of Regional Councils would be employees of government agencies in the locality, military officers, and representatives of interest groups with no party affiliation. This conception of regional government is extended to the municipal level with similar Local Councils.

(3) Political Parties

Article 19 point 15 of the Constitution guarantees political pluralism, but clarifies that against the Constitution are political parties striving for totalitarian regimes, or resort to violence. Political parties span the spectrum from left to right, from the Communist Party of Chile (PCCh), to the ruling Coalition of Parties for Democracy (CPD) dominated by the Christian Democratic Party (PDC), to the right wing National Renewal (RN) and Independent Democratic Union (UDI).

2.2.3 Outline of the Economy

(1) Overview

For the past decade, the Chilean economy has grown rapidly fueled by steadily rising domestic savings and foreign investment. It is a market-based economic system in which the private sector is the engine of growth, while the public sector plays only a guiding and supportive role by setting the ground rules, compensating for major imbalances, and maintaining macroeconomic stability. Copper remains Chile's most important product, accounting for about 40% of export earnings. However, exports of fish, forestry and manufactured products, and especially fresh fruit are of growing importance.

The governments of former President Patricio Aylwin (1990-1994) and current President Eduardo Frei have emphasized the need to maintain macroeconomic stability and the export orientation of the economy. The independent Central Bank has gradually loosened foreign exchange restrictions on capital outflows. The government remains concerned about the exchange rate effects of rapid foreign capital inflows. Although privatization has slowed down in recent years, some regional water and sewage companies are getting ready to be privatized starting at the end of 1998.

The Central Bank monetary policy adjusts interest rates as a means to affect domestic spending. One goal is to keep inflation under control while maintaining the economy on a path of steady growth. Another goal is to stabilize the exchange rate by buying or selling dollars in the official inter-bank market, in order to keep the short-term exchange rate fluctuations within a 10% band on either side of the reference data, which changes daily. A legal parallel market operates with rates similar to the inter-bank rate.

The government rarely sets specific prices, except for urban public transportation, some public utilities and port charges. An 18% value added tax (VAT) applies to all sales transactions, and brings in over 40% of total tax revenues. Government regulation affects a few sectors such as utilities, banking, securities market, and pension funds.

Chile's strong economic growth and careful debt management over the past decade meant that foreign debt is not a major problem. As of late 1996, Chile's public and private foreign debt was about US$20 billion, equivalent to around 27% of GDP. Since the mid-1980s, public sector foreign debt has declined steadily, but private sector debt has risen as firms have borrowed abroad to finance investments.

On most imports there is an 11% tariff, but a proposal was made in the second half of 1998 to lower tariff levels. Chile has free trade agreements with Mexico, Venezuela, Colombia, Ecuador and Canada, providing for duty-free trade in most products by the late 1990s. In 1996, Chile signed a trade liberalization agreement with MERCOSUR (Argentina, Brazil, Paraguay and Uruguay). Tariffs are also lower than 11% for certain products from member countries of the Latin American Integration Association (ALADI). Chile's most important non-tariff barrier is the import price band system for certain agricultural commodities: wheat, wheat flour, vegetable oil and sugar. Under this system, when import prices are below a set threshold, surtaxes are levied on top of the 11% tariff in order to bring import prices up to an average of international prices.

(2) Gross Domestic Product (GDP)

Table 2.2.1(1) shows that Chile's GDP between 1995 and 1997 increased from 6,800,000 Million to 7,800,000 Million in 1986 Chilean $, implying strong annual

growth rates of 10.6% in 1995, 7.4% in 1996 and 7.1% in 1997. IDB estimates the 1997 Chilean per capita GDP at around US$3,700 (in value of the US$ in 1990), having grown at 5.3% per year between 1988 and 1997. The exchange rate of the Chilean $ in terms of US$ fluctuated from 407.1 $ in 1995, to 425.0 $ in 1996 and 439.8 $ in 1997. The value of the US$ in 1998 was around 450 $ in June and 470$ in September

Economic activities comprising GDP show that the tertiary sector is dominant, followed by the secondary sector. Agriculture, livestock, and forestry together comprise less than 7% of GDP and show a declining trend over the past 3 years, reportedly due to irregular climate consisting of too little or too much rain. This is reflected in the year to year growth rate which has been declining, being the only economic activity that showed a negative growth rate in 1997 (-2.1%). In contrast, fishery has been increasing its share in the GDP, even though its year to year growth rate also declined over the past 3 years. Major crops are grapes, apples, plums, potatoes, sugar beet, and forest products. The main agricultural export is fruit, while leading agricultural imports are banana, coffee, cotton, soybean, sugar, tea, and wheat.

Mining accounts for around 8% of GDP, and showed a strong growth rate between 1995 and 1997. Copper is the most important mining product, but Chile produces 24 non-metallic minerals that are exported. Manufacturing accounts for around 16% of GDP, showing a moderate growth rate between 1995 and 1997. Construction accounts for around 5% of GDP, showing a strong growth rate from 1995 to 1997.

Services account for about half of GDP, showing strong growth rates between 1995 and 1997. Main services are Commerce, Hotel and Restaurant accounting for about 17% of GDP, and Financial Services for about 13% of GDP. Tourism is one key service industry, with around 1.5 million visitors, half of whom from Argentina, who spend about US$900 million.

(3) Employment

Table 2.2.2(2) shows employment trend by economic activity between 1995 and 1997. It can be seen that the tertiary sector accounts for more than half of employment, the most important being Personal, Communal & Social Services with around 26%, followed by Commerce with about 18%, Transport & Communications with around 7%, and Financial Services with about 7%.

Manufacturing accounts for around 16% of total employment, Construction for around 8%, and Mining & Quarry for less than 2% of employment. Employment in Agriculture & Fishing declined continuously in the past 3 years, from 16% in 1995 to 15% in 1996 and 14% in 1997.

(4) Inflation

According to the Central Bank of Chile, the consumer price index (CPI) was double digit up to 1994, and single digit afterwards, declining year by year as shown below.

Year	1993	1994	1995	1996	1997
CPI (%)	12.7	11.4	8.2	7.4	6.1

(5) Foreign Trade

Table 2.2.3(3) and Table 2.2.4(4) show that Chile in 1997 exported around US$17,0000 million and imported nearly US$19,000 million. Copper is still the most important single export product, accounting for around 40% of export values between

1995 and 1997. Agriculture accounts for about 10% of export values, mostly fresh fruit with around 8% of export values. Export of manufactured products accounts for about 40% of total values, the most important items being food (16%), chemicals and plastics (6%), paper (6%), and wood furniture (5%). Main destinations of exports in 1997 were the US (16%), Japan (16%), UK (6%), South Korea (6%), Brazil (6%), Argentina (5%), but Chile exports to some 60 countries worldwide.

Of the imported items, Intermediate Goods comprise around 50% of total import values, Capital Goods around 27%, and Consumption Goods around 18%. Within each of these categories, the share of Agriculture is minimal, the most important being around 2% of total import values under Intermediate Goods. Manufactured Products comprise the highest import values as Consumption Goods and Intermediate Goods, with 18% and 40% of import values, respectively. Machinery and Equipment are the most important Consumption Good, while Chemicals and Oil are the most important Intermediate Good. On the other hand, Machinery, Equipment and Transportation Materials are the most important Capital Goods with around 27% of import values. Main origins of import products are the US (23%), Argentina (10%), Brazil (7%), Mexico (6%), Japan (6%), Germany (4%), Italy (4%), but Chile imports from some 60 countries worldwide.

2.2.4 Agriculture

(1) General situation of the study area

According to 1997 Census, 315,966 development plans of 27,115,580 ha in total in agriculture were carried out in Chile. 13,718 forest development plans of 19,937,485 ha was planed for forestry and silviculture and at least over its 90% was executed as forest development.

However, figures regarding forest development is not considered for analyzing the study on agriculture and livestock used in this report. The area of forest or forest works saying herein the report means agricultural development purposed on these aspects.

The Census mentioned above recorded 4,191 agricultural development plans which are not intermediate land on their production process but investment of capital and labor as swine and poultry productions.

Outline of land use on agricultural and livestock development is shown as follows;

Land use	Area (x ,000 ha)	%
Total Agriculture and Livestock	27,115.6	100.0
A. Cultivation land	2,293.4	8.5
- Annual and perennial crop cultivation	1,398.3	5.2
- Improved grassland for permanent and rotation	452.6	1.7
- Seasonal fallow and fallow land	442.5	1.6
B. Other land	24,822.2	91.5
- Improved grassland	1,009.8	3.7
- Natural grassland	11,922.2	44.0
- Planted forest	1,098.5	4.1
- Natural forest, mountain	4,870.1	18.0
- Indirect production area	236.9	0.9
- Abandoned land or non production land	5,684.7	21.0

Crops	Area (ha)
1. Fruits	233,973.1
2. Vineyard for wine	81,256.4
3. Seedlings production	2,339.1
4. Cereal, garden crops	774,011.3
5. Processing crops	70,263.7
6. Seeds production	29,620.1
7. Vegetables and flowers	113,113.5
8. Improved grassland for permanent and rotation	452,605.7
9. Seasonal fallow and fallow land	442,504.2

Source: 1997 Census

Animals raised on livestock are as follows;

Animals	Heads
Cow	4,141,545
Sheep	3,710,459
Swine	1,722,403
Horse	415,184
Mule / Donkey	31,172
Goat	738,183
Lama	79,365
Alpaca	45,282

Source: 1997 Census

Agriculture sector is shared 6.0% of GDP and 14% of population is engaged in agriculture. Approximately half of agricultural sector in GDP is produced from livestock and the rest is from other activities.

(2) Characteristics of agriculture by areas

Agriculture in Chile is divided into four (4) major zones from north to south based on characteristics of respective production systems.

- Desert area: subtropical climate zone located from northern frontier to Copiapó valley, intensive farming of flower and fruits production in irrigable area in valley.
- Mediterranean climate zone adaptable to diverse use: the area from Copiapó to Biobío
- Transitional zone: cereal , forest and livestock production area located from Biobío to the Torten river
- Wet marine climate zone in south of the Tortén river: basically livestock and forestry and also intensive farming is adapted in surrounding of swamp area

For east- west direction of above areas to IX region could divided to dry zone in front of Andean mountains, central valley, crossing valley of Norte Chico and dry zones of inland and coastal areas.

Following table shows crops and cultivating areas for understanding outline of Chilean agriculture;

Productions	Production Areas
Fruits cultivation	- Irrigable valleys from III to V region - Cultivation in hillsides of V & metropolitan regions (Avocados & Citrus) - Irrigable area of Central valley in metropolitan and VI regions - An area from VII & IX region

Vineyard for wine	- Valley in IV region - Irrigable area of Central valley of from metropolitan and IIX region - Scattered irrigable areas between metropolitan and VII regions - Casablanca valley
Vegetable	- Irrigable area with clean water scattered in metropolitan region - Irrigable Central valley in valley in V region and between VI and VII region - Valley between II and IV regions (Flowers)
Flower	- Irrigable area in Valley of V region - Scattered irrigable area in coastal dry zone of metropolitan region
Dairy products	- Between x and metropolitan regions - Area between VII and IX regions
Poultry / Swine	- Metropolitan region - Concentrated between V and VII regions
Beef cattle	- Concentrated between V I and IIX regions - From IV and X regions and metropolitan region
Seedbed (seedling)	- Irrigable area in Central valley of metropolitan region - Irrigable area in Central valley from V to VII regions - IX and X regions
Forestry	- Coastal dry zone of metropolitan region to IIX region - From IX region to X region

2.3 Agricultural Development Policy and Development Plans

2.3.1 National Agricultural Development Policy

The national agricultural policy of Chile represents in "Strategic Agenda: 1998-2000 Objectives for Agricultural Development" by the Ministry of Agriculture.

The urgent objective toward 2000 of this "Agenda" is the agricultural "modernization." Increasing the productivity of each sub-sector (agriculture, animal husbandry, and forestry) is expected contributing to achieving this objective. In order to increase productivity, the stress for the increase will be put on middle and small scale farmers. Thus, it states that the recognition of the national support requirement for these farmers who will play a nucleus role in the improvement of the productivity.

On the basis of the concept above, the Agenda sets the basic programs which concern following 6 items on the table below and each program has some targets. Promotion of the policies and implementation of the programs are guaranteed by the national budget. The Government of Chile appropriates 344.5 million dollars for these programs in 1998. This is about 66 million dollars increase, compared to the last year's.

Programs	Targets
Improvement of irrigation systems	- Doubling of pumping irrigated area - Giving the benefit to 22,500 small scale farm households(44,500ha) - Giving priority to middle and small scale farm house-holds when applying to the Law No.18450*
Recovery of deteriorated soils	- 450,000 ha (18,000 farm households in III to XII Regions) in 4 years (1996-1999) - The targets in 1998 and 1999 are 145,000 ha and 165,000 ha respectively - Incorporating private consultants so as to implement the program

to be continued

Improvement of epidemic free resources**	- Strengthening of quarantining and monitoring animals and plants for agricultural exports including transportation means such as packing by woods - Establishing the quarantine system by cooperation bet-wen public and private sectors - Altering the area where middle and small scale farm households live into the disease and insect pest free area - Incorporating the private sector into the program activities
Promotion of technical innovation and improvement of business administration	- Establishing the business center network in Chile Foundation (Fundación Chile) - Incorporating 12 business administration centers into the network - Expanding INDAP long-term loan by competition - Doubling the covered area by FAT and PROFOS (CORFO) through the 25% increase of the subsidies against 4,000 producers - Improvement of the CRI (INIA)'s administration - Easing the access to modern technologies for small scale farmers through the cooperation between INIA and INDAP - Strengthening FIA as the fund's resource for technological innovation and expanding its activities - Applying INDAP to 35,000 producers through SAP and SAL
Development and improvement of markets	- Strengthening the institutions which concerned with adjustment of competition in domestic and international markets - Establishing the fund for the markets' distortion survey - Strengthening the monitoring system for the markets' distortion and monopolization - Considering a harvest guarantee system and income stability institutions by the private sector - Approving the regulation of labeling exporting vegetables and fruits - Extending the utilization of a promoting agricultural export fund - Implementing and expanding the agreement on animals and plants in quarantine at the relevant foreign markets
Forestry development	- Forestation for the small scale farmers' owned land (10,000 ha) - Normalizing the land ownership of 3,000 households - Strengthening the monitoring function of CONAF - Incorporating the private sector into the activities of disease and insect pest prevention and the fire monitoring - Promoting the conservation of virgin forests - Promoting the establishment of the Virgin Forest Law

Notes; * the Law No.18,450: when an irrigation project is executed under the Law of Promoting Irrigation Project, the subsidy can be obtained by the proposal system

** epidemic free animals and plants resources: the high reputation of Chilean agricultural products in the international market is the reward of efforts to prevent epidemics and maintain good sanitary conditions. Thus, this situation is called "resource" or "heritage".

2.3.2 Principles of Agricultural Development in the Metropolitan Area

The authority of the Metropolitan Region aims at sustainable agricultural development based on environmental conservation. The environmental conservation will be achieved by conservation of natural resources such as "land and water." In the policy for the population increase in the metropolitan area, it is recognized that development and promotion of suburban agricultural area are important subject to be solved.

(1) Natural resources

The agricultural production in the Metropolitan Region which occupies the important place in Chile. Particularly, it plays the main role in the production and supply of vegetables and fruits. Yet, the surroundings of land and water with the agriculture in the Metropolitan Region have been deteriorated and causes stagnating and decreasing the agricultural production.

1) Land resource

Thirty percent of the fertile farmland with irrigation among total of that in Chile is located in the Metropolitan Region. Even so, expansion of urban area has led to decreasing the area of farmland, and then aggravating the surroundings of farming. In Santiago city, the most fertile farmland with irrigation has been decreasing in the past 20 years because of expanding the urban area and industrialization. The agricultural production has been also decreasing. One of the specific reasons is that urban sprawl has been progressing in the fertile farmland because farmland has been sold as sub-divided housing lots with 0.5ha farmland mainly in Santiago suburbs. Accordingly, the legislative control of land use is the important issue to be considered from the view of protecting farmland from urban sprawl and promoting the agriculture in the metropolitan area.

2) Water resource

The authority of the Metropolitan Region manages water distribution to the agriculture, domestic use, and the other industries, and then tries to keep agricultural water. Aiming at effective water use in the metropolitan area, there are three targets; a) water source development on the Maipo river basin, b) optimum water distribution, and c) water management in overall basin. From the view of agriculture, there are two targets;

- Effective utilization of irrigation water
- Water quality conservation of irrigation water

Regarding to the water quality conservation, 85% of irrigated farmland in the Metropolitan Region is regarded as the water contamination area. EMOS had established the Master Plan on the sewerage disposal system in the Metropolitan Region, and has already started the project which intends to complete until 2024. However, vegetable cultivation with contaminated irrigation water is limited in the Metropolitan Region at present. Although the vegetable cultivation in the metropolitan area occupies 28% of that in whole country, it has been decreasing in the recent years. The Ministry of Health and Welfare recommends vegetable cultivation with groundwater or non-contaminated water. The countermeasures for water quality, which protect the agriculture are important for following about 25 years, or in the other words, until the sewerage-disposal plant is operated by EMOS.

(2) Others

The supporting policies on agricultural production activities under the guidance of INDAP are as follows;

- Cultivating technique and credit system's utilization
- Water saving irrigation
- Effective land use with cultivation in green houses
- Expanding financial support for promoting small farmers' intensive agriculture
- Providing information on marketing of agricultural production and enforcing organizations and technique

The authority of the Metropolitan Region also intends to conserve the virgin forestry (2,700 ha), distribute planting stocks to ward offices and farm households, and forestation support for small farmers to produce fire wood.

2.3.3 Agricultural Development Activities in the Study Area

(1) Irrigated agricultural development

1) Irrigation projects in the Maipo river basin

The study on the irrigation projects in the overall Maipo river basin was started in 1970 by MOP (Dirección de Riego). This was "*Estudio de los recursos hidrológicos de la hoya del río Maipo*." The Study examined the potential of water resources in the Maipo river basin, and agricultural development in the overall Maipo river basin. Then, the basic plan of agricultural development in the Maipo river basin was presented. Afterward, MOP implemented various surveys on the irrigation projects in the Maipo river basin. Yet, after the Irrigation Law (the Law No.1123) enacted in 1981, the responsibility of the study was transferred to CNR. The water resources evaluation and the soil survey in the Maipo basin were implemented in 1981. Furthermore, the water balance study on the overall basin and the agro-climatic survey were implemented in 1984 and 1987 respectively.

2) The relevant projects by MOP

The other surveys in the objective area by MOP were as follows;

a) *Factibilidad técnica Embalse Pirque. Estudio Hidrogeológico* (1981), (MOP-DDR)
b) *Estudio de Factibilidad para Abastecer El Canal Las Mercedes Con Aguas Superficiales Reguladas y Aguas Subterráneas del Estero Puangue* (1993), (MOP-DDR)
c) *Proyecto Regadío Cuncumen* (1993), (MOP-DDR)
d) *Proyecto Regadío las Brisas de Santo Domingo* (1993), (MOP-DDR)

3) The other projects

According to the Law of Promoting Irrigation Projects No. 18450 which was established in 1985, it is possible to implement irrigation projects with the application from beneficiaries. Yet, there had been no actual results in the study area. The rehabilitation of existing facilities are implemented by beneficiaries themselves.

Table 2.2.1 Gross Domestic Product by Economic Activity (1995-1997)

Economic Activity	(Million 1986 Chilean $)			(Annual Growth Rate %)			(Sectoral Weight %)		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
Agriculture, Livestock, Forestry	464,295	476,478	466,579	5.2	2.6	-2.1	6.83	6.53	5.97
Fishing	100,040	109,628	118,269	15.9	9.6	7.9	1.47	1.50	1.51
Mining	527,800	596,215	644,274	9.3	13.0	8.1	7.76	8.17	8.24
Manufacturing	1,104,750	1,143,266	1,194,017	7.5	3.5	4.4	16.24	15.66	15.27
Electricity, Gas, Water	166,945	168,971	185,023	7.6	1.2	9.5	2.45	2.31	2.37
Construction	356,179	388,372	414,827	9.9	9.0	6.8	5.24	5.32	5.31
Commerce, Hotel, Restaurant	1,133,117	1,239,255	1,340,834	14.2	9.4	8.2	16.66	16.97	17.15
Transport, Communications	518,310	572,878	646,665	14.7	10.5	12.9	7.62	7.85	8.27
Financial services	915,060	981,183	1,053,955	9.8	7.2	7.4	13.45	13.44	13.48
Housing	237,006	244,441	253,517	2.9	3.1	3.7	3.48	3.35	3.24
Personal Services	422,005	439,119	457,400	3.2	4.1	4.2	6.21	6.01	5.85
Public Administration	162,933	165,160	167,403	1.4	1.4	1.4	2.40	2.26	2.14
Subtotal	6,108,440	6,524,966	6,942,762	9.2	6.8	6.4	89.82	89.36	88.81
Less: Bank Charges	444,527	476,532	512,200	8.5	7.2	7.5	6.54	6.53	6.55
Less: IVA	616,869	673,297	717,718	10.6	9.1	6.6	9.07	9.22	9.18
Plus: Import Duties	520,170	580,238	669,386	28.5	11.5	15.4	7.65	7.95	8.56
Gross Domestic Product	6,800,952	7,301,969	7,817,666	10.6	7.4	7.1	100.00	100.00	100.00

Source: Boletin Mensual, Banco Central de Chile, No. 845, Julio 1998

Table 2.2.2 Employed Population by Economic Activity (1995-1997)

Economic Activity	(Thousand Persons)			(Sectoral Share)		
	1995	1996	1997	1995	1996	1997
Total Employment	5174.4	5298.7	5380.2	100.00	100.00	100.00
Agriculture & Fishing	841.7	816.4	775.9	16.27	15.41	14.42
Mining & Quarry	87.7	90.6	87.9	1.69	1.71	1.63
Manufacturing	830.5	859.6	860.8	16.05	16.22	16.00
Construction	396.2	417	488.8	7.66	7.87	9.09
Electricity, Gas & Water	30.3	41.7	31.1	0.59	0.79	0.58
Commerce	947.1	931.9	975.9	18.30	17.59	18.14
Financial Services	330.9	369.4	376.5	6.39	6.97	7.00
Personal, Communal & Social Services	1312.5	1377.9	1382.4	25.37	26.00	25.69
Transport & Telecommunications	395.3	393.9	401	7.64	7.43	7.45
Unspecified Activities	0.0	0.2	0.0	0.00	0.00	0.00

Source: Boletin Mensual, Banco Central de Chile, No.845, Julio 1998

Table 2.2.3 Foreign Trade of Chile: Export Value (1995-1997)

Export Products	(Million US$ FOB)			(Sectoral Share %)		
	1995	1996	1997	1995	1996	1997
AGRICULTURE	1,530.40	1673.9	1637	9.31	10.87	9.62
Agriculture	162.7	161.5	172.1	0.99	1.05	1.01
Fruit	1,161.8	1,345.8	1,291.8	7.06	8.74	7.59
Livestock	29.6	26.4	26.8	0.18	0.17	0.16
Forest Products	147.7	111.2	116.4	0.90	0.72	0.68
Fishery	28.6	29.0	29.9	0.17	0.19	0.18
MINING	7,984.1	7,101.7	8,243.1	48.55	46.13	48.42
Copper	6,646.8	5,881.0	6,975.8	40.42	38.20	40.97
Others	1,337.3	1,220.7	1,267.3	8.13	7.93	7.44
MANUFACTURING	6,876.3	6,510.7	7,050.9	41.81	42.29	41.42
Food & Feed	2,626.2	2,729.8	2,684.1	15.97	17.73	15.77
Beverage, Liquor & Tobacco	223.2	342.0	470.3	1.36	2.22	2.76
Textiles & Apparel	149.9	172.0	193.3	0.91	1.12	1.14
Hide, Leather, Shoes	32.7	26.9	33.0	0.20	0.17	0.19
Wood Furniture	734.5	729.2	838.0	4.47	4.74	4.92
Paper, Cardboard, Cellulose	1,628.5	952.9	966.3	9.90	6.19	5.68
Chemicals, Petroleum, Plastics	822.6	771.5	1,014.2	5.00	5.01	5.96
Ceramics, Glass, Non-metallic	28.3	33.0	41.9	0.17	0.21	0.25
Iron, Steel, Non-ferrous	220.8	198.3	200.3	1.34	1.29	1.18
Machinery, Equipment, Electric.	237.1	347.4	385.5	1.44	2.26	2.26
Transportation Materials	145.6	177.3	201.4	0.89	1.15	1.18
Unspecified Manufacturing	26.9	30.4	22.6	0.16	0.20	0.13
OTHERS	53.9	109.9	93.8	0.33	0.71	0.55
TOTAL	16,444.7	15,396.2	17,024.8	100.00	100.00	100.00

Source: Indicadores de Comercio Exterior, Banco Central de Chile, Abril 1998

Table 2.2.4 Foreign Trade of Chile: Import Value (1995-1997)

Import Products	(Million US$ CIF)			(Sectoral Share %)		
	1995	1996	1997	1995	1996	1997
CONSUMPTION GOODS	2,668.6	3,160.2	3,480.5	17.39	18.21	18.43
AGRICULTURE	39.1	41.0	45.3	0.25	0.24	0.24
MANUFACTURED PRODUCTS	2,629.5	3,119.2	3,435.0	17.13	17.97	18.19
Food, Beverage, Liquor, Tobacco	171.8	176.5	215.9	1.12	1.02	1.14
Textiles, Apparel, Leather Goods	450.6	602.0	647.1	2.94	3.47	3.43
Wood, Paper, Printing Goods	94.7	115.0	142.0	0.62	0.66	0.75
Chemicals, Oil Products	296.7	411.9	456.5	1.93	2.37	2.42
Non-mineral Metal Products	46.8	56.0	58.0	0.30	0.32	0.31
Metal Products, Machin. & Equip.	1,420.9	1,589.1	1,724.5	9.26	9.16	9.13
Other Manufactured Products	148.0	168.7	191.0	0.96	0.97	1.01
ART WORKS	0.0	0.0	0.2	0.00	0.00	0.00
CAPITAL GOODS	4,091.3	4,651.6	5,166.7	26.66	26.81	27.35
AGRICULTURE	0.9	1.5	1.5	0.01	0.01	0.01
MACHIN. & EQUIP., TRANSPORT	4,087.8	4,645.2	5,161.3	26.63	26.77	27.33
ART WORKS	2.6	4.9	3.9	0.02	0.03	0.02
INTERMEDIATE GOODS	8,138.2	8,992.8	9,458.0	53.02	51.82	50.07
AGRICULTURE	321.0	428.7	342.3	2.09	2.47	1.81
MINING	1,227.1	1,457.7	1,432.1	8.00	8.40	7.58
Petroleum, Carbon, Organic Min.	1,028.1	1,366.6	1,331.3	6.70	7.88	7.05
Copper, Iron, Other Minerals	199.0	91.1	100.8	1.30	0.52	0.53
MANUFACTURED PRODUCTS	6,587.8	7,104.1	7,680.7	42.92	40.94	40.66
Food, Beverage, Liquor, Tobacco	535.0	649.2	715.5	3.49	3.74	3.79
Textiles, Apparel, Leather Goods	493.5	488.9	494.3	3.22	2.82	2.62
Wood Products	44.7	63.0	84.1	0.29	0.36	0.45
Paper, Printing Products	428.8	348.1	387.9	2.79	2.01	2.05
Chemicals, Oil Products	2,353.3	2,646.7	2,757.1	15.33	15.25	14.60
Non-mineral Metal Products	156.6	194.1	219.9	1.02	1.12	1.16
Basic Metal Products	630.7	572.9	688.9	4.11	3.30	3.65
Metal Products, Machin. & Equip.	1,903.8	2,098.6	2,288.6	12.40	12.09	12.12
Other Manufactured Products	41.4	42.6	44.4	0.27	0.25	0.24
ART WORKS	2.3	2.3	2.9	0.01	0.01	0.02
OTHERS	162.5	170.4	225.5	1.06	0.98	1.19
Simplified Procedures, Postal	157.6	164.9	218.8	1.03	0.95	1.16
Remainder	4.9	5.5	6.7	0.03	0.03	0.04
Subtotal	15,060.6	16,975.0	18,330.7	98.13	97.82	97.05
Free Trade Zones	287.7	378.1	557.6	1.87	2.18	2.95
TOTAL	15,348.3	17,353.1	18,888.3	100.00	100.00	100.00

Source: Indicadores de Comercio Exterior, Banco Central de Chile, Abril 1998

CHAPTER 3

PRESENT CONDITION OF THE STUDY AREA

3 PRESENT CONDITION OF THE STUDY AREA

3.1 Rural Society and General Information

3.1.1 Area and Population

Administrative organization in Chile divide into Nation, Region (*Región*), Province (*Provincia*) and Community (*Comuna*) . Basically, community is the end-organization on the national administration. The study area consists of the Metropolitan Region and the parts of the V and VI Regions which includes 9 provinces and 64 communities. Total area of the study is about 19,500 km^2 and population is about 5.5 million in total. Details are as follows.

Region	Province	Community	Area (km^2)	Population
V Region	Valparaíso	Valparaíso(Penuelas)	120.0	639
		Casablanca	870.5	16,590
	San Antonio	San Antonio	404.5	78,158
		Cartagena	245.9	11,906
		El Tabo	98.8	4,513
		El Quisco	50.7	6,097
		Algarrobo	175.6	5,968
		Santo Domingo	536.1	6,218
VI Region	Cachapoal	Graneros	112.2	22,453
		Mostazal	522.9	18,138
		Codegua	284.6	9,600
		Las Cabras	747.1	17,738
Metropolitan	Santiago	Santiago	23.0	230,977
		Independencia	7.4	77,794
		Conchali	10.6	152,919
		Huechuraba	44.3	61,784
		Recoleta	15.0	164,767
		Providencia	14.2	111,182
		Vitacura	28.6	79,375
		Lo Bamechea	1,029.5	50,062
		Las Condes	98.5	208,063
		Nunoa	16.3	172,575
		La Reina	23.3	92,410
		Macul	12.3	120,708
		Penalolen	54.9	179,781
		La Florida	70.2	328,881
		San Joaquin	9.9	114,017
		La Granja	10.0	133,285
		La Pintana	30.3	169,640
		San Ramon	6.6	100,817
		San Miguel	9.5	82,869
		La Cisterna	10.0	94,712
		El Bosque	13.9	172,854
		Pedro Aguirre Cerda	8.8	130,441
		Lo Espejo	8.1	120,075
		Estacion central	14.3	140,896
		Cerrillos	19.0	72,649
		Maipu	133.0	256,550
		Quinta Normal	11.6	116,349
		Lo Prado	6.6	110,933
		Pudahuel	196.5	137,940
		Cerro Navia	11.0	155,735
		Renca	22.8	128,972
		Quilicura	56.6	41,121
	Chacabuco	Colina	966.8	52,769
		Lampa	449.4	25,033
		Tiltil	650.0	12,838
	Cordillera	Puerlte Alto	87.8	254,673
		San Josede Maipo	4,977.9	11,646
		Pirque	441.2	11,368

To be continued

Region	Province	Community	Area (km^2)	Population
	Maipo	San Bemardo	154.8	190,857
		Buin	212.3	52,792
		Paine	675.6	37,529
		Calerade Tango	73.2	11,843
	Melipilla	Melipilla	1,338.9	80,255
		Maria Pinto	393.5	8,735
		Curacavi	691.2	19,053
		Alhué	840.6	4,013
		San Pedro	788.5	6,746
	Talagante	Talagante	124.4	44,908
		Penaflor	68.8	50,148
		Isla de Maipo	189.1	20,344
		El Monte	117.6	21,882
		Padre Hurtado	80.8	29,372
TOTAL			19,517.9	5,455,955

Based on the Census in 1992 carried out by INE, the population in the study area was 5,455,955. The population according to the resident registration in 1996 is 5,922,046 and annual population growth rate is 1.7%. While about 96% of the total population lives in urban areas, 230,000 or 4% of those in rural areas, according to the Census in 1992. The transition of the population in the study area is as follows;

Item	Population			% of Rural
	Total	Urban	Rural	
Census 70	3,285,542	3,046,056	239,486	7.29
Census 82	4,458,995	4,254,958	204,037	4.58
Census 92	5,455,955	4,255,907	228,135	4.18
92/70	1.66	1.66	0.95	0.58

Transition of the population in the Census has been increasing because the study area involves the capital city of Santiago. Compared the Census in 1970 with that in 1992, the increase is mainly due to concentration of the population in the urban areas. The rural population has been slightly decreasing. However, compared three censuses in 1970, 1982, and 1992, even though the rural population had decreased drastically in 1982, the population in many communities (*Comuna*) increased in 1992. This means that the rural population tends to go back to the level of 1970 in recent years.

Compared the Census in 1970 with the Census in 1992, 12 communities in rural areas show decrease of the population. Among them, 6 communities, Puente Alto, Huechuraba, La Florida, Quilicura, Penaflor, and El Tabo, depicts more than 50 % decrease. On the other hand, 23 communities show population increase. Among them, 2 communities, Colina, Tiltil, show more than 50% increase.

The reasons why some communities show the population decrease might be migration of persons who quit agriculture and of young generations to the urban areas. This is particular in communities located in mountainous areas. On the other hand, the communities which show the population increase are located mainly around the metropolitan area of Santiago and the surroundings of local cities. Especially, the communities which show more than 50 % increase of population are the areas which involve sub-divided housing lot with farm land.

3.1.2 Rural Society

(1) Structure

Rural society in Chile was drastically changed from the simple structure, which there are the owners of large plantations and their labor farmers, by enforcing Agrarian Reform Law (*Ley de Reforma Agraria*) in 1962. The Agrarian Reform was proceeded

under Agrarian Reform Corporation (CORA: *Corporación de Reforma Agraria*) and small scale owner farmers who held about 8.5ha irrigation farmland (BIH: Basic Irrigated Hectares) were created. Allen Administration (1970~1973) combined large scale farmers with state farms and cooperative farms. However, military administration in 1974 redistributed these state farms and cooperative farms as private land and approved the land ownership of about 110,000 small scale owner farmers. Agrarian Reform was finished in 1978. Accordingly, rural communities consist of large number of these small scale farmers and their families, and small number of medium and large scale agricultural enterprises (most of them is business type agricultural management).

As mentioned above, the present rural society is a newly created society which consists of new and old landholders. Therefore, forming communal society as an unity of inhabitants has been not matured yet. The field of community as unit itself is vague. Take an example, so as to determine the community as an unity of inhabitants, "*Distrito*" which is the survey division of the Census for indicating a fundamental community, or the classification by population scale; *Ciudad* (city), *Pueblo* (town), and *Aldea* (village) has been used. They do not represent the community as a social unit but are just classifications in statistics. However, this does not mean that no social unit is formed. The living field of inhabitants is formed by setting churches and schools as the center. Moreover, *Juntas de Vecinos* (JJVV) have been formed as territorially related inhabitants' groups by man and women who are older than 18 year old .

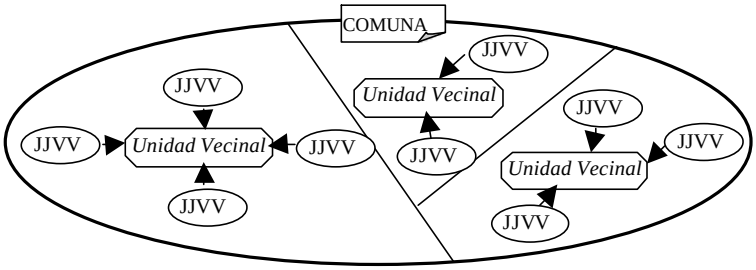
On the other hand, after transferring to civil administration in 1990, restoration of local election in 1992 induced active promotion of decentralization such as expanding local government finance. Corresponding with this, social policy extended into the fields of education, welfare, dwellings, labor, the administration of justice, and so on. In the administrative organizations of Chile, principally *Comuna* is the terminal of national administrative organizations. So as to promote decentralization, *Comuna* is divided into some blocks. This classification was primarily the living field based in order to promote the operation of *Comuna* effectively based on participation of inhabitants. This administration block is called *Unidad Vecinal* (UV).

UV is the unity whose constituents are JJVV that are territorially related self-governing communities. Therefore, it can be said that JJVV are the terminal organizations of administration and they are equal to so-called fundamental communities. So as to promote decentralization, the right of self-government was established for JJVV and its integrated unit, UV legally by Ley No.19,483 (*D.O., 30 de Noviembere de 1996*).

The summary of UV and JJVV is shown in the table below.

Unidad Vecinal (UV)	*Juntas de Vecinos* (JJVV)	*Vecinos*
Organization which tends un-concentration of operating *Comuna* and promotion of participation of inhabitants. It has the right of juridical person who does not seek profit-making for its development and benefit.	Community organization which represents inhabitants in UV. It cooperates with the nation and local government concerned to promote regional development, and protect inhabitants' benefit and right.	Individual inhabitants who settle in UV. The members of JJVV are inhabitants who are older than 18 years old and they have to register JJVV.

Relation between UV and JJVV in *Comuna* is shown in the figure below. In *Comuna*, there are some UVs.



However, some *Comunas* use the survey divisions (*Distrito*) for the Census as administrative divisions. The administrative classification is not well organized yet because the concept of UV is relatively new. In many cases, UV does not correspond with *Distrito*. Because *Distritos* have the characteristics of the survey divisions which divided by roads and rivers. On the contrary, UV which consist of JJVVs are based on territorially related connection. Thus , the gaps between UV and *Distritos* can be often seen.

(2) Human resources

In rural areas in the study area, about 95% of inhabitants engage in agriculture. According to the landholding scale of farmers, about 75%, 19% and 6% of total farmers are small scale farmers, medium scale farmers, and large scale farmers, respectively. Among them, large scale farmers mostly carry out business enterprise type farming and do not live in rural areas. On medium scale farmers, only about 50% of them live there. Therefore, most constituents of rural society are small scale farmers, and rural society is managed and operated by small scale farmers.

Although small scale farmers include tenants of large plantations and the second or the third sons of farm households, most of them are entrants into agriculture. Therefore, standard of agricultural technology is generally low, and they cannot develop farming eagerly. As a result, many farmers had to quit agriculture or leave communities. Accordingly, so as to establish stable farm management, public relations and extension of support services against farmers and the support system for guidance and training to change the present situation are indispensable, and the national government intends to strengthen the support system through INDAP and INIA as policy. Nevertheless, the support services have not so penetrated farmers that the methods of expanding the support services to all farmers are big problems. Moreover, overcoming this problem brings about development of human resource in rural areas.

Age composition of population in the study area represents almost same shape with national average one. Yet, the ratio of economically inactive population (0-15 years old and older than 65 years old) is higher, 32% while the main population of economic production activities (from 31 to 50 years old) is lower than national average ones. This might be caused by following reasons; the principal industry in the area is agriculture and the area is a pure farm village area where most of inhabitants engage in agriculture; a part of economically active population demand job opportunities out of regions' cities and its surroundings because it is relatively close to the metropolitan area of Santiago. Therefore, it is indispensable to obtain human resources for promoting regional industries and regions. Decreasing of young and middle aged generations is a problem of obtaining the successors for next generation.

In order to obtain human resources, securing job opportunities is important for the part of rural permanent settlement. In the strawberries' cultivation and its processing system in *Comuna* San Pedro, creating special products and obtaining job opportunities are combined. This system can be considered the model for regional permanent settlement in the future.

(3) Communities

The smallest unit as a group in the study area is JJVV as mentioned above. Because JJVV is formed through territorially related connection, it can be regarded as an unit community. Thus, hereafter, when the report says "community," it refers to JJVV. The communities in the study area are extended into both sides of main roads and shape row communities. There are few concentrated communities and dense communities. This is because farmland was divided at right angle along with roads and distributed with long and narrow shaped. So, farm households constructed their houses along with roads, and then this shape was formed. Consequently, farmland and houses are located in the same sections.

