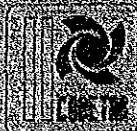


THE REPUBLIC OF BOLIVIA



CORPORACION REGIONAL
DE DESARROLLO DE
TARIJA (CODETAR)

**THE FEASIBILITY STUDY
ON
AGRICULTURAL AND
RURAL DEVELOPMENT PROJECT
IN SANTA ANA, TARIJA**

ANNEX

SEPTEMBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

JICA LIBRARY



1084867(9)

21515

THE REPUBLIC OF BOLIVIA



CORPORACION REGIONAL
DE DESARROLLO DE
TARIJA (CODETAR)

**THE FEASIBILITY STUDY
ON
AGRICULTURAL AND
RURAL DEVELOPMENT PROJECT
IN SANTA ANA, TARIJA**

ANNEX

SEPTEMBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

国際協力事業団

21515

THE FEASIBILITY STUDY
ON
AGRICULTURAL AND RURAL DEVELOPMENT PROJECT
IN
SANTA ANA, TARIJA

A N N E X

CONTENTS

ANNEX A	SOCIO-ECONOMY
ANNEX B	METEOROLOGY AND HYDROLOGY
ANNEX C	GEOLOGY AND GOUNDWATER
ANNEX D	SOIL AND LAND USE
ANNEX E	AGRICULTURE AND AGRO-ECONOMY
ANNEX F	IRRIGATION AND DRAINAGE
ANNEX G	PROPOSED FACILITIES
ANNEX H	RURAL INFRASTRUCTURE
ANNEX I	COST ESTIMATE
ANNEX J	PROJECT EVALUATION
ANNEX K	TOPOGRAPHIC SURVEY
ANNEX L	DRAWINGS

ANNEX A SOCIO-ECONOMY

ANNEX A SOCIO-ECONOMY

CONTENTS

	page
A.1 General Aspect of Socio-Economy in Bolivia	A- 1
1.1 Population and Society	A- 1
1.2 Currency	A- 1
1.3 National Economy	A- 2
1.4 Foreign Trade	A- 2
1.5 Agriculture	A- 3
A.2 General Features of Tarija Department	A- 4
2.1 Gross Production in Tarija Department	A- 4
2.2 Sectorial Analysis of Agriculture	A- 4
2.3 System of Agricultural Production	A- 5
2.4 Livestock	A- 6
2.5 Forestry	A- 8

LIST OF TABLES

	page
Table A.1 Gross Domestic Production (GDP) and Distribution Rate of GDP by Industry	A- 9
Table A.2 Major Exporting Goods	A- 9
Table A.3 Major Importing Goods	A- 9
Table A.4 Landholding Scale by Area	A- 10
Table A.5 Distributed of Landholding Area as a Result of Agricultural Land Reform	A- 10
Table A.6 Main Agricultural Production and Planted Area by Department	A- 11
Table A.7 Comparative of Main Crops Productivity with Andean Groups	A- 14
Table A.8 Distribution of Irrigation Area in the Country	A- 14
Table A.9 Expected Production of Main Agricultural Products in the National Development Plan	A- 15
Table A.10 Investment Program by Departmental and Industrial Sector	A- 16
Table A.11 Change of Population by Province	A- 17
Table A.12 Change of Population by Main Cities	A- 17
Table A.13 Population Forecast of Tarija Department	A- 17
Table A.14 Agricultural Production of Main Crops in Tarija Department	A- 18
Table A.15 Food Consumption per Capita	A- 18

LIST OF FIGURES

	page
Fig. A.1 Organization of MACA	A- 19
Fig. A.2 Administrative Division of Tarija Department	A- 20

ANNEX A SOCIO-ECONOMY

General aspect of the socio-economy and agriculture of the Bolivia and Tarija department are mentioned follows.

A. 1 General Aspects of Socio-Economy in Bolivia

1.1 Population and Society

With a land area of 1,098,581 km² and a mid-1988 population estimated at 6.9 mm, Bolivia has a low population density of 6.3 per km². Population growth averaged 2.8 per cent a year. between 1980 and 1985. The crude birth rate has fallen only slightly from 46 per thousand in 1960 to 43 per thousand in 1986, while the crude death rate has dropped from 22 to 15 per thousand over the same period. Life expectancy at birth (53 in 1986) is the lowest in South America. The urban population grew by 2.9 per cent a year between 1965 and 1980 but but by 5.6 per cent between 1980 and 1985. It now accounts for over 44 per cent of the total. The capital La Paz, is neither the only nor the greatest focus of urbanization. The following show the population of major cities.