It is hard to form the centers of communities because each community shapes this kind of row communities but the places where public facilities such as churches and schools are located are regarded as the centers of the communities. Distance between communities is ranged approximately from 1km to 4km.

The communities are operated by mainly JJVVs. Ratio of those who join in the organizations is from about 50% to 70%. At present, integrated general opinions have not been achieved, yet.

(4) Rural organizations

As the organizations which form rural society, there are a fundamental organization which is an integrated self-governing body, UV, JJVV which is a self-governing body of communities, Center of Mother (*Centro de Madres*) which is the organization for improving women's education, Sports Club (*Clubes Deportivos*), Aid Committee (*Comités Allegados*) which is the organization for supporting poor households, Juveniles Group (*Grupos Juveniles*) which is the activity group of young generation, Culture Club (*Centros Culturales*) which is the club for fostering general education and so on. The activities of these organizations promote self-governmental activities with deepening mutual help and relationship among inhabitants in the study area.

The fundamental of each organization is JJVV, and its integrated unit is UV. So, basically each organization is formed JJVV. Forming JJVV, the mother bodies are often territorially related groups. The membership is the inhabitant who is older than 18 years old. President, director general, and secretary are selected by mutual vote. JJVV have to submit a members' list to *Comuna*, hold general meeting, and make an annual report. Each JJVV holds monthly meetings and discusses the present facing problems, the direction of regional operation, project plans, and so on.

On the other hand, there are producers' organizations by farmers and canal organizations by water right holders. They are not limited by UV and *Comuna* but formed as wide-ranged organizations which specialize their objectives and functions. The organizations are operated with general opinions of the members, democratically. Particularly, producers' organizations are formed fundamentally by medium and small scale farmers. When they are formed, support institutions such as INDAP provide support services.

(5) Gender

According to the data of MIDEPLAN-CASEN 96 (Socio-economic Characterization Survey), the effect of economic growth and social policy is shown, for example, the percentage of poor and extremely poor households got about halved, compared with 1987. Nevertheless, income disparity has not shrunken but relatively expanded. The same data also determines the extreme poverty lines (*Indigente*) by the

cost of food baskets (sum of the food prices to satisfy the nutritious level for subsistence and non-food prices for subsistence) ; $17,136/month in urban areas, and less than $13,204/month in rural areas and that the poverty lines (*Pobre No Indigente*) are $34,272/month in urban areas and less than $23,108/month in rural areas.

Changes of population ratio of the poor (%) in Chile is as follows;

	1987	1990	1992	1994	1996
The extremely poor	17.4	12.9	8.8	7.6	5.8
Not extremely poor	27.7	25.7	23.8	19.9	17.4
The poor	45.1	38.6	32.6	27.5	23.2

The present administration sets poverty eradication as the important problem of policy, and implements various projects through Fund for Solidarity and Social Investment (FOSIS), and so on. These projects are not just distribution of subsidies and welfare but implemented with the aim at independence of the social vulnerable and participation of the poor in the process of development through expanding primary and vocational education, measurements for women and young generation, and support for middle and small enterprises.

On the poverty situation in the study area, the situation of *Comuna* Melipilla which is a typical rural area is summarized as the table below based on CASEN 96.

	Comuna Melipilla	Metropolitan Area	Nation
Extremely poor	3.4	2.7	5.8
Not extremely poor	13.3	12.1	17.4
Total	16.7	14.8	23.2

According to the table above, both the extremely poor and the poor are smaller than the national average, but both of them are higher than those of the Metropolitan Region as a whole. Improving poverty in rural areas is a objective. Thus, it is important to promote economic self-independence of small scale farmers.

On the other hand, education plays a big role to alleviate poverty. Improvement of educational environment has been implemented, actively. This results in drastic improvement of illiteracy rate. The change of illiteracy rate is shown in the table below.

	1990	1991	1992	1993	1994	1995	1996	1997
Illiteracy rate	6.3	6.1	5.7	5.2	4.9	4.9	4.8	4.7

According to CASEN 96, illiteracy rate by region in the study area is as follows;

	Urban areas			Rural areas			Total		
	Man	Woman	Total	Man	Woman	Total	Man	Woman	Total
Vth Region	2.2	3.2	2.7	9.5	7.4	8.5	3.0	3.6	3.3
VIth Region	4.9	4.8	4.8	13.9	14.6	14.2	8.2	8.0	8.1
MR	1.8	3.0	2.4	9.6	7.1	8.4	2.1	3.1	2.7
Chile	2.6	3.8	3.2	12.9	14.3	13.6	4.4	5.3	4.8

In the study area, the illiteracy rate of the VIth Region is extremely high, and it shows more than twice as much as the national average. The illiteracy rate in rural areas is about five times as much as that in urban areas. There is a big gap between urban and rural areas. Therefore, improvement of educational environment in rural areas will be the problem to be solved in the future.

Social advance of women in Chile started with acceptance of girls' students to elementary schools in 1810. Association for women's right is established in 1933, and

women's right of vote established legally in 1949. In 1971, Recommendation on Equality of Job Opportunity Between Men and Women by ILO ratified. As a result, advance of women to various fields such as public officers, teachers, health and sanitary, and institutions has been activated, but this is not a situation in rural areas.

In many cases, women's share of works in rural areas is limited to housework and bringing up children. The concept that men work outside and women protect houses takes root. Therefore, women are isolated from the activities of JJVV and economic activities. The reason of this situation is that there are not enough training and education of skills for economic independence and of organized activities for women. At present, advance of women in various fields is active, but is not penetrated enough in rural areas. Dealing with this, INDAP promotes the support program for rural women's independence (PRODEMU) with National Service of Women, SERNAM. PRODEMU promotes participation of women on the field of green house cultivation and agricultural processing as the main activity. Not so many, but there are some organizations which are working with acquisition of skills for economic independence through forming producers' organizations by women. Accordingly, the activities for improving rural women's status are taking root, gradually. So as to establish this tendency more effectively, forming organizations of women in community level is needed. For this, improvement and construction of the base facilities for interchange among rural women and the support system for forming organization are indispensable.

3.1.3 Sub-basin Division

To grasp the basin characteristics in regional-wise, the study area is divided into 12 sub-basins based on administrative and basin boundaries. The sub-basins are as follows;

	Sub-basin	Communities(*Comuna*)		
1	Río Maipo Alto	Puente Alto	San Jose de Maipo	
2	Río Clarillo	Pirque		
3	Río Mapocho Alto	Santiago	Independencia	Conchali
		Huechuraba	Recoleta	Providencia
		Vitacura	Lo Barnecha	Las Condes
		Nunoa	La Reina	Macul
		Penalolen	La Florida	San Joaquin
		La Granja	La Pintana	San Ramon
		San Miguel	La Cisterna	El Boaque
		Lo Espejo	Pedro Aguire Cerda	Cerrillo
		Maipu	Estacion Central	Quinta Normal
		Lo Prado	Pudahuel	Cerro Navia
		Renca	Quilicura	
4	Est. Lampa	Colina	Lampa	Tiltil
5	Río Mapocho Bajo	San Bernardo	Calera de Tango	Talagante
		Penaflor	El Monte	Padre Hurtado
6	Río Angostura	Graeros	Mostazal	Codegua
		Buin	Paine	Isla de Maipo
7	Est. Alhué	Las Cabras	Ahué	
8	Cue. Melipilla	Melipilla		
9	Est. Puangue	Maria Pinto	Curacavi	
10	Est. Yali	Santo Domingo	San Pedro	
11	Cue. San Antonio	San Antonio	Cartagena	El Tabo
12	Est. Casablanca	Casablanca	El Quisco	Algarrobo
		Penuelas		

Distribution of communities and sub-basin division are shown in Fig.3.1.1 and Fig.3.1.2 respectively.

The population of each sub-basin is as follows;

	Population Census 92			Urban			Rural			%Rural population		
	Total	Urban	Rural	82/70	92/82	92/70	82/70	92/82	92/70	70	82	92
1. Río Maipo Alto	266,319	262,038	4,281	1.67	2.22	3.71	0.36	0.78	0.28	17.70	4.44	1.61
2. Río Clarillo	11,368	2,640	8,728	1.09	8.71	1.43	1.24	1.04	1.29	84.63	96.50	76.78
3. Río Mapocho Alto	4,311,133	4,298,240	12,893	1.36	1.18	1.60	0.59	0.71	0.42	1.13	0.49	0.30
4. Est. Lampa	90,640	60,910	29,730	1.96	1.56	3.07	0.91	1.64	1.50	50.03	31.73	32.80
5. Río Mapocho Bajo	349,010	313,459	35,551	1.75	1.46	2.57	0.98	0.96	0.94	23.63	14.75	10.19
6. Río Angostura	160,856	108,199	52,657	1.82	1.36	2.47	0.89	1.06	0.95	55.89	38.39	32.74
7. Est. Alhué	21,751	6,116	15,635	1.49	0.82	1.23	0.87	1.43	1.24	71.68	59.55	71.88
8. Cue. Melipilla	80,255	51,306	28,949	1.28	1.23	1.60	0.96	1.28	1.22	47.32	35.26	36.07
9. Río Puangue	27,788	12,999	14,789	1.56	1.25	1.95	1.01	1.32	1.33	62.48	51.83	53.22
10. Est. Yali	12,964	2,081	10,883	2.96	0.96	2.85	0.91	1.23	1.13	92.97	80.35	83.95
11. Cue. San Antonio	94,577	89,268	5,309	1.34	1.18	1.59	0.70	1.17	0.82	10.28	5.64	5.61
12. Est. Casablanca	29,294	20,564	8,730	1.59	1.31	2.08	0.89	1.06	0.95	48.25	34.45	29.80
Total	5,455,955	5,227,820	228,135	1.36	1.23	1.66	0.85	1.12	0.95	7.29	4.58	4.18

3.2 Natural Resources

3.2.1 Geology

Chile locates the part of volcanic and seismic zones in the Pacific Rim. The downgoing plate from the Pacific Ocean to the South American Continent forms the upheaval of the Andes mountains and volcanic and seismic zones exist in the country. To explain outline of geology in the study area, the area can be divided into 5 zones; the Andes mountains, the front part of the Andes mountains, the central basin, the coastal mountains, and the coastal plain.

(1) The Andes mountains

The Andes mountainous zone consists of sedimentary and volcanic rocks which deposited from the Mesozoic Jurassic period to the Mesozoic Cretaceous period. These rocks are folded drastically by orogenic movement or are displaced by faults. These axes of the fold and the fault lines are stretched from almost north to south not only in the study area but also in overall Chile. This orogenic movement was active from the Tertiary to the beginning of the Quaternary periods. One of the movements was intrusion of granodiorite during the Miocene of the Tertiary period. The size of this rock is about 2 to 20 km, and exposes many places such as in the main stream of the Maipo river. Furthermore, this orogenic movement has continued during the Quaternary period . One of the movements has been volcanic activity since the end of the Tertiary period. The andesite series, which has extruded from the Mesozoic deposit, are stretched as high mountains. The volcanoes which had been active during the Tertiary period became dormant volcanoes. On the other hand, the volcanoes which started their activities after the Quaternary period are still active volcanoes. There are three active volcanoes in the upstream of the Maipo river's tributary, the Volcán river. One of them, Mt. San Jose (Volcán San Jose, 5856m above the sea level) erupted violently in 1960.

(2) The front part of the Andes mountains

Geological structure of the front part of the Andes mountains consists of the upper part of the Mesozoic Cretaceous sedimentary rocks and the volcanic rocks which has erupted from the Tertiary Miocene to Pliocene. There is no new volcano. An axis of fold and a fault line stretch from north to south as same as the Andes mountains.

(3) The central basin

Base rock series of the central basin consist of almost the upper part of the

Mesozoic Cretaceous sedimentary rocks. Developed fault in the eastern part of the central basin depicts that the western part of that has sunk. There is no developed fault (zone), and no noticeable topographical change. There is no information to specify the starting era of the basin's depression, but it is estimated that the depression had been occurred in the beginning of the Diluvial epoch. The height of the depression is more than 450m. After forming the basin on the base rock, gravel flew into the central basin through rivers, and then alluvial fans were formed. The sediments of the alluvial funs include some stratums of pumiceous pyroclastic materials. Each river forms large or small alluvial fans, and also compound alluvial fans. After forming the alluvial fans, the Andes mountains and the front part of the Andes mountains still continues to be uphove. Thus, the surface of the alluvial funs has formed terrace by erosion. The top of the alluvial fans, which is from 25 to 30 m, has become terrace. Alluvial gravel bed has developed in the present river bed.

(4) The coastal mountains

The coastal mountains consist of the area which formed by the Mesozoic Cretaceous sedimentary rocks and volcanic rock series. The area was intruded by the granite series from the late Cretaceous period to the beginning of the Tertiary period. This coastal mountains are also uphove, but Alluvial and Diluvial deposits are developed widely because the large upheaval of the coastal terrace than the coastal mountains interrupt the rivers originating the coastal mountains..

(5) The coastal plain

The coastal plain consists of coastal terrace which is from 150 to 200m in relative height. The base rock is formed by the granite series which intruded in the Palaeozoic. The coastal terrace is covered by the Diluvial gravel deposit, but is divided by rivers. Poor alluvial deposit is spread along the present river bed.

Regarding the relationship between the water resources and geology, it should be considered that the dam site locates in the area which is not only orogen but also volcanic and seismic zones. Regarding the groundwater resources development, the sediments of the alluvial fans, which deposited on the depressed central basin in the process of the orogenic movement, can be considered as the main aquifer.

The summary of the geology in the study area is as follows. Moreover, Fig. 3.2.1 shows the geological map including the study area.

Period	Kinds of rock	Distributed area	Relationship with the water resources development
Alluvial age of the Quaternary period	sand・clay・gravel	The central basin, the present river bed・flooding area	Groundwater resources development
Diluvial age of the Tertiary period	sand・clay・gravel	Alluvial fans・terrace, the central basin・the coastal terrace	Groundwater resources development
The Miocene of the Tertiary period	Sedimentary rock series	The Andes mountains, the front part of the Andes mountains	Groundwater resources development
The Mesozoic period	Sedimentary rock series	The base rock in the central basin	Dam sites
The Tertiary period	Granodiorite	The Andes mountains	Dam sites
The Mesozoic period	Granodiorite	The coastal mountains	Dam sites
The Palaeozoic period	Granodiorite	The coastal terrace	Dam sites

3.2.2 Climate

Atmospheric dynamics in Chilean country is governed by the Pacific high pressure, a cold air mass from the South Pole, the Humboldt ocean current and the existence of the Andes Mountains. Climate in Chile can be classified into four from the north to south, arid, semi-arid, semi-humidity and humidity zones. The study area categorizes in semi- humidity zone and called the Mediterranean climate.

Most of the observatories, continuous observation is being carried out regarding the temperature, rainfall, evaporation and wind velocity though many lack of records can be found. The table below summaries major features of climatic condition within and near the study area. Cerro Calan may be considered representative of the basin situated between coastal mountains and the Andean Mountains, and Melipilla of the areas related to the coastal mountain areas.

Cerro Calan

Item	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Temperatura (ºC)													
Max.	34,6	34,2	33,2	30,5	26,7	24,0	24,5	26,4	28.2	29,9	32,7	34,2	29,9
Min.	10,2	9,8	7,9	5,5	3,2	1,0	0,6	1,0	1,9	3,4	5,4	8,1	4,8
Mean	22,2	21,8	20,1	16,6	13,2	11,1	10,5	11,3	12,6	15,3	18,2	20,8	16,1
Precipitación (mm)													
	0,9	2,3	5,6	25,2	65,0	85,6	105,9	66,5	42,2	20,6	11,3	7,4	438,1
Evaporación (mm)													
	189,6	155,9	125.4	61,6	31,4	18,5	20,8	33,4	53,0	102,6	137,3	181,0	1110,7
Humedad Relativa (%)													
	59,3	63,0	65,4	70,1	75,1	77,6	76,1	75,7	73,9	68,1	62,9	58,4	68,8
Horas de Sol (Hr)													
	11,4	10,6	8,6	6,4	4,4	3,6	4,0	4,9	5,6	8,0	9,7	10,7	7,3
Viento (km/month)													
	1156,4	815,5	721,0	441,3	294,8	286,1	404,7	437.4	598,0	780,1	955,6	1212,6	675,3

Melipilla

Item	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Temperatura (ºC)													
Max.	32,2	32,4	31,1	29,0	25,2	21,8	21,9	23,8	26,8	28,4	31,1	32,5	28,0
Min.	7,4	7,2	5,3	2,9	1,2	0,4	0,0	0,2	1,4	2,7	4,4	6,3	3.3
Mean	19,1	18,9	17,7	15,1	12,6	10,7	10,1	11,0	12,6	14,5	16,5	18,4	14,8
Precipitación (mm)													
	0,1	0,2	3,0	17,8	76,1	94,7	107,4	57,6	25,4	10,9	6,0	1,3	400,6
Evaporación (mm)													
	206,3	165,9	124,9	70,7	34,9	20,1	21,8	36,2	62,2	112,5	154,8	202,0	1212,4
Humedad Relativa (%)													
	60,1	62,5	66,3	70,9	77,5	80,7	80,1	77,1	72,9	67,2	62,5	58,7	69,7
Horas de Sol (Hr)													
	10,5	9,6	7,7	6,1	4,2	3,4	3,6	5,0	5,8	8,0	8,9	9,9	6,9
Viento (km/month)													
	1599,5	1158,1	877,9	508,1	526,5	693,6	845,6	751,2	900,3	1158,6	1381,8	1641,8	1003,6

(1) Rainfall

For estimation of average annual rainfall in the study area except the Andes Mountain areas, twelve (12) meteorological observatories were selected taking the location of observatories into account. Furthermore, to grasp the basin characteristics in regional-wise, the study area is divided into 12 sub-basins based on administrative and basin boundaries. Average monthly rainfall at each sub-basin is as follows taking the basin ratio estimated by the Theissen Polygon and the rainfall record at each meteorological station into account.

Unit : mm

No.	Station	Annual Average	85% Probability	No.	Station	Annual Average	85% Probability
1	Embalse Ruange	426,5	185,1	9	Las Melosas	904,5	554,1
2	Cerro Calan	438,1	252,7	10	Laguna Aculeo	625,5	280,6
3	Los Panguiles	357,5	182,8	11	Casablanca	366,1	206,8
5	Bocatoma Central la Ermita	501,8	185,2	12	Colliguay	596,5	317,3
6	Pirque	505,6	269,2	13	Rapel	486,8	292,6
8	Melipilla	400,6	212,6	14	Graneros	529,2	303,2

Unit: Area - km^2, Ratio - %, Rainfall - mm

Sub-Basin	Basin Area	Area Ratio	Annual Average		85% Probability	
			Sub-basin Rainfall	Areal Rainfall	Sub-basin Rainfall	Areal Rainfall
1 Río Maipo Alt	213	0,0158	503,6	7,9	225.0	3,5
2 Río Clarillo	441	0,0326	543,5	17,7	294.6	9,6
3 Río Mapocho Alt	1110	0,0821	432,6	35,5	238.8	19,6
4 Estero Lampa	1831	0,1355	434,7	58,9	246.3	33,3
5 Río Mapocho Bajo	620	0,0459	474,1	21,8	240.4	11,0
6 Río Angostura	1997	0,1478	598,1	88,4	315.0	46,5
7 Estero Alhué	1588	0,1175	562,9	66,1	288.8	33,9
8 Melipilla	1339	0,0991	428,1	42,4	219.7	21,7
9 Estero Puange	1085	0,0803	403,2	32,4	210.9	16,9
10 Estero Yali	1325	0,0980	470,0	46,1	277.0	27,1
11 San Antonio	749	0,0554	388,7	21,5	211.9	11,7
12 Estero Casablanca	1217	0,0900	373,1	33,6	210.2	18,9
	13515	1,0000		472,4		254,1

With above-mentioned average annual rainfall in the sub-basin, average annual rainfall in the study area can be estimated at 472 mm. Also annual rainfall under the condition of 85% exceedance probability is at 254 mm.

(2) Other meteorological items

The maximum air temperature in the study area except the Andes Mountains occurs in the mid of summer, December to February, and the minimum is the mid of winter, June to August. Annual average air temperature ranges 14 to 16 ºC, while summer shows 17 to 19 ºC and 10 to 13 ºC in winter. Daily difference of air temperature counts around 20 to 25 ºC through the year.

Annual average relative humidity shows 53 to 69 % in the study area except the Andes Mountains. Those values count 60 to 80 % in summer and 48 to 70 % in winter. On the other hand, annual average evaporation ranges 1100 to 1400 mm. During the summer, those values count over 100 to 250 mm though less than 100 mm shows in winter.

3.2.3 Soil and Land Use

(1) Present land use

Land use by basins in the study area is described as follows;

Zone	Farmland '97 Census	Farmland (ha)				Grassland (ha)	Forest (ha)	Urban (ha)	River etc. (ha)	Total (ha)
		Vegetable	Fruit	Cereals	Total					
1 .Río Maipo Alto	3,489	1,226	1,159	1,936	4,322	553	33	4,310	497,352	506,570
2. Río Clarillo	7,105	3,030	4,658	814	8,501	651	123	471	34,374	44,120
3. Río Mapocho Alto	9,795	8,422	2,073	3,189	13,683	5,150	450	51,746	131,632	202,660
4 Est. Lampa	19,482	10,521	5,534	5,432	21,486	13,321	401	25,164	146,247	206,620
5 Río Mapocho Bajo	28,111	11,753	15,657	4,586	31,996	2,076	30	11,583	16,276	61,960
6. Río Angostra	56,325	12,092	29,132	19,224	60,448	6,562	13,130	6,464	113,066	199,670
7 Est. Alhue	15,404	2,389,	2,500	5,385	10,274	3,752	725	288	143,735	158,774
8 Cue. Melipilla	30,492	9,070	10,706	17,547	37,323	8,635	522	2,133	82,278	133,890

To be continued

Zone	Farmland '97 Census	Farmland (ha)				Grassland (ha)	Forest (ha)	Urban (ha)	River etc. (ha)	Total (ha)
		Vegetable	Fruit	Cereals	Total					
9 Río Pangue	13,235	8,738,	2,394	6,711	17,842	5,549	290	1,649	83,139	108,470
10 .Est. Yali	17,884	311	7	30,313	30,632	20,687	25,977	1,373	53,791	132,460
11 Cue. San Antonio	16,177	214	26	23,787	24,027	5,303	15,931	3,493	26,166	74,920
12 Est. Casablanca	17,084	605	2,362	29,165	32,132	16,882	37,802	4,623	30,241	121,794
Total	234,585	68,370	76,206	148,089	292,666	89,121	95,414	113,295	1,361,298	1,951,794

Trend of land use in Santiago metropolitan area and local cities is that agricultural land is rapidly diverted to use for residential and commercial purposes. On the other hand, land in grassland and forestland are purchased by large-scale farmers for large scale orchard development. Information of SEREMI-MINVU is described an expansion of Santiago metropolitan area by invading to farmland summarized as follows;.

Year	Population (x ,000)	Area (ha)	Density (/ha)
1940	952.1	11,340	84.0
1952	1,354.4	15,570	86.9
1960	1,907.4	22,880	83.4
1970	2,779.5	29,480	94.3
1982	3,937.3	38,364	102.6
1992	4,676.9	46,179	101.3

Expansion of Santiago metropolitan area in 1992 is four times of 1940 and its trend is continuing more after then. Especially in Chacabuco province (Colina, Lampa, Tiltil) is urbanized rapidly. Therefore, SEREMI-MINVU has an intention to develop in disciplinary by establishment a urban plan including Chacabuco area in 1995. However, basic infrastructure development as potable water and sewerage seemed to be delayed. On the other hand as effects on agriculture, involvement of residential areas in the farmland is being caused environmental aggravation and confusion on agricultural production.

According to 1997 Census, 16,285 agriculture and livestock development plans were executed in the Study area and their total development area is 1,465,265 ha, however 465,215 ha (32%) of the area is not cultivated land and the rest was arable direct or indirect for production. 231,493 ha (approximately 15.8% of total development area) of arable land direct and indirect for production is under cultivation as shown below. 417,604 ha (Approximately 28.5% of total area) is natural and improved grassland, 321,187 ha (Approximately 21.9% of total area) is under forest mainly virgin forest, and 29,675 ha (Approximately 2.0% of total area) is indirectly concerned in production as canals, road, facilities, lakes and marshes.

Region	Total developed area (ha)	Cultivated Land*	Natural Grassland**	Forest, Canal	Indirect Use	No Arable land***
Metropolitan	1,139,180	162,293	278,887	231,215	24,121	442,665
V	207,119	35,495	92,562	69,674	2,473	6,915
VI	118,966	33,706	46,155	20,298	3,172	15,635
Total	1,465,265	231,493	417,604	321,187	29,765	465,215

* : Including improved grassland (30,879 ha), seasonal fallow and fallow land (43,384 ha)
** : Including natural grassland, improved grassland (improved grassland is 14,193 ha)
*** : Approximately 82% of no arable land is in San Jose de Maipo

It is for demonstrates significant relation of irrigated area and cultivated area. Irrigated area and the ratio of irrigable area to total development and total cultivated areas are shown below. Availability of irrigation is critical factor in order to determine benefit level of cultivation of non-irrigable land, it is particularly significant in majority

of Metropolitan Region and V Region excluding Casablanca. V Region, on the other hand, cultivation in non-irrigable land is highly possible though 50% of farmland is grassland and fallow land.

Region	Total developed area (ha)	Irrigated area (ha)	Ratio of Irri. area/ Developed area	Ratio of Irri. area/ cultivated area
Metropolitan	1,139,180	143,671.0	12.6%	88.5%
V	207,119	6,664.6	3.2%	18.8%
VI	118,966	28,624.9	24.0%	84.9%
Total	1,465,265	178,960.5	12.2%	

Land use information of cultivated land in agricultural and livestock development in the study area is summarized in Table 3.2.1 based on 1997 Census. From the table, it is understand that intensive cultivation possible to high productivity per unit area is carried out around 43% of farmland in the study area. Fruits cultivation occupies 55,304 ha equivalent to 24% of total cultivated areas in the study area. Following fruits cultivation, vegetable cultivation shows 12% of 27,955 ha and grapes for wine counts 3.7% of 8,702 ha. In other crops, intensive cultivation is prevailed for seed, seedling and flower cultivation. A lot of profitable crop cultivation shows the fact that the study area has favorable characteristics for crop cultivation in view of soil and climate.

(2) New potential irrigation area

The classification of land productivity (REA) used by the office of Internal Tax Services (Servicio de Impuestos Internos) is obtained at CIREN for the study area in order to evaluate land productivity and of new irrigation development area. However the classification is involving problem such as indicate irrigated area if there is canal in an area and on accuracy and overestimation due to purpose mainly for evaluate farmland, however, it is an advantage on available of information by individual community and of information relatively close to reality. It is only information on potential and ration of land use because it is classified land potential by with and without irrigation classification

Information by each community of 12 sub-basin in the study area described in Table 3.2.2 based on the data obtained REA. The table is shown only community holding large farmland area and completely subdivided communities as Wechuraba and Lo Barunechea are not included. Total irrigated area in the Study area reaches 1,767,332 ha by REA and it is approximately 300,000 ha more than 1997 Census. The difference is occurred that REA is including the area of forest development and the Census is not. Land use classification in REA for Class VI and VII is 1,224,892 ha in total, it is correspond to 786,402 ha of the land not utilized for agriculture and the natural forest in the figure of Census.

Total irrigated area in the study area by REA is 217,093 ha which is excess 39,000 ha in the ’97 Census’s 178,960 ha. The figures in REA is relatively close to the official figures of 206,000 ha for actual irrigated area at present in the study area by CNR. The area where canals are developed in the study area is 231,00 ha. The ’97 Census is seemed to be responded to actual irrigated area and the area was probably little underestimated during the ’96-’97. Therefore, the difference between REA and the Census on irrigated area is depend upon include or exclude an area where insufficient water supply in canals are equipped.

Non irrigated farmland belong to the first priority of classes I, II, III and the second priority of class IV of classification of potential land productivity by respective sub-basins and communities was studied in order to specify high potential irrigation development area. Classes I to III are identified as an arable land with certain limitation

and class IV is arable but with considerable limitation. Class VI which is mainly slope land without irrigation classified as non-arable was considered as potential arable land utilizing slope in case of favorable climate and no limitation of slope. Irrigable areas in sub-basin bases according to above mentioned priorities are shown below;

Sub-basin	Potential Classification of land Productivity (ha)		
	I - III	IV	VI
Est. Yali	10,474	15,528	35,206
Est. Casablanca	9,961	15,818	20,962
Cue. San Antonio	4,727	12,012	20,536
Est. Alhue	4,240	14,944	10,178
Est. Lampa	4,143	16,545	21,817
Est. Puangue	2,611	7,023	17,041
Cue. Melipilla	1,673	8,710	27,324

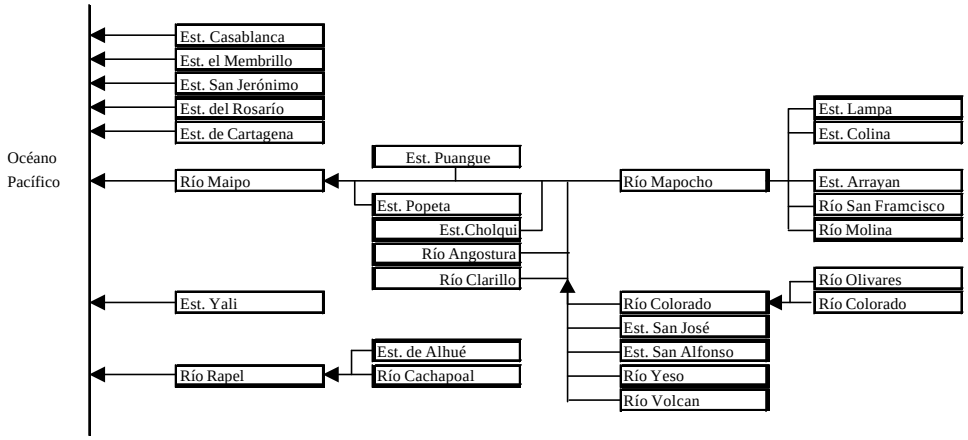
In case of San Antonio sub-basin, considerable part has become the area for expansion of neighboring resort and water diversion to this area is difficult due to high altitude. Santo Domingo of Est. Yali sub-basin is also similar and resort area is expanding into the majority land of 5,357 ha of classes I and III. However, the rest of land in Santo Domingo and San Pedro are far from resort area and remain 6,000 ha of classes I and III and 30,000 ha of class IV. Est. Lampa sub-basin has large irrigable land, however, holding special situation. Chacabuco province has 35,000 ha of arable land according to SEREMI de Agriculture and 49,000 ha of land is divided for sale as lots for villa residence. High potential irrigation development areas are Est. of Yali, Casablanca, Alhue, Puangue, Lampa and Melipilla according to REA information of arable land without irrigation.

Fig.3.2.2 shows soil map, classification of potential land productivity in Fig. 3.2.3, and present land use in Fig.3.2.4.

3.2.4 Water Resources

(1) Surface runoff

Rio Maipo, main stream and its tributaries, composes the river system in the study area. As for the other rivers, Rio Rapel located the southern part of the study area and small rivers originated in the coastal mountains flow down separately with Rio Maipo into the Pacific Ocean. River diagram regarding the major rivers and streams related to the study area is as follows;



Concerning the water utilization in the study area, surface runoff in each sub-basin is estimated to clarify the available surface runoff under the condition of average

and 85% exceedance probability. Runoff from each sub-basin is calculated with the following procedures;

- Estimation of runoff in each sub-basin divides into two manners, one is runoff from the Andes Mountains and other is runoff from the areas except the Andes Mountains. Observation record is employed as the runoff from the Andes Mountains and areal rainfall is used for estimation of runoff in other areas.
- Following three sub-basins are involved with runoff from the Andes Mountains. Observatories used for the estimation are also shown in the table.

Sub-basin	River	Observatory
Río Maipo Alto	Río Maipo	Río Maipo en el Manzano
		Río Yeso en Embalse el Yeso
Río Mapocho Alto	Río Mapocho	Estero Arrayan en La Montosa
		Río Mapocho en los Almendros
Est. Lampa	Est. Colina	Colina en Compuerta Vargas

- Runoff from areas except the Andes Mountains is estimated by using areal rainfall in each sub-basin. Runoff coefficient is used for conversion from the rainfall amount to the runoff volume. Runoff coefficient is employed at 0.276 with the discharge record at Quilamuta (Est. de Alhué) and Boqueron (Est. Puangue) observatories, and areal rainfall of its river basins.

Observatory	Basin Area km^2	Annual runoff (1) MCM	Annual Rainfall (2) MCM	Runoff (1) / (2)
Quilamuta	779	133,8	470,9	0,284
Boqueron	137	21,9	81,7	0,268

Estimated results of surface runoff in each sub-basin are as follows with procedures mentioned above. Estimation is made on average year and 85% exceedance probability year conditions.

Sub-Basin	Basin –area (km^2)	Annual Average (MCM)	85% Probability (MCM)
1 Río Maipo Alt	213	3,743.21	2,337.25
2 Río Clarillo	441	66.16	35.86
3 Río Mapocho Alt	1110	448.65	183.32
4 Estero Lampa	1831	250.11	138.81
5 Río Mapocho Bajo	620	81.13	41.13
6 Río Angostura	1997	329.68	173.61
7 Estero Alhué	1588	246.72	126.59
8 Melipilla	1339	158.19	81.21
9 Estero Puange	1085	120.73	63.16
10 Estero Yali	1325	171.86	101.29
11 San Antonio	749	80.36	43.81
12 Estero Casablanca	1217	125.32	70.59
Total	1,3515	5,822.1	3,396.6

With these estimation results, surface runoff of annual basis in the study area can be summarized as follows;

Item	Annual Average (MMC)	85% Probability (MMC)
Total annual runoff	5,822.1	3,396.6
Oct. to Mar.	2,989.6	1,756.0
Apr. to Sep.	2,832.5	1,640.6
Runoff from the Andean Mountains	4,060.2	2,448.5
Oct. to Mar.	2,867.7	1,689.1
Apr. to Sep.	1,192.5	759.4
Runoff from areas except the Andean Mountains	1,761.9	948.1
Oct, a Mar,	121.9	66.9
Apr. to Sep.	1,640.0	881.2

Surface runoff in the study area can be estimated around 58 MCM in the average year. 70% of total surface runoff is supplied by thaw in the Andes Mountains, furthermore, 70% of runoff from the Andes Mountains concentrates upon summer, from October to March. Runoff from areas except the Andes Mountains is estimated around 17.6 MCM and 90% of total runoff generates by precipitation falling in winter from April to September.

(2) Groundwater

The potential yield of groundwater in the study area is estimated based on following assumptions.

- So as to estimate potential yield of groundwater in the study area, groundwater units are settled based on hydrogeological structure in the study area. Twelve (12) groundwater units are settled in the study area on the basis of existing data compiled by the hydrogeological survey results.
- The area of aquifer distribution in each groundwater unit refers to the figures in "*Proyecto Maipo – Estudio Hidrologico e Hidorogeologico y Album de planos, CNR, 1984.*" For the units having no area data, unit area is estimated by the topographical map.
- The depth of water holding stratum is settled referring to the depth of existing wells and the hydrogeological profile.
- The ratio on depth of aquifer is estimated through dividing the total depth of aquifer and semi-aquifer, which shown in the hydrogeological profile, by drilling depth of well.
- The capacity of aquifer is estimated through multiplying the area of aquifer, the depth of water holding stratum, and the ratio on the depth of aquifer.
- Effective porosity is employed the value shown in the above reference data. The value is applied to each aquifer; unconfined, confined, and semi-confined aquifers.

According to the assumptions above, estimated potential yields of groundwater in each unit are as follows;

Groundwater unit	Area of aquifer distribution (km^2)	Depth of water holding stratum (m)	Ratio on depth of aquifer (%)	Capacity of aquifer (MCM)	Effective porosity (%)	Potential yield (MCM)
Maipo - Mapocho Superior	40.0	50	59	1,180	15	177
Maipo - Mapocho U	1,635.6	100	59	96,500	15	14,475
Maipo - Mapocho L	1,308.5	200	59	154,403	5	7,720
Maipo - Inferior	625.1	180	50	56,259	0.3	169
Til Til - Lampa	64.6	150	53	5,136	20	1,027
Chacabuco - Polpaico U	168.5	100	46	7,751	6	466
Chacabuco - Polpaico L	134.8	50	46	3,100	0.2	6
Colina - Batuco U	477.8	100	32	15,290	0.4	61
Colina – Batuco L	382.2	150	32	18,346	0.4	73
Angostura u/s	203.8	50	34	3,465	0.4	17
Angostura d/s	72.0	100	34	2,448	0.3	7
Puangue u/s	51.3	100	34	1,744	5	87
Puangue d/s	483.3	150	37	26,823	4	1,073
Casablanca U	162.5	50	39	3,169	13	412
Casablanca L	130.0	150	39	7,605	0.3	23
San Geronimo	15.9	50	81	644	8	52
Del Rosario	31.8	50	47	747	6	45
Cartagena	7.0	100	51	357	5	18
Yali	192.9	100	52	10,031	0.2	20
Alhué	237.7	100	52	12,360	0.6	74
Total	6,425.3			427.358		26,002

U, L, u/s and d/s accompanied with the groundwater units in the above table

show qualitative division for the area of aquifer, based on the hydrogeological structure of each unit.

U: The area of aquifer distributed in the alluvial and diluvial deposits within the groundwater units.
L: The area of aquifer distribution which extracted the area of shallow base rock, and 80% of the groundwater unit area is employed for the area.
u/s: The area of aquifer distribution located in the upstream reach of rivers.
d/s: The area of aquifer distribution located in the downstream reach of rivers.

According to the table above, the potential yield of groundwater in the study area counts around 26,000 MCM, but Maipo-Mapocho groundwater unit occupies more than half of it, 22,000 MCM.

3.3 Economy

3.3.1 Regional Economy

Table 3.3.1 shows the gross regional product (GRP) of each administrative Region of Chile, in relation to the gross domestic product (GDP). The three Regions comprising the Study area, namely, Region V, Metropolitan Region and Region VI, together account for around 53% of GDP (39% Metropolitan Region, 9% Region V, and 5% Region VI). However, since only small areas of Region V and Region VI are included in the Study area, the gross regional product of the Study area can be estimated as 45% of GDP. Still, inclusion of Metropolitan Area makes the study area a dominant element in the national economy.

Table 3.3.2 shows gross regional products of Region V, Metropolitan Region and Region VI, respectively, by economic activity. In Region V, Manufacturing is the most important component of GRP comprising more than 20%, while in the Metropolitan Region the service sector such as Commerce and Financial Services comprise the overwhelming majority, and in Region VI Mining is the most important GRP component with around 30%.

Agriculture and Forestry as a component of GRP comprise the highest proportion in Region VI and the lowest in Metropolitan Region. Interestingly, however, Agriculture and Forestry of Metropolitan Region make the highest contribution, among the three Regions, to the Agriculture component of GDP. In other words, Agriculture and Forestry in Metropolitan Region comprise around 3% of GRP, but about 16% of GDP. On the other hand, Agriculture and Forestry in Region V comprise around 10% of GRP and 11% of GDP, while in Region VI the corresponding figures are about 25% of GRP and 15% of GDP. The dominant weight of Agriculture and Forestry of Metropolitan Region can be attributed to the large size of its GRP, and to the high value of the agricultural outputs produced in the Metropolitan Region.

3.3.2 Water Utilization in the Economic Sector

Water utilization in the study area is broadly divided into three categories, irrigation water use over 179.000 ha of farmland, drinking water supply for 5.5 million residents including Santiago city and industrial water utilization.

(1) Irrigation water use

Present water utilization for irrigation is estimated on the basis of the irrigation area shown in the Census in 1997 carried out by INE and the water requirement of crops

with the sub-basin wise. Present irrigation area with the sub-basin and crop wise is summarized as follows;

Unit : ha

	Sub-basin	Trigo	Maiz	Cebolla	Alfalfa	Vid	Vinas	Total
1	Río Maipo Alt	136,4	59,0	302,4	744,9	560,5	449,9	2253,0
2	Río Clarillo	705,5	28,5	292,2	1624,9	1724,7	591,5	4967,3
3	Río Mapocho Alt	1146,0	539,3	3428,5	2542,5	1338,7	423,7	9418,8
4	Estero Lampa	880,8	161,8	7261,7	3594,9	5284,5	107,8	17291,5
5	Río Mapocho Bajo	3818,7	1002,1	5254,1	5714,5	9939,4	839,6	26568,2
6	Río Angostura	10709,7	1153,4	8732,5	3844,5	21913,7	4174,0	50527,9
7	Estero Alhué	5808,3	1319,5	693,7	1278,6	2815,7	435,3	12351,2
8	Melipilla	7961,3	1123,2	5318,5	9546,9	7399,7	462,5	31812,1
9	Río Puange	3009,4	1678,6	3493,4	4068,0	2253,3	362,9	14865,7
10	Estero Yali	88,2	197,5	171,3	1864,0	544,9	11,2	2877,1
11	San Antonio	23,5	88,2	266,2	209,1	151,1	9,0	747,1
12	Estero Casablanca	220,6	19,0	465,7	2757,8	509,2	1308,4	5280,7
	Total	34508,5	7370,0	35680,2	37790,6	54435,4	9175,9	178960,5

Crop water requirement is estimated considering the potential evapo-transpiration (ETo), crop coefficient, effective rainfall and prevailing irrigation method in the study area.

Meteorological data at Melipilla and Cerro Calan are employed for the estimation taking the meteorological conditions into account. Data at Melipilla is applied for the areas located from coastal mountains to the coast and Cerro Calan for the areas central basin in the study area. Potential evapotranspiration of crop and diversion water requirement by crops at field level are as follows;

Item	Unit	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Cerro Calan														
ETo	mm/day	6,45	5,72	4,13	2,72	1,79	1,39	1,45	1,89	2,56	3,73	5,01	6,26	**mm**
	mm/month	200,0	177,3	123,9	84,3	53,7	43,1	45,0	52,9	79,4	111,9	155,3	187,8	1314,5
Melipilla														
ETo	mm/day	5,99	5,17	3,83	2,49	1,53	1,15	1,24	1,78	2,68	3,98	5,05	5,9	**mm**
	mm/month	185,7	160,3	114,9	77,2	45,9	35,7	38,4	49,8	83,1	119,4	156,6	177,0	1243,9

Crops	Application Efficiency	Unit	Unit Water Requirement	
			Cerro Calan	Melipilla
Trigo	0,3	mm	1390	1416
Maiz	0,45	mm	1869	1770
Alfalfa	0,3	mm	3207	3110
	0,9	mm	-	1037
Cebolla	0,45	mm	1588	1541
	0,9	mm	-	770
Vid	0,45	mm	2453	2115
	0,9	mm	973	1058
Vinas	0,45	mm	1962	1692
	0,9	mm	-	846

Based on the crop water requirement and irrigation area in sub-basin wise, irrigation water amount can be summarized as follows;

Sub-basin	Irrigation Area (ha)			Irrigation Demand (MCM)	
	Total	Surface Flow	Groundwater	Surface Flow	Groundwater
1. Río Maipo Alt	2252,9	2153,2	99,7	64,78	1,02
2. Río Clarillo	4967,3	4439,4	527,9	135,07	5,41
3. Río Mapocho Alt	9418,8	8871,0	547,8	237,15	5,61
4. Estero Lampa	17.291,5	13381,8	3889,7	352,78	39,84
5. Río Mapocho Bajo	26568,2	25423,6	1144,6	713,40	11,72

To be continue

6. Río Angostura	50527,9	45105,7	5422,2	1148,49	55,53
7. Estero Alhué	12351,2	11070,8	1280,4	244,87	14,25
8. Melipilla	31812,1	28690,6	3121,5	762,22	34,75
9. Estero Puangue	14865,7	13412,3	1453,4	344,65	16,18
10. Estero Yali	2877,1	488,5	2388,6	13,81	25,68
11. San Antonio	747,1	455,3	291,8	10,39	3,23
12. Estero Casablanca	5280,7	3026,0	2254,7	103,50	22,09
Total	178960,5	156518,2	22422,3	4131,12	235,32

With the table shown above, required irrigation water amount in the study area counts around 4,370 MCM. Out of which, 4,130 MCM depends on surface runoff and 240 MCM on the groundwater.

(2) Drinking water utilization

Following public and/or private corporations perform drinking water supply in the study area.

Region	Corporation	Commanding Area	Related Sub-basin of the Study
Metropolitan	Empresa Metropolitana de Obras Sanitarias S. A. (EMOS)	Gran Santiago, Agua Potable Rural	Río Maipo Alt, Río Mapocho Alt, Río Mapocho Bajo, Est. Lampa, Melipilla, Río Angostura, Est. Puangue
	Servicio Municipal de Agua Potable y Alcantarillado de Maipú (SMAPA)	Maipú	Río Mapocho Alt
	Empresa Agua Potable Manquehue (EAPM)	Manquehue, La Dehesa Huechuraba, Chicureo	Río Mapocho Alt
	Aguas Cordillera S. A. (AC)	Las Condes, Vitacura	Río Mapocho Alt
	Servi*Comuna*l S.A. (SC)	Colina, Lampa	Est. Lampa
V	Empresa de Obras Sanitarias de Valparaíso (ESVAL)	Gran Valparaíso	Casablanca
	Aguas Quinta S.A. (AQ)	San Antonio	San Antonio, Casablanca
VI	Empresa de Servicios Sanitarias del Libertador (ESSEL)		Río Angostura

Based on the information regarding the annual production value of drinking water and forecasted production value obtained from each corporation, present and future drinking water supply of each sub-basin in the study area can be summarized as follows. Some figures are compensated by the report such as "*Análisis Uso Actual y Futuro de los Recursos Hídricos de Chile - IPLA Ltda*" and "*Modelo de Simulación Hidrológico Operacional Cuencas de los Ríos Maipo y Mapocho - Informe Etapa II Demandas de Agua - AC Ingenieros Consultores Ltda*."

Sub-basin	Major Cities	Supply	Present Water Supply			Forecasted Water Supply		
			1997	Water Source		2010	Water Source	
			Production	Surface flow	Groundwater	Production	Surface flow	Groundwater
1. Río Maipo Alt	San Gabriel	EMOS	0,09	-	0,09	0,12	-	0,12
	San José de Maipo	EMOS	1,05	-	1,05	1,36	-	1,36
	El Canelo-Las Vertientes	EMOS	2,05	-	2,05	2,65	-	2,65
	Total		3,19	-	3,19	4,13	-	4,13
2. Río Clarillo	Pirque		0,62	-	0,62	0,78	-	0,78
3. Río Mapocho Alt	Gran Santiago	EMOS	442,21	385,61	56,60	462,30	392,03	70,27
	Maipú	SMAPA	53,19	-	53,19	68,82	-	68,82
	Manquehue	EAPM	3,77	-	3,77	7,68	-	7,68
	Las Condes	AC	69,90	52,42	17,48	107,21	80,41	26,80
	Total		569,07	438,03	131,04	646,01	472,44	173,57
4. Estero Lampa	Lampa, Colina	SC	4,07	-	4,07	13,59	-	13,59
	Til Til	EMOS	0,44	-	0,44	0,57	-	0,57
	Total		4,51	-	4,51	14,16	-	14,16
5. Río Mapocho Bajo	Talagante	EMOS	4,30	-	4,30	5,56	-	5,56
	El Monte	EMOS	1,69	-	1,69	2,19	-	2,19
	Padre Hurtado	EMOS	3,44	-	3,44	4,45	-	4,45
	Malloco Peñaflor	EMOS	5,40	-	5,40	6,99	-	6,99
	Total		14,83	-	14,83	19,19	-	19,19

6. Río Angostura	Isla de Maipo	EMOS	0,68	-	0,68	0,88	-	0,88
	Valdivia de Paine	EMOS	0,14	-	0,14	0,18	-	0,18
	Buin-Paine-Linderos	EMOS	6,98	-	6,98	9,03	-	9,03
	Graneros	ESSEL	1,38	-	1,38	1,78	-	1,78
	Total		9,18	-	9,18	11,87	-	11,87
7. Estero Alhué	Villa Alhué		0,15	-	0,15	0,19	-	0,19
	Las Cabras	ESSEL	0,43	-	0,43	0,56	-	0,56
	Total		0,58	-	0,58	0,75	-	0,75
8. Melipilla	Melipilla	EMOS	3,21	-	3,21	4,15	-	4,15
	Pomaire	EMOS	1,56	-	1,56	2,02	-	2,02
	Total		4,77	-	4,77	6,17	-	6,17
9. Estero Puangue	Curacaví	EMOS	1,35	-	1,35	1,75	-	1,75
10. Estero Yali			0,69	-	0,69	0,89	-	0,89
11. San Antonio	San Antonio	AQ	7,30	4,74	2,56	9,04	5,85	3,19
	Cartagena	AQ	2,08	1,35	0,73	2,51	1,63	0,88
	El Taba	AQ	1,41	0,92	0,49	2,48	1,61	0,87
	Total		10,79	7,01	3,78	14,03	9,09	4,94
12. Estero Casablanca	Casablanca	ESVAL	0,82	-	0,82	1,07	-	1,07
	El Quisco	AQ	1,81	1,18	0,63	2,37	1,54	0,83
	Algarrobo	AQ	1,31	0,85	0,46	2,12	1,38	0.74
	Total		3,94	2,03	1,91	5,56	2,92	2,64
Grand Total			623,52	447,07	176,45	725,29	484,45	240,84

With the table shown above, drinking water supply at present situation in the study area counts around 623 MCM. Out of which, 447 MCM depends on surface flow and 176 MCM on the groundwater. In future, those drinking water supply are estimated to increase around 102 MCM.

(3) Industrial and mining water use

Industrial and mining water use in the study area depends entirely on the groundwater. Most of the factories locates in the Río Mapocho basin, and others in the Estero Lampa and Río Angostura basins. Basic data for present and future water utilization in those economic sectors are extracted from the report "*Análisis Uso Actual y Futuro de los Recursos Hídricos de Chile - IPLA Ltda*".

	Industrial (MCM)		Mining (MCM)		Total (MCM)	
	1997	2010	1997	2010	1997	2010
1. Río Maipo Alt	-	-	-	-	-	-
2. Río Clarillo	-	-	-	-	-	-
3. Río Mapocho Alt	224,87	382,93	10,37	13,62	235,24	396,55
4. Estero Lampa	33,96	57,83	-	-	33,96	57,83
5. Río Mapocho Bajo	13,26	22,57	-	-	13,26	22,57
6. Río Angostura	0,55	0,93	-	-	0,55	0,93
7. Estero Alhué	-	-	-	-	-	-
8. Melipilla	0,40	0,68	-	-	0,40	0,68
9. Estero Puangue	-	-	-	-	-	-
10. Estero Yali	-	-	-	-	-	-
11. San Antonio	-	-	-	-	-	-
12. Estero Casablanca	6,91	9,73	-	-	6,91	9,73
Total	279,95	474,67	10,37	13,62	290,32	488,29

With the table shown above, industrial and mining water use in the study area estimate around 290 MCM. In year 2010, it is estimated that those water use increase around 70% as it was.

(4) Summary of the water utilization

Present water utilization of the economic sector in the study area can be summed up 5,280 MCM in total as follows. Out of which, 4,580 MCM depends on surface runoff and 700 MCM on groundwater.

Unit: MCM

Water Source	Irrigation Use	Drinking Water Use	Industrial Use	Total
Surface runoff	4,131.12	447.07	-	4,578.19
Groundwater	235.32	176.45	290.32	702.09
Total	4,366.44	623.52	290.32	5,280.28

(5) Water balance

The model for the water balance study is constructed to clarify the water utilization in the study area. The model consists of twelve (12) basin-blocks and those basin-block equivalent to sub-basin division of the study. Expression of the balance on demand and supply of water in the sub-basin is made with inflow and outflow of the sub-basin as variables. Calibration of the model is made by the monthly basis precipitation and runoff records of three years, from 1993 to 1995. Verification between measured and estimated discharges is made at points, Río Mapocho Rinconada de Maipú, Río Angostura en Valdivia de Paine and Río Maipo en Cabimbao.

Water shortage on irrigation and other water utilization can be summarized as follows using the simulated results in average and 85% exceedance probability on precipitation and runoff.

Sub-basin	Demand (a) (MCM)		Average		85% probability	
			Deficit (b)	Ratio (b/a)	Deficit (b)	Ratio (b/a)
	Irrigation	Others	(MCM)	%	(MCM)	%
1. Río Maipo Alt	65.798	3.190	0.000	0.00	0.000	0.00
2. Río Clarillo	140.478	0.620	0.000	0.00	3.048	0.02
3. Río Mapocho Alt	242.758	804.310	0.000	0.00	0.000	0.00
4. Estero Lampa	392.614	38.470	158.857	0.37	194.815	0.45
5. Río Mapocho Bajo	725.123	28.085	0.000	0.00	62.610	0.08
6. Río Angostura	1204.022	9.726	508.621	0.42	594.097	0.49
7. Estero Alhué	259.128	0.580	199.570	0.77	214.339	0.83
8. Melipilla	796.971	5.168	549.590	0.69	564.292	0.70
9. Estero Puangue	360.834	1.350	126.089	0.35	131.278	0.36
10. Estero Yali	39.495	0.690	5.746	0.14	7.315	0.18
11. San Antonio	13.625	7.010	7.855	0.38	8.774	0.43
12. Estero Casablanca	125.595	8.939	48.650	0.36	54.470	0.40
Total	4366.440	908.138	1604.978		1835.038	

Following can be pointed out regarding the present water utilization in the study area;

- Irrigation water use occupies over 80% among the water demand in the study area,

- Water shortage shown in the above table arises in irrigation use. Irrigation demand is estimated on the basis of theoretical crop water requirement, therefore, ratio of deficit for irrigation can be considered as the sufficiency ratio against the theoretical crop water requirement.

- Water shortage arises in the most of the sub-basins except the sub-basin can easily be used runoff from the upstream reach of Río Maipo.

3.4 Present Agricultural Situation

3.4.1 Land Classification by Land-holding Scale and Degree of Modernization on Farm Management

(1) Land-holding scale

The classification on land-holding scale in Chile has following legislative and

institutional aspects.

1) Equivalent area or Basic Irrigation Area (HRB)

All land is regarded as being converted in and equivalent to basic irrigation area. Basic Irrigation Area (HRB) is evaluated to estimate of all land by equivalence of basic irrigation area. This concept is come up so as to establish the common estimation criteria for farmland by tax office and the criteria for land expropriation by scale on the process of agricultural reform. At present, this concept is applied to various laws such as the Law No. 18450 which formulated on the base of land estimation and the Agricultural Reform Law.

2) Landholding by household unit

About 8 HRB land, which can be used stably without someone's help and with which one family can live. The size was determined with concerned technical level in the time when the Agricultural Reform Law became effective (1968),.

3) Large scale landholding

In the Agricultural Reform Law, "large scale landholding" refers to over 80 HRB landholding. This criterion was determined in order to promote efficient middle scale farming by household unit. In the Agricultural Reform law, efficient landholders can hold until 320 HRB land, exceptionally.

4) Small scale landholding

In the INDAP Basic Law, "small landholder" refers to those who have the land of smaller than 12 HRB. All plans for small scale farm households by INDAP and other public institutions have been established on the base of this category. The support services for small scale farm households under the Law No. 18450 are based on this category. Moreover, a definition of small scale farm households of INDAP describes two points which land holder lives mainly by agriculture and property to be succeeded is within a certain limits

5) Landholding except agricultural use in rural area

The Law 3516 which approves division of local farmland by up to 5,000m^2 unit resulted in promotion of diverting local farmland into land for cottage building or housing lot. They are scattered in traditional small scale farmland.

6) Information on the '97 Census

The most current information on landholding classification is the Census in 1997. In the Census, no distinction is made on irrigated or non-irrigated farmlands on land holding classification. Also, no reference is mentioned on the characteristics of each farmlands.

According to these conditions and the purpose of the study, landholding scale of each farm household in the study area is classified into following three types.

- 0.5 - 15.0 ha :
  Small scale landholding. Most of small landholders in the central valley are in irrigated area, and it is considered that the scale of most irrigated land in the Maipo river basin is about 1.0 HRB. This classification assumes the landholders who hold 0.5 - 12.0 HRB.
- 15 - 100 ha
  Middle scale landholding. Almost the same criterion with small landholders is applied to middle scale landholders. This classification assumes the landholders who hold 12 - 80 HRB.

- Larger than 100 ha
  Large scale landholding. This criterion assumes over 80 HRB landholding, but most of such scale's land does not have irrigation facilities.

Under 0.5 ha land is excepted from the land classification because most of them are not farmland. The Census in 1997 did not care under 0.5 ha landholding as the subject of the agricultural development. In the study area, 1,251 landholdings were assured and their total area is 371.1 ha. Thus, it does not affect to the study. Under 0.5 ha landholding occupies less than 0.2 % of total area in all sub-basins, and the number of farm households does not excess 12.2 % of total ones. This scale's farm households occupy 6.0% in the whole study area.

The table below shows the summary on number of farm households, total area, average area by three classifications described above and sub-basin wise based on the Census in 1997.

Sub-basin	< 0.5ha			0.5 ～ 15.0ha			15.0 ～ 100.0ha			100.0 ha<		
	No. of farm H/H	Total area	Average area	No. of farm H/H	Total area	Average area	No. of farm H/H	Total area	Average area	No. of farm H/H	Total area	Average area
Maipo Alto	10	3	0.30	191	705.2	3.69	51	2041.4	40.0	29	490363.6	16909.0
Clarillo	46	12.3	0.27	341	1423.8	4.18	95	3328.5	35.0	19	20242.4	1065.0
Mapocho Alt.	39	11.6	0.30	841	3041.0	3.62	171	5839.9	34.2	45	31850.2	708.0
Est.Lampa	45	14.2	0.32	1331	6524.3	4.90	320	10967.7	34.3	133	115375.4	868.0
Mapocho Ba.	125	38.6	0.31	1814	7566.9	4.17	508	17798.3	35.0	73	16565	227.0
Angostura	649	186.7	0.29	3658	14063.3	3.84	859	32527.7	38.0	157	97229.9	619.0
Rapel	73	21.8	0.30	1187	5119.9	4.31	273	10028.2	38.0	104	113188	1088.0
Melipilla	155	50.4	0.33	2184	8218.2	3.76	537	18646.2	35.0	200	81881.8	409.0
Puangue	50	14.2	0.28	1018	4935.6	4.85	206	6900.4	33.5	65	53513.3	823.0
Yali	24	8.3	0.35	1023	4170.6	4.08	510	23514.3	46.1	234	100257.9	429.0
San Antonio	11	3.4	0.31	489	1940.5	3.97	198	7989.3	40.4	95	56971.3	600.0
Casablanca	24	6.6	0.28	500	2620.3	5.24	324	12628.3	39.0	130	74884	576.0
TOTAL	1251	371.1	0.30	14577	60329.6	4.14	4.052	152210.2	37.6	1284	1252323	21095.0

Note; No.: Number, H/H: Household

The number of small scale farm households occupies 68% in the whole study area, or 14,577 households, and total occupied area is 60,348 ha or under 4.1% of the whole study area. Average landholding in area is 4.14 ha, but most of average area by each sub-basin ranges from 3.62 ha in Maipo Alto to 5.24 ha in Casablanca. Among total small scale households, 5 - 10 ha landholding and 10 - 15 ha landholding occupy about 25 % and about 10.7 % respectively.

The number of small scale farm households concentrates in the sub-basins of Angostura, Mapocho Bajo, and Mapocho Alto. These areas have large irrigated farmland and small non-irrigated farmland, and occupies about 43.3% of total number of farm households and holds about 40.9% of total farmland. This is because small farm households intend to be concentrated in irrigable area. The sub-basins of Melipilla, Alhué, Yali, and Puangue which have large non-irrigated farmland occupy about 37.3% of total small farm households, and about 37.2% of total landholding. This figures show the second largest concentration in these sub-basins. Among these sub-basins, Melipilla and Puangue have large irrigated farmland, and Lampa has slightly smaller irrigated farmland than average one, and occupies about 9.1 % of total small farm households,

and about 10.8 5 of landholdings. The sum of Casablanca and San Antonio sub-basins occupy 6.8% of total small landholders, and 7.5% of landholding area. The sub-basins of Maipo Alto and Clarillo in the highest elevated area have a few small farm households, and occupy 3.6% of number of that and landholding.

The number of middle scale farm households is 4,025 and occupy 19.2% of total households and 152,210 ha or 10.4 % of the study area. Average area of total middle scale farm households is 37.6 ha, but mostly ranges from 33.5 ha of Puangue to 46.1 ha of Yali. As for the area of farmland, there is no big difference among middle scale farm households. The number of middle scale farm households in sub-basins of Angostura, Mapocho Bajo, and Mapocho Alto occupies 37.7%. The sum of the number of middle scale small farm households in sub-basins of Mapocho Bajo, Mapocho Alto, Melipilla, Yali, Alhué, and Puangue is 38%. In the sub-basin of Lampa, the middle scale farm households are fewer than the small scale farm households, 7.9%. In the sub-basins of Casablanca and San Antonio, the former is more than the latter, 10.4%. Moreover, in the sub-basins of Maipo Alto and Clarillo, the former is same as the latter, 3.6%.

Total number of large scale farm households is 1,284, and total cultivated area by them in the study area is 1,252,322 ha. The total holding area by large scale farm households is 490,363 ha, if 29 large scale farm households who hold land without irrigation in the sub-basin of Maipo Alto is subtracted from total held area by the large scale farm households. Likely, average area decreases from 975 ha to 607 ha, if 29 households mentioned above is subtracted from the total area. Average area ranges from 227 ha in Mapocho Bajo to 16,909 ha in Mapocho Alto. In the sub-basins of Maipo Alto and Lampa, the large farm households are the majority within the sub- basins; 39%, 490,363 ha and about 9.2 %, 115,375 ha respectively.

(2) Level of modernization on farm management

To classify the farm households, degree of ability for the introduction of new technology, efficient farming, participation to the market and response on the new requirements can be considered as the criteria other than the land holding size. These are the level of modernization on farm management in each farm household.

In case of new irrigation projects, many improvement factors on prevailing farm management exist in compliance with the changing from the extensive agriculture in the non-irrigated farmland to the intensive agriculture with irrigation. Therefore, it is required to put stress on the importance of improvement for the farmers living in the new irrigation area. Empresa Agraria sets framework on the index for the improvement of existing farm management and many variables tie with the farming scale and the level of modernization on farm management. On the contrary, in the Census in 1997, farming scale variable is only usable as the index of this study. Finally, it is appropriate to divide the farmers into following two groups in view of productivity of the crop cultivation.

Small-scale farm households
: Holding 0.5 to 15 ha of farmlands and performing the agricultural production by traditional farming method.

Medium and large scale farm households
: Holding over 15 ha of farmlands and performing the agricultural production by modernized method.

There are farmers who manage modernized farming even though their landholding classify into small-scale. Similarly, there are farmers who manage extremely traditional farming though their landholding classify into medium and/or

large scale. However, certain trend on the farm management can be recognized for each farm households and that trend should be reflected to settle the framework on the future projects.

Present crop cultivation on small, medium and large scale farm households of each sub-basin is shown in Table 3.4.1 and 3.4.2. The table shows difference of production activity on both farmers group. In case of small-scale farmers, around 42% of cultivated areas used for low productivity or indirect (natural glass-land, fallow-land, etc.) productive activities though only 19%is occupies in case of medium and large scale farmers. Further, 42 % of farm-land is used for intensive agriculture (fruits, vegetables, grapes, seed, etc.) in case of medium and large scale farmers, however, those utilization are limited only 28% in case of small-scale farmers.

3.4.2 Crops and Cultivation

A comparison of land use in the study area based on 1997 Census and the Census carried out during 1975 to 1976 is shown below.

Crops	'75-'76 Census (ha)	'97 Census (ha)
Cereals, Processing crops	67,391	31,748
Vegetable, Flower	23,686	25,885
Fruits	28,411	43,506
Vineyard	2,985	6,703
Seed sand seedlings	N.A.	5,898
Forage	28,979	30,619
Total	151,452	144,359

Source: Domestic agriculture and livestock, Recent trend and forecast, , CORFO, 1998

From the table, sector of intensive cultivation such as fruits, vegetables, grapes for wine, seed production is significantly increased. On the contrary, cultivation of cereals and *chacras* is decreased over 50% at present. This phenomenon can be considered as the process of intention on agricultural production in Metropolitan Region or in the study area. These movements on intention are recent trend relating to the process on open market economy.

Present situation of crops and its cultivation in the study area is as follows;

(1) Cereals and traditional crops

Cultivated area for these crops is approximately 36,000 ha and it is decreased by over 50% in 20 years from previous Census to the last Census. Crop production in metropolitan region is above the national average in any crops except potato by the same Census. Result of basic survey for agriculture and livestock (EMA) of INE from 1990 described that cultivated area of these crops decreased over 25,000 ha in the last 10 years and trend of decrease significant comparing 11,000 ha from 1976 to the beginning of the survey. Trend of decrease of cultivation area is for entire crop except potato, which was not decrease during 1990 to 1997.

(2) Fruits

Fruits is cultivated in 24% of orchard area in the study area which is equivalent to 55,304 ha. 40% of fruit cultivation, 22,452 ha, are concentrated in Angostura and followed by 7,000 ha in Melipilla and 6,000 ha in Est. Lampa sub-basins. Change of cultivation area of major fruits in 1994 and 1997 is shown below;

Crops	1994 (ha)	1997 (ha)	Fluctuation (%)
Almond	2,172	2,653	18
Cherry	343	302	-12
European Plum	1,842	2,159	17
Japanese Plum	2,625	2,669	2
Apricot	838	817	12
Peach	2,319	1,495	-36
Peach for Preservation	1,690	1,331	-27
Nectarine	3,047	2,504	-15
Lemon	2,803	2,926	20
Red Apple	451	608	35
Green Apple	193	169	-12
Quince	100	105	5
Orange	1,602	1,713	23
Olive	197	285	45
Pear	3,114	1,622	-48
Table grape	12,679	9,251	-25
Kiwi	1,356	1,005	-26
Walnut	3,419	3,542	4
Avocado	2,803	3,672	31
Total	44,038	39,778	-9.7

Source: Land registration of fruit cultivation 1994 & 1998, CIREN

Rate of cultivation area and area of table grapes and pears has been decreased significantly. Table grapes decreased approximately 25% of area that is 3,428 ha and pears decreased approximately 48% that is 1,492 ha. Peaches, nectarine and kiwi are also decreased. Avocado, in the other hand, has increased most at 31% that is equivalent to 869 ha and followed by plum of 317 ha (17%). Lemon, orange, almond and walnut are expanded cultivation areas.

As the reason of decrease on cultivation area of fruits, it is noted that orchard situated in the suburbs of Santiago competes its conditions of location with development and subdivision of the housing lot, high payroll costs in the outskirts of Santiago, and effects for profitability on fruits cultivation due to continuos decreasing of exchange rate in recent 5 years.

Base on the data of CIREN, cultivation area of fruits is not decrease in totally, provinces located in the outskirts of Metropolitan area are rather decrease but increase in the areas far from the Metropolitan area. The reason that decrease of areas for fruits production in the study areas is already described in the previous paragraph. On the other hand, expanded areas of fruits cultivation locates in the Melipilla province having the areas for new irrigation development.

(3) Vegetable

Vegetable cultivation is characterized as intensive cultivation with relatively high technique and cultivation is total 27,955 ha share of 12% of cultivated area. Vegetable is cultivated in all the sub-basin. Vegetable cultivation area in metropolitan region by Census of 1975 to '96 and 1997 and the data of 1990 to 1991 and 1994 to 1995 of ODEPA are compared below;

Item	Census	ODEPA		Census
	1975 - 76	1990 - 91	1994 - 95	1996 - 97
National total	103,835	119,268	120,268	113,113
Metropolitan region total	23,686	40,327	32,260	25,641
Metropolitan/National	22.8%	33.8%	26.8%	22.6%

Source: 1975-76 Census, 1997 Census INE, Outline of local agriculture 1991, 1997 2nd half agriculture report ODEPA

Vegetable cultivation in metropolitan region in 1990 to 1991 has shared approximately 33.8% of entire nation, however, fell to 22.6% in 1997 Census.

Following factors are considered on decrease of vegetable cultivation in metropolitan region.

- Vegetable cultivation using sewage for irrigation in metropolitan region decreased considerably by outbreak of cholera in early nineties.
- Urbanization has rushed into traditional vegetable cultivation area as Chiccureo in Santiago. It is considered that vegetable cultivation particularly affected by urbanization recently.
- Vegetable cultivation tends to move to the other area due to increment of labor cost in metropolitan region, particularly as Lamp and Collina.
- Facility and purchasing point of food Processing industry, as of tomatoes, tend to move out from metropolitan region.
- Effect of draught in 1996- 97 according to 1977 Census is raised as a reason
- Vegetable prohivited the cultivation by using contaminated irrigation water is as follows;

Cabbage	Chicory	Radish	Celery	Srrawberry
Spinach	Chard	Carrot	Cauliflower	Halian Parsley
Coriander	Turnip	Water cress		

(4) Grapes for wine production

Regarding fruit cultivation, grape for wine production is raised as successful contribution on exportation. Trend of metropolitan region and national on wine grape cultivation is shown below;

Unit: (ha)

	SAG					Census
	1975	1980	1985	1990	1996	1997
Metropolitan region	9,425	9,280	3,410	3,027	5,904	6,703
National	104,599	102,690	62,152	54,267	55,894	81,256

Source: SAG& INE, Agriculture and livestock sector, Recent trend and forecast, CORFO, 1998

Cultivation area of grape for wine production in the study area is 8,702 ha and its over 90% is located in irrigated area. It is 10.7% of cultivated area of the country and 17.7% of irrigated grape cultivation. 20% of good quality wine grape cultivation is in the study area and most of large-scale producers are located in the area.

National wine consumption in the last 30 years is taken its place by pisco and beer from 53lit./head to 20 lit./head. Traditional brands as “Concha y Toro” and “Undurraga” and others have shifted largely their business to exportation. Success of export raised necessity of new cultivation method for high quality product and competitive quality by drastic improvement of wine brewing technology.

(5) Seed production

Seeds are produced in large area in the study area. Multiplication of pure line and commercial seeds of cereals, vegetable and processing crops as corn, wheat, mervil-of -Peru (*Mirabilis jalapa*) and potatoes are produced.

Area of seed production in the study area is 7,970 ha and its 44% is located in Angostura sub-basin and over 10% in Lampa, Puangue and Melipilla sub-basins respectively. The study area has shared seed production area approximately 27% of the country according to 1997 Census.

Seed production is normally carrying on by contract bases. Expansion of this business by assigning various functions to the enterprises is possible. Chile has long

experience of business in this field. Specialized farmers are available and selection for training is also possible. Chile situated seasonal lag with Northern Hemisphere, which is seed large consumer and less damages of diseases and pests by geographical isolation, therefore, seed production in Chile is considered large advantage under its advanced legal systems and favorable climate and soil condition.

(6) Forage crops and livestock

Forage crop cultivation occupies 18.3% of the total cultivated areas and aims at important role of the cultivation crops in the study area. A part of produced forage crop are sold in Metropolitan region and its outskirts, and consumed by the producers for their livestock.

Livestock is not major industry in Maipo river basin, however, high potentiality of livestock in the outskirts of Santiago shows due to high demands on dairy milk, beef, chicken, pork and eggs.

Head of animals and share in the country of the study area according to 1997 Census are shown below. Many head of swine is realized by modernized technique for raising and making possible to raise near the markets and produced area of the forage crops. Maize which is basic forage crop is mainly produced in VI region but Metropolitan region is also produced. Presently, market of the forage crops is Santiago however export market is being considered making the best use of location on near the port for export.

Animals	Head		%
	Metropolitan Region	National	
Cow	229,531	4,141,545	5.5
Sheep	60,544	3,710,549	1.6
Swine	643,066	1,722,403	37.3
Horse	40,016	415,184	9.6
Goat	21,005	738,183	2.8

Source: 1997 Census

Metropolitan region occupy 12.3% of milk supply to the daily products factories in 1997. This trend has been continued from the last decade and reflects close relation between milk production and Metropolitan region and its outskirts. Milk production in Metropolitan region is supported by the high technique of production and profitability. Recently, many small-scale farmers participate to the milk production but occupy less than 3 % of the total production value due to low technique of production.

Data of dairy products is shown below. Factory in metropolitan region emphasizes on fresh products as milk, natural cheese and yogurt. Highly reservable products as powdered milk and cheese are not produced.

	Metropolitan Region	National	Rate (%)
Received milk at factory (lit.)	188,246,789	1,525,693,711	12.3
Price at factory ($/lit.)	108.78	98.13	--
Milk production (lit.)	123,422,357	270,662,130	45.6
Powdered milk (kg)	0.0	65,726,445	0.0
Natural cheese (kg)	6,771,886	7,106,429	95.3
Yogurt (lit.)	66,942,114	79,422,500	84.3

Source: Publication of Milk products 1997, ODEPA

Indicators of meat production, broiler and egg is shown below. Beef and pork productions as well as broiler have a tendency to concentrate to large fresh food consumption area of Santiago. As for the pork and broiler, production is concentrated in VI region other than Metropolitan region because those areas produce forage crops for food.

	Metropolitan Region	National	Rate (%)
Beef production (ton)	120,351	262,105	45.9
Lamb production (ton)	684	9,811	7.0
Pork production (ton)	96,695	208,703	46.3

Source: Slaughterhouse survey, INE, ODEPA. Livestock report March 1998 ODEPA

	Metropolitan Region	National	Rate (%)
Broiler (thousand ton)	57,322	136,673	41.9
Egg (pieces)	1,002,707	1,852,760	54.1

Source: Poultry farm survey, IV to IIX region, INE, ODEPA. Livestock report March 1998 ODEPA

3.4.3 Yield

The 1997 Census is available to observe present yields per unit of the study area. Yields of cereals, minor cereals and major crops for processing in the Census is shown in Table 3.4.3. Yield per unit area is shown for each crops on irrigated area and non-irrigated area, and number of farmer using irrigation or not, because the Census is not describe yield with and without irrigation. For small scale farmers, it was prepared based on 1986 EMA data and summary is shown below;

Unit: qq/ha

Crops	Irrigated			Non Irrigated		
	Small scale	Middle/large Scale	Variant (%)	Small scale	Middle/large Scale	Variant (%)
Wheat	31.9	37.2	16.7	14.8	23.1	-56
Oats				8.7	25.2	-189.1
Corn	62.0	86.5	-39.5	46.0	51.3	-11.6
Beans (domestic)	9.4	12.4	-31.5	5.3	8.0	-51.4
Beans (export)	11.7	12.9	-10.6			
Lentil				4.0	5.1	-26.9
Chick pea				8.4	10.6	-25.6
Potato	96.0	158.9	-65.5	42.7	91.0	-113.0
Mervel-of-Peru	20.7	24.3	-17.5	14.1	34.0	-140.9
Tobacco	29.5	30.7	-4.1			

Source: Prepared by Agraria based on ENA '86-'87, Echenique J. & Rolando N., Small scale farming

Yield of fruits is referred a study carried out by the Catorica University because it is not available in 1997 Census. The data are described by age of tree and domestic and export purposes. Technical levels were set on capable to supply continuously for export market. Table below is summary of yield of fruits;

Crops	For Domestic (kg/ha)	For Export
European Plum	27,000	
Japanese Plum	19,881	2,250 box/ha
Apricot	10,880	1,280 box/ha
Peach (late variety)	28,800	6,300 box/ha
Kiwi	24,000	6,300 box/ha
Gala Apple	60,000	2,526 box/ha
Nectarine (late variety)	28,800	3,063 box/ha
Serr. Walnut	4,000	4,000 kg/ha
Hass Avocado	10,000	6,000 kg/ha
Pakham's Pear	40,000	1,680 box/ha
Thompson S. ha Table Grape	20,300	2,070 box/ha

Source: Yield of fruits per unit area, J.I. Dominguez & other. Economic prospect of agriculture, No.100, Feb. 1995

3.4.4 Agro-processing

Agro-processing activity in the study area occupies the most important position in the nation. A lot of number and kinds of processing facilities can be found in the study area and its production capacity is high compared with other areas. Outline of the processing facilities in the study area is as follows;

Kind of Agro-processing	Nos.	Productive Capacity
Fine powder processing	16	800,000 ton / year
Winery for export	37	120000 lit. /year
Dairy product processing	4	200000 lit. / year
Dry fruits factory	30	795 ton / day
Dry vegetable factory	4	178 ton / hour
Frozen fruits and vegetable	8	276,850 ton / hour
Fruits juice processing	6	300,000 ton / year
Canning factory	4	223,100 kg / day
Preserved fruits	3	303,000 kg / day
Jam	6	21,100 kg / day
Tomate processing	4	800 ton / day
Dry fruits processing	24	147,781 kg / day
Pickles	10	14 ton / day
Freezing facility	111	1,100,000 (area) m^2
Packing facility	444	8,533 ton / day
Disinfection facility	38	1,091 ton / day
Slaughterhouse	4	-

3.4.5 Farmers Income

Farmers income by agricultural activities is estimated in each sub-basin basis in accordance with the farming type of small, medium and large scale farmers. Average land use by sub-basin basis shown in 1997 Census is employed as the basic conditions of farming type for estimation.

Farming type of small-scale farmers shown in the Census is employed as it is because those farming scale correspond to the average value of each sub-basin. Meanwhile, farming type of 100 ha is employed to reflect the average land holding size in case of medium and large scale farmers. Farming size of these types is not expressed with certain accuracy since many farm lands which no farming activities is made at present include in the data of Census.

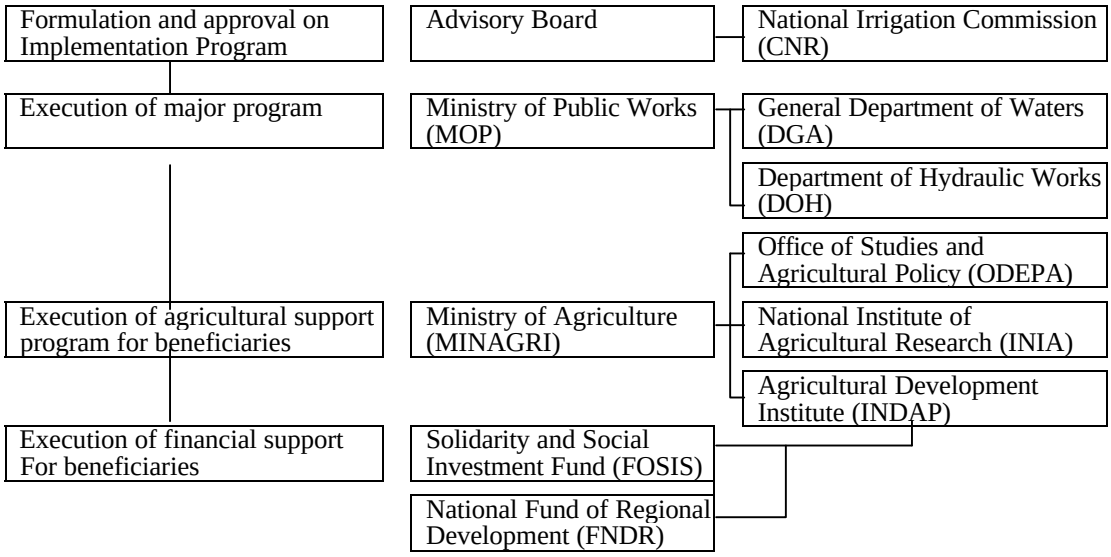
Table 3.4.4 and 3.4.5 show cropping pattern, gross income by cultivated crops and areas in accordance with the farming type of each sub-basin. The lowest, highest and average gross income of small-scale farmers come to $ 822,000 of Casablanca, $ 3,370,000 of Lampa and 1,854,000 of whole sub-basin, respectively. Many small-scale farmers engage vegetable cultivation in Lampa therefore their income show the highest value among the sub-basin.