Cities	Unit:1,000 hab.		
	1978	1987	% change
La Paz	729	993	3.5
Santa cruz	279	442	5.4
Cochabamba	220	317	4.1
Potosi	-	113	-
Sucre	-	87	-

Source: The Economist Intelligence Unit
(EIU, Country Profile, 1989-1990)

Adult literacy was officially estimated at 74 % in 1985 compared with 39 % in 1960. In 1985 91% of the relevant age group were enrolled in primary schools compared with 73 % in 1965. Only 37 % increased from 18 % in 1965. The World Health organization data put the population per average daily food intake supplied 2,171 calories, 90 % of the recommended minimum.

1.2 Currency

During most of the 197s the dollar was worth 20 pesos but in November 1979 the currency was devalued to \$1=24.51 pesos and in November 1982 to \$1=196 pesos. A continuing exchange shortage resulted in further large devaluations and a widening disparity between the official rate and parallel rate. Immediately before the introduction of the New Economic Policy the official rate was \$1=7,500 pesos whereas the parallel rate was \$1=1 mn pesos. Since August 1985 the official rate has been allowed to float more or less freely and gap between the two rates has virtually disappeared. On January 1, 1987, a new currency, the boliviano, replaced the peso at a rate of 1 to 1 mn pesos. In June 1989 it stood at 2.6 to the dollar, a rate at which it is generally considered to be somewhat over valued. Average \$ exchange rate showed as follow.

Year	Pesos	Year	Pesos	Year	Bolivianos
1975	20	1981	25	1987	2.06
1976	20	1982	64	1988	2.35
1977	20	1983	230	1989	2.60
1978	20	1984	2,178		
1979	20	1985	441,900		
1980	25	1986	1,922,000		

Source: IMF, International Financial Statistics
Elaborated by EIU.

1.3 National Economy

After recording average annual growth of 4.5% in the period 1965-1980, GDP contracted in 1982 year until 1987. There was a particularly disastrous performance in 1983 which was in part the result of the freak weather wrought by changes in the Nino current off the coast of Peru - a reminder of Bolivia's vulnerability to natural, as well as man made, disasters.

World Bank figures give Bolivia's GNP per capita as 4.4 in 1980, 3.2 in 1984 and 2.9 in 1985, with the USA = 100; the United Nations International Comparison Project, which uses purchasing power parties instead of exchange rates as the basis of comparison, provides somewhat higher annual figures(14.2,10.0, 9.5) but illustrates the same trend: an already poor standard of living which has been reduced by a further third since 1980. Although Bolivia's GDP is now growing again all sectors of the official economy remain depressed.

1.4 Foreign Trade

(1) General

A squeeze on imports, resulting from repeated devaluation and a contraction in demand, contributed to trade surpluses being achieved every year from 1980 to 1985. But in 1986 and 1987 imports were quite a bit higher than they had been in 1982 - 1985, which meant that as exports dropped in both years trade deficits re-emerged. It took a recovery in exports and another drop in imports to produce a surplus again in 1988. For most of the 1980s the terms of trade have gone against Bolivia. Gas sales accounted for 58% of total exports in 1986, 44 % in 1987, and 36% in 1988.

(2) Regional Trading Associations

At the end of 1978 the eleven signatories of the 1960 Montevideo Treaty(Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela) approved a resolution which envisages the restructuring of the free trade organization and, 20 months later, 1980 Montevideo Treaty brought the Asociacion Latinoamericana de Integracion (Aladi) into being.

Aladi aims, as Alac did, at free trade and greater economic integration between the member countries. It differs from Alac, ever, in

that it allows many different forms in which countries can pursue these goals.

a. Aladi countries

Territory(1,000 km2)	: 19,294
Total population(1,000)	: 360,737
GDP(mn US\$)	: 843,621
GDP per caput	: 2,339
Total exports	: 80,482
Intrazonal export	: 8,453
Total Imports	: 57,702

b. Direction of trade with Aladi, 1987

Export to: us\$ mn	Import from: us\$ mn
Argentina 304.8	Argentina 90.7
Brazil 14.4	Brazil 224.3
Chile 8.4	Chile 44.5
Colombia 3.4	Colombia 1.5
Ecuador 0.2	Ecuador 0.3
Mexico 0.9	Mexico 1.4
Paraguay 0.4	Paraguay 0.5
Peru 7.4	Peru 5.8
Uruguay 0.1	Uruguay 0.9
Venezuela 0.1	Venezuela 112.0
Total 340.1	Total 481.8

1.5 Agriculture

The share of agriculture, forestry and fishing in GDP fell from 30% in 1960 to under 17% in 1979; since then it has recovered to about 20%. The sector's recent performance has been uneven and dogged by bad weather; in 1983 this caused the sector to contract by an unprecedented 29%. Very heavy rains again fell on the Altiplano in early 1986, causing Lake Titicaca to rise and flood large areas of the fertile lake shore; 40,000 were made homeless and crop losses were estimated at us\$ 50 mn. In 1988 drought in the east hit commercial production of maize, wheat, rice and soybeans and many cattle suffered; output was 1.1% below that in 1987 as agricultural prices were squeezed in both domestic and export markets.

Bolivia has a great variety of territory - much of which has unexploited potential. Development everywhere has been hampered by the lack of mechanization and investment, and poor infrastructure. However, agriculture and rural development are now being given higher priority in government development plans than in the past. Agriculture remains labour intensive and employs almost half the labour force; of this, 62% is employed in subsistence farming, mainly in the central highlands.

Of a land area of 108.4 mn ha, only 8.77 mn ha were arable land and 127,000 ha were under cultivated crops in 1986; the area actually

cultivated during the 1987-1988 was about 1.3 mn ha. In 1986 55.8 mn ha were under forest and woodland, 26.8 mn ha were permanent pasture and 22 mn ha were in other categories, including a large area of unused but potentially productive land. FAO estimated the irrigated area at 100,000 ha in 1986, 33% more than in 1975 but still only 4.7% of the area devoted to arable farming and permanent crops.

The principal crops for domestic consumption are potatoes, rice maize and wheat. But production for the domestic market falls well short of requirements, making imports, particularly of grains, necessary. Sugar cane, cotton and coffee are the main agricultural exports. Soya production has responded sharply to the recent growth in demand and high prices. A notable feature of conventional Bolivian farming in recent years has been the rise in livestock numbers as Amazonian forest and savanna give way to poorish pasture. In 1987 there were an estimated 5.38 mn cattle, 18% more than in 1979-81, and the estimated numbers of pigs, sheep and goats were 1.7 mn, 9.5 mn and 2.3 mn respectively.

Bolivia has substantial potential for forestry production which is currently largely unexploited. Nonetheless there was a 28% increase in wood exports between 1973 and 1984.

A. 2 General Features of Tarija Department

2.1 Gross Production in Tarija Department

As far as the national matters are concerned, the regional economy has undergone the influence of the crisis of the economy of the country. As shows the Gross Domestic Production in the Tarija department follow table, the analysis made of them shows the vocation given to the agricultural policy in the region; the GDP for 1987 was 24,3 % and this is because of the production of industrial crops for the agroindustry such as sugar cane, vineyard, crops for the vegetable oil industry, etc. in relation with other sectors.

Sector	1985	1987
Agriculture	24.30	24.34
Petroleum	4.00	4.00
Manufacture Industry	9.10	9.69
Construction	3.20	3.26
Energy	0.30	0.29
Transport & Communication	12.50	12.78
Trade & Finances	6.40	6.33
Central Government	8.50	8.39
Housing & Properties	11.70	11.55
Total	100.00	100.00

2.2 Sectorial Analysis of Agriculture

(1) Man power

Agricultural sector, even though it absorbs most of the labour

force available in the Department(24.9%), reveals a high percentage of sub-employment and seasonal unemployment due to high percentage of land with seasonal crops (rain season) and the size of productive units.