In case of medium and large scale farmers, gross income varies from $ 45,334,000 of San Antonio to $ 161,120,000 of Angostura. Agricultural development program is being carried out intensively in Angostura thus income value shows high compared with other sub-basins. Average gross income of medium and large scale farmers accounts more than $ 108,000,000 and over $ 100,000,000 is shown at 8 sub-basins out of 12 sub-basins.

3.5 Agricultural Support System

3.5.1 Governmental Institutions for Agricultural Support

Agricultural support in Chile is dealt with various measures depending on the purpose of assistance. Institutions related to the agricultural support extends over the several governmental organizations. Basic procedures on agricultural support can be summarized as follows;



Related organizations for the agricultural support are dispersed among the ministries with purpose of assistance as shown below. However, formulation and execution of the support program are entrusted to the regional administration body which know the actual situation of local society well and in view of the promotion of decentralizations. Also, those procedures are being made with the participation of the beneficiaries.

MIDPLAN (Ministry of Planning and Coordination)	FOSIS(Solidarity and Social Investment Fund) FNDR(National Fund of Regional Development)
MOP (Ministry of Public Works)	DGA (General Department of Waters)) DOH(Department of Hydraulic Works) INH (National Institute of Hydraulics)
MINAGRI (Ministry of Agriculture)	SEREMI (Ministerial Regional Secretariat) ODEPA (Office of Studies and Agricultural Policy) INDAP (Agricultural Development Institute) SAG (Agriculture and Livestock Service) INIA (National Institute of Agricultural Research) CONAF (National Forest Corporation)
MEFR (Ministry of Economic Promotion and Reconstruction)	CNR (National Irrigation Commission) CORFO (Production Development Corporation) INE (National Statistics Institute) CIREN (Center of Natural Resources Information)

3.5.2 Agricultural Support Organizations

Share of social policy expense (the policy for fields such as education, welfare, dwellings, labor, jurisdiction) occupied 58.1% of national budget in 1988, but 65.7% in 1997. While national budget in 1997 is 4.9 times as much as that in 1988, social policy expense in 1997 is 5.5 times as much as that in 1988. Growth rate of social policy expense has increased more than that of national budget.

Within social policy expense, the budgets relevant to agricultural support directly are INDAP project expense and FOSIS project expense. All INDAP project expense is the budget for agricultural support. FOSIS project expense covers not only agricultural field but also all fields relevant to independence of the social vulnerable. With increasing social policy expense, expense of INDAP services has increased. This was 8,431 million pesos (1.0% of social policy expenses) in 1988, but there was a big growth and it increased by 8.7 times or 73,343 million pesos (1.6% of social policy expenses) in 1997.

On the other hand, FOSIS services started in 1991, and the budget was 3,643

million pesos at that time (0.2% of social policy expense), but it was steadily grown and increased by 5.7 times or 20,913 million pesos (0.5% of social policy expense) in 1997.

Unit：million pesos

Item	1988	1991	1994	1997
National Budget	1,415,671	2,620,030	4,615,392	6,909976
Social policy expense	822,032	1,583,526	2,953,402	4,538,828
of FOSIS	-	3,643	15,032	20,913
of INDAP	8,431	15,412	37,429	73,343

Social support system in Chile extends into various ministries and agencies. Therefore, it was hard to understand and utilize the system. Due to this, the manual (*Manual de Consulta Sobre Proyectos de Inversión Local*) which contains the results of social support system is published by MIDEPLAN-BID in 1995. It intends to strengthen solidarity of whole social policy and to increase efficiency of that. According to the manual, main programs implemented as agricultural support are summarized in following table.

Section	Program	Executives	Subject
Enlightenment	・Agricultural information support plan	MINAGRI	the whole
	・Agricultural organization development plan	MINAGRI	the whole
	・Irrigation law promotion plan	CNR	the whole
	・Basic activities for resource development plan	INDAP	small farmers
	・Farmers with irrigation development plan	CNR-INDAP-	small farmers
	・Economical forestry promotion plan	ODEPA	the whole
	・Agricultural market development	INFOR ODEPA	the whole
Forming organization	・Forming farmers' organization plan	FOSIS-INDAP	small farmers
	・Promotion of rural job opportunity plan	FOSIS-INDAP	small farmers
	・Support for small producers' organization establishment plan	FOSIS-INDAP	small farmers
	・Middle and small irrigation promotion plan (PROMM)	DOH-INDAP	small farmers
Technology transfer	・Agricultural technology transfer plan	INDAP	small farmers
	・Agricultural technology promoting organization plan	GTT	large and middle scale farmers
	・Consulting for farmers plan	INIA、U-Ch	the whole
Credit	・Small farmers' support fund	INDAP	small farmers
	・Forming farmers' organization fund	FOSIS	small farmers
	・Promoting middle and small irrigation plan (PROMM)	DOH-INDAP	small farmers

Source: Manual de Consulta Sobre Proyectos de Inversion Local, MIDEPLAN-BID

Basic condition for receiving the support from these organizations is holding water right. The preconditions of participating INDAP services which are the main part of agricultural support are that those who hold from 0.5ha to 12ha irrigated land and water right, beneficiaries have already organized, the project plan concerned has already established, and so on. In short, the support policy by the national government is not just distribution of subsidies or projects but also proceeds to promote independence and participation of inhabitants to the development process. Therefore, achieving agreement on the support project by beneficiaries is indispensable.

At present, agricultural support services are implemented mainly by INDAP in Chile. According to INDAP-RM, the number or the percentage of farm households which participate in INDAP services was 2,458 households or about 17% of total small scale farmers and 4,525 households or 31% of that in the field of credit support and technological support, respectively. These numbers include those who received both types of support. In sum, only about 20% of total small scale farmers are benefited by INDAP services except the overlapped persons. As mentioned above, the support system has not expanded to general beneficiaries because basic conditions are that beneficiaries have to form an organization and establish a project plan, and the service

systems were not enlightened enough.

INDAP service budget by Region

	1996	(%)	1997	(%)	97/96
INDAP total	64,476,732	100	68,595,544	100	1.064
Vth Region	2,713,976	4.21	3,541,937	5.02	1.301
VIth Region	6,453,688	10.00	7,382,146	10.47	1.144
Metropolitan Region	2,611,512	4.05	2,998,564	4.26	1.148

Source; The budget includes only portion of local currency. MEMORIA 1997, INDAP

Composition of INDAP services in RM

Item of Service	1996		1997	
	Beneficiaries	Service cost (%)	Beneficiaries	Service cost (%)
Credit (Financiero)	1,355	69.9	2,458	72.8
Technological development (Desarrollo Tecnológico)	2,081	14.8	2,447	13.1
Organization development (Desarrollo Organizaciones)	1,072	2.6	1,050	3.0
Agricultural marketing (Agronegocios)	900	2.5	340	2.7
Small scale irrigation (Riego Campesino)	817	10.2	688	8.4

Source : MEMORIA 1997, INDAP

Under this situation, INDAP established "New technological support services for innovation and transformation of productivity (*Nuevos servicios de asesorá técnica para la innovación y transformación productiva*)" for that beneficiaries can receive the support step by step. This program consists of "Local Support Services (SAL: *Servicio Assesoría Local*)," "Project Support Services (SAP: *Servicio de Asesría a Proyectos*)" and "Specialization Support Services (SAE: *Servicio de Asesoría Especializada*)." The beneficiaries can receive from the first step's service, SAL and then higher steps of support service gradually. The points of each support service are shown in the table below.

Item	Local Support Service (SAL)	Project Support Service (SAP)	Specialization Support Service (SAE)
Step	The 1st step	The 2nd step	The 3rd step
Supporting period	Maximum 2 years	Maximum 5 years	No limitation
Purpose of the service	Promoting small farmers' cooperation, strengthening organizations, support of farming technology, increase of productivity through strengthening farming	Value added products and improvement of production technology and business operating	Making cooperative business enterprises which is operated by small scale farmers highly-advanced
Basic condition	• Small scale producers • Groups of more than 20 persons • 7～10% burden of total cost	• Small scale producers • Groups of more than 10 persons • 10～30% burden of total cost	• Small scale producers • Cooperative business organization which has already reached a certain level • 25～35% burden of total cost

As mentioned above, the steps are systematized for that beneficiaries themselves can participate in the process of development step by step. Nevertheless, the problems with forming organization at the beginning and how farmers establish the project plan are not solved yet.

INDAP establishes a local office in each Region, and intends to promote agricultural support. Yet, INDAP has not penetrated into farmers because it does not cover all *Comunas*. Therefore, close relationship with SECPLAC is required to broad the base of farmers' support and promote farmers' independence. Local offices of

INDAP and the related *Comuna* are as follows;

Region	INDAP local offices	*Comuna*
V	Casablanca	Casablanca, El Quisco, Algarrobo
	San Antonio	San Antonio, Cartagena, El Tabo, Santo Domingo
VI	Rancagua	Graneros, Mostazal, Codegua
	Las Cabras	Las Cabras
RM	Melipilla	Melipilla, Mariá Pinto, Alhué, San Pedro
	San Bernardo	San Bernardo, Buin, Paine, Calera de Tango
	Talagante	Talagante, Peñaflor, Isla de Maipo, El Monte
	Norte	Colina, Lampa, Tiltil, Curacaví

Based on the structure of agricultural support system as mentioned above, the process that small scale farmers receive the support services is as follows.

(1) Forming producers' organization by small scale farmers themselves
(2) Employment of a private consultant by the producers' organization
(3) Making the project plan under the guidance of the private consultant (the purpose of the project, necessity, detail design of the project to be received the support, fund plan, basic information on the members such as water right and scale of irrigation farmland, and the project agreement sheet)
(4) Submission of the plan to the local INDAP and a preliminary survey
(5) Screening the plan at the head quarter of INDAP and appraisal
(6) If the project passes the screening, the local INDAP office would start technological and financial support. If the project plan is not approved, the plan is reviewed and applied again. All application expense is paid by farmers, and subsidies for the application are not provided.

As mentioned above, small farmers have to form organization for application till to establish the plan. Moreover, there is no guarantee for approval of the plan, and the system is not easy to be dealt with. Because of lack of the system on this basic part, the support services for small scale farmers after this is not connected with farmers' realities. Thus, it is hard to penetrate every measurement to farmers.

On the other hand, Communal Secretary of Planning and Cooperation (SECPLAC: *Secretario Comunal de Planificación y Coodinación*) is formed in each *Comuna* as an organization which takes promotion of decentralization. Social policy has been pushed forward through participation of inhabitants by SECPLAC. SECPLAC can be said a public organization which has close relationship with local areas. However, it does not extend into farmers' support because its implementing policy is strongly partial to social infrastructure improvement. Therefore, its cooperation with INDAP is not close.

SECPLAC in each *Comuna* is stationed under SERPLAC (*Secretario Regional de Planificación y Coodrinación*) at the Region level, administratively. SERPLAC collects regional information and distribute subsidies.

On the other hand, farmers who hold less than 0.5ha irrigated land had the support system for implementing an improvement project of irrigation facilities, and so on by PROMN. This system was carried out from 1993 to 1998 by the fund of World Bank. According to the appraisal of the project effect, it is discussed if it continues or new support system is created. There is no support systems for small scale farmers who hold less than 0.5ha at present. So as to promote independence of small scale farmers, continuous PROMM type support system is needed.

3.5.3 Farmers' Credit

Financial support is implemented by financial institutions (private or public banks) which known well generally, and also governmental institutions concerned such as INDAP and PROMM. Small scaled farm households do not have enough mortgage to receive credit from commercial banks. The financial support by PROMM usually involves irrigation projects. It consists of subsidies for irrigation facilities and for field irrigation at farm lot. Moreover, the financial support by PROMM involves technical support for the benefits of beneficiaries to be obtained and making the financial support effective. INDAP has different financial support systems from that mentioned above. They are the long credit system for investment and the short credit system for annual cultivation. In addition, INDAP has a technical support system for the producers who want to. Regional distribution of commercial financial institutions is shown in the table below.

Region/Country	1995		1996	
	Institutions	Branch offices	Institutions	Branch offices
R. Metroplitana	34	508	34	537
V	19	133	19	136
VI	15	50	15	51
Chile	34	1,214	34	1,251

Source: Compendio Estadísticas Regionales, MIDEPLAN, Noviembre 1997

3.5.4 Farmers' Organization

Farmers' organizations in the study area are canal associations by water users, an integrated canal association for controlling the canal associations, farmers' organizations, producers' organizations, but there is not a comprehensive organization like a cooperative organization which includes economic and guidance sections, and so on.

Most of farmers' organizations are formed by small scale farmers who hold less than 15ha by purpose of production. They work as producers' associations (*Asociación Gremial de Pequeño Agricultores*). The government concerned such as INDAP, FOSIS, PROMM, ODEPA, and INIA gives technological and financial support especially to these small scale farmers. INDAP plays a main role in this field. It gives advice to water right holders for highly-advanced farming. It also gives advice for obtaining water right, forming farmers' organizations, and provides credit to the farmers who do not hold water right.

So as to form organizations, INDAP do not instruct farmers directly, but they have to try to form an organization by themselves and to submit an establishment plan to INDAP. Only afterward, INDAP starts to give the support for activities. In short, the farmers who can receive its support indicate the farmers whose subsistence is agriculture, who have ability and motivation to improve the present situation. The structure is that INDAP gives support to the organizations and the groups which have already formulated agreement on the service through participation of these farmers.

On the other hand, there is National Solidarity of Agriculture (SNA; *Sociedad Nacional de Agricultura*) as a business enterprise type farmers' organization for large and medium scale farmers. This organization is that of business enterprise type farmers, and plays a big role in Chilean economy.

(1) Canal associations

The canal associations are established for securing the right of water users, distributing water appropriately, operate and manage of facilities. The executives are selected through election by members. The project plans are determined at general

meeting of the organizations. The organizations are operated by organizations fees which the members pay by amount of water right. The scale of the canal associations are ranged between a few from hundreds members, but the organizations are operated by direct participation of members. Large organizations hire private consultants as advisers to operate the organization and operate and manage the facilities appropriately. Nevertheless, many of irrigation facilities have been decrepit. Thus, it is the time for many organizations to improve the facilities. It becomes a big problem how to restrain the cost for operation and management of the facilities.

As an integrated organization of canal association, these is Confederation of Chilean Canal (*Confederación de Canalistas de Chile*). The confederation secures the right of canal associations, raises the status of them, controls canal association's information comprehensively, and gives advice for operation of unit organization. The joint of the confederation is voluntary, thus some canal associations are not the members. Yet, the percentage of the members is about 80% of all canal associations.

Distribution of canal associations in the basins of the rivers is summarized as follows. Distribution of beneficiaries is beyond *Comuna* and extends widely.

Basin	River	Organization	Canal association
RIO MAIPO	1 Estero Tiltil	Asoc.	1
	2 Estero Colina	Asoc.	1
	3 Estero Lampa	Asoc.	8
	4 Estero Arrayan	J.V.	1
	5 Estero Arrayan	Asoc.	6
	6 Rio Mapocho	Asoc.	40
	7 Quebrada de Macul Mapocho	J.V.	6
	8 Estero Agua Fria	J.V.	1
	9 Estero Agua Fria	Asoc.	6
	10 Rio Maipo	J.V.	1
	11 Rio Maipo	Asoc.	3
	12 Rio Maipo 1ª Seccion	Asoc.	8
	13 Rio Maipo 2ª Seccion	Asoc.	15
	14 Estero Puangue	J.V.	1
	15 Estero Puangue	Asoc.	10
	16 Estero Paine	Asoc.	3
	17 Estero Codegua	J.V.	1
	18 Estero Codegua	Asoc.	7
	19 Estero Angostura	Com.	4
	20 Estero Peuco	J.V.	1
RIO RAPEL	1 Estero Alhue	Asoc.	3
	2 Estero Polulo	Asoc.	3
	3 Estero Las Palmas	Asoc.	2
	4 Estero Caren	Asoc.	2

(2) Farmers' association / Producers' organizations

Farmers' association in Chile consists of agricultural labors and small scale farmers and started to form the association in large scale so as to improve socio-economic condition of farmers in 1967. Afterward, it became a larger political pressure with 300,000 members in 1972. During military administration period, the activities of farmers' association was restrained because its social demand was regarded as illegal activity. Then, the association was disbanded. In 1987, the association was reorganized but its activities are stagnant.

On the other hand, as farmers' organizations, there are producers' organizations for increase of agricultural productivity and stabilization of farming. The producers' organizations are formed by production, and they are not comprehensive cooperative organizations. The producers' organizations are the bases for receiving the support services by INDAP and plays an important role for stabilization and improvement of regional agriculture.

The number of the producers' organizations formed by instructions of INDAP is 45 mainly in the Metropolitan Region and its distribution is as follows;

Comuna	No. of organizations	*Comuna*	No. of organizations
Alhué	1	Paine	1
Buin	2	Pirque	1
Colina	2	San Bernardo	4
Curacavi	1	San Pedro	1
Lampa	2	Santiago	16
Maria Pinto	4	Talagante	4
Melipilla	6		

Source: INDAP Region Metropolitana, 1998

Classifying these organizations by products, Centers of Collecting Milk (CAL: *Centros de Acopio de Leche*) by small scale livestock farmers is the majority. Most of them are organized by the project of small scale milk collection (PMR: *Proyecto Microregional Lechro*). Most of CALs adopt the method of collecting milk which producers bring to milk collecting plants and then selling it together to processors. However, some organizations whose projects are well under way plan to process dairy food and to sell the milk directly to the central market through utilizing the project systems provided by SAP and SAE.

Through utilizing PRODEMU which is the women support project of INDAP for improvement of rural women's status and their independence, some organizations are formed for organic vegetable cultivation, making folk crafts and handicrafts, and produce special products of regions.

Establishment of producers' organizations is not only for improvement of productivity and stabilization of farming, but also influence regional society and economy directly. The producers' organizations play a very important role for economic independence of region and promotion for rural permanent settlement. There is bid demand for forming organizations among producers, but many of them have troubles with the method of forming an organization, individual information of producers, obtaining fund and so on. This is because the base of forming organizations is dependent on farmers themselves. The necessity of advisers for forming organizations and introducing institutions becomes a big problem.

3.5.5 NGOs

The main activities of NGOs were supports for the urban poor and protection for fundamental human right. However, the field of the activities has been expanded. NGOs are active in various fields and there are about 800 groups in all parts of the country.

According to Directory of Institution without profit purpose (*Directorio de Instituciones Privadas Sin Fines de Lucro*) by MIDEPLEAN-CDI or MIDEPLAN-Cooperation of International Development (*Corporación de Desarrollo Internacional*), the activities of NGOs in the study area are summarized as a following table, and 450 groups are working. The number of working groups in each region is as follows. Among them, only 3 groups implement the activities related to agriculture. One group is in the Vth Region, and two groups are in the Metropolitan Region. Main activity fields are small scale credit, regional development, health and sanitation, social development , and environmental education.

Item	The Vth Region	The VIth Region	The Metropolitan Region
Assistance (*Asistenciales*)	26	11	95
Communication and Culture (*Comunicación y Cultura*)	1	1	45
Development of Natives (*Desarrollo Indígna*)	-	-	-
Rural Development (*Desarrollo Rural*)	4	4	26
Human right (*Derechos Humanos*)	3	1	26
Local Development (*Desarrollo Local*)	7	6	66
Education (*Educación*)	8	4	42
Infancy and adolescence (*Infancia Adolescencia*)	11	5	60
Environment (*Medio Ambiente*)	11	3	25
Micro credit (*Microempresas*)	14	3	22
Women (*Mujeres*)	10	-	25
Health (*Salud*)	3	2	40
Dwelling (*Vivienda)*	-	-	9

SODEM (*Corporación Solidaridad y Desarrollo*) which provides agricultural support has its base in Maipú city and implements the programs for small scale farmers' independence by organic farming. In the study area, it constructed the field for training in *Comuna* San Pedoro, Loica area, in the study area. It extends the technology or strawberries' organic cultivation and achieved the results that strawberries come to stay a special product in *Comuna* San Pedoro. OCAC (*Fundación Oficina Coordinadora de Asistencia Campsina*) is a large scale group which has its base in Santiago. It works for modernization of rural areas and improvement of farmers' status through especially financial support for farmers' organizations. Although the activities of agricultural support by NGOs are small scaled and not enough, the field of activities has been expanded steadily. The recognition of farmers has been increasing. Therefore, it is required to construct cooperation methods with NGOs because the importance of NGOs will increase in the field of farming support, forming farmers' organizations, and rural improvement from now on.

On the other hand, as mentioned above, it is fatal for small scale farmers to receive the INDAP service that the support system lacks for forming organizations such as a producers' organization at the initial stage. If the support activities of NGOs engage in this field, a part of the problem could be solved.

3.6 Agricultural Economics and Marketing

3.6.1 Market System and Organization

The Metropolitan Region is the main center for marketing, industrialization, and consumption of agricultural products in the country. Major economic agents involved in these activities are wholesale markets, supermarkets, exporters, agroindustry and mills. Vertical integration is observed in pork and chicken production, while beef production is more horizontal and based mainly on cattle fairs and Lo Valledor slaughterhouse. Small producers of the region market their products mainly through intermediaries, traditional wholesale markets, and cattle fairs. Small producers also sell their outputs to a diversity of industrial plants processing agricultural products, and less frequently, to exporters and supermarkets.

(1) Wholesale markets

a) Vega Central
This is an old market located in a congested area in downtown Santiago, which has ceased to be a good location for a wholesale market, and the infrastructure does not meet the required sanitary conditions.

b) Lo Valledor
It is located in the south of the capital city, being the destination of most vegetable and fruit produced in the country, especially by small producers. Lo Valledor market has an estimated area of 25,000 m^2 for sale stalls, storage and parking.

In recent years, traditional wholesale markets have lost ground to other buyers (supermarkets, agroindustry, exporters), due to the following factors:

- Predominance of informal transactions, and lack of transparency
- Unclassified products, thereby penalizing high quality products
- Limited capacity in relation to regional production and marketing needs
- Deficient security measures

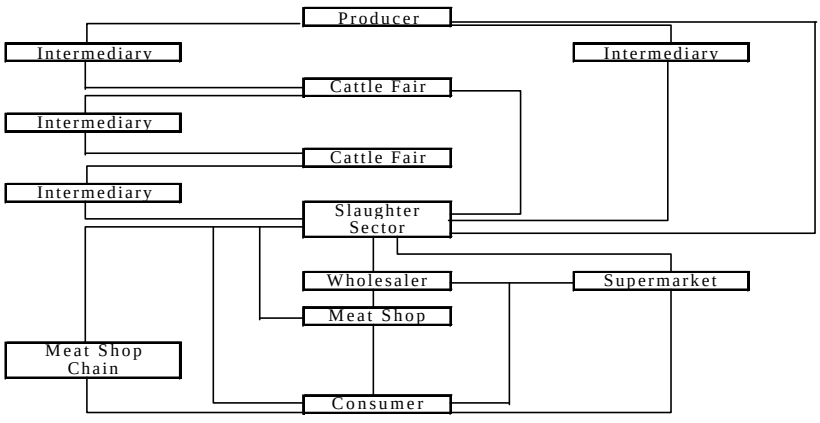
The above mentioned negative factors induced proposals to set up two new wholesale markets for fresh fruit and vegetable, as well as other consumption items like meat, dairy, fish and groceries. These two new wholesale markets seek to regain the confidence and preference of producers and consumers through transparent transactions, lower cost and increased profits to producers by reducing the role of intermediaries, and improved relationship between producers, intermediaries and distributors. The two new markets are:

c) Wholesale market of Santiago (MERSAN)
It is located in the industrial district of Lo Espejo, with the target total market area of 50 ha and 350 shops. The idea is for shops to be operated by producer's groups, so that these producers can sell directly to consumers.

d) Model market of Santiago
The target total market area is 30 ha and 1,600 shops. The idea is for producers to buy a plot to become an associate of the market, or to rent the space they need.

(2) Marketing of beef and livestock products

A study by ODEPA shows the flow chart below as fresh beef marketing channel from producer to consumer. In addition, there is a second beef market involving firms that process beef products, such as dry or canned beef factories, restaurants and food service companies. These firms are usually supplied by slaughterhouses, beef wholesalers, or beef importers, and are estimated to account for 40-45% of the beef market.



Source: Temporada Agricola, ODEPA, Dic.1997

Agents participating in fresh beef marketing are: brokers, fairs, slaughterhouses, meat shops, and supermarkets.

a) Cattle brokers
Cattle Brokers are intermediaries between demand and supply, charging 0.5% of the transaction value. Some brokers may actually buy and sell cattle in an attempt to increase their profit margin.

b) Livestock fairs
Livestock Fairs are physical spaces where cattle sellers bring their livestock to be auctioned off by buyers. Fairs charge 3% to sellers and buyers alike. As communication means improve, the role of brokers and fairs has decreased, from an estimated 50% in the 1970s to 30% of cattle marketing at present.

c) Slaughterhouses
Slaughterhouses supply beef to wholesalers and retailers. Rather than the traditional supply of carcass, the recent trend is to supply beef cuts, which have increased from the original 8 to the present 52 cuts. The supply of beef as cuts, rather than as carcass in half or quarter animal, has the advantage of facilitating specific demand satisfaction at each retailer outlet (meat shop, supermarket), and lowering transportation costs (cuts are free of unnecessary bones and fat). Slaughterhouses operate at the commercial level and at the family consumption level, and their locations are as follows.

Region	Slaughterhouse	
	Commercial	Family Consumption
Region V	12	0
Metropolitan Region	12	0
Region VI	11	6
Chile	112	52

The slaughterhouse in Lo Valledor, Metropolitan Region, accounted for 13.4% of beef production in 1995. Not a single slaughterhouse in Chile, however, is permitted to export beef to the US, Japan, Canada and the European Union.

d) Milk marketing
In the study area, a well developed marketing scheme is collective milk marketing by a group of small producers ("*centro de acopio de leche*"). This is a very interesting scheme that gives bargaining power to small producers, in their negotiation with other milk buyers or with milk processing plants. Some of these groups of small milk producers, however, do not consider milk industrialization, alleging that quality control of milk production is extremely difficult under rudimentary and unsanitary conditions prevalent among small producers.

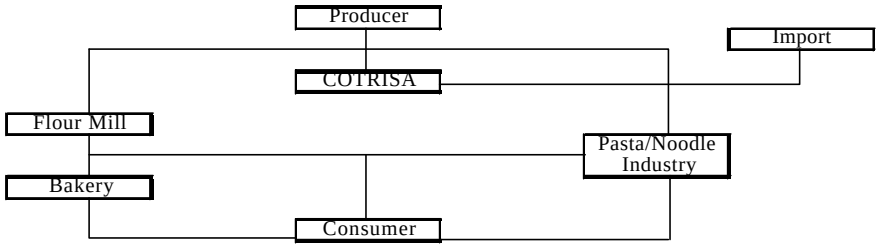
(3) Marketing of farm products

In the marketing of farm products, the concern is always with small producers who lack bargaining power to sell their products. Theoretically, bringing these small producers together, to induce collective marketing of their products, should increase their bargaining power, and should benefit everyone in the group with better prices from their products. This scheme, however, is difficult to put into practice, due to the quality differential in their products, whereby high quality producers are penalized by the price averaging with lower quality products. The quality differential problem can be

overcome, as in the case of milk, since collective marketing of milk ("centro de acopio de leche") in the study area is fairly well developed.

a) Cereal marketing

Cereal species may require milling and processing prior to consumption (e.g. wheat), or may require just milling (e.g. rice), or can be marketed as such even without milling (e.g. corn). The marketing channel can be schematically represented as follows;



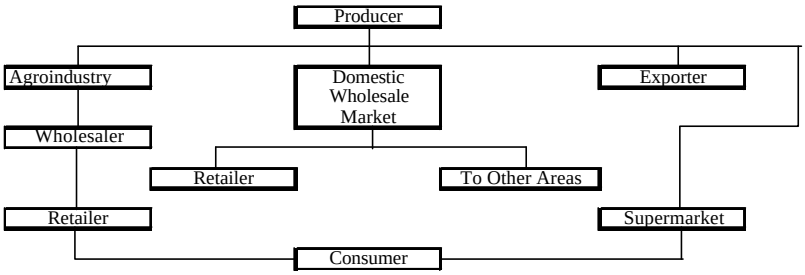
b) Vegetable and fruit marketing

Freshly consumed vegetable and fruit are usually produced near consumption centers. Since Santiago Metropolitan Area concentrates around one-third of Chilean population, vegetable/fruit production and marketing take place predominantly near this major consumption center. Wholesale markets serving the Santiago Metropolitan Area were already described above. Within the study area, the coastal cities of Valparaiso and Viña del Mar are also important consumption centers.

All these consumption centers and production areas are served by the best road network of the country. These are very favorable circumstances for agricultural marketing, opening up diverse options to producers. Selling to intermediaries who come to the farm is obviously an option, but it is usually the least attractive due to the low price paid by intermediaries. A second option for farmers is to sell their products in popular fairs or roadside stalls. Yet another option is to take their products to a "*concesionario*" or broker, paying him between 2% and 7% commission on sales value. Another option is to take their products to be auctioned off among wholesalers.

When a vegetable or fruit farmer earns a reputation as a producer of quality products, wholesalers or supermarkets or brokers may place direct orders with the said producer, implying better prices for less cost to the farmer, who can save transportation cost to the market. A producer who has an advantage, like clean groundwater instead of polluted river water for irrigation, may receive direct order or contract production for supermarkets or exporters. Exporters and agroindustry are buyers whose importance have grown in the recent past.

The marketing channel of fresh fruit and vegetable can be schematically represented as follows;



3.6.2 Agricultural Commodities

The study area is recognized to be the most important fruit producing area of the country, due to the proximity of the main consumption center, processing plants and export facilities. By the same reasons, vegetable production in the study area is favorable, hindered only by the polluted irrigation water.

Agricultural commodities under consideration in this section are basically staple food, and those produced in the study area are summarized in Table 3.6.1.

It is clarified that meat production refers to slaughterhouse carcass meat, and not to livestock production. Therefore, the share of the study area is high, since slaughter occurs near consumption centers, and the study area is the main consumption center of the country. The Metropolitan Region accounts for around 50% of beef and pork carcass meat production of the country.

In cereal production, the study area is important only in terms of wheat and corn. Wheat production in the Metropolitan Area accounts for around 7% of the country, while corn production accounts for about 10%.

The study area has very little weight in terms of legume production, be it beans, lentils, garbanzo or peas. Likewise, the Metropolitan Region accounts for only around 5% of potato production of the country.

3.6.3 Prices and Quality

(1) Prices

Government support for agricultural marketing consists of measures to improve and stabilize prices, to open up new markets, and to make updated price information available to interested parties. Specific measures supporting agricultural marketing include the following.

- COTRISA (Wheat Marketing Company): price regulation and purchase of wheat, to eventually include corn and rice in the future
- Price band to avoid violent price fluctuations in wheat, wheat flour, sugar and vegetable oil
- PROCHILE, an office of the Ministry of Foreign Affairs, promotes Chilean agriculture and forestry products in foreign markets
- Suppliers Development Program, of CORFO, gives support to improve relationships between agroindustry and farmers
- ODEPA provides updated price information by fax or by Internet

ODEPA provides price information concerning farm, livestock, forestry and agroindustry products, as well as prices of agricultural inputs, on daily basis or as

monthly and yearly averages, for the domestic as well as for the international markets. Examples of price information provided by ODEPA are shown in Table 3.6.2.

(2) Quality

Quality in agriculture involves the establishment of criteria to determine quality classification, and the practical application of these criteria. Obviously, quality criteria are established by specific products, like cereals (humidity content, broken grain, foreign matter), milk (fat content, foreign matter), fresh vegetable (physical appearance), etc. In the case of milk, field work observation within the study area revealed that quality control was implemented upon receipt of each batch of milk, and it is probably this quality control applied to each individual producer what makes collective milk marketing possible.

3.6.4 Household Income

A 1996 household income survey by type of economic activity shows that the rich-poor gap, measured as the ratio between the average incomes of the top 20% and the bottom 20%, is widest in agriculture at 11 times, as detailed below.

Type of Economic Activity	Bottom 20%	Top 20%	Income Gap
Agriculture, Fish., Forest., Hunt.	53.696	590.794	11,00
Mining	82.264	687.335	8,36
Manufacturing	72.809	553.181	7,60
Electricity & Water	85.913	498.373	5,80
Construction	74.865	686.853	9,17
Commerce, Restaurant	64.559	458.189	7,10
Transport, Communic., Storage	73.116	559.989	7,66
Financial, Insurance, Real Estate	76.858	713.131	9,28
Services	57.635	427.242	7,41
Unspecified	71.684	540.674	7,54
Total	62.954	530.132	8,42

Source: CASEN 1996, MIDEPLAN, January 1998

The average household income of the bottom 20% in agriculture is absolutely the lowest of all economic activities, but the average household income of the top 20% in agriculture is higher than in six categories (manufacturing, electricity / water, transportation / communications / storage, commerce / restaurant, services, and unspecified).

Unfortunately, the household income differential by type of activity is not reported by geographic region. Instead, the gap between the average incomes of the top 20% and the bottom 20% by geographic region is specified in terms of earned income and monetary subsidies, as detailed below.

Geographic Region	Income Gap: Top 20%/Bottom 20%		
	Earned Income	Subsidies	Total Income
Metropolitan Region	13.92	0,0837	13,25
Region V	9,78	0,1094	9,11
Region VI	12,32	0,1573	11,17
Chile	14,84	0,1117	13,63

Source: CASEN 1996, MIDEPLAN, January 1998

The Metropolitan Region shows a wider income gap than Regions V and VI, but shows also a smaller ratio of subsidies to earned income.

3.7 Agricultural Infrastructure

3.7.1 Existing Irrigation and Drainage System

Historically, irrigation has been applied to the study area through the utilization of water from Río Maipo and Río Mapocho. In the beginning of the 19th century, diversion works were built around the upstream of Río Maipo, La Obra. The alignment of Canal San Carlos led to the beginning of large irrigation projects. Afterward, irrigation development through utilizing surface runoffs has been carried out in the basins along with both river banks. Until the 20th century, large irrigation projects have been implemented such as San Carlos, Canal de Maipo, Pirque, and Buin with Río Maipo, and Mercedes and Mallarauco with Río Mapocho. These works have been done by private sector. Until around 1950, construction of most existing irrigation systems has implemented. Santiago locates in alluvial fan, and thus groundwater is plentiful. Since 1950, it has been used as irrigation water in the area where has been no available surface runoff, and as drinking water in urban areas. According to the Census in 1997, the irrigated area in the study area is 178,960ha, which is the sum of surface runoff and groundwater irrigated area. Figure 3.7.1 shows the existing irrigation canal networks.

3.7.2 Level of Facilities in the Existing Irrigation System

Based on the survey results on the existing irrigation facilities in the study area, structural level of the existing irrigation facilities are as follows;

(1) Diversion weirs

Irrigation system starts from the diversion works at rivers or reservoirs. Then, the irrigation water flow through the settling basin, main canals, branch canals, and then to fields. Existing diversion works differ in its structural level. The diversion works having large commanding areas, such as Las Vertientes, Obra, Eyzaguirre, Clarillo, and Mercedes, are made of concrete. Thus, intake efficiencies are high. On the other hand, small intake facilities are made of gabion and earth levees. The structure of them is damaged so easily by flood. O & M such as rehabilitation has been carried out every year. The cost for rehabilitation of damaged facilities by flood is high and this burdens farming cost. Moreover, insufficient capacity of settling basins causes the inflow of various materials into the canals. Except the weirs managed individually, Asociación de Canales, which also manages canals, is responsible for the management of weirs.

(2) Canals

Both main and branch canals in the study area are unlined. Reinforcement by concrete and/or masonry lining is made at the places, sliding of canal slopes, canal route running hillside, and geologically weaken points. Percolation loss is large because of unlined canals and O & M has been carried out every year. Even though the lining by concrete or masonry might be effective against the leakage from canals, it is hard to facilitate at the moment because beneficiaries have to bear the cost for the rehabilitation works. Lining of canal sections will bring low leakage of water, however, fostering volume to the groundwater will also become smaller. These phenomenon affect to the downstream areas where return flow is used as the irrigation water. An incentive to change the present structural condition of canals comes low, because irrigation is made counting the return flow from the upstream areas. The ratio of water loss of main canals can be considered as 10 to 15 % taking the discharge measurement results of the *Associación de Mallalauco*. The maintenance activities of canals are the small scale rehabilitation works, removal of deposits and weeding during winter or no cropping season.

(3) Division structures and its management

Most division structures of the canals are applied to dividing wall distributors because off-take amount is decided by the size of water right. The canals whose canal slope is enough steep to take fall are divided by lateral intakes. The division structures are important to distribute irrigation water on the base of water right. Associación de Canales manages up to the secondary canals as well as weirs.

(4) Irrigation at the field level

The method of most irrigation in the areas where river runoff is used, is furrow irrigation. However, the areas where suffered from irrigation water shortage applies water saving irrigation such as Californian Method and drip irrigation to the field level. After the severe drought in 1968, technique of water saving irrigation has been gradually expanded, and then during 1980s, was expanded drastically. Many of farm households started to irrigate reclaimed farm land with the surplus water, which brought by introduction of water saving irrigation. Most of the areas, where groundwater is used for irrigation, adopt pumping irrigation.

3.7.3 O & M of Irrigation Facilities

(1) Canal association

O & M of irrigation facilities is implemented by canal associations. Many of canal associations have the system of enterprises and are managed just as enterprises. Legally, the canal associations are regarded as enterprises and keep the facilities as their property. Farmers or users have water right and the association is managed by the collected tariff for canal management from the users. The association will be approved legally through the procedure of application to the DGA and approval of the DGA for establishment of the association. Some directors (5-6 directors) are selected in each association. They organize the board of directors, and manage the association. Large canal associations hire engineers as technical advisers for canal management, establish the authorities, and carry out canal management and rehabilitation projects. O & M cost in these associations is paid by the users as water tariff. The associations that are not approved legally will take disadvantage. For example, the Law No. 18450 is inapplicable to them when they carry out rehabilitation works.

(2) O & M cost

O & M costs consist of rehabilitation cost (rehabilitation of collapsed portion of canal, removal of earth and rocks from the canal and intake structure, etc.) and management cost of canal association. O & M costs of each canal association changes due to the management conditions (maintenance works and its extent, and collecting method of water tariff), condition of the intake structure and canals.

In the case that a power station involves in canal network, sometimes the power generation sector pays the management cost to the canal associations. Yet, all canal associations were established by users individually, and O & M cost is paid according to the *Accións*. The tariff of one *Acción* is from 40,000 peso to 400,000 peso and such amount can not neglect as the farming cost for some farmers. Water users in Melipilla, Puangue and Angostura are being paid high water tariff other than the canal associations because structural level of irrigation facilities on those areas is lower than other areas. In either case, deterioration of existing irrigation facilities is now in progress and annual O & M cost has a tendency to increase.

(3) The present condition of water utilization

1) Water utilization and water right

Water right stipulated in the low (Codigo de Aguas) are divided into three categories depending on the condition of water source and the form of utilization. They are permanent or eventual water rights, consumptive or no consumptive water rights and continuous or discontinuous water rights. An application of water right is made to the DGA. Confirmation on the water right, which it applies for, is made by the DGA regarding the intension of existent water right owners by public notice and available water amount by water balance study. The settlement of water right is permitted when procedures of confirmation shows without inconvenience. The settlement of water right for the rivers in the study area is made by division of three sections in Rió Maipo, five sections in Rió Mapocho and one section from the up to down streams in other rivers.