Comparative in the utilization of man power of agricultural sector:

Items	Year	1980	1986
Population	:	217,543	273,518
PEA	:	69,614 32.0%	91,656 33.5%
Rural population	:	127,919 58.8%	151,987 55.5%
PEA rural	:	40,934 58.8%	50,931 55.5%
Population employed:	:	33,282 47.8%	43,940 47.9%

From the total population employed in agriculture, the sector generated full employment for 57.8% in 1980, the percentage increased up 65.6% in 1986, which shows the dynamics of this sector. Because of the statements given above, in the country side, there are periods of time in which the generation of employment is almost nil, and this is what stimulates in the farmer to migrate to and from rural-urban areas, as can estimate the decrease of the rural population from 58.8% to 55.5% during the last five-year term.

(2) Potential of Land Use

In a study area of 15,219.6 km² of the Department it is observed that 925,639 ha are potentially apt. for agricultural development and it is equivalent to 24.6% of the extension of the Department.

Potential extension of land in the Department:

Suitability	Area(ha)	%
For crops with limitations	: 519,087	34.3
For crops with moderate or severe limitation	: 406,552	26.9
For grazing and stockbreeding:	334,484	22.1
Forestry and wildlife	: 252,845	16.7
Total	1,512,968	100.0

2.3 System of Agricultural Production

Within the structure which characterizes agricultural economy of Tarija, it is possible to distinguish the following production systems: that of self-consumption, typified because the worker and his family depend upon their own production for their subsistence, the commercial one whose destination is the market, and the stock-breeding system which is made of, in general, a mixed system, the main part of the production, the stock-breeding is assigned to the commercialization, but the worker, for his own agricultural production.

(1) Self-consumption production system

In spite of the importance of self-consumption within this system, its numerical relevance makes its commercial profit margin amount to the main supplier of agricultural produce in the Department: fruit, potatoes, vegetables, eggs and some semi-processed products.

The productivity, which is extremely low in this group is related to the discontinuity of the planted area, the lack of irrigation, the reduce or inadequate use of pesticides and fertilizers and very insipid institutional support.

(2) Commercial agriculture

Characterized for its especialization and integration in the agroindustrial field: soya, maize, sugar cane, its importance is based on the fact that it is the main supplier of prime material of sugar, cane, vegetable oil, liquor, and animal feed.

Commercial agricultural is also characterized for the large size of its operations which is growing all the time, this includes in machinery, fertilizers, pesticides, improved seeds, and attention to the institutional system, in spite of all of this its production is still low. Among the problems which afflict commercial agriculture have the following: the shortage and high prices of the necessary supplies, reduced government support in research material, extension and agricultural capacity, such as the insufficient network of local roads which increase the transportation costs.

(3) Stock-breeding system

The importance of this system is that it is the main source of the meat supply for the southern Department of the country. One of the obstacles in the development of the stock-breeding areas is the scarce and inefficient infrastructure of transportation which makes it difficult to carry out the required investments needed to increase the productivity level, which at present is terribly low. The low productivity and the isolation of the stock-breeding operations in the Chaco region, make it such, that the majority of the farmers in order to cover the principal part of the nutrition diet, they devote their activities to an agricultural subsistence production.

2.4 Livestock

The majority of the cattle which exists in the Department is of a local type (criollo), although it is of poor quality it is well adapted to the ecological conditions of the Department.

(1) Cattle

The cattle which exists in the Department are mainly of two types. The largest majority is made up of local (criollo) animals destined for meat production, some of which are milked, and a small number of dutch-

type mostly milk cows. The local (criollo) cattle which are very rustic type, are distributed all over the department; the highest proportion is in the Chaco region which is the main meat producing area in the Department. The milking is carried out seasonally, and is related to the calving-time season. The main part of the production is used for cheese. In the last few years, cebu and other European varieties (specially breeding animals) have been introduced.

The breeding system in total liberty and the absence of cross-breeding control does not allow the influence of this work to be appreciated. The carcass yield is on average of 160 kg per animal of 4 to 5 years of age. The milking type cattle is mainly bred in the Central Valley, because of the influence of the daily promotion program.

The animals that have been produced by cross-breeding from bloodstock animals from other Departments and imported from Argentine and Uruguay, show a good milking temperament. The milk production is 8 liters per cow per day and the nursing period is around 240 days. For cattle in general, the main production problems are related to the feeding, and the deficiencies in the sanitary aspect which bring foot-and-mouth disease, internal parasites (*Fasciola hepatica*, lung and intestinal) and external ticks, lice, and mange.