Transision of existent water right is carried out at the water market (Mercado del Agua) which is assured legally. In the river section which water demand is abundant in, there is a form that water right is kept by the purchase and sale not for the actual water utilization but for speculation purpose. These water rights unused are brought about un-necessity for irrigation use by retirement from agriculture, project hasn't started though water right was acquired, amout of actual water utilization is less than the amount of water right, reserved water right for future project, etc. Present water utilization in the study area from the view of water rights is as follows;

- 8,133 of water rights has been settled in the first section of Río Maipo which consenrates over 60% of annual runoff in the study area and the section is maintained the major water utilization in the metropolitan area. Among the water rights settled in the first section of Río Maipo, 82% is occupied by 10 irrigation systems and 16% is by EMOS. Remaining 2% exists as the water right which is not identified or utilized. Transision of existent water right at the water market is carried out mainly in the first section of Río Maipo and it is scarce in other sections and rivers.
- Because water utilization by gravity system is limited in the second and third sections of Río Maipo, reserved and/or unused water rights exist in the sections due to suspension of project execution and/or provision for the future projects. Since intake structures of the existing canal system in the sections are constructed independently, intake amount is regulated by the canal capacity and/or the river discharge at the time of intake.
- Water rights cover the whole runoff of river on the first, second and third sections in the Río Mapocho. They are maily irrigation purpose. In the fourth and fifth sections of the Río Mapocho, regulation of water utilization is being made by the Junta de Vigilancia as well as the sections in the upper streams. However, stabilized water utilization is being carried out compared with the upper stream sections due to inflow of the drainage water from the upper basin and of groundwater flow.
- Rivers and streams which thaw water is not available have limitation such as water volume and time to use on its river runoff. Water rights are set out for the whole runoff of the rivers and/or streams.
- No steady flow type but longitudinal separation devices is normally used as the diversion devices in the canal system. Therefore diversion over the regulated amount is practiced when there exists unused water rights.

As mentioned in the above, water rights registered for the river surface flow in the study area reached its limits. Difficulties to set out the new water rights and recent increased water demand in the metropolitan area are focused on the actual status of the existent water rights. Also, efficient utilization measures of water resources including

taxation measures for the unused water rights is now being discussed in the national assembly and the mass communication. These discussions concerning the efficient utilization of the unused water rights stand that the obligations occur in the right use though water can be used on the basis on the water rights as the private property, in other words, recognition that water is the social overhead capitals is being required.

2) Irrigation use

Reflecting the historical background such as landlords constructed diversion weirs in conformity with the expansion of farmland and present water right system, irrigation water distribution in Chile has not depended on the commanding farm land. River discharge is divided by Acción based on river management sections (*Sección*). Within a section, there can be taken 100% of river flow at the time water shortage. The consent among those who have water right is required when the water is tried to be transferred to other places. The water right is not involved with the farm land. They can be sold freely, and the purpose of their utilization is not fixed. The facilities are recognized legally as individual property of private sector (personnel, canal association). The owners are responsible for rehabilitation of their facilities, principally. Under this condition, there is low incentive for improving canal facilities to save water in the areas where have plenty of water. In the area where the improvement of the facilities is needed, only rehabilitation of the parts that needed to be used is executed.

3.8 Rural Infrastructure

3.8.1 General Condition

According to the statistics of municipalities, present condition of the basic infrastructures in the study area is as follows;

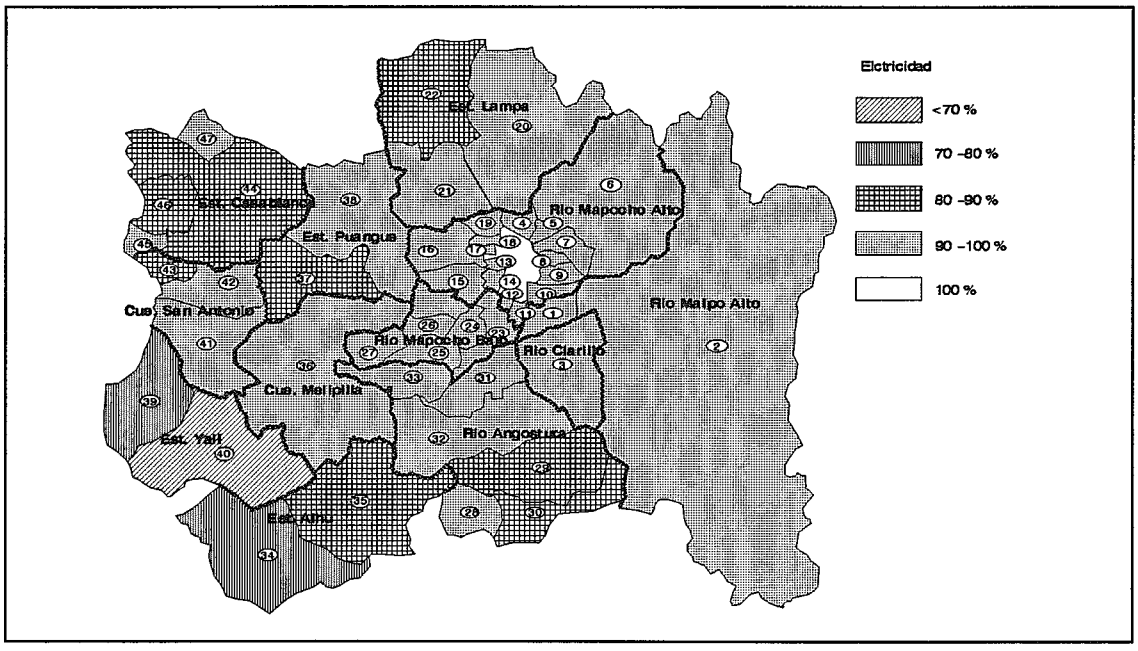
Sub-basin	No. of Households	Electricity %	Water supply %	Drainage %
1.Rio Maipo Alto	68,416	98.6	98.0	87.7
2.Rio Clarillo	2,949	94.6	48.6	38.8
3.Rio Mapocho Alto	1,056,176	99.4	99.2	89.3
4.Est. Lampa	21,595	92.3	76.9	45.2
5.Rio Mapocho Bajo	79,805	97.7	94.6	72.5
6.Rio Angostura	38,530	92.6	80.0	46.6
7.Est. Alhué	6,891	76.0	46.7	27.3
8.Cue. Melipilla	20,297	94.5	81.1	52.0
9.Rio Puangue	7,552	90.4	76.0	39.1
10.Est. Yali	4,775	70.5	30.5	28.7
11.Cue. San Antonio	39,424	95.3	91.1	71.0
12.Est. Casablanca	18,515	88.6	62.6	51.3
Total	1,364,925	98.5	96.8	84.4

Installation ratio of basic infrastructure is generally high in the study area. It is particularly high in the sub-basins which involves urban areas. Yet, the installation ratios of water supply and sewage system are low in rural areas, especially, in the sub-basins which involve mountainous areas.

3.8.2 Installation Condition of Basic Infrastructures

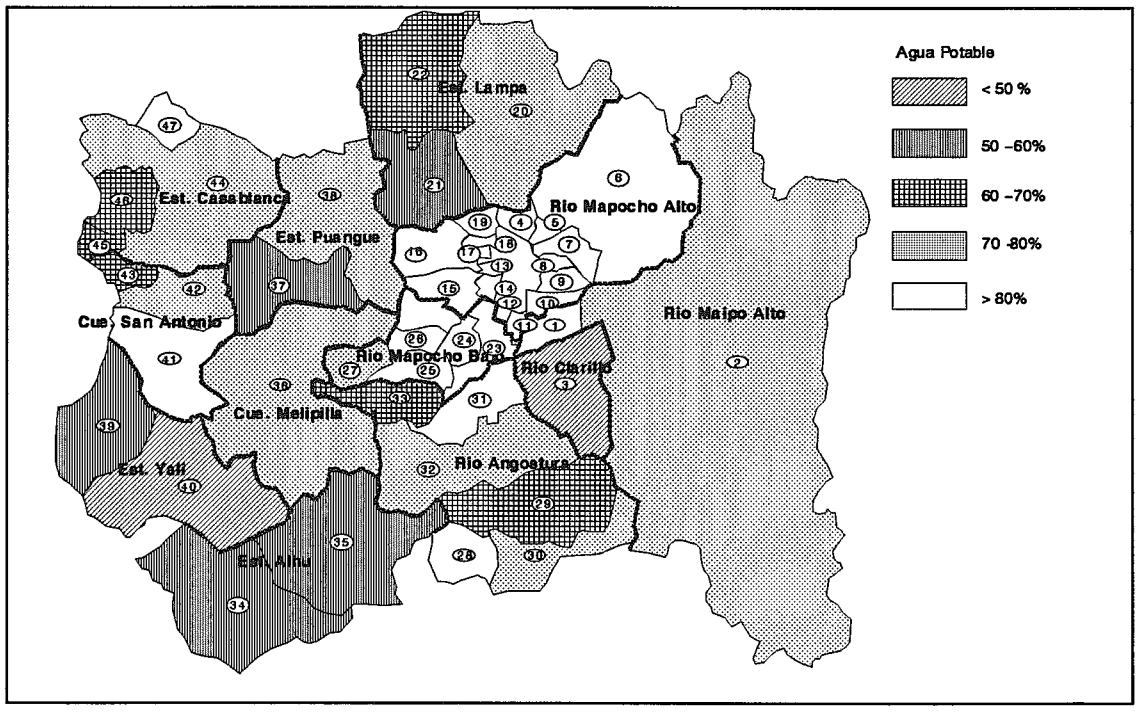
(1) Electricity

Installation of electricity supply facilities is proceeding, but electric uninstalled communities can be seen in mountainous areas. The installation ratio in most communities is over 80%.



(2) Water supply

The installation of waterworks is almost completed in rural areas located in flat plain. In those areas, domestic water is supplied through water pipe networks. On the contrary, in the mountainous areas, domestic water supply depends on small scaled waterworks by groundwater. The Metropolitan Region has the waterworks installed by EMOS. While, most of mountainous communities have own water supply system.

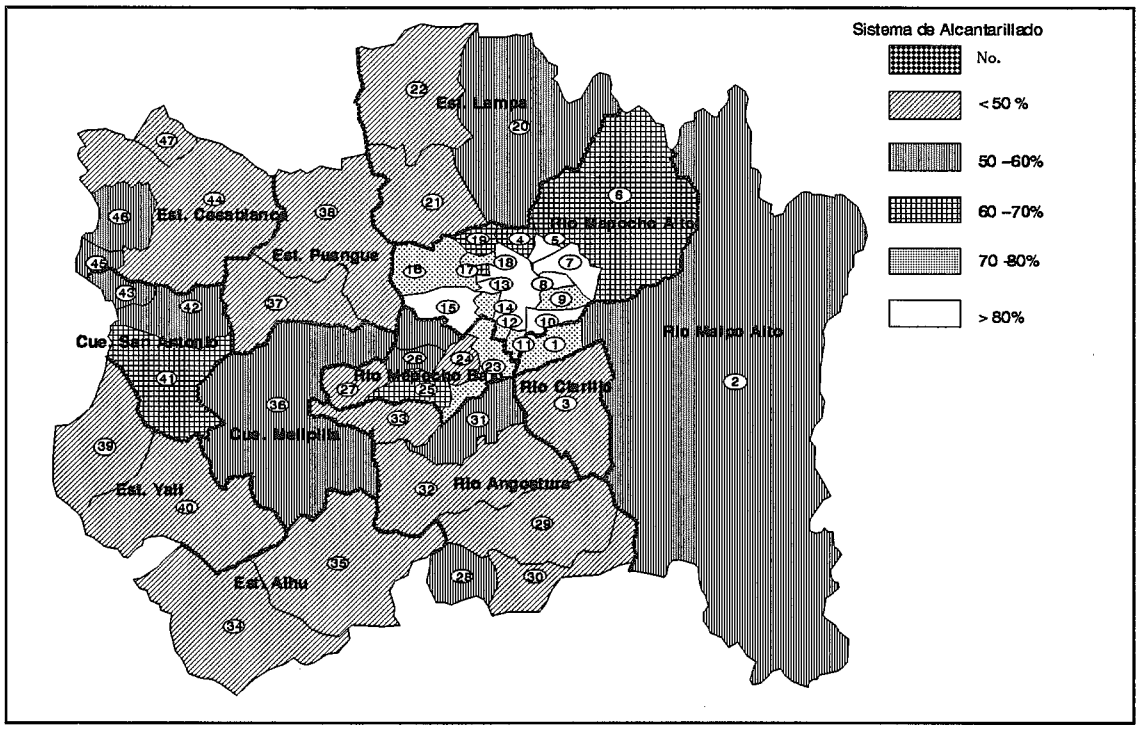


Installation of waterworks is retarded in sub-basins of Río Clarillo, Est. Alhué, Est. Yali, and Est. Casablanca.

(3) Sewerage system

Sewerage systems are installed mainly in the central areas of each community. Although the sewerage systems have already installed, final sewerage disposal systems have not installed yet in most areas. Thus, indisposed domestic miscellaneous waste water is discharged into rivers directly. This causes deterioration of water quality on irrigation and rivers, and environmental aggravation of sanitary aspect. Indisposed waste water discharges especially into basins of the Maipo river and the Mapocho river which involve the urban area of Santiago city. The areas whose agricultural water sources are these rivers have cultivation limits by regulations. Thus, agricultural producing is aggravated. Moreover, water quality of rivers is deteriorated by inflow of waste water in local cities. Agricultural producing and living environment are also degraded.

Installation condition of sewerage systems in each community is shown in the figure on the following.



Installation of the sewerage system is retarded in sub-basins of Río Clarillo, Est. Lampa, Río Angostura, Est. Alhué, Melipilla, Río Puangue, and Est. Casablanca.

A plan on sewerage disposal in Santiago city aimed at 2024 has been established by EMOS. The planning area consists of three disposal sections. Construction of a sewerage-disposal plant has already started in the first disposal section. The disposal service will be available from 2001. Then, improvement of water quality can be achieved.

(4) Education and medical service

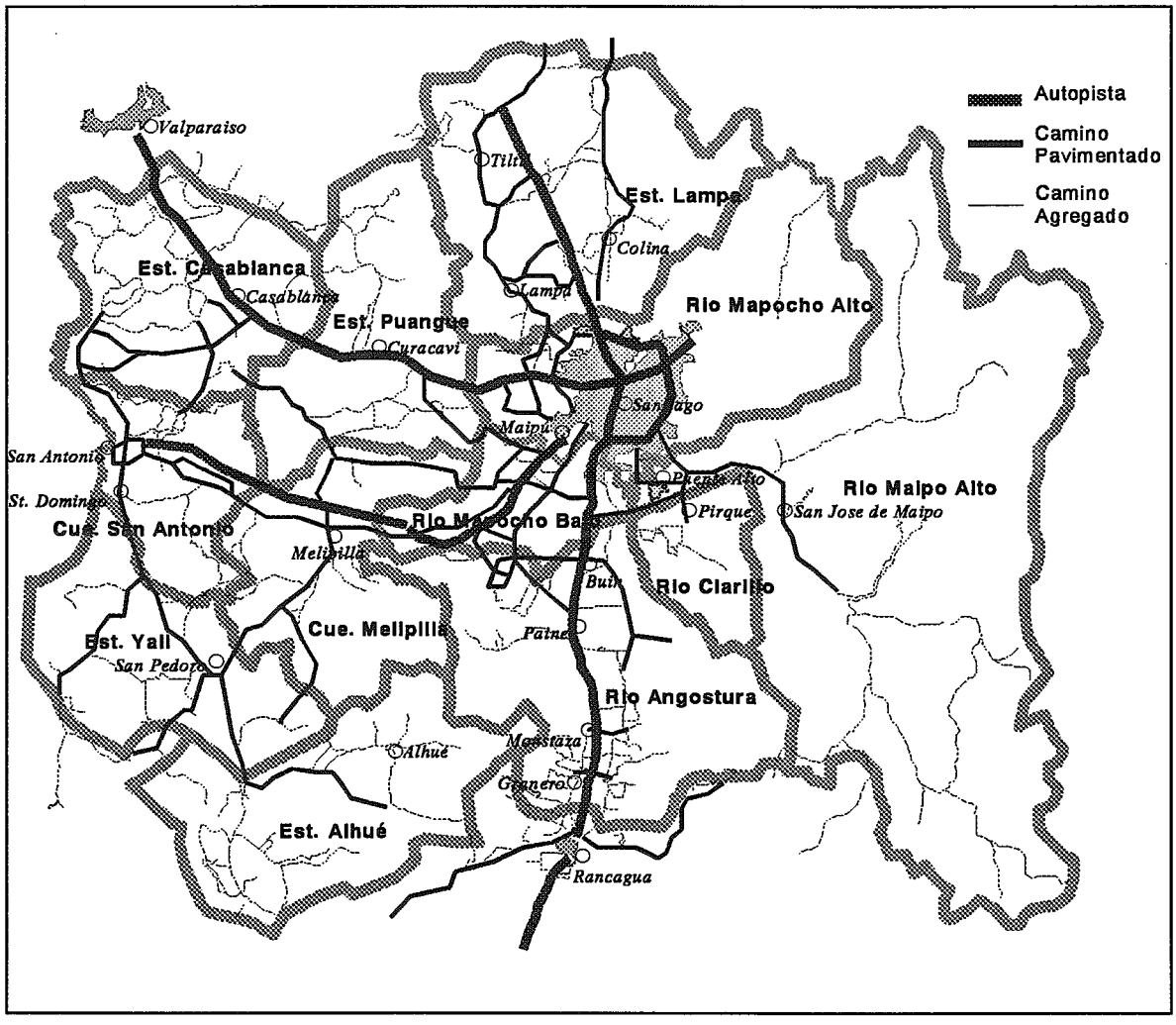
Generally, installation of educational and medical facilities are completed in the study area. However, both facilities are not well installed in rural communities.

As for educational facilities, long-distance school commuting and dormitory

system are common in mountainous areas. Some measurements need to be taken for this situation. As for medical facilities, rural communities have only health centers.

(5) Roads

Roads as far as the levels of national and regional highways are completely paved. Road network which covers wide area has been established, and it becomes a main artery for physical distribution. Most of provincial highways which managed by community offices are unpaved. Yet, there is no hindrance for the passage of cars. As a general transportation system, the buses run in as far as the smallest units of each community. All community have access to national and regional highways, but there is not enough connected roads among or between community.

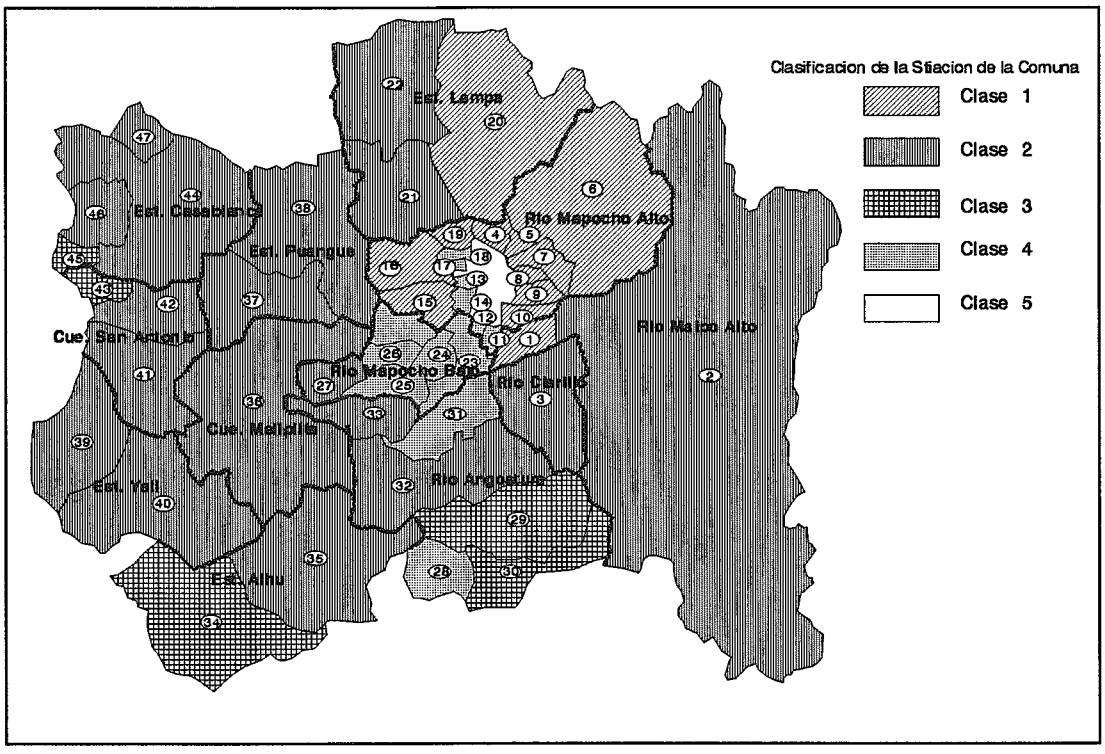


(6) Classification of community

To clarify the characteristics of each community, cluster analysis is made with five indicators such as employment ratio on primary industry, electrification ratio, covering ratio of water works and sewerage. Community in the study area divided into five classes based on the results of cluster analysis. Characteristics of each class are as follows;

Class	Characteristics
1	Insufficient basic infrastructure and low engagement ratio on agriculture Rapidly urbanization area
2	Insufficient basic infrastructure and high dependence on agriculture Typical agricultural area
3	Low facilitation of basic infrastructure and dependence on agriculture Agricultural area in a remote region
4	High facilitation of basic infrastructure and dependence on agriculture Agricultural area in outskirts of urban area
5	Urbanized area

For the classification of community in study area, fundamental structures can be seen such as behind of basic infrastructure in the rural area and sprawl by rapid urbanization in outskirts of Santiago. About 65% of community belongs to Class 2 and upgrade of basic infrastructure relating to the production and living is indispensable for activation and stabilized development of regional society. Classification of community is as follows based on the level of basic infrastructure in the study area.



3.9 Environmental Situation

The environment in the urban area is consisted in a correlation between the impermeable land including human habitations, roads and buildings, and the permeable land involving farmland, forest, meadow and water. In other words, it is the human-centered system into which such elements as air, water, soil, plants, animals, and micro-organisms are integrated: Ecosystem in the urban area.

The metropolitan region where deciduous-tree-fruits such as grapes have been produced for a long time and where a city area and farmland are closely involved, is characterized by its original ecological view. However, the recent increase in population in the city area is leading the region to an expansion, which seems to have a great influence on the ecosystem in the urban area.

3.9.1 Environmental Administration

The promulgation of the Fundamental Law of Environment (Law No. 19,000) in March 1994 and establishment of CONAMA led the environmental administration in Chile to the new stage. Meanwhile, the environment assessment system was more systematically established by the Law. In an agriculture field, the Ministry of Agriculture takes the lead to preserve soil for agricultural use, limit the use of agrochemical, and promote the preservation of forest and ecosystem.

Eleven objects for work are under consideration in the Assessment System of Environment approved in April 1997. Works related to water among them are works that have a great influence on waterworks, dams, drainage, the natural water system, and environmental improvement facilities. The following objects are included in the object with respect to the present project: the construction of a dam equal to or higher than 5 meters, or equal to or longer than 15 meters; an object in which the area influenced by draining water from natural lakes and marshes is equal to 20 hectares; the construction of a sewage disposal plant; and works or activities in the national parks. The assessment is conducted by the public organization having the authority for environment, which is coordinated by CONAMA. The public organization considers the necessity of DIA or EIA in accordance with the contents of works planned together with EIA section of CONAMA.

The assessment of the investment projects has been voluntarily carried out from 1993 until the establishment of guidelines for the assessment of environment in 1997. It takes 180 days as the whole period for EIA from the submission of reports to CONAMA until the decision of approval or rejection. The period may be prolonged, provided there is an observation on EIA. EIA system of projects is under control of COREMA. The offices in Santiago, Valparaiso, and Rancagua are in charge of the assessment of projects over the metropolitan region, the fifth province, and sixth province respectively. Projects over two or more provinces are assessed by CONAMA Headquarter.

There are provided regulations concerning water quality according to the purpose of use; a standard for water for agricultural use, drinking water, water for marine industrial use, water for recreation use, factory effluent and others. The standard value for water for agricultural use includes 27 standard values mainly composed of heavy metals. These regulations, however, have no binding force such as the penal regulations.

In discharging factory effluent into a sewer, on the basis of the law promulgated in July 1998, the effluent is first dealt by the plant, which each factory has the legal obligation to install, and then discharged into a sewer in the regulated standard value for discharging. In directly discharging factory effluent into rivers, there is provided the provisional regulations of 1992, giving a grace period for installing the plant to the existing factories, but not observed so far.

3.9.2 Natural Environment

(1) Designated area for protection

Designated areas within the object region such as the national parks are shown in the table below, which are managed by the Natural Forestry of Agricultural Department.

Type of Designation	Name of Areas	Size	Place (Basin)
National Park	No area designated	-	-
National Reserve	RIO CLARILLO	10,185ha	Rio Clarillo
	ROBLERIA DEL COBRE DE LONCHA	5,870ha	Est. Alhue
	LAGO PENUELAS	9,094ha	Est. Casablanca
	ESTERO EL YALI	520ha	Est. Yali
Natural Monument	EL MORADO	3,000ha	Rio Maipo U.
Natural Sanctuary	YERBA LOCA	11,575ha	Rio Mapoch U.
	LOS NOGALES	11,025ha	Rio Mapocho U.
	CASCADA DE LAS ANIMAS	3,600ha	Rio Maipo U.

Estero el Yali was registered as the marsh of the Ramsar Convention in December 1996,whose size was 520ha including the mouth of the Yali River and three lakes around the marsh. The marsh is also a bait and rest area for migratory birds. SECTOR BATUCO (Protection Zone (Priority III)) is to be entered on the list of the Convention. Fig. 3.9.1 shows areas for environmental preservation.

The number of animals and plants, and species has been rapidly decreasing recently over the metropolitan region compared to other provinces. Such factors are considered to be the cause of the phenomenon as water, soil, and air pollution, forest fire, the indiscriminate hunting, capture of animals for pets, and loss of soil because of human activities including industry, mining industry, housing, and agriculture (*Memoria del "Diagnostico ambiental para el Plan Regional de Desarrollo Urbano 1998-1999 Comision Ambiental del Plan Regional de Desarrollo Urbano, 1998*). Countermeasures against these factors are conducted by CONAF, CONAMA, and SNAPSE such as guarding against poaching, foiling an attempt to smuggle animals for pets, preventing forest fire, expanding the no-hunting area, and preserving the vegetation. Although there are organizations for environmental preservation, the watching activities are not carried out thoroughly.

One of the purposes of the Fundamental law of Environment Ley 19.300 is to preserve the diversities of animals and plants. In the Law, the conduct of the EIA is prescribed. Also prescribed in the Law are the EIA and actions in consideration for environment such as decrease in influence on environment or recovery of environment in the case where there is a great influence on the recyclable resources or there are resources or preservation areas around the project site.

The table below shows a distribution of the economic forest in every province in Chile, showing that few economic forests are distributed in the northern area of and around the metropolitan region, while 98.22% of the forests in the southern of the seventh province.

Province	Artificial Forest (ha)	Natural Forest (ha)	Total (ha)	Ratio (%)
I ～ IV	1,457	4,000	5,457	0.06
V	43,703	0	43,703	0.49
VI	59,589	41,200	100,789	1.14
MR	4,851	2,700	7,551	0.09
VII～XII	1,108,305	7,568,600	8,676,905	98.22
Total	1,217,905	7,616,500	8,834,405	100.00

Source: Report for Support of Planning the Preservation of Environment in Developing Countries – Republic of Chile-, Overseas Environment Cooperation Center Co. Ltd., March 1995.

The table below shows the condition of plants to be preserved and of vertebrate animals on land or in water. Numbers in brackets show the numbers of vertebrate animals over the metropolitan region.

Category	Tree	Succulent *1	Cryptophyte	Pteridophyte	Total
Extinct	-	1	1	-	2
Endangered	11	36	6	8	61
Vulnerable	26	105	40	8	177
Rare	32	19	31	23	105
Insufficiently Known	-	13	34	7	54
Total	69	173 *3	111 *3	44	397 *3

*1 Cactaceae and Ananas Comosus, *2 Total includes two species belonging to two categories., *3 Extinct species are excluded. *Source: Benoit, 1989.(PRICA, 1995)*

Category	Mammal	Bird	Reptile	Amphibia	Fish	Total
Extinct	1(1)	1(0)	0(0)	0(0)	0(0)	2(1)
Endangered	15(3)	10(4)	1(2)	6(2)	18(0)	50(11)
Vulnerable	15(4)	32(4)	13(5)	9(1)	23(0)	92(14)
Rare	12(2)	12(11)	18(1)	10(0)	1(0)	53(14)
Indetermination	2(1)	0(0)	0(0)	0(0)	0(0)	2(1)
Insufficiently Known	7(4)	18(6)	13(0)	6(2)	2(0)	46(12)
Total	51(14)	72(25)	45(8)	31(5)	44(0)	243(52) *1

*1 Extinct species are excluded. *Source: Libro Rojo de los Vertebrados Terrestres de Chile, CONAF, 1988.*

(2) Present condition of pollution

Within the metropolitan region, water pollution in the urban area including 34 communes and 4.7 million people in 1992 is most remarkable. The amount of living sewage and factory effluent accounts for 90% of the whole state. The sewage network spreads out in Santiago, the total length of which in the urban area reaches, according to EMOS, 6,500 km as of 1997. However, there is no sewage disposal plant so that filthy water in 13 m3/sec on the average of stream amount brought together from that area is directly discharged without disposed from 40 points of the Mapocho River, Zanjon de la Aguada Canal, and Maipo River. Such discharging brings about terrible water pollution of the rivers to be discharged, causing damage on nature and living surroundings. Water quality of the middle of the Maipo River, which has considered relatively good, is getting seriously worse recently because of the expansion of the urban area.

In the agricultural area where water for irrigation has been taken from the rivers polluted, the agricultural activity is seriously influenced by the water such as the limitation of crops to grow, fall of value as merchandise, and consumer's avoidance of the crops. Farmers considering difficulty of maintaining agriculture decide to give up farming and sell their farmland for housing those results in the disordered and unplanned expansion of the urban area.

The group number of coliform bacilli included in water for agricultural use taken from those rivers and canal is distributed within a range from 1,000 MPN/100ml or more to 105 MPN/100ml or more (cited from "Chile Managing Environmental Problems: Economic Analysis of Selected Issues", The World Bank, 1994). The former number corresponds to that of coliform bacilli in water taken mainly from the middle and lower part of the Maipo River and upper part of the Mapocho River, while the latter corresponds to that of coliform bacilli taken from Zanjon de la Aguada Canal and the middle and lower part of the Mapocho River.

In order to grasp the present condition of water quality surveys on water quality of river irrigation canals, and wells were carried out by an entrusted local consultant in July, August, and December 1998. 13 objects, water temperature, pH, EC, SS, DO, BOD, the group number of coliform bacilli, NO3-N, Ca2+, Mg2+, Cu2+, SO42- and Cl-, were analyzed, mainly based on bacteria broken out by living sewage. In the third survey in December, the survey points of the upper of the Maipo River and the Mapocho river where water quality was found relatively clear in the first and second

surveys were not re-surveyed, while survey points were increased on canals instead. Figs. 3.9.2 and 3.9.3 show the survey points of water quality and the condition of water pollution respectively. Respective tables 3.9.1 to 3.9.3 show the analysis result of water quality.

The present survey particularly shows, compared to the past one carried out by the Chile organization, that the group number of coliform bacilli taken from the middle of the Maipo River has remarkably increased. Evaluation of fecal coliforms is shown in Table 3.9.2. Of the group number of fecal coliforms taken from rivers, 1,000 MPN/100ml or more accounts for about two third, around a quarter of which is 100 million MPN/100ml or more corresponding to the number of coliform bacilli taken from the lower part of the Mapocho River. The number of coliform bacilli taken from most of the excess points was 1000 MPN/100ml or more, though the numbers from the Lampa River and Puangue River were 0.1 mil. MPN/100ml or so. Of the number of canals, the value of 8 canals taken from Zanjon de la Aguada, the middle and lower of the Mapocho River are 100 million MPN/100ml or more. Of well water, no group number of 100 MPN/100ml or more was found.

	Evaluation of fecal coliforms (number of excess point/number of survey point)					
The number of fecal coliforms	1,000 MPN/100ml or more			100 mil. MPN/100ml or more		
Place	River	Canal	Well	River	Canal	Well
First Survey	18/26	2/3	0/7	5/26	1/3	0/7
Second Survey	17/29	1/2	0/7	8/29	1/2	0/7
Third Survey	14/23	15/16	0/7	2/23	9/16	0/7

The table below shows the evaluation of BOD, which is the index of river pollution. Rivers passing through the urban area and canals from which water is taken shows BOD 10mg/l or more because of city sewage. Survey points of Zanjon de la Aguada and confluence with the Mapocho River shows BOD 200mg/l or more.

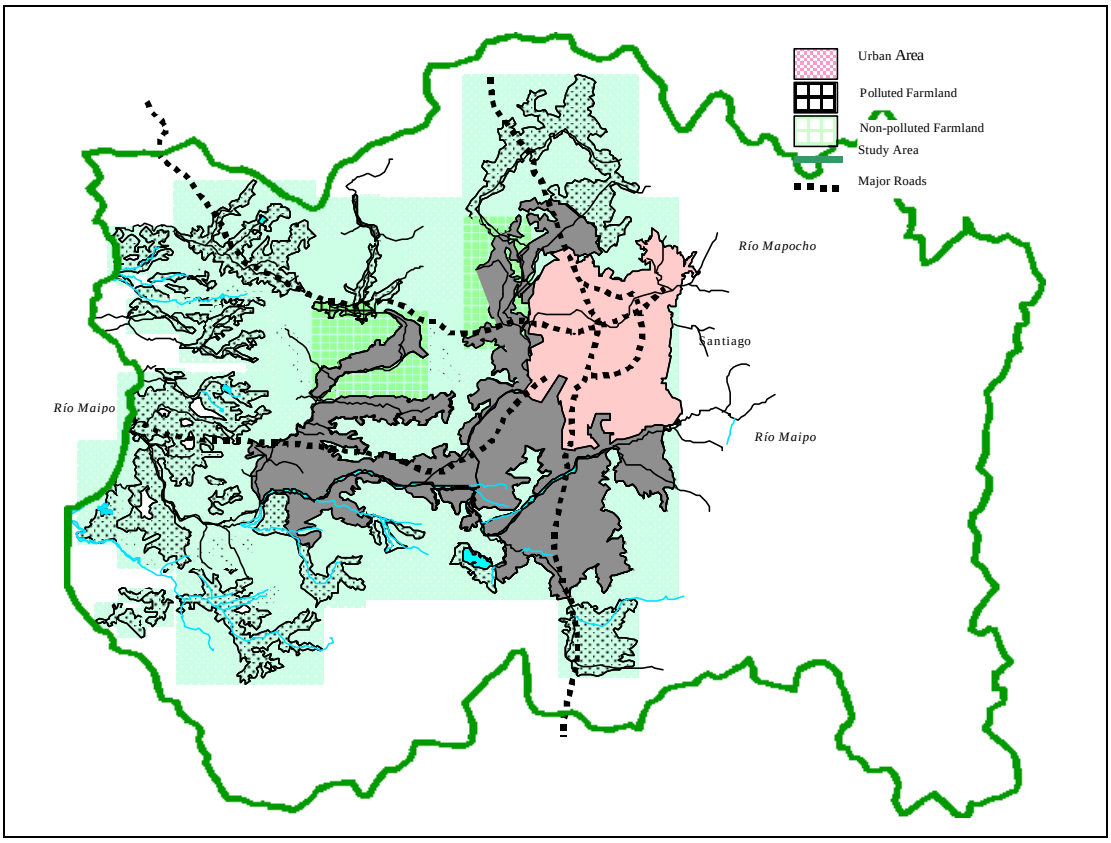
	Evaluation of BOD (number of excess point/number of survey point)					
Concentration	10 mg/l or more		100 mg/l or more		200mg/l or more	
Place	River	Canal	River	Canal	River	Canal
First Survey	16/26	3/3	1/26	1/3	0/26	1/3
Second Survey	13/29	1/2	1/29	1/2	1/29	1/2
Third Survey	22/23	15/16	2/23	6/16	0/23	0/16

The table below shows the comparison of copper ion (Cu) in water for agricultural use. The concentration value over the Chile standard one was found at one point of the upper of the Mapocho River. 13 survey points of 23 shows 0.02 mg/l or more. Particularly, all points of the Mapocho River until those of the confluence with the Maipo River show 0.02 mg/l or more. 14 points of 16 surveyed on canals and 2 of 7 on wells show 0.02 mg/l or more.

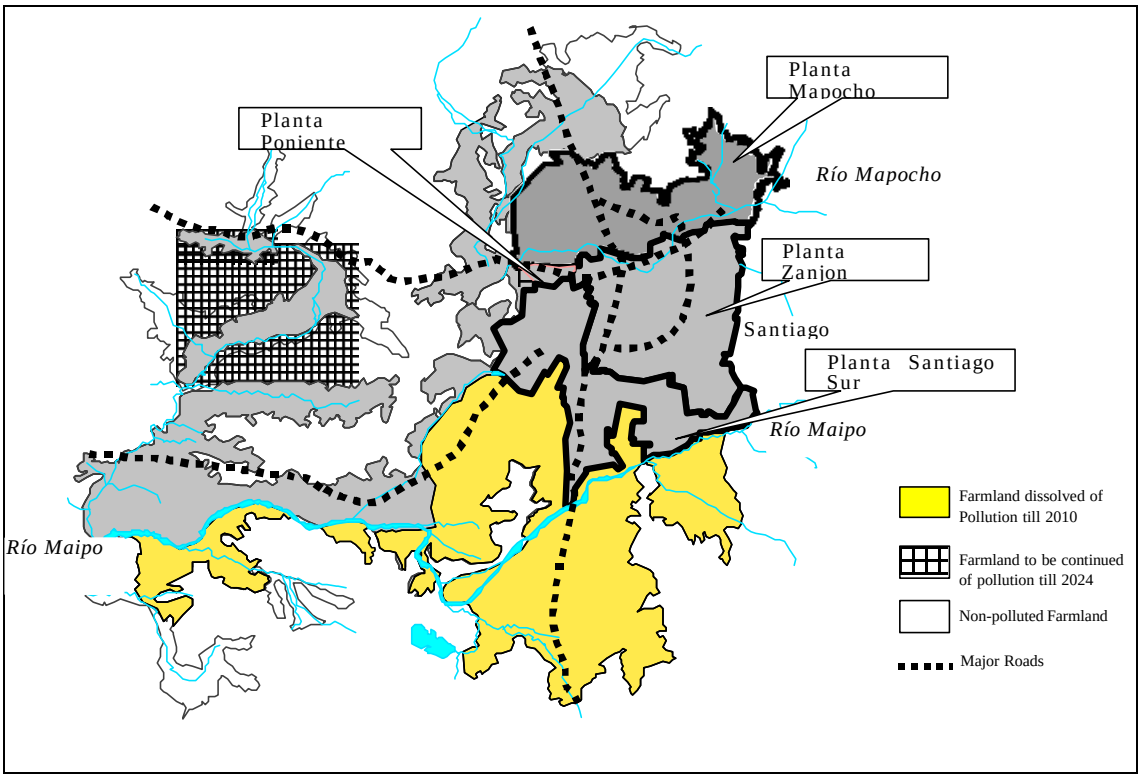
	The Comparison of Copper Ion (Cu) in Water for Agricultural Use (number of excess point/number of survey point)					
Concentration	0.20mg/l (Chile Standard) or more			0.02mg/l (Japanese Standard) or more		
Place	River	Canal	Well	River	Canal	Well
First Survey	0/26	0/3	0/7	1/26	0/3	0/7
Second Survey	1/29	0/2	0/7	5/29	1/2	0/7
Third Survey	1/23	0/16	0/7	13/23	4/16	2/7

The construction of a sewage treatment plant has been planned by EMOS since 1995 in order to improve such condition of water quality. According to the plan, Santiago City is divided into three sections for treatment, the South, Central, and North Section. A part of operation is to start in the South section in 2001 (from 3.5 m3/s in the beginning to 6.4 m3/s in the end), and in the North in 2009 (from 6.1 m3/s to 8.2 m3/s). It is not until 2024 that the plant will be completely constructed because the dealing amount of water to be treated will be escalated in every section in the plan. Sewage disposal population and the average amount of discharged water will be estimated at 8.7 million and 25 m3/sec respectively in 2024, the last stage of the plan. The sewage treatment plant in operation now is only the Poniente Pilot Plant built in 1993 whose dealing amount is only 0.2m3/sec. Fig. 3.9.4 shows the plan of sewage treatment in Santiago.

The installation of interceptor collectors and construction to change the drain point of rivers have been carried out in order to prevent sewage from flowing into water for agricultural use. These constructions cause, however, another water pollution by discharging sewage into the lower part of rivers. Following is the irrigation area that water for irrigation has been taken from the Mapocho and Maipo rivers and sewerage is incoming to those rivers.



Distribution of the area to be avoided the contamination of irrigation water with the sewage treatment plan of EMOS is as follows;



3.9.3 Social Environment

The outbreak of cholera in 1991 brought about such problems as the influence of sewage in the metropolitan region on agriculture and the necessity of disposing of the sewage. Economic loss because of the outbreak of typhoid and hepatitis caused by the worse public health and distribution of polluted agricultural products was roughly calculated and estimated to be about $2.63 million as of May 1993 (cited from the publication, The World Bank, 1994). Raising the specified vegetables such as lettuce with surface water is still prohibited in the whole metropolitan region, but not prohibited in the other regions. When growing the specified vegetables with ground water in the metropolitan region, the permission of the supervising organization, SAG, is necessary, which is given on condition that the group number of fecal coliforms in underground water is no more than 1,000 MPN/100ml.

The number of the outbreak of typhoid per 100,000 people in the metropolitan region from 1985 to 1996 is shown in the table below, indicating that the number had been less than 100 until 1991 but has remained less than 10 since 1992.

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number	86	78	54	56	76	46	49	8	6	6	6	5

Source: "Indicatdores de atencíon de salud," Ministerio de Salud, 1996

Further, the total number of the outbreak of typhoid in1996 within the whole metropolitan region, and each amounted number of six areas consisting of the region are shown in the table below, indicating that the total within the whole region accounts for 305 in which 180 comes from SUR zone and the other zones are within a range from 18 to 36.

Zone	Whole Region	ORIENTE	CENTRAL	SUR	NORTE	OCCIDENTE	SUR ORIENTE
Number	305	24	20	180	27	36	18
Per 0.1mil.	5.32	2.24	2.76	16.67	4.37	3.40	1.52

Source: "Indicadores de atencíin de salud," Ministerio de Salud, 1996

The amount of solid waste in every province of Chile in 1988 is shown in the table below, indicating that the most amount discharged from the Santiago metropolitan region accounts for 120,000 ton/month, about 60 % of the total.

Region	Population (1.000 persons)	Production per month (1.000 ton)	%
I ～IV	1.183	14	7,0
V	1.180	21	10,5
VI	366	7	3,5
MR	4.831	120	60,0
VII～ X II	2.793	38	19,0
Total	10.353	200	100,0

Source: Ximena Alegría., "Residuos Sólidos",Insituto de Ingenieros 1990.

As to general waste, every community contracts individually to private companies to dump in the landfill for general waste. Lo Errazuriz was completely closed in December 1995 so that waste generated from 36 municipal over the metropolitan region was to be distributed to the other two landfills with initiative of SESMA. The amount of solid waste in 1998 was 120,000 tons/month, which accounted for 60 % of the total amount in all areas of Chile.

At the site where the irrigation facilities such as canals for irrigation passing through the living area, there have been problems recently such as inflow of domestic sewage into canals, deterioration of water quality because of dumping waste into canals, and decrease in area of canals. The present situation is that there is no activity for amelioration of environment by residents at the site and that a guild of canal association is dealing with those problems by itself on the other.

3.10 Constraints and Development Potentials on Agricultural Development

3.10.1 Present Problems and Future Prospects

To grasp the basin characteristics in regional-wise, the study area is divided into 12 sub-basins based on administrative and basin boundaries. According to the results of the study on the present condition, major index of each sub-basin concerning nature, social and agriculture can be summarized as shown Table 3.10.1. Also the problems on the agriculture in the study area can be summarized in following four points.

(1) Present problems

1) Disparity caused by landholding scale

The landholding structure in the study area is distorted. 6% of landowners who hold more than 100ha farmland occupy 86% of total farm land in the study area and more than 80% of landowners who hold less than 15ha occupy only 5% of that. Large and middle scale farmers have established their bases for farming (management scale, labor force, irrigation, and agricultural machinery) and of management (access to distribution and markets, fund, and credit access). They farm as enterprises and industry. On the other hand, small scale farmers have not established stable farming and management bases because of small farming scale and traditional agricultural technology. Thus, extended reproduction of agriculture is difficult for them. In addition, migration of these small scale farmers from rural to urban areas has been increased in these years. The increase of the migration has been caused by that installation of BHN infrastructure has been behind in rural areas compared to in urban areas

besides low income structure of small scale agriculture.

2) Tightness and competition of water use

Almost whole water use depends on the runoff from upstream of Maipo river (Andes mountains) in the study area at present. Irrigation use dominates its water use, but utilization for water supply, mining and manufacturing industries, and electric generation has been increased with expansion of capital city, Santiago. Both surface and ground water uses are controlled by water right system. However, from the point of established water right, its water amount has already reached its limit, and it is almost impossible to establish new water right.

3) Contamination of agricultural water

Irrigation systems, which intake water from the rivers which run near the metropolitan area of Santiago, uses contaminated water by waste water from the metropolitan area as agricultural water. At present, the cultivation of designated vegetables such as lettuce by contaminated irrigation water is prohibited. On the other hand, treatment of urban waste water is planned to be improved gradually by EMOS and its target year is 2024. Nevertheless, it will take about 25 years for the irrigation systems to obtain purity irrigation water from rivers.

4) Decrease of farmland

Based on the expanding metropolitan economy, abandonment of agricultural land use from agricultural sector in the suburb of the metropolitan area has proceeded due to demand of expanding urban land use from the urban side and decreasing sustainability of agricultural land use in the farmland The farmland which alter to urban land is the superior farmland which consisted of proper soil for crop cultivation and for irrigation water use.

The future tendency on each problem can be prospected as follows.

(2) Future prospects

1) Disparity caused by landholding scale

The problem of disparity caused by landholding scale is, in the other words, the problem of small scale agriculture. There is no indication that technological and financial problems on the small scale agriculture can be improved at present. If the situation remains as it is, small scale farmers who are the main executives of the small scale agriculture would be left alone in competitive society and gradually be ignored, and then would have to abandon their farmland. The farmland will be combined with large and middle scale farmland or be not used as farmland. In this case, the first point to notice is the existence of job opportunity. When quitting agriculture directly means unemployment, rural or urban areas will hold new social and economic problems. The other one is the role which small scale farmers have been playing in rural areas. They have relationship with surrounded nature through agriculture which is their subsistence. The ecology system is formed and sustained through activity system of agriculture. The fact that total small scale farmers dominate 80% in whole Study Area depicts that small scale farmers are main constituents of rural society. Therefore, decrease or disappearance of small scale agriculture means structural disruption of rural area. This will cause serious social problems.

2) Tightness and competition of water use

The water use in the metropolitan area has already reached its limit. Thus, it is difficult to settle new water right through the easy methods such as use of river surface runoff. New water utilization will be promoted through the use of small scale ground water development, obtaining the established water right in the market, utilization of unused water right, rationalization of water use so far, storage of flood runoff, and so on. In the existing irrigation system, the frequency of water shortage has been increased at the terminal of the system with superannuating facilities.

3) Contamination of agricultural water

Chilean agricultural product for export achieved good reputation internationally by its quality and price, and maintains it until now. The reputation also needs to be sustained from now on. It will be brought through that Chile can produce not only high quality products with competitive power by technology but also low agricultural chemical products under isolation condition which resulted by peculiar weather and nature. This natural environment is precious property for Chile.

The competition in an agricultural market is very severe. Examples of competitive power loss, which resulted from something contained in or mixed with the products by accident, have been frequently heard. In addition, it can never be ignored that bad rumor on the products damage the dealings in the market even if the fact is not so bad. The fact in Chile is the use of contaminated irrigation water for crop cultivation. Even if the regulation on epidemics such as Cholera concerned with sanitation, contaminated water flow and bad smell which can be felt in cultivation areas would damage the image against the agricultural products in case that this spreads as rumor, once. This will obviously damage agricultural processing food and perishable food such as fruits and vegetables which have been expanded in Chie and will also influence low agricultural chemical products which mentioned above.

4) Decrease of farmland

Decrease of farmland in the metropolitan area and its suburb result from the trend of expanding urban areas and the gap on senses of value between present value of farmland for agricultural use and that for multiple use. The other causes are promotion for farmland transfer under current system, restriction of crop cultivation by contaminated irrigation water and so on. However, urban planning was established in Santiago city and other main cities. Through the planing, areas are clarified by land use and change of land use tends to be limited within designated framework from now on. On the other hand, development of subtropical fruit cultivation has been promoted through utilizing micro climate condition and ground water. The farmland for this use has increased. According to the demand in the market, the development of this type's fruit cultivation areas tends to continue for the time. Nevertheless, this restricts to particular fruit cultivation and cannot satisfy the demand for various crop cultivation. Thus, development of new farmland is required.

3.10.2 Constraints and Potentials

Based on the present problems and their future prospects, the constraints and development potentials for examining effective use of resources, agricultural promotion, and environmental conservation as the countermeasures to solve the problems in the study area are recognized as follows.

(1) Constraints

- Limited support system for small scale farmers

Supporting activities for small scale farmers are implemented by governmental institutions such as INDAP, but in order to use this program, farmers are required to establish the utility plan of the supporting system and to operate a supported program after its approval. It is not easy for small scale farmers to receive the support under such a system which requires a formed organization by the beneficiaries and their ability of establishing the plan. The basic condition for receiving the farming support from government and strengthening power of negotiation is to form small scale farmers' organizations. Nevertheless, following reasons prevent forming small farmers' organizations at present; small farmers do not know the existence of the supporting program, there is no farmers who can be a leader even if they know it, and individualistic living custom and so on. On the background of this situation, the "small scale farmer" is historically new class which emerged after agricultural reform.

- Superannuated infrastructure and facilities' environment

Most part of the cultivated land located along main stream and tributaries of the Maipo river is equipped with irrigation facilities. Most of these facilities were built before 1950 and are superannuated. Thus, O & M cost of them has been increased annually. In addition, problems such as deterioration of water quality and shrinking cross-sectional area of flow due to inflow of gray water and thrown away garbage into canals have been recently emerged at the points which the canals pass through.

- Little amount of rainfall and imbalanced rainfall distribution

Annual rainfall is about 400mm. This amount of rainfall is not enough to crop cultivation. Moreover, most rainfall is concentrated in winter from May to September. Therefore, irrigation is indispensable for stable farming.

- Difficulty of obtaining new water right

Present water use is dominated by irrigation use, but urban use such as water supply service has been increasing. Present settled water right relevant to surface and ground water in metropolitan area has reached the limit of available amount of water source. Therefore, methods which do not influence settled water right such as dam construction for water storage are needed in order to obtain a certain amount of water and stable new water right.

- Discharge of untreated waste water

Most of waste water from urban areas is discharged into the Mapocho river without treatment in the end because the Mapocho river which flows along the edge of southwest functions as a drain due to topography of the city area of Santiago. Step-by-step construction of waste water treatment plants are planned relevant to amount of treated water, and costs of facility and operating. Thus, present discharge of untreated waste water into the river will continue for time being.

- Demand of urban land use

In the capital city of Santiago and local cities, land demand for housing,

factories, and offices due to population concentration has been satisfied with altering land use of surrounding farmland. It is promoted to alter farmland use to multiple land use through deteriorating farming environment by urbanization, abandoning farming resulted from economic motivation led by increasing land price, subdividing farmland approved as the system, and so on.

(2) Development potentials

- Existence of a large market

The Study Area is located in the suburbs of Santiago city which is the largest domestic agricultural market. It is possible for even small scale producers to sell products under the better condition than the present one by forming organizations and developing a new channel of self-sale. Not only domestic agricultural market but also export markets of fruits, vegetables, and seeds have been established through making use of the inverse season of the northern hemisphere. Because ODEPA provides the market price information service to farmers, the basic condition is prepared to improve the present sale condition by controlling the period of shipment.

- Farmers' high intention for improvement of farming

In the study area, some small scale farmers achieved the power of price negotiation in the market and sold their products under favorable condition for them through forming producers' organizations for specific crops and standardizing requirements and quality of products, and intending stable shipment in these years. This kind of examples suggests the possibility of forming farmers' organizations in other areas. There is the possibility of promoting forming organizations with assembling forms which suit to each area, strengthening their negotiation power in the markets, and accelerating receipt of agricultural support.

- Meteorological and topographical condition which suit for cultivation

The Study Area is belonging to the Mediterranean climate zone and also has advantage on protecting against epidemics because of its topographical condition which makes the area isolate from other areas. Thus, if only irrigation condition is satisfied, this would mean the area has meteorological condition that can develop various types of agriculture such as fruits and vegetables.

- Possibility of utilizing water by reservoir

Irrigation water which used in summer when crop cultivation reaches its peak is snowmelt runoff from the Andes mountains which emerged in rivers with going up temperature. In the areas where snowmelt water cannot be used, water whose origin is ground water is used as irrigation water. On the other hand, in winter when no-irrigation period and simultaneously flood runoff occurs by rainfall, most of river runoff is not used. So, there is the possibility to expand water use through storing the runoff and leveling water use. In addition, some established water rights are unused and only held or are sold in a water right market. These is also possibility of new water use by utilizing these water rights.

- Existence of suitable farmland for development

Mainly in coastal mountain area, extensive farming is operated by using rainfall in winter because there is no available water source near farmland. Under this situation, unirrigated farmland and uncultivated land that suit for irrigation are estimated about 110,000ha in the study area. From the point of land resource, there is large possibility to develop irrigated agriculture.

- The sense of crisis against contaminated agricultural water

Farmers think it is unreasonable that they have to deal with water quality's improvement by themselves because quality of irrigation water has been deteriorated by urban waste water in the metropolitan area. On the other hand, so as to keep up the boom of agricultural export stably, it is recognized that water quality as infrastructure should be considered, at present. The farmers and inhabitants around farmland have high sense of crisis on their health and sanitary.

3.10.3 Direction for the Development

Based on the results of site survey on current agriculture in the metropolitan area, its problems are summarized as follows;

- Disparity caused by landholding scale
- Competition of land and water resources between agricultural and urban uses
- Deterioration of living and producing environment that represent discharge of untreated waste water into rivers

The direction of countermeasures to solve these problems are summarized in a following figure based on future prospects of each problem, constraints on agricultural development, and development potentials mentioned before.

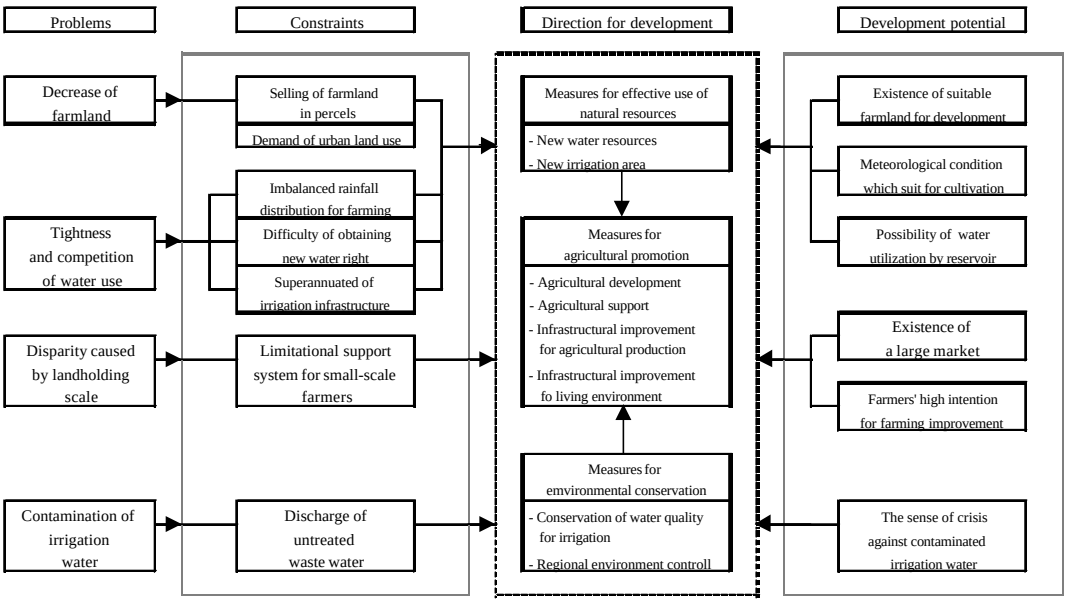


Table 3.2.1 Area by Cultivated Crop

Sub-basin	Province	Total farm-land (ha)	Planted Area (ha)	Cereal (ha)	Chacras * (ha)	Industrial crops (ha)	Horticultural Crops (ha)	Flowers (ha)	Forage crops (ha)	Fruits (ha)	Grapes (wine&table) (ha)	Nursery bed (ha)	Seed Production** (ha)	Forested area (ha)
1. Río Maipo Alto (sub-total)	Cordillera	493,094.30	3,489.10	129.5	56.6	0	224.7	49.2	704.4	531	424.7	0.5	13	1,355.50
2. Río Clarillo (sub-total)	Cordillera	24,852.00	7,104.90	703.4	31.7	0.4	179.6	22.3	1,618.70	1,718.40	584.8	5.1	90.7	2,149.70
3. Río Mapocho Alto (sub-total)	Santiago	40,408.10	9,795.20	1,164.00	523.3	28.5	3,008.30	28.7	2,589.70	1,360.50	380.1	44.9	449	218.1
4. Est. Lampa (sub-total)	Chacabuco	132,163.70	19,482.40	961.8	161.5	24	6,783.00	11.4	3,890.60	5,719.30	93.5	20.4	1,081.10	734.80
5. Río Mapocho Bajo (sub-total)	Talagante Maipo	41,108.00	28,110.90	3,960.60	1,040.20	5	4,674.80	78.6	5,919.10	10,322.90	755.9	99.7	689.1	564.9
6. Río Angostura (sub-total)	Talagante Maipo Cachapoal	142,979.80	56,324.70	10,981.50	1,147.30	83.3	5,390.40	48.5	3,917.20	22,452.50	3,951.10	332.7	3,489.00	4,523.80
7. Est. Alhué (sub-total)	Cachapoal Melipilla	128,210.50	15,404.10	6,579.80	1,501.10	0.3	674.7	0	1,441.80	3,183.30	458	27	100.6	1,437.50
8. Cue. Melipilla (sub-total)	Melipilla	108,447.70	30,492.40	7,363.50	1,039.60	1.7	3,828.10	6.7	8,821.40	6,837.10	410.7	35.9	1,037.80	1,089.90
9. Est. Puangue (sub-total)	Melipilla	65,283.00	13,235.20	2,633.90	1,473.10	1	2,209.20	1.6	3,563.80	1,974.40	314.6	0.5	851.4	211.7
10. Est. Yali (sub-total)	Melipilla San Antonio	127,798.00	17,884.60	6,429.90	679.5	0	281.2	3.3	2,226.00	544.9	11.2	4.1	139.8	7564.7
11. Cue. San Antonio (sub-total)	San Antonio	66,563.50	16,177.30	2,852.70	77.6	0	250.1	0.1	2,465.80	151.1	9	0.8	16	10,354.10
12. Est. Casablanca (sub-total)	Valaparaiso	89,923.80	17,084.20	956.3	256.5	0.1	451.6	1.2	5,838.40	509.2	1,308.40	7.9	12.9	7,741.60
Total		1,460,832.40	234,585.00	44,716.90	7,988.00	144.3	27,955.70	251.6	42,996.90	55,304.60	8,702.00	579.5	7,970.40	37,946.30

Source: Censo Nacional Agropecuario 1997

* Chacras (Traditional Crop) : Main crops which farmers cultivated in the land where was provided instead of salary during the plantation era (Potato, Maize, Beans, Melon and etc.) .
** Seed Production: Seed for export and domestic consumption (Vegetable, Maize, Wheat and etc.).

Note: Total farmland area does not include fallow land (4,432.3ha).

Table 3.2.2 Area by Land Productivity

Sub-basin	Community (Comuna)	Total Area (Ha)	With irrigation					Without irrigation									Province (Provincia)	Community (Comuna)
			I	II	III	IV	Total	I	II	III	IV	V	VI	VII	VIII	Total		
1. Río Maipo Alto	PUENTE ALTO	5,545.85	513.65	789.04	2,004.08	347.70	3,654.47	0.00	2.70	13.64	11.41	5.99	603.35	703.40	550.89	1,891.38	CORDILLERA	PUENTE ALTO
	SAN JOSE DE MAIPO	492,697.64	1.50	22.37	586.76	739.83	1,350.46	45.72	0.00	320.06	242.34	0.94	5,669.47	82,430.39	402,638.26	491,347.18	CORDILLERA	SAN JOSE DE MAIPO
	subtotal	498,243.49	515.15	811.41	2,590.84	1,087.53	5,004.93	45.72	2.70	333.70	253.75	6.93	6,272.82	83,133.79	403,189.15	493,238.56		
2. Río Clarillo	PIRQUE	44,230.14	625.47	3,630.74	2,267.27	1,085.33	7,608.81	1.80	54.00	335.18	480.13	3,350.65	3,756.01	11,744.19	16,899.37	36,621.33	CORDILLERA	PIRQUE
	subtotal	44,230.14	625.47	3,630.74	2,267.27	1,085.33	7,608.81	1.80	54.00	335.18	480.13	3,350.65	3,756.01	11,744.19	16,899.37	36,621.33	CORDILLERA	
3. Río Mapocho Alto	PUDAHUEL	17,669.76	202.12	660.75	2,575.88	1,377.76	4,816.51	0.00	154.10	184.08	2,613.32	0.00	4,066.72	4,786.54	1,048.49	12,853.25	SANTIAGO	PUDAHUEL
	MAIPU	11,055.05	863.05	2,161.75	2,736.44	626.15	6,387.39	200.86	92.20	0.00	616.73	66.80	1,505.62	1,723.47	461.98	4,667.66	SANTIAGO	MAIPU
	QUILICURA	5,496.71	795.41	398.22	1,110.63	858.26	3,162.52	0.00	0.00	0.43	384.10	44.90	750.00	911.15	243.61	2,334.19	SANTIAGO	QUILICURA
	subtotal	34,221.52	1,860.58	3,220.72	6,422.95	2,862.17	14,366.42	200.86	246.30	184.51	3,614.15	111.70	6,322.34	7,421.16	1,754.08	19,855.10		
4. Est. Lampa	COLINA	115,060.08	346.38	2,646.16	5,998.39	2,748.32	11,739.25	8.01	446.72	989.42	6,214.18	17.40	9,464.46	48,373.51	37,807.13	103,320.83	CHACABUCO	COLINA
	LAMPA	42,967.73	102.55	330.83	2,485.21	2,961.24	5,879.83	1.06	283.89	1,012.47	4,824.23	107.85	6,730.24	20,650.84	3,477.32	37,087.90	CHACABUCO	LAMPA
	TILTIL	66,097.12	6.20	592.30	1,183.43	1,617.97	3,399.90	61.00	579.13	762.47	5,506.77	2.50	5,622.53	35,691.93	14,470.89	62,697.22	CHACABUCO	TILTIL
	subtotal	224,124.93	455.13	3,569.29	9,667.03	7,327.53	21,018.98	70.07	1,309.74	2,764.36	16,545.18	127.75	21,817.23	104,716.28	55,755.34	203,105.95		
5. Río Mapocho Bajo	SAN BERNARDO	11,956.60	608.58	5,617.56	2,381.57	224.32	8,832.03	0.00	3.50	1.80	20.69	0.10	269.50	1,651.31	1,177.67	3,124.57	MAIPO	SAN BERNARDO
	CALERA DE TANGO	7,051.45	84.18	4,123.79	1,698.62	52.35	5,958.94	0.00	17.81	22.40	0.00	0.00	80.92	333.10	638.28	1,092.51	MAIPO	CALERA DE TANGO
	TALAGANTE	10,912.65	29.05	4,085.97	3,516.26	1,098.09	8,729.37	75.56	9.08	72.00	120.70	4.42	27.32	1,556.32	317.88	2,183.28	TALAGANTE	TALAGANTE
	PENAFLOR	14,030.50	298.31	3,433.63	3,852.82	1,230.07	8,814.83	17.22	38.60	248.79	92.93	118.18	564.04	3,551.15	584.76	5,215.67	TALAGANTE	PENAFLOR
	EL MONTE	10,783.98	26.82	2,536.19	2,636.75	964.17	6,163.93	0.50	84.70	0.00	204.65	8.50	410.52	3,718.95	192.23	4,620.05	TALAGANTE	EL MONTE
	subtotal	54,735.18	1,046.94	19,797.14	14,086.02	3,569.00	38,499.10	93.28	153.69	344.99	438.97	131.20	1,352.30	10,810.83	2,910.82	16,236.08		
6. Río Angostura	BUIN	18,909.21	5,341.53	6,336.83	2,780.22	1,146.83	15,605.41	38.19	0.00	39.38	34.08	41.25	102.20	2,508.58	540.12	3,303.80	MAIPO	BUIN
	PAINE	72,832.47	1,369.26	5,930.04	8,496.29	3,235.50	19,031.09	24.01	85.94	620.11	605.13	501.87	3,021.23	35,838.83	13,104.26	53,801.38	MAIPO	PAINE
	ISLA DE MAIPO	18,041.03	289.15	1,457.93	4,311.91	1,379.33	7,438.32	3.53	56.50	269.90	246.60	26.90	768.88	6,795.44	2,434.96	10,602.71	TALAGANTE	ISLA DE MAIPO
	GRANEROS	10,668.90	1,919.94	3,182.51	1,347.33	218.49	6,668.27	7.50	2.20	35.32	6.10	0.00	716.76	2,345.55	887.20	4,000.63	CACHAPOAL	GRANEROS
	MOSTAZAL	43,649.76	5.60	2,073.41	3,245.84	1,681.02	7,005.87	0.00	9.80	135.85	715.70	147.65	2,705.88	13,619.43	19,309.58	36,643.89	CACHAPOAL	SAN FRANCISCO DE MOSTAZAL
	CODEGUA	18,044.43	799.84	3,147.79	2,892.17	973.94	7,813.74	0.00	0.00	2.70	90.50	13.53	827.99	7,226.17	2,069.80	10,230.69	CACHAPOAL	CODEGUA
	subtotal	182,145.80	9,725.32	22,128.51	23,073.76	8,635.11	63,562.70	73.23	154.44	1,103.26	1,698.11	731.20	8,142.94	68,334.00	38,345.92	118,583.10		
7. Est. Alhué	LAS CABRAS	68,242.12	23.11	2,101.16	5,840.35	3,027.58	10,992.20	377.91	623.47	1,284.80	5,774.27	371.85	7,043.88	38,925.74	2,848.00	57,249.92	CACHAPOAL	LAS CABRAS
	ALHUE	94,145.26	4.50	71.04	483.29	476.15	1,034.98	0.00	314.66	1,640.42	9,168.47	25.20	3,134.55	61,385.30	17,441.68	93,110.28	MELIPILLA	ALHUE
	subtotal	162,387.38	27.61	2,172.20	6,323.64	3,503.73	12,027.18	377.91	938.13	2,925.22	14,942.74	397.05	10,178.43	100,311.04	20,289.68	150,360.20		
8. Cue. Melipilla	MELIPILLA	136,825.45	275.58	9,349.70	13,922.07	10,982.19	34,529.54	46.30	644.80	983.16	8,708.74	491.56	27,324.25	55,984.95	8,112.15	102,295.91	MELIPILLA	MELIPILLA
	subtotal	136,825.45	275.58	9,349.70	13,922.07	10,982.19	34,529.54	46.30	644.80	983.16	8,708.74	491.56	27,324.25	55,984.95	8,112.15	102,295.91		
9. Est. Puangue	MARIA PINTO	40,747.85	290.34	1,908.80	3,773.99	2,773.00	8,746.13	3.80	485.18	1,043.37	3,635.40	105.85	9,600.31	15,717.55	1,410.26	32,001.72	MELIPILLA	MARIA PINTO
	CURACAVI	71,460.34	216.98	1,528.37	3,056.13	1,357.22	6,158.70	15.00	34.54	1,029.66	3,384.05	155.92	7,440.71	43,724.66	9,517.10	65,301.64	MELIPILLA	CURACAVI
	subtotal	112,208.19	507.32	3,437.17	6,830.12	4,130.22	14,904.83	18.80	519.72	2,073.03	7,019.45	261.77	17,041.02	59,442.21	10,927.36	97,303.36		
10. Est. Yali	SAN PEDRO	69,699.02	0.00	0.00	241.41	86.20	327.61	37.50	199.30	4,879.80	11,271.69	442.60	20,481.66	30,855.20	1,203.66	69,371.41	MELIPILLA	SAN PEDRO
	SANTO DOMINGO	47,358.57	0.00	195.67	141.32	22.85	359.84	0.00	73.64	5,284.44	4,255.63	369.62	14,725.32	19,472.85	2,817.23	46,998.73	SAN ANTONIO	SANTO DOMINGO
	subtotal	117,057.59	0.00	195.67	382.73	109.05	687.45	37.50	272.94	10,164.24	15,527.32	812.22	35,206.98	50,328.05	4,020.89	116,370.14		
11. Cue. San Antonio	SAN ANTONIO	37,685.04	0.00	188.49	413.32	224.87	826.68	26.25	184.60	2,047.88	8,763.97	584.10	13,868.50	10,765.70	617.36	36,858.36	SAN ANTONIO	SAN ANTONIO
	CARTAGENA	24,485.58	0.00	52.00	5.20	4.60	61.80	19.28	0.00	2,315.33	2,471.81	0.00	3,629.70	15,485.56	502.10	24,423.78	SAN ANTONIO	CARTAGENA
	EL TABO	10,827.80	0.00	0.00	0.00	7.00	7.00	0.00	0.00	135.60	776.56	0.00	3,038.50	6,583.73	286.41	10,820.80	SAN ANTONIO	EL TABO
	subtotal	72,998.42	0.00	240.49	418.52	236.47	895.48	45.53	184.60	4,498.81	12,012.34	584.10	20,536.70	32,834.99	1,405.87	72,102.94		
12. Est. Casablanca	CASABLANCA	105,858.54	10.90	976.40	2,319.02	562.29	3,868.61	422.02	402.33	8,831.86	10,524.17	83.70	13,507.60	66,548.02	1,670.23	101,989.93	VALPARAISO	CASABLANCA
	EL QUISCO	4,481.18	1.90	0.00	0.00	3.00	4.90	4.00	0.00	71.31	666.55	0.00	1,278.96	2,444.09	11.37	4,476.28	SAN ANTONIO	EL QUISCO
	ALGARROBO	16,705.51	0.00	0.00	116.43	0.00	116.43	0.00	0.00	230.42	4,627.69	8.00	6,175.57	5,321.20	226.20	16,589.08	SAN ANTONIO	ALGARROBO
	subtotal	127,045.23	12.80	976.40	2,435.45	565.29	3,989.94	426.02	402.33	9,133.59	15,818.41	91.70	20,962.13	74,313.31	1,907.80	123,055.29		
	Total study area	1,766,223.32	15,051.90	69,529.44	88,420.40	44,093.62	217,095.36	1,437.02	4,883.39	34,844.05	97,059.29	7,097.83	178,913.15	659,374.80	565,518.43	1,549,127.96		Total study area

Table 3.3.1 Gross Regional Product (GRP) (1990-1992)

Region	(Million 1986 $)			(Regional Weight %)		
	1990	1991	1992	1990	1991	1992
I	124,828	131,198	141,620	2.81	2.79	2.73
II	271,778	289,155	303,012	6.13	6.15	5.84
III	61,161	70,939	79,994	1.38	1.51	1.54
IV	102,791	108,367	115,996	2.32	2.30	2.24
V	380,935	397,111	423,096	8.59	8.44	8.15
R.M.	1,736,198	1,853,863	2,080,761	39.14	39.40	40.10
VI	204,748	207,054	228,128	4.62	4.40	4.40
VII	161,150	185,353	211,066	3.63	3.94	4.07
VIII	409,815	429,243	457,223	9.24	9.12	8.81
IX	94,790	99,083	103,825	2.14	2.11	2.00
X	161,988	164,561	171,461	3.65	3.50	3.30
XI	19,171	20,974	21,792	0.43	0.45	0.42
XII	117,493	116,391	114,999	2.65	2.47	2.22
GRP	3,846,846	4,073,292	4,452,973	86.72	86.57	85.82
VAT, Import Duty, Others	589,196	631,781	735,738	13.28	13.43	14.18
GDP	4,436,042	4,705,073	5,188,711	100.00	100.00	100.00

Source: Compendio Estadisticas Regionales, MIDEPLAN, Noviembre 1997

Table 3.3.2 (1) Region V: Gross Regional Product by Economic Activity (1989-1990)

	(Million 1986 $)			(Sectoral Share %)			(Share in GDP %)		
	1988	1989	1990	1988	1989	1990	1988	1989	1990
Agriculture, Forestry	37,496	33,189	41,470	10.91	8.82	10.89	11.99	10.35	11.92
Fishery	5,286	6,387	6,577	1.54	1.70	1.73	11.71	12.60	13.68
Mining	38,771	47,937	46,235	11.28	12.73	12.14	10.52	11.87	11.67
Manufacturing	82,405	88,748	78,565	23.97	23.57	20.62	11.77	11.43	10.06
Electricity, Gas, Water	11,207	14,450	14,554	3.26	3.84	3.82	10.96	14.54	14.91
Construction	17,057	21,800	21,358	4.96	5.79	5.61	8.80	9.60	9.00
Commerce	35,231	38,114	38,026	10.25	10.12	9.98	6.25	6.00	5.70
Transport, Communication	38,384	46,345	50,021	11.17	12.31	13.13	14.85	15.80	16.02
Financial Services	21,575	23,750	24,530	6.28	6.31	6.44	4.38	4.23	4.22
Housing	18,431	18,712	19,160	5.36	4.97	5.03	9.23	9.21	9.19
Personal Services	29,662	30,329	31,465	8.63	8.06	8.26	9.17	9.07	9.13
Public Administration	18,862	18,000	19,663	5.49	4.78	5.16	13.52	12.97	13.94
Minus: Bank Charges	-10,647	-11,310	-10,689	-3.10	-3.00	-2.81	3.90	3.65	3.39
GRP	343,720	376,451	380,935	100.00	100.00	100.00	8.79	8.74	8.59

Source: Compendio Estadisticas Regionales, MIDEPLAN, Noviembre 1997

Table 3.3.2 (2) Metropolitan Region: Gross Regional Product by Economic Activity (1988-1990)

	(Million 1986 $)			(Sectoral Share %)			(Share in GDP %)		
	1988	1989	1990	1988	1989	1990	1988	1989	1990
Agriculture, Forestry	48,589	52,085	58,757	3.25	3.14	3.38	15.54	16.24	16.89
Fishery	117	151	195	0.01	0.01	0.01	0.26	0.30	0.41
Mining	15,098	14,738	15,142	1.01	0.89	0.87	4.10	3.65	3.82
Manufacturing	329,607	371,317	381,769	22.02	22.36	21.99	47.10	47.82	48.90
Electricity, Gas, Water	24,158	27,308	27,913	1.61	1.64	1.61	23.63	27.48	28.59
Construction	80,631	89,926	95,395	5.39	5.42	5.49	41.60	39.60	40.20
Commerce	372,134	427,879	451,672	24.86	25.77	26.02	66.00	67.40	67.70
Transport, Communication	128,189	143,900	154,314	8.56	8.67	8.89	49.58	49.05	49.41
Financial Services	392,192	447,261	462,146	26.20	26.94	26.62	79.55	79.65	79.55
Housing	99,900	101,929	104,884	6.67	6.14	6.04	50.01	50.18	50.32
Personal Services	176,064	183,903	189,045	11.76	11.08	10.89	54.45	54.97	54.85
Public Administration	59,277	59,756	60,285	3.96	3.60	3.47	42.49	43.05	42.75
Minus: Bank Charges	-228,768	-259,711	-265,319	-15.28	-15.64	-15.28	83.71	83.75	84.08
GRP	1,497,188	1,660,442	1,736,198	100.00	100.00	100.00	38.28	38.54	39.14

Source: Compendio Estadisticas Regionales, MIDEPLAN, Noviembre 1997

Table 3.3.2 (3) Region VI: Gross Regional Product by Economic Activity (1988-1990)

	(Million 1986 $)			(Sectoral Share %)			(Share in GDP %)		
	1988	1989	1990	1988	1989	1990	1988	1989	1990
Agriculture, Forestry	45,448	49,052	55,527	23.36	24.71	27.12	14.53	15.29	15.96
Fishery	126	126	134	0.06	0.06	0.07	0.28	0.25	0.28
Mining	69,015	62,530	57,021	35.47	31.50	27.85	18.73	15.48	14.39
Manufacturing	16,931	19,394	19,177	8.70	9.77	9.37	2.42	2.50	2.46
Electricity, Gas, Water	6,463	6,875	5,961	3.32	3.46	2.91	6.32	6.92	6.10
Construction	14,343	14,988	18,035	7.37	7.55	8.81	7.40	6.60	7.60
Commerce	13,943	15,840	17,798	7.17	7.98	8.69	2.47	2.50	2.67
Transport, Communication	5,540	6,137	6,386	2.85	3.09	3.12	2.14	2.09	2.04
Financial Services	7,542	8,575	8,938	3.88	4.32	4.37	1.53	1.53	1.54
Housing	6,556	6,632	6,764	3.37	3.34	3.30	3.28	3.26	3.25
Personal Services	9,139	9,326	9,731	4.70	4.70	4.75	2.83	2.79	2.82
Public Administration	3,214	3,202	3,156	1.65	1.61	1.54	2.30	2.31	2.24
Minus: Bank Charges	-3,691	-4,153	-3,880	-1.90	-2.09	-1.90	1.35	1.34	1.23
GRP	194,569	198,524	204,748	100.00	100.00	100.00	4.97	4.61	4.62