(2) Goats and Sheep

In the Department there are goats and sheep which receive extensive management, maintaining them free during the whole days so they can take advantage of natural vegetation by nibbling and grazing. The pressure of this type of management on the vegetation is one of the cause of the existing erosion in some sectors of the Department, specially in the valleys and the slopes of the mountains. The main sanitary problems of these animals are the intestinal and respiratory parasites, in sheep it is very common to observe foot-and-mouth disease. In general terms, very few veterinary products are used.

(3) Pigs

Pig breeding is a complementary activity in the farming unit. The majority of the animals are the criollo type with a low productivity scale. In the last five-year period thorough bred varieties such as Yorkshire, Hampshire, Landrace have been introduced but the management systems show delay in the projected results. Pig breeding constitutes an alternative economy in the agricultural development of the Department, now that there are areas with ecological characteristics apt for the development in this field. The total amount of animals is shown in the following table and correspond to the whole Department. Special interest is shown in horses, llamas, etc. The first mentioned will allow the implementation of intermediate technology in the different region of the department.

<u>Livestock</u>	<u>Number(1,000 head)</u>
Cattle	234
Pig	89
Caprine	168
Sheep	199
Poultry	310
Others	7

LLamas and alpacas, which are found in south America, represent good possibilities for the high areas in the Department because of the demand of wool and leather in the international market.

2.5 Forestry

Forestry in the Department, in spite of its potential, is not developed to the full. The majority of the timber mills only produce wood in planks. In the following table there is represented a summary of the extraction of wood by species and volume. The following table shows specifically the forestry extraction activity, which brings as a consequence the extinction of species in some parts of the Chaco.

Policies of forestry development should be carried out in order to allow a rational exploitation of these resources.

<u>Species</u>	<u>Volume(M3)</u>	<u>%</u>
Cedro	930.2	29
Alizo	446.2	14
Pino	433.7	13
Palo blanco	392.6	12
Quina	357.0	10
Nogal	147.4	5
Pacara	117.0	4
Tipa	91.2	3
Barrozo	72.2	2
Lapacho	56.2	1
Others	203.0	7
Total	3,246.7	100

Table A.1 Gross Domestic Production (GDP) and Distribution
Rate of GDP by Industry

Items	Year	1982	1983	1984	1985	1986	1987	1988
1. GDP (Million Bolivianos)		118,674	110,943	110,611	110,445	107,211	109,479	112,553
Growth rate (%)		- 4.36	- 6.51	- 0.30	- 0.15	- 2.93	2.4	2.5
2. Per-Capita of GDP								
Growth rate (%)		- 6.9	- 9.0	- 3.0	- 2.8	- 5.6	- 0.3	- 0.3
3. Distribution rate of GDP by Industry (%)								
Agriculture		15.51	13.08	17.27	19.09	18.68	18.15	17.43
Livestock		4.09	4.34	4.34	4.57	4.50	4.50	4.38
Others		0.54	0.60	0.59	0.59	0.63	0.63	0.58
Sub-total		20.14	18.01	22.20	24.26	23.82	23.28	22.39
Minig Industry		16.45	16.78	14.77	12.93	11.25	11.19	12.84
Construction		12.24	12.50	10.78	9.79	10.30	10.43	10.79
Sub-total		3.12	3.28	3.21	2.87	2.72	2.64	2.78
Electricity, Water and Gas		31.81	32.56	28.76	25.59	24.27	24.26	26.41
Transport and Communication		0.78	0.85	0.85	0.86	0.92	0.85	0.87
Others		6.57	6.36	6.51	6.64	7.05	7.28	7.47
Sub-total		40.70	42.22	41.68	42.65	43.94	44.33	42.86
Sub-total		48.05	49.43	49.04	50.15	51.91	52.46	51.20
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: (1) Instituto Nacional de Estadística, 1989