Source: Compendio Estadisticas Regionales, MIDEPLAN, Noviembre 1997

Table 3.4.1 Small Scale Farmers' Farming by Sub-basin

Crop \ Sub-Basin		1. Río Maipo Alto	2. Río Clarillo	3. Río Mapocho Alto	4. Est. Lampa	5. Río Mapocho Bajo	6. Río Angostura		7. Est. Alhué		8. Cue. Melipilla	9. Est. Puangue	10. Est. Yali	11. Cue. San Antonio	12. Est. Casablanca	Total
							RM	Cachapoal	RM	Cachapoal						
1. Fruits	ha	71.9	145.2	264.7	117.4	794.5	1,410.1	394.6	-	562.3	591.7	355.4	-	-	31.4	4,739.3
	%	10.2	10.2	8.7	1.8	10.5	13.3	11.4	-	12.1	7.2	7.2	-	-	1.2	7.9
2. Grapes for Wine Production	ha	10.6	21.4	-	-	196.7	-	-	-	-	-	-	-	-	-	228.7
	%	1.5	1.5	-	-	2.6	-	-	-	-	-	-	-	-	-	0.4
3. Vegetables and Flowers	ha	112.3	226.4	860.6	3,262.2	1,990.1	1,950.8	394.6	-	139.4	1,955.9	1,174.7	-	188.2	31.4	12,286.6
	%	15.9	15.9	28.3	50.0	26.3	18.4	11.4	-	3.0	23.8	23.8	-	9.7	1.2	20.4
4. Cereals	ha	215.8	435.7	468.3	1,122.2	1,339.3	2,290.1	1,145.6	231.2	613.4	1,331.4	799.6	1,626.5	-	-	11,619.1
	%	30.6	30.6	15.4	17.2	17.7	21.6	33.1	49.0	13.2	16.2	16.2	39.0	-	-	19.3
5. Field Crops	ha	26.8	54.1	21.3	163.1	401.1	137.8	138.4	65.1	41.8	427.4	256.7	575.5	126.1	94.3	2,529.6
	%	3.8	3.8	0.7	2.5	5.3	1.3	4.0	13.8	0.9	5.2	5.2	13.8	6.5	3.6	4.2
6. Industrial Crops	ha	13.4	27.1	-	-	60.5	84.8	100.4	-	51.1	-	-	-	-	-	337.3
	%	1.9	1.9	-	-	0.8	0.8	2.9	-	1.1	-	-	-	-	-	0.6
7. Forage Crops	ha	81.6	165.2	130.8	117.4	597.8	275.7	100.4	-	-	394.5	236.9	-	500.7	-	2,600.8
	%	11.6	11.6	4.3	1.8	7.9	2.6	2.9	-	-	4.8	4.8	-	25.8	-	4.3
8. Forage	ha	111.4	225.0	1,094.8	815.5	1,392.3	3,901.6	1,086.8	29.3	3,169.3	2,342.2	1,406.7	258.6	937.3	2,463.1	19,233.7
	%	15.8	15.8	36.0	12.5	18.4	36.8	31.4	6.2	68.2	28.5	28.5	6.2	48.3	94.0	31.9
9. Fallow	ha	61.4	123.9	200.7	926.5	794.5	551.3	100.4	146.3	69.7	1,175.2	705.8	1,710.0	188.2	-	6,753.7
	%	8.7	8.7	6.6	14.2	10.5	5.2	2.9	31.0	1.5	14.3	14.3	41.0	9.7	-	11.2
Total	ha	705.2	1,423.8	3,041.1	6,524.3	7,566.9	10,602.3	3,461.0	471.9	4,647.1	8,218.2	4,935.6	4,170.6	1,940.5	2,620.3	60,328.8
No. of Small Farmers	No.	191.0	341.0	841.0	1,331.0	1,814.0		901.0		1,187.0	2,184.0	1,018.0	1,023.0	489.0	500.0	14,577.0
Farming Area	ha	705.2	1,423.8	3,041.0	6,524.3	7,566.9	10,602.3	3,461.0	471.9	4,647.1	8,218.2	4,935.6	4,170.6	1,940.5	2,620.3	60,329.6
Average Farming Area	ha	3.69	4.18	3.62	4.90	4.17		3.84		3.91	3.76	4.85	4.08	3.97	5.24	4.1

Table 3.4.2 Medium and Large Scale Farmers' Faming by Sub-basin

Sub-basin / Crop / Region		1. Río Maipo Alto	2. Río Clarillo	3. Río Mapocho Bajo	4. Est. Lampa	5. Río Mapocho Bajo	6. Río Angostura	7. Est. Alhué	8. Cue. Melipilla	9. Est. Puangue	10. Est. Yali	11. Cue. San Antonio	12. Est. Casablanca	Total
		Cordillera	Cordillera	Santiago	Chacabuco	Maipo Talagante	Talagante Maipo Cachapoal	Cachapoal	Melipilla	Melipilla	Melipilla San Antonio	San Antonio	Valparaíso	
Fruits	(ha)	459.1	1,573.2	1,095.8	5,601.9	9,528.4	20,647.8	2,621.0	6,245.4	1,619.0	544.9	151.1	477.8	50,565.4
	%	15.0	25.7	13.6	37.7	41.8	43.0	19.1	24.3	15.5	4.0	1.0	2.8	25.5
Grapes	(ha)	414.2	563.4	380.1	93.5	559.2	3,951.1	458.0	410.7	314.6	11.2	9.0	1,308.4	8,473.4
	%	13.6	9.2	4.7	0.6	2.5	8.2	3.3	1.6	3.0	0.1	0.1	7.7	4.3
Vegetables	(ha)	112.4	0.0	2,147.7	3,520.9	2,684.7	3,045.0	535.3	1,872.2	1,034.5	281.2	61.9	420.2	15,715.9
	%	3.7	0.0	26.7	23.7	11.8	6.3	3.9	7.3	9.9	2.1	0.4	2.5	7.9
Flowers	(ha)	49.2	22.3	28.7	11.4	78.6	48.5	0.0	6.7	1.6	3.3	0.1	1.2	251.6
	%	1.6	0.4	0.4	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Cereals	(ha)	0.0	267.7	695.7	0.0	2,621.3	7,545.4	5,735.2	6,032.2	1,834.3	4,803.4	2,852.7	956.3	33,344.1
	%	0.0	4.4	8.6	0.0	11.5	15.8	41.7	23.4	17.6	35.7	18.5	5.6	16.8
Field Crops	(ha)	29.8	0.0	502.0	0.0	639.2	871.0	1,394.2	612.2	1,216.5	104.1	0.0	162.2	5,531.1
	%	1.0	0.0	6.2	0.0	2.8	1.8	10.1	2.4	11.7	0.8	0.0	1.0	2.8
Industrial Crops	(ha)	0.0	0.0	28.5	24.0	0.0	0.0	0.0	1.7	1.0	0.0	0.0	0.1	55.3
	%	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forage Crops	(ha)	622.8	1,453.5	2,458.9	3,773.2	5,321.3	3,541.0	1,441.8	8,426.9	3,326.9	12.0	1,965.2	5,838.4	38,181.9
	%	20.4	23.7	30.5	25.4	23.4	7.4	10.5	32.7	32.1	0.1	12.8	34.5	19.2
Seedling	(ha)	0.5	5.1	44.9	20.4	99.7	332.7	27.0	35.9	0.5	4.1	0.8	7.9	579.5
	%	0.0	0.1	0.6	0.1	0.4	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.3
Seeds	(ha)	13.0	90.7	449.0	1,081.1	689.1	3,489.0	100.6	1,037.8	851.4	139.8	16.0	12.9	7,970.4
	%	0.4	1.5	5.6	7.3	3.0	7.3	0.7	4.0	8.2	1.0	0.1	0.1	4.0
Forest Products	(ha)	1,355.5	2,149.7	218.1	734.8	564.9	4,523.8	1,437.5	1,089.9	211.7	7,564.7	10,354.1	7,741.6	37,946.3
	%	44.3	35.0	2.7	4.9	2.5	9.4	10.5	4.2	2.0	56.2	67.1	45.8	19.1
Total	ha	3,056.5	6,125.6	8,049.5	14,861.2	22,786.3	47,995.3	13,750.5	25,771.6	10,412.0	13,468.7	15,410.8	16,926.9	198,614.8

Source; Agriculture and Forestry Census 1997

Table 3.4.3 Average Yield of Main Crops by Province

Province	Crops	Irrigated Area (ha)	Unirrigated Area (ha)	No. of Agricultural households with irrigated land (H/H)	No. of Agricultural households without irrigated land (H/H)	Yield (qq/ha)
San Antonio	Avena (grano seco)	1.0	487.1	1.0	27.0	10.6
	Cebada forrajera	0.0	162.2	0.0	20.0	18.8
	Garbanzo	0.0	512.0	0.0	112.0	6.6
	Maíz (grano seco)	135.4	9.0	23.0	9.0	48.4
	Papa	86.1	11.2	114.0	19.0	107.4
	Poroto consumo	23.5	4.1	36.0	9.0	9.6
	Trigo blanco	74.7	6,157.2	4.0	301.0	33.3
	Trigo Candea	37.0	110.0	3.0	2.0	37.3
Cachapoal	Arveja (grano seco)	29.7	8.4	31.0	4.0	9.4
	Maíz (grano seco)	34,081.4	19.1	6,457.0	4.0	101.2
	Papa	2,660.5	15.5	2,243.0	2.0	131.8
	Poroto consumo	511.4	0.1	546.0	1.0	12.8
	Poroto exportación	75.3	0.0	35.0	0.0	18.9
	Trigo blanco	3,337.8	477.4	435.0	51.0	53.4
	Trigo Candeal	5,949.4	108.9	549.0	13.0	62.8
	Curagulla	89.0	0.0	51.0	0.0	13.8
	Maní	86.2	0.0	87.0	0.0	17.7
	Maravilla	82.7	0.0	18.0	0.0	25.2
	Remolacha	399.4	0.0	64.0	0.0	535.0
	Tabaco	188.7	0.0	36.0	0.0	28.0
Valparaiso	Avena (grano seco)	80.7	12.5	7.0	5.0	6.6
	Papa	200.1	6.2	184.0	8.0	82.2
	Trigo blanco	153.1	365.9	14.0	37.0	32.4
	Poroto consumo	56.6	0.1	76.0	1.0	10.3
	Arveja	2.9	19.1	4.0	13.0	3.0
Santiago	Maíz (grano seco)	146.0	0.0	23.0	0.0	93.7
	Papa	481.3	0.0	146.0	0.0	135.3
	Trigo blanco	282.1	0.0	15.0	0.0	48.2
	Trigo candeal	735.7	0.0	27.0	0.0	55.7
Chacabuco	Maíz (grano seco)	78.8	0.0	26.0	0.0	46.6
	Papa	120.3	0.0	61.0	0.0	141.6
	Trigo Blanco	315.0	0.0	12.0	0.0	29.0
	Trigo Candeal	568.0	0.0	19.0	0.0	49.5
		18.0	0.0	18.0	0.0	2.0
Cordillera	Maíz (grano seco)	221.2	0.0	32.0	0.0	109.4
	Papa	61.9	0.0	67.0	0.0	80.8
	Trigo blanco	120.0	0.0	8.0	0.0	44.3
	Trigo candeal	478.2	0.0	30.0	0.0	50.4
	Menta	4.0	0.0	1.0	0.0	
Maipo	Maíz (grano seco)	1,832.3	0.0	426.0	0.0	94.3
	Papa	990.9	0.0	352.0	0.0	174.7
	Poroto consumo	129.4	0.0	101.0	0.0	11.1
	Trigo blanco	1,097.6	35.0	156.0	1.0	53.6
	Trigo candeal	3,415.2	11.5	342.0	2.0	60.8
	cáñamo	3.0	0.0	1.0	0.0	150.0
Melipilla	Garbanzo	0.0	54.0	0.0	16.0	3.3
	Maíz (grano seco)	5,934.8	0.0	764.0	0.0	109.1
	Papa	2,460.7	0.0	1,026.0	0.0	153.1
	Poroto consumo	117.0	0.0	85.0	0.0	16.5
	Trigo blanco	1,390.7	2,180.0	164.0	276.0	35.5
	Trigo candeal	3,480.5	55.0	224.0	4.0	60.7
	Soya	37.0	0.0	1.0	0.0	20.0
Talagante	Maíz (grano seco)	1,205.7	0.0	198.0	0.0	107.0
	Papa	758.7	0.0	485.0	0.0	117.9
	Poroto consumo	114.9	0.0	95.0	0.0	12.2
	Trigo Blanco	457.6	0.0	47.0	0.0	49.4
	Trigo Candeal	1,810.0	0.0	133.0	0.0	59.5

Source:Censo Nacional Agropecuario 97

Table 3.4.4 Gross Income by Cropping Pattern of Each Farming Type, Crops and Area (Small Scale Farmers)

			Fruits & Grape vines	Vegetables & Flowers	Cereal & Traditional Crops+	Forage crops & Improved Glassland	Natural Glassland	Seasonal Fallow & Fallow Land	Total
		Benefit$/ha	1,400	1,100	390	360	100	0	
		($000)	1,000 *	1,200 *	360 *	330 *	60 *		
			1,800 **						
Sub-basin			1,500 ***						
1.- Río Maipo Alto	Ha/Crop		0.4	0.6	1.4	0.4	-	0.9	3.7
	Benefit/crop	($000)	560	660	546	144	-	-	1,910
2.- Río Clarillo	Ha/Crop		0.5	0.7	1.5	0.6	-	0.9	4.2
	Benefit/crop		700	770	585	216	-	-	2,271
3.- Río Mapocho Alto	Ha/Crop		0.3	1.0	0.5	0.2	1.6	-	3.6
	Benefit/Crop		420	1,100	195	72	160	-	1,947
4.- Est. Lampa	Ha/Crop		-	2.4 *	1.0	-	1.0	0.5	4.9
	Benefit/Crop		-	2,880	390	-	100	-	3,370
5.- Río Mapocho Bajo	Ha/Crop		0.5	1.1 *	0.9	0.4	0.9	0.4	4.2
	Benefit/Crop		700	1,320	351	144	90	-	2,605
6.- Río Angostura	Ha/Crop		0.5	0.7	0.8	-	1.8	-	3.8
	Benefit/Crop		700	770	312	-	180	-	1,962
7.- Est. Alhué	Ha/crop		0.5 *	-	1.3 *	-	2.5 *	-	4.3
	Benefit/Crop		500	-	468	-	150	-	1,118
8.- Cue. Melipilla	Ha/crop		0.3	0.9	0.6	-	1.2	0.8	3.8
	Benefit/Crop		420	990	234	-	120	-	1,764
9.- Est. Puangue	Ha/crop		0.4	1.3	1.0	-	1.3	0.8	4.8
	Benefit/Crop		560	1,430	390	-	130	-	2,510
10.- Est. Yali	Ha/Crop		0.1 **	-	2.1	-	-	2.0	4.2
	Benefit/Crop		180	-	819	-	-	-	999
11.- Cue. San Antonio	Ha/Crop		-	0.4	-	1 *	2.0	0.6	4.0
	Benefit/Crop		-	440	-	330	200	-	970
12.- Est. Casablanca	Ha/Crop		0.1 ***	0.1 *	0.2 *	-	4.8	-	5.2
	Benefit/Crop		150	120	72	-	480	-	822

Source: Censo Nacional Agropecuario 1997

+ Traditional Crop (Chacras) : Main crops which farmers cultivated in the land where was provided instead of salary during the plantation era (Potato, Maize, Beans, Melon and etc.) .

Table 3.4.5 Gross Income by Cropping Pattern of Each Farming Type, Crops and Area (Medium and Large Scale Farmers)

			Cereale Crops	Traditional Crops+	Vegetables & Flowers	Forage Crops	Fruits	Grape Vine	Seed Production++	Planted Forset	Total
Sub-basin	Benefit$/ha	($000)	360	610	1,300	650	2,330	2,400	2,000	400	
1.- Río Maipo Alto	Ha/Crops		-	1.0	5.0	21.0	16.0	14.0	1.0	42.0	100.0
	Margen/cult	($000)	-	610	6,500	13,650	37,280	33,600	2,000	16,800	110,440
2.- Río Clarillo	Ha/cult		4.0	-	1.0	24.0	25.5	8.5	2.0	35.0	100.0
	Margen/cult		1,440	-	1,300	15,600	59,415	20,400	4,000	14,000	116,155
3.- Río Mapocho Alto	Ha/cult		9.0	6.0	27.0	31.0	14.0	4.0	6.0	3.0	100.0
	Margen/cult		3,240	3,660	35,100	20,150	32,620	9,600	12,000	1,200	117,570
4.- Est. Lampa	Ha/cult		-	-	24.0	26.0	38.0	1.0	6.0	5.0	100.0
	Margen/cult		-	-	31,200	16,900	88,540	2,400	12,000	2,000	153,040
5.- Río Mapocho Bajo	Ha/cult		12.0	3.0	12.0	23.0	42.0	3.0	3.0	2.0	100.0
	Margen/cult		4,320	1,830	15,600	14,950	97,860	7,200	6,000	800	148,560
6.- Río Angostura	Ha/cult		16.0	2.0	6.0	7.0	43.0	10.0	7.0	9.0	100.0
	Margen/cult		5,760	1,220	7,800	4,550	100,190	24,000	14,000	3,600	161,120
7.- Est. Alhué	Ha/cult		42.0	10.0	4.0	11.0	19.0	3.0	1.0	10.0	100.0
	Margen/cult		15,120	6,100	5,200	7,150	44,270	7,200	2,000	4,000	91,040
8.- Cue. Melipilla	Ha/cult		23.0	2.0	7.0	33.0	24.0	3.0	4.0	4.0	100.0
	Margen/cult		8,280	1,220	9,100	21,450	55,920	7,200	8,000	1,600	112,770
9.- Est. Puangue	Ha/cult		18.0	12.0	10.0	32.0	16.0	3.0	7.0	2.0	100.0
	Margen/cult		6,480	7,320	13,000	20,800	37,280	7,200	14,000	800	106,880
10.- Est. Yali	Ha/cult		31.0	1.0	2.0	5.0	8.0	4.0	1.0	48.0	100.0
	Margen/cult		11,160	610	2,600	3,250	18,640	9,600	2,000	19,200	67,060
11.- Cue. San Antonio	Ha/cult		18.00	-	1.0	13.0	0.8	0.1	0.1	67.0	100.0
	Margen/cult		6,480	-	1,300	8,450	1,864	240	200	26,800	45,334
12.- Est. Casablanca			6.0	1.0	2.0	34.0	-	11.0	-	46.0	100.0
			2,160	610	2,600	22,100	-	26,400	-	18,400	72,270

Source: Censo Nacional Agropecuario 1997

\+ Chacras (Traditional Crop) : Main crops which farmers cultivated in the land where was provided instead of salary during the plantation era (Potato, Maize, Beans, Melon and etc.) .

++ Seed Production: Seed for export and domestic consumption (Vegetable, Maize, Wheat and etc.).

Table 3.6.1 Production by Region (ton) (1990-1995)

Meat/Region	1990	1991	1992	1993	1994	1995
Beef						
Region V	16,888	14,701	12,848	13,720	13,925	16,505
Metropolitan Region	111,590	104,949	95,290	112,452	120,749	127,031
Region VI	8,187	7,883	7,166	7,415	8,005	9,636
Three Regions	136,665	127,533	115,304	133,587	142,679	153,172
Chile	242,452	229,791	199,972	224,099	239,615	257,792
Pork						
Region V	3,735	3,243	2,731	2,010	2,102	2,894
Metropolitan Region	59,116	63,793	68,022	70,865	79,424	85,750
Region VI	38,284	37,449	41,708	47,913	52,533	57,216
Three Regions	101,135	104,485	112,461	120,788	134,059	145,860
Chile	123,171	128,835	137,571	147,282	160,814	172,410
Lamb						
Region V	114	117	220	100	72	97
Metropolitan Region	1,893	2,048	1,697	1,602	1,182	1,022
Region VI	282	259	243	225	216	202
Three Regions	2,289	2,424	2,160	1,927	1,470	1,321
Chile	14,880	13,451	12,784	13,372	12,180	10,229
Goat Meat						
Region V	29	20	38	43	14	3
Metropolitan Region	0	1	1	2	0	0
Region VI	0	1	1	1	1	1
Three Regions	29	21	40	46	15	4
Chile	227	199	257	229	146	74
Horse Meat						
Region V	5,410	5,454	5,022	3,812	4,155	4,511
Metropolitan Region	4,187	4,609	3,122	1,643	1,890	5,218
Region VI	1	0	0	1	1	0
Three Regions	9,598	10,063	8,144	5,456	6,046	9,729
Chile	10,807	11,533	9,519	6,582	7,162	10,831

Cereal/Region	1990	1991	1992	1993	1994	1995
Wheat						
Region V	43,560	52,526	39,959	34,184		36,067
Metropolitan Region	149,886	136,146	88,524	92,427		92,751
Region VI	219,617	173,412	97,645	125,964		156,243
Three Regions	413,063	362,085	226,128	252,575	0	285,062
Chile	1,588,677	1,556,588	1,322,336	1,271,202		1,227,148
Oats						
Region V	177	1,037	36	51		1,163
Metropolitan Region	1,960	3,396				87
Region VI	796	1,901	199	627		1,500
Three Regions	2,932	6,334	235	678	0	2,750
Chile	206,684	182,699	202,435	176,434		199,627
Region V	1,571	849	1,232	184		774
Metropolitan Region	1,957	523	382	807		618
Region VI	2,567	2,989	2,804	3,306		1,879
Three Regions	6,095	4,360	4,419	4,296	0	3,271
Chile	106,959	109,089	83,970	100,289		64,103
Corn						
Region V	9,448	20,541	17,288	17,443		17,133
Metropolitan Region	121,793	119,246	106,851	97,075	0	96,922
Region VI	596,583	629,555	654,660	700,167		695,486
Three Regions	727,824	769,342	778,799	814,685	0	809,541
Chile	835,723	911,056	899,496	937,250		931,572
Rice						
Region V						
Metropolitan Region						
Region VI	19,482	23,108	32,194	29,891		33,201
Three Regions	19,482	23,108	32,194	29,891	0	33,201
Chile	117,115	133,531	130,629	133,080		152,795

Legume/Region	1990	1991	1992	1993	1994	1995
Beans						
Region V	1,329	3,829	1,755	748		651
Metropolitan Region	1,300	1,312	632	426		1,990
Region VI	11,494	12,806	7,918	4,459		8,877
Three Regions	14,123	17,947	10,304	5,633	0	11,518
Chile	116,954	90,693	54,560	53,980		65,581
Lentils						
Region V	3	372	36	18		
Metropolitan Region	14	101				
Region VI	270	327	71	44		163
Three Regions	287	799	107	62	0	163
Chile	11,883	15,782	9,796	8,911		9,697
Garbanzo						
Region V	445	1,261	495	309		253
Metropolitan Region	902	89	187	148		77
Region VI	1,451	6,114	2,012	1,835		1,856
Three Regions	2,798	7,464	2,694	2,292	0	2,185
Chile	8,778	18,638	10,767	10,090		10,073
Peas						
Region V	87	106	12	11		
Metropolitan Region	20	44		7		63
Region VI	171	662	117	36		118
Three Regions	278	812	128	54	0	181
Chile	5,346	7,784	4,906	4,120		3,295
Chickpeas						
Region V	16	232	73	165		5
Metropolitan Region	1	20	68	85		
Region VI	219	436	124	99		54
Three Regions	236	688	265	349	0	59
Chile	1,650	2,098	1,537	1,759		1,120

Potato/Region	1990	1991	1992	1993	1994	1995
Potato						
Region V	47,141	59,888	41,151	44,822		21,494
Metropolitan Region	57,244	37,246	45,137	35,985		48,588
Region VI	60,263	69,365	61,652	51,193		47,865
Three Regions	164,648	166,499	147,939	131,999	0	117,947
Chile	843,938	1,023,236	926,036	899,619		827,633

Source: Compendio Estadisticas Regionales, MIDEPLAN,Noviembre 1997

Table 3.6.2 Price Information by ODEPA

Wholesale Price in Santiago in 1997 ($/ton without VAT)

Product	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct.	Nov	Dec
Wheat	83,030	85,200	85,450	85,610	87,920	90,580	88,330	87,670	87,330	85,080	82,580	81,880
Corn	82,500	78,130	67,130	64,250	64,690	64,000	63,190	62,380	61,690	63,380	68,310	70,810
Rice	82,500	82,500	87,500	92,500	92,500	92,500	95,000	95,000	85,000	85,000	85,000	85,000
Beans	326,670	373,330	360,000	370,000	376,670	373,330	333,330	313,330	283,330	273,330	330,000	400,000
Potato	54,070	48,199	43,264	44,338	52,825	58,735	62,725	65,470	71,387	94,676	136,458	153,731
Beets	23,952	23,272	22,929	23,174	23,202	23,241	23,113	22,940	23,068	22,990	23,261	23,898
Rape Seed	109,890	109,890	111,480	111,480	112,440	112,440	112,440	112,440	112,440	111,600	111,600	111,600
Sunflower	128,520	128,520	128,520	128,520	128,520	128,520	128,520	128,520	128,520	128,520	128,520	126,520
Beef	842,500	855,000	862,500	835,000	840,000	879,000	951,000	1,065,000	1,341,500	1,131,500	910,000	917,500
Pork	540,000	540,000	600,000	645,000	730,000	845,000	845,000	725,000	780,000	688,000	665,000	700,000
Chicken	616,500	654,000	652,500	640,000	547,500	547,500	550,000	550,000	580,000	590,000	590,000	590,000
Butter	1,543,760	1,519,400	1,505,200	1,506,640	1,533,740	1,546,720	1,552,520	1,557,920	1,571,320	1,579,440	1,601,030	1,598,750
Whet Flour	137,333	128,167	127,500	134,000	131,833	133,333	133,667	132,333	130,333	128,000	127,333	124,667
Sugar	233,860	235,180	235,180	235,180	235,180	235,180	235,180	235,180	235,180	235,180	235,180	239,370
Urea	130,900	127,433	125,595	123,920	122,666	121,860	118,560	121,900	115,363	104,593	103,113	105,082
Ammonium Phos.	141,573	140,044	137,314	136,600	135,533	135,533	136,347	137,800	136,047	133,320	133,320	137,687
Fish Meal	256,330	254,330	264,000	274,250	275,630	272,600	276,800	276,800	282,280	280,360	288,760	288,760

Source: Mercados Agropecuarios,ODEPA, Ministerio de Agricultura, No. 71, Junio 1998

International Price in 1997 (US$ FOB/ton)

Product	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct.	Nov	Dec
Wheat US	167.2	165.5	172.7	180.0	172.1	155.1	142.2	152.8	153.3	152.9	149.8	146.6
Wheat Argentina	143.8	148.1	167.3	181.1	183.5	168.3	164.6	163.7	155.0	149.4	139.3	134.6
Yellow Corn US	123.5	124.8	131.4	127.1	120.1	115.0	107.8	114.5	115.7	122.5	119.6	115.7
Yellow Corn Arg.	115.7	113.3	120.5	119.4	116.9	114.7	107.8	111.0	112.3	118.4	118.0	116.4
Rice Bangkok	373.0	390.0	380.5	354.1	350.0	350.0	350.0	334.3	304.1	303.9	281.5	290.2
Sugar London	305.9	308.4	309.6	312.8	322.0	329.1	332.4	345.4	319.8	299.5	304.4	300.7
Soybeans Oil US	495.2	494.6	513.8	513.7	525.8	504.0	484.1	489.2	508.2	537.1	566.1	547.1
Soybeans Oil Arg.	510.3	510.7	515.8	514.1	526.9	525.1	518.0	521.2	542.7	588.3	630.1	622.3

Source: Mercados Agropecuarios,ODEPA, Ministerio de Agricultura, No. 71, Junio 1998

Price Band Annual Average (US$/Ton)

Product	1990	1991	1992	1993	1994	1995	1996	1997
Wheat								
Floor	187	201	190	187	183	183	210	213
Ceiling	261	252	232	240	246	234	240	251
Vegetable Oil								
Floor	592	626	604	609	625	628	699	705
Ceiling	1,114	845	719	706	740	692	778	772
Refined Sugar								
Floor	353	362	400	400	410	418	442	449
Ceiling	490	465	453	453	453	438	479	496

Source: ODEPA Internet Information

Table 3.9.1 (1) Results of water quality analysis Observation period： 20/7/1998～23/7/1998

Date		21/7	21/7	21/7	21/7	21/7	22/7	22/7	23/7	23/7	23/7	21/7	21/7	21/7
Item	Unit	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	St.12	St.13
Temperature	℃	7.4	8.0	13.3	7.5	8.9	10.1	12.1	10.3	12.2	11.5	4.8	3.1	11.0
pH	-	8.0	7.8	6.4	7.6	7.8	6.8	7.3	7.0	7.1	7.1	7.6	8.0	7.8
EC	μmhos/cm	600.0	1,260.0	1,330.0	1,270.0	1,290.0	970.0	1,230.0	1,200.0	1,200.	1,220.0	830.0	1,050.0	300.0
SS	mg/l	70.0	230.0	322.0	285.0	270.0	95.0	140.0	130.0	120.0	135.0	105.0	195.0	130.0
DO	mg/l	9.0	8.0	8.5	0.0	1.0	9.0	0.0	1.0	1.5	0.0	0.0	9.0	9.0
BOD	mg/l	<3.0	<3.0	14.0	38.0	28.0	<10.0	32.0	21.0	18.5	40.0	5.7	<3.0	3.9
No. of Coliform Group	MPN/100ml	5.4E+02	2.2E+03	5.4E+07	3.5E+04	1.6E+04	2.4E+04	9.2E+05	3.5E+05	3.3E+02	5.4E+03	7.9E+01	7.9E+01	2.4E+03
No. of Fecal Coliform Group	MPN/100ml	3.5E+02	4.9E+02	2.4E+07	3.5E+03	1.6E+03	3.5E+03	9.2E+04	9.2E+04	3.3E+01	1.7E+03	7.8E+00	2.7E+01	3.5E+02
NO_3－N	mg/l	5.6	5.4	4.1	3.7	5.1	3.3	3.1	6.0	5.5	7.1	4.7	3.7	6.7
Ca^{2+}	mg/l	87.6	183.1	207.0	175.1	191.0	175.1	183.1	199.0	191.0	183.0	167.2	183.1	42.2
Mg^{2+}	mg/l	25.6	41.7	22.5	88.4	41.5	37.3	37.0	27.3	64.7	51.0	11.9	37.0	14.2
Cu^{2+}	mg/l	0.003	0.003	0.003	0.003	0.001	0.003	0.003	0.002	0.003	0.003	0.003	0.002	0.003
SO_4^{2-}	mg/l	145.8	280.0	420.0	395.0	401.4	360.0	390.0	350.0	380.0	370.0	346.3	305.0	76.3
Cl^-	mg/l	105.4	238.4	265.9	256.8	284.3	183.0	220.0	192.6	201.7	220.0	87.1	165.1	19.3

Date		21/7	22/7	23/7	20/7	20/7	20/7	22/7	22/7	20/7	23/7	20/7	20/7	20/7
Item	Unit	St.14	St.15	St.16	St.17	St.18	St.19	St.20	St.21	St.22	St.23	St.24	St.25	St.26
Temperature	℃	12.0	13.2	9.2	3.2	11.1	14.5	11.0	12.0	12.0	8.4	4.5	12.5	6.1
pH	-	7.4	6.7	6.9	7.7	7.3	7.2	7.4	7.3	7.8	7.1	7.8	7.9	7.7
EC	μmhos/cm	1,000.0	230.0	1,340.0	234.0	1,140.0	1,420.0	1,350.0	1,310.0	1,520.0	1,740.0	1,800.0	1,430.0	790.0
SS	mg/l	310.0	80.0	180.0	120.0	240.0	410.0	205.0	160.0	246.0	100.0	90.0	112.0	95.0
DO	mg/l	2.0	7.0	0.0	6.5	0.0	0.0	0.0	0.0	4.5	8.0	0.0	9.0	9.0
BOD	mg/l	14.7	4.3	64.0	10.0	45.0	179.0	96.0	45.0	20.0	3.8	78.0	<10.0	<3.0
No. of Coliform Group	MPN/100ml	5.4E+04	3.3E+01	2.4E+04	<1.8	2.4E+07	2.4E+06	9.2E+06	1.6E+07	2.4E+04	3.5E+04	2.3E+01	1.6E+04	3.3E+01
No. of Fecal Coliform Group	MPN/100ml	5.4E+03	1.1E+01	2.2E+04	<1.8	1.4E+06	9.2E+05	1.7E+06	7.9E+05	9.2E+03	3.5E+03	<1.8	1.1E+03	6.8E+00
NO_3－N	mg/l	4.5	2.9	3.7	3.5	3.0	12.7	3.3	2.6	2.8	2.5	3.9	6.6	4.5
Ca^{2+}	mg/l	318.4	30.2	159.2	35.8	175.1	175.1	183.1	183.1	183.1	445.8	183.1	199.0	95.5
Mg^{2+}	mg/l	47.5	12.7	51.7	11.1	32.1	46.6	41.7	46.3	83.5	34.9	23.3	45.9	20.7
Cu^{2+}	mg/l	0.002	0.003	0.007	0.110	0.003	0.003	0.003	0.003	0.005	0.007	0.002	0.003	0.003
SO_4^{2-}	mg/l	290.0	32.2	390.0	80.3	302.6	402.3	405.0	395.0	496.7	980.0	396.8	455.0	122.5
Cl^-	mg/l	284.3	12.8	266.0	18.3	238.4	220.1	257.0	229.0	275.1	82.5	458.5	247.6	142.1

Table 3.9.1 (2) Results of water quality analysis

Date		20/7	20/7	20/7	20/7	20/7	22/7	22/7	22/7	22/7	23/7
Item	Unit	C1	C2	C3	#1	#2	#3	#4	#5	#6	#7
Temperature	℃	8.7	7.0	15.2	14.9	16.8	13.0	14.2	13.0	16.0	15.9
pH	-	7.9	8.1	7.0	8.2	7.5	7.3	6.7	7.1	6.7	7.3
EC	μmhos/cm	1,295.0	1,290.0	1,570.0	260.0	830.0	1,230.0	1,140.0	2,800.0	600.0	900.0
SS	mg/l	152.0	148.0	450.0	90.0	88.0	83.0	70.0	60.0	80.0	100.0
DO	mg/l	7.0	6.5	0.0	9.0	9.0	9.0	7.5	1.0	9.0	9.0
BOD	mg/l	10.0	15.0	645.0	<10.0	<10.0	<10.0	6.8	20.9	<10.0	<10.0
No. of Coliform Group	MPN/100ml	2.2E+05	1.6E+03	2.4E+07	3.3E+01	7.9E+01	4.9E+01	<1.8	1.1E+02	7.9E+01	1.1E+01
No. of Fecal Coliform Group	MPN/100ml	2.1E+04	3.5E+02	3.5E+06	3.3E+01	4.9E+01	<1.8	<1.8	3.3E+01	1.1E+01	<1.8
NO_3－N	mg/l	2.8	2.2	18.0	3.8	3.6	6.2	3.5	9.2	4.1	2.7
Ca^{2+}	mg/l	2,14.9	175.1	127.4	13.5	127.4	254.7	296.8	350.2	67.7	111.0
Mg^{2+}	mg/l	40.8	41.9	61.7	7.1	43.1	16.6	21.5	144.2	37.7	36.6
Cu^{2+}	mg/l	0.003	0.003	0.016	0.003	0.003	0.003	0.002	0.002	0.003	0.002
SO_4^{2-}	mg/l	384.0	405.6	420.0	30.0	255.7	410.0	350.0	560.0	127.0	410.0
Cl^-	mg/l	275.0	256.8	265.9	21.1	128.4	192.6	183.0	477.0	119.0	275.0

St.1: Río Maipo antes Río Volcan, St.2: Río Maipo en la Obra, St.3: Río Maipo en Pte. San Ramón (antes Río Clarillo)
St.4: Río Maipo en Pte. Los Morros (después Río Clarillo), St.5: Río Maipo en Viluco (Puente Ferrocarril), St.6: Río Maipo en Rosario (después Río Angostura)
St.7: Río Maipo después Río Mapocho, St.8: Río Maipo antes Estero Cholqui, St.9: Río Maipo en Cabinbao
St.10: Río Maipo en Desembocadura, St.11: Río Yeso antes Junta Río Maipo, St.12: Río Colorado antes Río Maipo
St.13: Río Angostura en Angostura, St.14: Río Angostura en Valdivia de Paine, St.15: Estero Puangue en Curacaví
St.16: Estero Puangue en camino a San Antonio, St.17: Río Mapocho en Los Almendros, St.18: Río Mapocho en canal La Punta
St.19: Río Mapocho en Canal Las Mercedes, St.20: Río Mapocho en Canal Mallarauco, St.21: Río Mapocho en El Monte
St.22: Estero Lampa después Estero Colina, St.23: Estero Alhue en Quilamuta
St.24: Río Maipo en Fdo Cruz de Piedra, St.25: Estero Las Cruces antes Estero Lampa, St.26: Río Volcán en Pte. Bolsón
C1: Canal San Carlos en Tobalba (Frente Hotel Radison), C2: Canal el Carmen en las Canteras, C3: Zanjón de La Aguada antes Río Mapocho
#1: Pozo Quilicura (Oxiquim), #2: Pozo Pudahuel (Embot. Andina Planta Renca), #3: Pozo Padre Hurtado (Camino Guanaco, Piscicultura 2)
#4: Pozo El Monte (AP El Monte), #5: Pozo Maria Pinto (18 Sept Nº215), #6: Pozo Bollenar (Hostería)
#7: Pozos Tejas Verdes (P5 San Juan Aguasquinta)

Table 3.9.2 (1) Results of water quality analysis Observation period : 8/8/1998～12/8/1998

Date		8/8	13/8	13/8	13/8	13/8	13/8	12/8	12/8	12/8	12/8	8/8	8/8	13/8
Item	Unit	St.1	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.11	St.12	St.13
Temperature	℃	9.0	7.2	11.6	4.5	8.8	11.9	9.5	8.8	11.0	11.3	7.0	5.4	12.6
pH	-	8.6	8.2	7.3	8.2	8.4	7.5	7.2	7.5	7.6	7.5	7.9	8.1	8.8
EC	μmhos/cm	5,10.0	1,300.0	1,440.0	1,370.0	1,400.0	980.0	1,330.0	1,190.0	1,220.0	1,200.0	860.0	1,250.0	320.0
SS	mg/l	328.0	482.0	518.0	542.0	448.0	460.0	305.0	390.0	365.0	262.0	340.0	350.0	540.0
DO	mg/l	8.8	9.0	0.0	8.7	3.1	9.0	0.0	1.0	5.6	6.5	9.3	9.5	9.0
BOD	mg/l	<10.0	<10.0	95.0	2.9	11.0	<10.0	65.0	35.0	9.0	16.0	<10.0	<10.0	<10.0
No. of Coliform Group	MPN/100ml	2.2E+03	3.5E+04	2.2E+06	1.7E+03	3.5E+03	1.6E+07	9.2E+06	2.8E+06	3.3E+05	3.5E+05	7.0E+01	1.3E+02	1.6E+05
No. of Fecal Coliform Group	MPN/100ml	2.2E+02	7.9E+01	3.3E+04	4.9E+02	7.9E+02	1.1E+05	2.8E+06	2.4E+04	1.7E+05	2.6E+04	4.5E+00	<1.8	1.3E+02
NO3－N	mg/l	1.7	1.0	3.8	1.5	2.6	3.3	2.9	3.0	4.8	5.4	1.6	2.1	2.8
Ca2+	mg/l	70.8	215.0	199.0	159.5	183.1	151.2	175.1	207.0	183.1	214.9	151.2	191.0	44.6
Mg2+	mg/l	11.2	18.0	55.6	56.6	14.1	47.5	102.8	50.7	46.9	36.6	28.6	36.9	12.6
Cu2+	mg/l	<0.001	0.007	0.005	0.007	0.006	0.006	0.019	0.012	0.008	0.002	<0.001	0.003	0.006
SO42-	mg/l	125.5	437.0	443.0	324.0	425.0	335.0	351.0	344.0	347.0	334.0	301.0	430.0	74.5
Cl-	mg/l	89.9	265.9	293.4	284.0	293.4	165.1	275.1	229.3	229.3	238.4	73.4	146.7	18.3

Date		13/8	12/8	12/8	10/8	11/8	11/8	11/8	11/8	11/8	12/8	10/8	11/8	8/8
Item	Unit	St.14	St.15	St.16	St.17	St.18	St.19	St.20	St.21	St.22	St.23	St.24	St.25	St.26
Temperature	℃	12.7	8.0	10.7	4.7	5.3	14.1	12.8	12.6	11.1	9.3	4.0	10.0	8.8
pH	-	7.8	7.7	7.6	7.6	7.6	7.1	7.1	7.2	8.0	7.6	8.1	8.0	8.3
EC	μmhos/cm	1,020.0	240.0	1,380.0	220.0	1,200.0	1,450.0	1,310.0	1,270.0	1,720.0	1,800.0	1,730.0	1,620.0	710.0
SS	mg/l	448.0	374.0	264.0	352.0	500.0	510.0	520.0	504.0	482.0	380.0	352.0	378.0	306.0
DO	mg/l	9.0	8.4	8.2	8.5	0.0	0.0	0.0	0.0	0.0	9.0	3.1	7.5	9.0
BOD	mg/l	<10.0	3.0	10.0	<10.0	25.0	210.0	59.0	92.0	22.0	<10.0	9.2	10.0	<10.0
No. of Coliform Group	MPN/100ml	2.2E+04	2.4E+02	9.2E+03	4.9E+01	5.4E+06	2.8E+07	1.1E+08	9.2E+08	5.4E+04	1.1E+02	5.4E+02	1.1E+04	7.9E+01
No. of Fecal Coliform Group	MPN/100ml	2.2E+03	7.9E+01	2.4E+03	2.2E+01	2.4E+06	1.3E+07	2.4E+07	2.4E+07	3.5E+04	4.9E+01	<1.8	1.1E+03	3.3E+01
NO3－N	mg/l	3.1	3.6	4.5	3.9	2.5	9.8	6.4	4.8	3.1	2.8	1.5	2.4	1.6
Ca2+	mg/l	191.0	28.6	183.1	34.2	154.2	175.1	199.0	183.1	207.0	461.6	191.0	199.0	95.5
Mg2+	mg/l	46.6	13.8	74.6	10.7	70.2	41.9	64.5	74.2	82.9	16.1	92.6	41.3	30.0
Cu2+	mg/l	0.003	0.005	0.008	0.254	0.018	0.072	0.044	0.052	0.007	0.006	0.001	0.008	<0.001
SO42-	mg/l	290.0	29.3	381.0	74.5	352.0	410.0	381.0	373.0	694.0	515.0	407.0	617.0	110.5
Cl-	mg/l	165.1	13.8	256.8	11.0	229.3	284.3	275.1	256.8	293.4	275.1	466.9	275.1	155.9

Table 3.9.2 (2) Results of water quality analysis

Date		10/8	11/8	12/8	10/8	11/8	11/8	11/8	11/8	12/8	12/8	12/8	12/8
Item	Unit	St.27	St.28	St.29	C1	C3	#1	#2	#3	#4	#5	#6	#7
Temperature	℃	6.1	12.8	7.5	7.6	14.6	14.7	17.7	13.7	14.3	11.2	14.3	15.5
pH	-	7.3	7.2	7.2	8.1	6.9	8.0	7.4	7.2	7.1	7.2	7.2	7.6
EC	μmhos/cm	250.0	1,370.0	750.0	1,400.0	1,600.0	240.0	740.0	1,250.0	1,270.0	2,800.0	770.0	820.0
SS	mg/l	346.0	590.0	360.0	422.0	598.0	450.0	432.0	358.0	256.0	294.0	254.0	354.0
DO	mg/l	8.7	0.0	9.0	7.5	0.0	8.4	8.6	9.0	9.0	8.6	9.0	9.0
BOD	mg/l	<10.0	73.0	3.9	<10.0	472.0	2.7	<10.0	<10.0	<10.0	8.0	<10.0	<10.0
No. of Coliform Group	MPN/100ml	1.7E+04	9.2E+07	5.4E+04	7.0E+02	2.2E+08	2.4E+03	3.3E+01	3.3E+01	2.0E+00	2.3E+01	1.7E+01	6.8E+00
No. of Fecal Coliform Group	MPN/100ml	1.3E+04	2.2E+06	1.1E+04	3.3E+02	3.5E+06	2.2E+02	<1.8	<1.8	<1.8	<1.8	2.0E+00	4.0E+00
NO_3－N	mg/l	3.8	8.4	4.2	3.6	20.7	3.5	5.0	7.5	4.6	9.3	9.5	2.1
Ca^{2+}	mg/l	37.4	183.5	111.4	159.2	151.2	15.1	111.0	199.0	238.8	418.0	87.6	99.5
Mg^{2+}	mg/l	7.4	83.5	39.1	37.7	79.7	4.7	29.6	59.8	40.6	152.0	21.4	25.4
Cu^{2+}	mg/l	0.009	0.061	0.009	0.004	0.106	0.009	0.007	<0.001	0.007	0.007	0.002	0.006
SO_4^{2-}	mg/l	112.5	445.0	173.5	395.0	438.0	28.4	215.0	380.0	368.0	820.0	176.0	177.0
Cl^-	mg/l	6.4	293.4	114.6	284.0	311.8	19.3	114.7	201.7	229.3	573.1	137.6	55.0

St.1: Río Maipo antes Río Volcan, St.2: Río Maipo en la Obra, St.3: Río Maipo en Pte. San Ramón (antes Río Clarillo)
St.4: Río Maipo en Pte. Los Morros (después Río Clarillo), St.5: Río Maipo en Viluco (Puente Ferrocarril), St.6: Río Maipo en Rosario (después Río Angostura)
St.7: Río Maipo después Río Mapocho, St.8: Río Maipo antes Stero Cholqui, St.9: Río Maipo en Cabinbao
St.10: Río Maipo en Desembocadura, St.11: Río Yeso antes Junta Río Maipo, St.12: Río Colorado antes Río Maipo
St.13: Río Angostura en Angostura, St.14: Río Angostura en Valdivia de Paine, St.15: Estero Puangue en Curacaví
St.16: Estero Puangue en camino a San Antonio, St.17: Río Mapocho en Los Almendros, St.18: Río Mapocho en canal La Punta
St.19: Río Mapocho en Canal Las Mercedes, St.20: Río Mapocho en Canal Mallarauco, St.21: Río Mapocho en El Monte
St.22: Estero Lampa después Estero Colina, St.23: Estero Alhue en Quilamuta
St.24: Río Maipo en Fdo Cruz de Piedra, St.25: Estero Las Cruces antes Estero Lampa, St.26: Río Volcán en Pte. Bolsón
St.27: Estero Arrayán antes Río Mapocho (Puente El Remanso), St.28: Río Mapocho aguas abajo junta Stero Lampa, St.29: Estero Puangue en canal Los Rulos
C1: Canal San Carlos en Tobalba (Frente Hotel Radison), C3: Zanjón de La Aguada antes Río Mapocho
#1: Pozo Quilicura (Oxiquim), #2: Pozo Pudahuel (Embot. Andina Planta Renca), #3: Pozo Padre Hurtado (Camino Guanaco, Piscicultura 2)
#4: Pozo El Monte (AP El Monte), #5: Pozo Maria Pinto (18 Sept N°215), #6: Pozo Bollenar (Hostería)
#7: Pozos Tejas Verdes (P5 San Juan Aguasquinta)

Table 3.9.3 (1) Results of water quality analysis Observation period ： 6/12/1998～11/12/1998

Date		10/12	10/12	10/12	8/12	8/12	10/12	10/12	7/12	7/12	8/12	8/12	9/12
Item	Unit	St.2	St.3	St.4	St.5	St.6	St.7	St.8	St.9	St.10	St.13	St.14	St.15
Temperature	℃	16.1	18.8	22.4	25.5	23.8	26.9	28.3	19.6	22.7	24.2	22.4	32.6
pH	-	8.0	8.1	7.6	9.8	8.7	8.2	8.7	7.9	8.6	9.3	8.6	9.3
EC	μmhos/cm	910.0	920.0	900.0	830.0	900.0	1,060.0	1,000.0	960.0	1,100.0	340.0	950.0	270.0
SS	mg/l	100.0	115.0	80.0	184.0	152.0	93.0	90.0	154.0	136.0	138.0	96.0	100.0
DO	mg/l	3.3	3.5	5.6	5.9	5.4	4.9	5.7	4.5	6.0	3.5	7.0	3.9
BOD	mg/l	23.0	24.0	9.0	19.0	21.0	16.0	11.0	42.0	20.0	49.0	15.0	17.0
No. of Coliform Group	MPN/100ml	3.5E+02	2.6E+06	2.2E+04	3.5E+01	1.6E+04	1.6E+04	2.7E+01	7.0E+03	3.5E+02	5.4E+02	3.5E+03	4.9E+01
No. of Fecal Coliform Group	MPN/100ml	2.4E+02	2.2E+05	9.2E+03	3.9E+01	9.2E+03	3.5E+03	7.8E+00	3.5E+03	3.3E+01	7.9E+01	1.3E+03	3.3E+01
NO3－N	mg/l	1.1	0.7	0.7	3.1	1.8	2.5	1.9	2.6	1.7	2.4	3.4	1.0
Ca2+	mg/l	145.8	134.0	134.0	122.2	157.6	220.6	173.4	197.0	204.9	41.8	181.2	44.8
Mg2+	mg/l	16.0	18.7	32.3	23.6	45.3	29.7	35.7	66.9	48.4	11.5	35.4	0.8
Cu2+	mg/l	0.097	0.090	0.020	0.007	0.007	0.058	0.009	0.029	0.018	0.008	0.021	<0.001
SO42-	mg/l	337.5	327.5	310.0	313.0	300.0	350.0	340.0	310.0	360.0	72.0	315.0	31.9
Cl-	mg/l	121.4	144.8	186.0	139.4	167.2	196.1	177.5	222.0	223.0	18.6	167.2	13.1

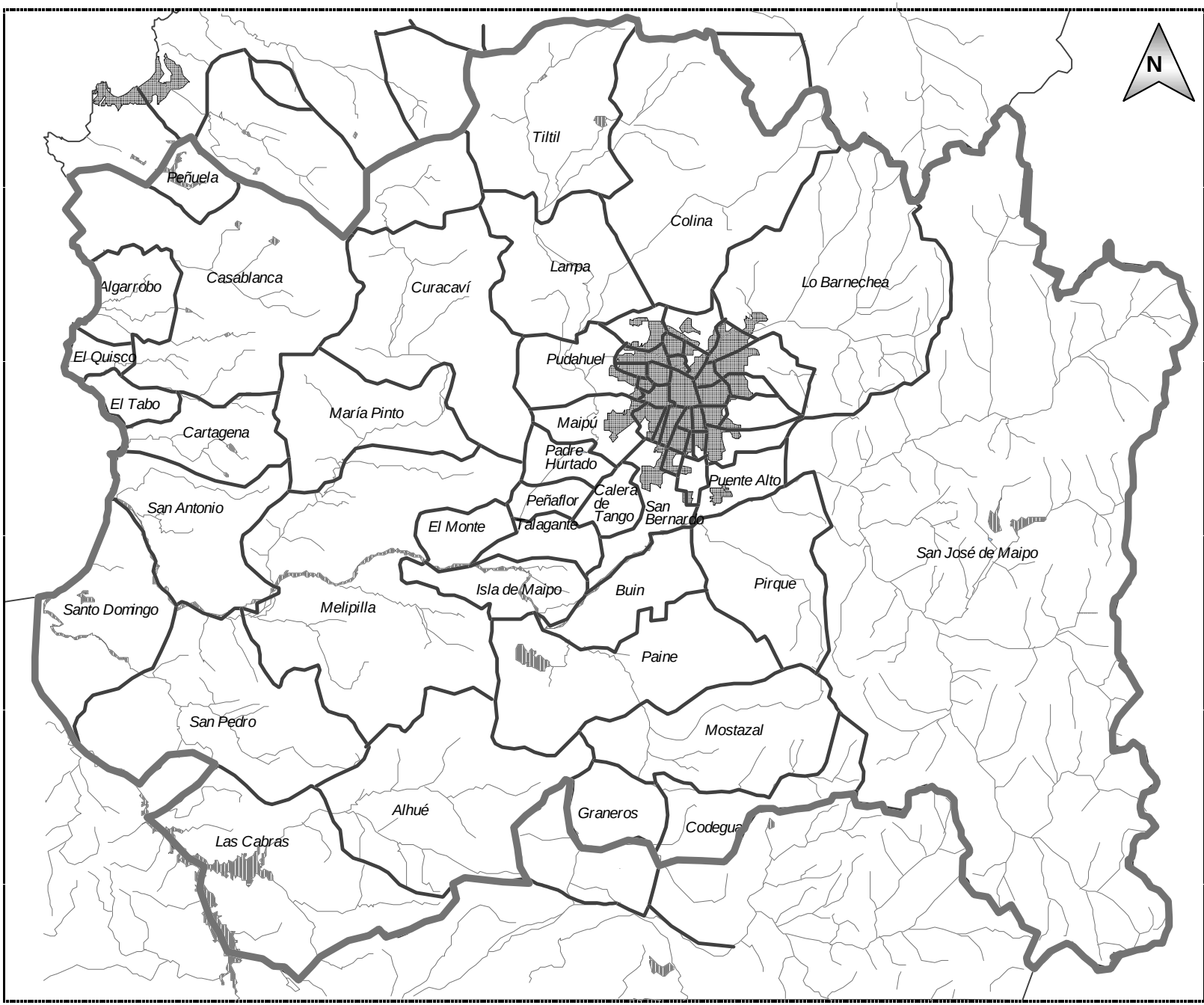
Date		7/12	10/12	9/12	6/12	8/12	10/12	9/12	7/12	9/12	9/12	8/12
Item	Unit	St.16	St.17	St.18	St.19	St.20	St.21	St.22	St.23	St.25	St.29	St.30
Temperature	℃	18.1	17.5	17.0	22.5	23.4	28.0	24.5	26.5	24.6	23.1	19.4
pH	-	7.7	6.0	7.5	7.5	7.7	7.5	8.3	7.5	7.6	7.5	7.8
EC	μmhos/cm	1,180.0	440.0	830.0	1,080.0	1,005.0	1,050.0	1,280.0	1,700.0	1,260.0	1,145.0	800.0
SS	mg/l	132.0	98.0	118.0	64.0	174.0	160.0	105.0	104.0	110.0	95.0	176.0
DO	mg/l	3.8	4.4	3.6	1.0	4.8	0.0	5.0	6.3	4.5	4.9	3.1
BOD	mg/l	35.0	17.0	45.0	140.0	38.0	150.0	32.0	25.0	32.0	33.0	45.0
No. of Coliform Group	MPN/100ml	3.5E+03	2.4E+02	1.7E+07	2.8E+08	1.7E+05	2.4E+02	1.7E+03	3.5E+03	3.5E+03	5.4E+05	9.2E+04
No. of Fecal Coliform Group	MPN/100ml	1.3E+03	1.3E+02	7.9E+06	1.7E+08	3.5E+03	1.3E+02	1.3E+03	1.4E+02	1.3E+03	1.7E+05	9.2E+04
NO3－N	mg/l	3.0	1.0	0.8	6.5	2.2	1.4	1.7	0.8	1.9	2.4	3.4
Ca2+	mg/l	189.1	76.4	122.2	173.4	181.2	173.4	165.5	614.4	173.4	165.5	157.6
Mg2+	mg/l	58.0	30.5	16.7	22.0	53.7	44.8	86.1	8.3	49.4	40.5	49.9
Cu2+	mg/l	0.040	3.100	0.043	0.076	0.020	0.027	0.005	0.017	0.013	0.006	0.022
SO42-	mg/l	410.0	220.0	290.0	350.0	324.0	356.0	345.0	410.0	411.0	350.0	320.0
Cl-	mg/l	241.5	11.2	149.4	195.1	204.4	196.1	205.5	83.6	178.0	214.8	167.2

Table 3.9.3 (2) Results of waterquality analysis

Date		10/12	9/12	10/12	11/12	11/12	11/12	11/12	11/12	11/12	10/12	11/12	12/16
Item	Unit	C1	C2	C3	C4	C5	C6	C7	C9	C11	C12	C13	C14
Temperature	℃	14.2	14.5	21.2	17.8	19.4	22.7	24.6	27.3	21.5	24.1	25.8	17.2
pH	-	8.2	8.1	7.1	7.1	7.2	7.3	7.3	7.4	7.4	8.4	7.9	7.8
EC	μmhos/cm	920.0	860.0	1,350.0	830.0	1,160.0	1,170.0	1,240.0	1,130.0	1,100.0	980.0	920.0	1,070.0
SS	mg/l	108.0	140.0	150.0	97.0	105.0	123.0	135.0	183.0	170.0	82.0	95.0	130.0
DO	mg/l	3.0	2.7	0.0	2.9	1.8	0.0	0.0	0.0	0.0	5.9	3.8	3.2
BOD	mg/l	28.0	42.0	170.0	33.0	45.0	110.0	116.0	108.0	110.0	12.0	15.0	19.0
No. of Coliform Group	MPN/100ml	5.4E+06	1.7E+04	2.2E+07	5.4E+08	5.4E+05	1.6E+09	5.4E+08	9.2E+08	9.2E+08	5.4E+08	1.7E+05	<1.8
No. of Fecal Coliform Group	MPN/100ml	1.6E+05	2.2E+03	1.3E+07	3.3E+06	1.3E+05	9.2E+08	2.8E+07	1.7E+08	1.1E+07	9.2E+06	1.3E+05	<1.8
NO3－N	mg/l	0.7	1.8	17.6	3.7	2.9	1.8	2.1	1.7	2.3	1.6	2.0	3.4
Ca2+	mg/l	134.0	130.0	149.7	118.2	157.6	157.6	165.6	165.5	173.4	204.9	173.4	181.4
Mg2+	mg/l	41.5	23.1	36.4	37.4	31.6	22.5	31.4	26.8	49.4	30.1	35.7	58.2
Cu2+	mg/l	0.021	0.021	0.100	0.051	0.019	0.032	0.032	0.033	0.069	0.027	0.012	0.041
SO42-	mg/l	326.0	300.0	302.0	294.0	371.5	294.0	292.0	321.0	326.0	309.0	311.0	363.0
Cl-	mg/l	168.1	126.1	289.5	149.4	214.8	224.2	214.8	252.2	224.2	177.5	186.8	261.5

Date		11/12	9/12	11/12	9/12	9/12	12/14	8/12	10/12	9/12	9/12	7/12
Item	Unit	C15	C17	C18	C19	#1	#2	#3	#4	#5	#6	#7
Temperature	℃	27.0	19.0	21.0	23.4	22.5	18.7	18.8	19.4	18.5	23.2	18.1
pH	-	7.8	8.4	8.1	7.3	8.4	7.7	7.4	7.2	7.2	7.2	7.8
EC	μmhos/cm	990.0	180.0	880.0	1,180.0	330.0	750.0	1,150.0	1,010.0	2,120.0	715.0	820.0
SS	mg/l	103.0	85.0	75.0	138.0	110.0	79.0	148.0	92.0	90.0	95.0	92.0
DO	mg/l	2.7	6.1	6.1	0.0	4.3	2.1	5.1	6.0	5.1	4.1	7.9
BOD	mg/l	25.0	21.0	6.2	175.0	15.0	39.0	24.0	11.0	25.0	14.0	9.0
No. of Coliform Group	MPN/100ml	1.6E+09	3.5E+03	1.7E+05	1.6E+09	<1.8	2.0E+00	1.7E+02	2.0E+00	3.3E+01	2.4E+02	4.9E+01
No. of Fecal Coliform Group	MPN/100ml	5.4E+07	2.4E+03	9.2E+03	1.6E+09	<1.8	<1.8	3.3E+01	<1.8	1.7E+01	4.9E+01	7.8E+00
NO3－N	mg/l	1.9	1.2	2.4	8.5	2.4	2.5	4.6	2.8	9.4	9.7	0.5
Ca2+	mg/l	173.4	23.6	173.4	149.7	15.8	118.2	197.0	197.0	334.9	134.0	106.4
Mg2+	mg/l	35.7	5.2	35.7	27.3	5.9	37.4	44.1	53.2	229.0	0.4	24.1
Cu2+	mg/l	0.027	0.006	0.013	0.045	0.003	<0.001	0.032	0.020	0.008	0.002	0.018
SO42-	mg/l	321.0	31.0	300.0	340.0	30.0	255.0	370.0	360.0	750.0	147.0	200.0
Cl-	mg/l	196.1	5.6	177.5	214.8	21.5	149.4	223.0	186.8	583.8	121.4	134.7

St.2: Río Maipo en la Obra, St.3: Río Maipo en Pte. San Ramón (antes Río Clarillo), St.4: Río Maipo en Pte. Los Morros (después Río Clarillo),
St.5: Río Maipo en Viluco (Puente Ferrocarril), St.6: Río Maipo en Rosario (después Río Angostura), St.7: Río Maipo después Río Mapocho (Haras Los Boldos),
St.8: Río Maipo antes Estero Cholqui (Pte. Ing. Maramblo), St.9: Río Maipo en Cabinbao (Quicanhue), St.10: Río Maipo en Desembocadura,
St.13: Río Angostura en Angostura, St.14: Río Angostura en Valdivia de Paine, St.15: Estero Puangue en Curacaví,
St.16: Estero Puangue en camino a San Antonio, St.17: Río Mapocho en Los Almendros, St.18: Río Mapocho en canal La Punta
St.19: Río Mapocho en Canal Las Mercedes, St.20: Río Mapocho en Canal Mallarauco, St.21: Río Mapocho en El Monte
St.22: Estero Lampa después Estero Colina, St.23: Estero Alhue en Quilamuta, St.25: Estero Las Cruces antes Estero Lampa,
St.29: Estero Puangue en Canal Los rulos, St.30: Estero El Gato (en Pte. Gato 1)
C1: Canal San Carlos en Tobalba (Frente Hotel Radison), C2: Canal El Carmen en las Canteras, C3: Zanjón de La Aguada antes Río Mapocho,
C4: Canal La Pólvora (frente calle Rapa-Nui), C5: Canal Casa de Pudahuel (Cam. Noviciado Alt.1300), C6: Canal Esperanza Alto (en la puntilla),
C7: Canal Esperanza Bajo (en cruce Carretera 78-Antigua), C9: Canal Castillo (Vicuña Mackenna Parad.23), C11: Canal Mallarauco (en salida del túnel),
C12: Canal El Paico (El Paico alto), C13: Canal San Miguel (en línea F.F.C.C), C14: Canal Lo Aguirre,
C15: Canal Lo Chacón (entrada Balneario Yamil), C17: Canal Esmeralda en Colina (En Esmeralda frente a Consultorio), C18: Canal Culiprán (en puntilla El Cerrillo),
C19: Canal Las Mercedes en Curacaví,
#1: Pozo Quilicura (Oxiquim), #2: Pozo Pudahuel (Embot. Andina Planta Coca Cola Renca), #3: Pozo Padre Hurtado (Camino Guanaco, Piscicultura 2)
#4: Pozo El Monte (AP EMOS El Monte), #5: Pozo Maria Pinto (18 Sept N^{o}215), #6: Pozo Bollenar (Hostería Las lilas II),
#7: Pozos Tejas Verdes (P5 San Juan Aguasquinta)

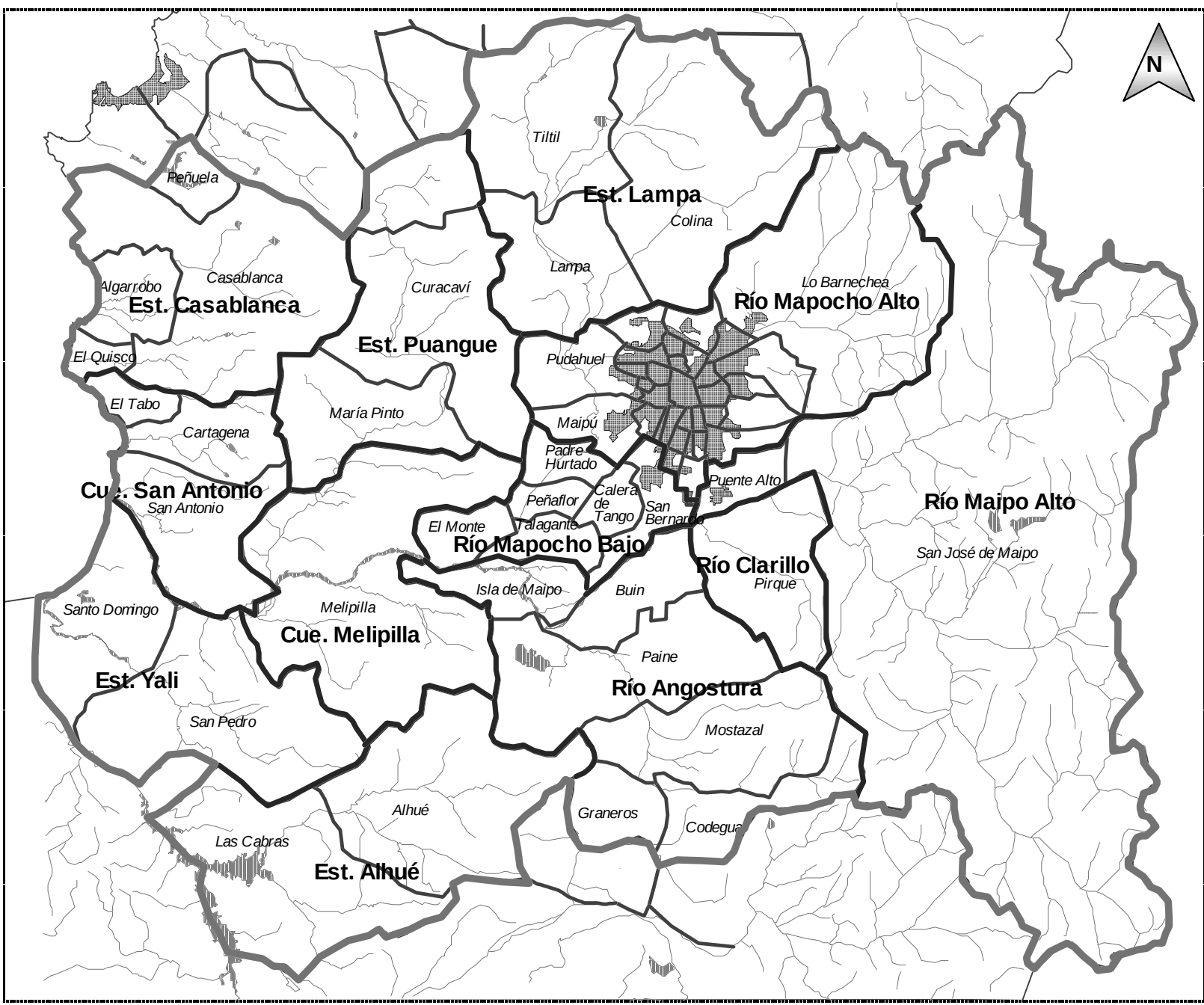


Región	Provincia	Comuna
V Región	Valparaíso	Peñuelas Casablanca
	San Antonio	San Antonio Cartagena, El Tabo El Quisco, Algarrobo Santo Domingo
VI Región	Cachapoal	Graneros, Mostazal Codegua, Las Cabras
R. M	Santiago	Santiago, Huechuraba Vitacura, Ñuñoa Peñalolén, La Granja San Miguel, Lo Espejo Maipœ ,Lo Prado Renca, Independencia Recoleta, Lo Barnecha La Reina, La Florida La Pintana ,La Cisterna Pedro Aguirre Cerda Pudahuel, Quilicura Estación Central Conchalí, Providencia Las Condes, Macul San Joaquín San Ramón, El Boaque Cerrillo, Quinta Normal Cerro Navia, Renca Quilicura
	Chacabuco	Colina, Lampa, Tiltil
	Cordillera	Puente Alto, Pirque San José de Maipo
	Maipo	San Bernardo, Buin Paine, Calera de Tango
	Melipilla	Melipilla, María Pinto Curacaví, Alhué San Pedro
	Talagante	Talagante, Peñaflor Isla de Maipo El Monte Padre Hurtado

Fig. 3.1.1 Administrative Boundaries

0 10 20 30 40km

DESARROLLO AGRICOLA Y MANEJO
DE AGUAS DEL AREA METROPOLITANA
JICA - CNR



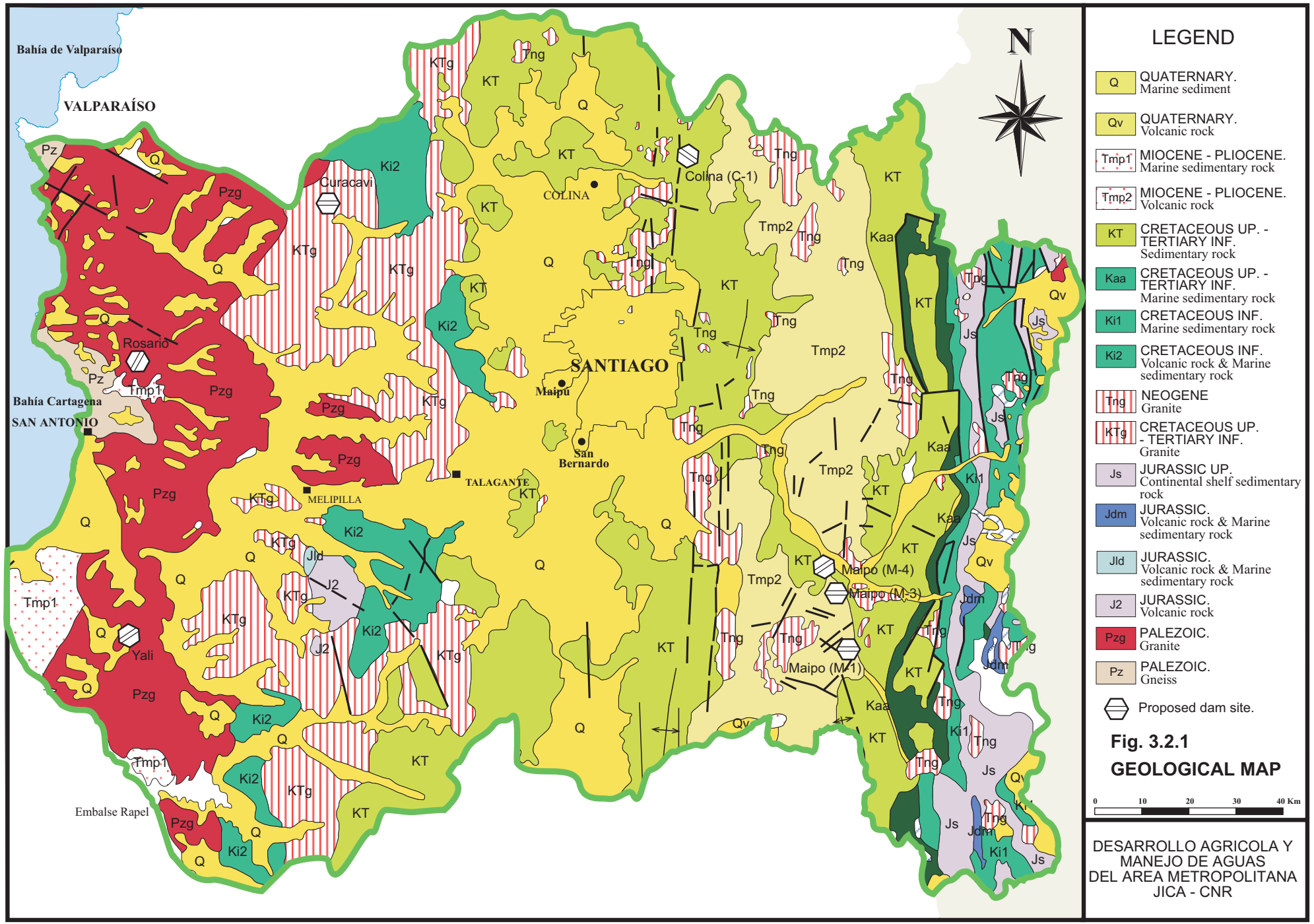
1 Río Maipo Alto	Puente Alto San José de Maipo
2 Río Clarillo	Pirque
3 Río Mapocho Alto	Santiago, Huechuraba Vitacura, Ñuñoa Peñalolén, La Granja San Miguel, Lo Espejo Maipú ,Lo Prado Renca, Independencia Recoleta, Lo Barnecha La Reina, La Florida La Pintana ,La Cisterna Pedro Aguirre Cerda Pudahuel, Quilicura Estación Central Conchalí, Providencia Las Condes, Macul San Joaquín San Ramón, El Bosque Cerrillo, Quinta Normal Cerro Navia
4 Est. Lampa	Colina, Lampa, Tiltil
5 Río Mapocho Bajo	San Bernardo, Peñaflor Calera de Tango El Monte, Talagante Padre Hurtado
6 Río Angostura	Granros, Buin, Mostazal Paine, Codegua Isla de Maipo
7 Est. Alhué	Las Cabras, Alhué
8 Cue. Melipilla	Melipilla
9 Est. Puangue	María Pinto, Curacaví
10 Est. Yali	Santo Domingo San Pedro
11 Cue. San Antonio	San Antonio, Cartagena El Tabo
12 Est. Casablanca	Casablanca, Peñuelas El Quisco, Algarrobo

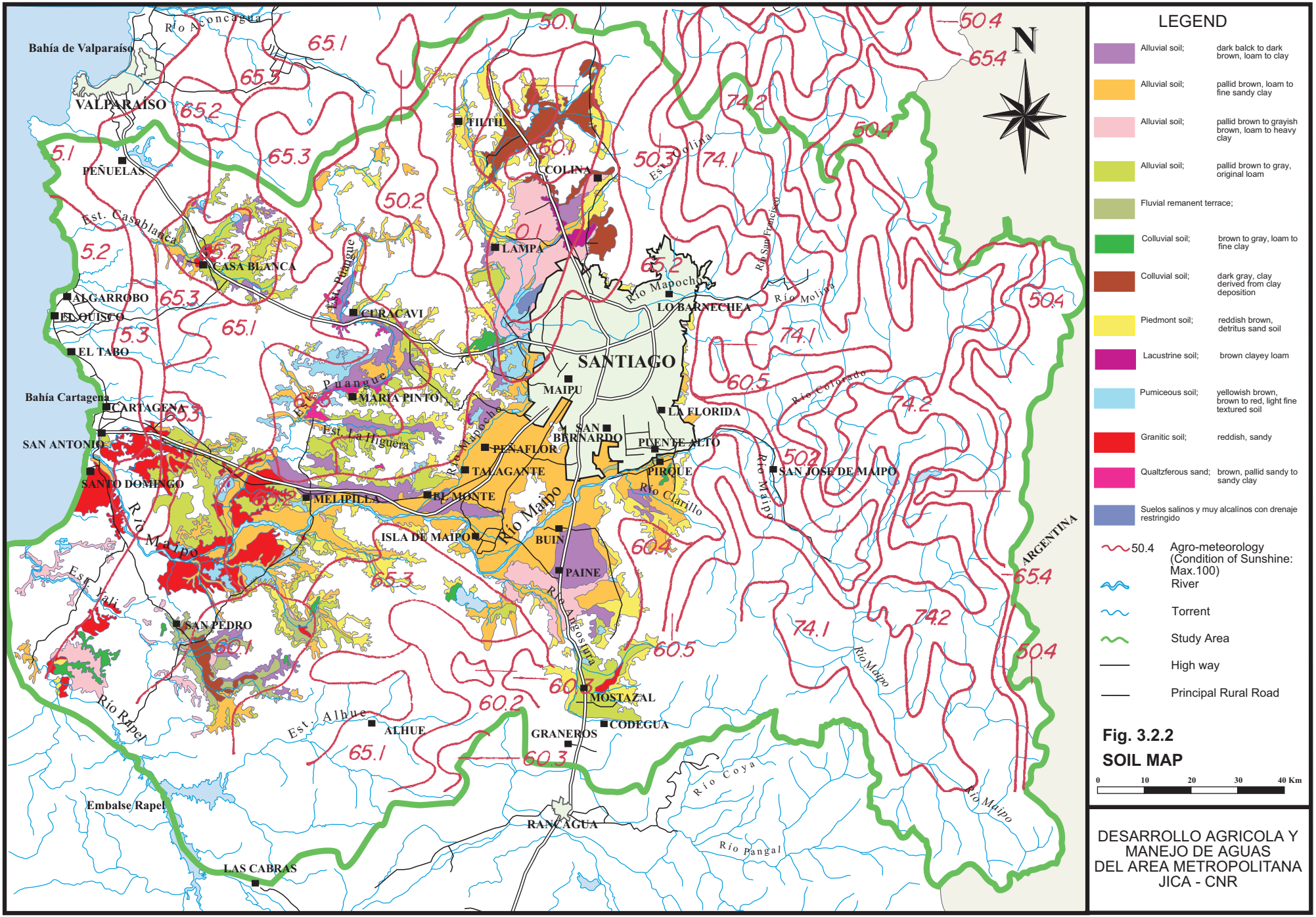
Fig. 3.1.2

Sub-Basin Division

0 10 20 30 40km

DESARROLLO AGRICOLA Y MANEJO
DE AGUAS DEL AREA METROPOLITANA
JICA - CNR


Bahía de Valparaíso
VALPARAÍSO
Bahía Cartagena
SAN ANTONIO
Embalse Rapel
Curacavi
Rosario
Yali
COLINA
Colina (C-1)
SANTIAGO
Maipú
San Bernardo
TALAGANTE
MELIPILLA
Maipo (M-4)
Maipo (M-3)
Maipo (M-1)
N
LEGEND
Q QUATERNARY. Marine sediment
Qv QUATERNARY. Volcanic rock
Tmp1 MIOCENE - PLIOCENE. Marine sedimentary rock
Tmp2 MIOCENE - PLIOCENE. Volcanic rock
KT CRETACEOUS UP. - TERTIARY INF. Sedimentary rock
Kaa CRETACEOUS UP. - TERTIARY INF. Marine sedimentary rock
Ki1 CRETACEOUS INF. Marine sedimentary rock
Ki2 CRETACEOUS INF. Volcanic rock & Marine sedimentary rock
Tng NEOGENE Granite
KTg CRETACEOUS UP. - TERTIARY INF. Granite
Js JURASSIC UP. Continental shelf sedimentary rock
Jdm JURASSIC. Volcanic rock & Marine sedimentary rock
Jld JURASSIC. Volcanic rock & Marine sedimentary rock
J2 JURASSIC. Volcanic rock
Pzg PALEZOIC. Granite
Pz PALEZOIC. Gneiss
Proposed dam site.
Fig. 3.2.1
GEOLOGICAL MAP
0 10 20 30 40 Km
DESARROLLO AGRICOLA Y MANEJO DE AGUAS DEL AREA METROPOLITANA
JICA - CNR


Bahía de Valparaíso
VALPARAISO
PEÑUELAS
Est. Casablanca
CASA BLANCA
ALGARROBO
EL QUISCO
EL TABO
Bahía Cartagena
CARTAGENA
SAN ANTONIO
SANTO DOMINGO
Río Maipo
Est. Yali
SAN PEDRO
Río Rapel
Embalse Rapel
LAS CABRAS
Est. Alhue
ALHUE
Est. Puangue
CURACAVI
MARIA PINTO
Puangue
Est. La Higuera
MELIPILLA
TALAGANTE
PEÑAFLOR
EL MONTE
ISLA DE MAIPO
Río Mapocho
Río Maipo
TILTIL
COLINA
LAMPA
Est. Colina
Río Mapocho
LO BARNECHEA
Río San Francisco
Río Molina
SANTIAGO
MAIPU
LA FLORIDA
SAN BERNARDO
PUENTE ALTO
PIRQUE
Río Clarillo
Río Colorado
SAN JOSE DE MAIPO
Río Maipo
BUIN
PAINE
Río Angostura
MOSTAZAL
CODEGUA
GRANEROS
RANCAGUA
Río Coya
Río Pangal
Río Maipo
ARGENTINA
N
LEGEND
Alluvial soil; dark balck to dark brown, loam to clay
Alluvial soil; pallid brown, loam to fine sandy clay
Alluvial soil; pallid brown to grayish brown, loam to heavy clay
Alluvial soil; pallid brown to gray, original loam
Fluvial remanent terrace;
Colluvial soil; brown to gray, loam to fine clay
Colluvial soil; dark gray, clay derived from clay deposition
Piedmont soil; reddish brown, detritus sand soil
Lacustrine soil; brown clayey loam
Pumiceous soil; yellowish brown, brown to red, light fine textured soil
Granitic soil; reddish, sandy
Qualtzferous sand; brown, pallid sandy to sandy clay
Suelos salinos y muy alcalinos con drenaje restringido
50.4 Agro-meteorology (Condition of Sunshine: Max.100)
River
Torrent
Study Area
High way
Principal Rural Road
Fig. 3.2.2
SOIL MAP
0 10 20 30 40 Km
DESARROLLO AGRICOLA Y MANEJO DE AGUAS DEL AREA METROPOLITANA
JICA - CNR