(2) ECLAC : Preliminary Overview of the Latin American Economy 1988

Table A.2 Major Exporting Goods

Unit : US\$ FOB

Items	Year	1983	%	1984	%	1985	%	1986	%	1987	%	1988	%
Tin		207.9	26.6	247.8	32.4	186.7	28.9	103.9	18.4	68.5	14.6	76.9	12.8
Natural gas		378.2	48.4	375.7	49.1	372.6	57.6	328.7	58.3	248.6	52.9	215.0	35.8
Silver		58.3	7.4	21.4	2.8	10.2	1.6	27.2	4.8	31.7	6.7	44.7	7.4
Sugar		12.3	1.6	6.6	0.8	1.8	0.3	-	-	-	-	-	-
Wolfram		20.0	2.5	18.9	2.5	10.3	1.6	6.6	1.2	5.1	1.1	5.3	0.9
Zinc		33.4	4.3	37.3	4.9	29.5	4.6	28.0	5.0	32.5	6.9	60.2	10.0
Antimony		16.3	2.1	22.9	3.0	15.9	2.4	14.1	2.5	22.9	4.9	15.5	2.6
Gold		-	-	-	-	-	-	4.1	0.7	37.2	7.9	68.0	11.3
Wood		7.8	1.0	6.0	0.8	5.8	0.9	-	-	-	-	-	-
Petroleum & Products		34.2	4.4	22.3	2.9	-	-	-	-	-	-	-	-
Coffee		12.9	1.7	6.6	0.8	13.8	2.1	-	-	-	-	-	-
Others		-	-	-	-	-	-	51.2	9.1	23.5	5.0	115.5	19.2
Total		781.3	100.0	765.5	100.0	646.6	100.0	563.8	100.0	470.0	100.0	601.1	100.0

Table A.3 Major Importing Goods

Unit: US\$ CIF

Items	Year	1983	%	1984	%	1985	%	1986	%
Non-durable consumer goods		46.4	7.9	42.5	8.7	65.7	8.6	73.4	10.1
Durable consumer goods		19.2	3.3	52.5	10.7	83.0	10.8	62.1	8.6
Raw material & semis		239.0	40.6	169.9	34.8	266.0	34.8	257.9	35.6
Capital goods for agriculture		7.3	1.2	13.5	2.8	21.5	2.8	13.1	1.8
Capital goods for industry		156.3	26.5	103.4	21.1	161.9	21.2	171.2	23.6
Transport equipment		58.6	9.9	68.2	14.0	106.8	14.0	85.2	11.7
Others		62.3	10.6	38.5	7.9	59.9	7.8	62.7	8.6
Total		589.1	100.0	488.5	100.0	764.8	100.0	725.6	100.0

Sources: (1) Banco Central de Bolivia;

(2) Ministerio de Industria; IMF

Table A.4 Landholding Scale by Area

Land holding scale (ha)	Altiplano and Valley Zone	Eastern Plain
< 3	28.85 (%)	9.35 (%)
3 - 5	15.50	6.90
5 - 10	16.70	9.20
10 - 20	13.65	14.18
20 - 35	3.70	14.40
35 - 50	1.80	8.90
50 - 75	1.50	22.50
75 - 100	0.60	1.70
100 - 200	0.58	2.20
200 - 500	0.40	2.80
500 - 1,000	0.09	2.50
1,000 - 2,500	0.03	2.90
> 2,500	-	2.47
Total	100.0	100.0

Source: Servicio Nacional de Reforma Agraria

Table A.5 Distributed of Landholding Area as a Result of Agricultural Land Reform

Area	Scale of Land Holding per Farmhousehold (ha)		
	Small	Middle	Large
Around the Titicaca Lake	10	80	400
Around the Poopo Lake	15	-	-
Southern Altiplano	35	150	800
Irrigated Field in the Valley	6	60	500
No Irrigated Field in the Valley	12	150	500
Irrigated Field in the Middle Valley	4	40-80	80-150
No Irrigated Field in the Middle Valley	8	-	80-150
Vineyard in the Valley	3	24	-
High land in the Valley	20	200	-
Irrigated Field in th High Valley	-	20-50	-
No Irrigated Field in th High Valley	-	100-150	-
Yungas Zone	10	150	-
Santa Cruz	50	550	-
Chaco	80	600	-
Tropical Zone	-	500	-
Sub-tropical Zone	-	-	2,000

Source: Diagnostico y Programa, MACA 1982 - 1984

Table A.6 Main Agricultural Production and Planted Area by Department (1)

Crops/Dept.	Year	1983				1985			
	Area	(%)	Production	(%)	Area	(%)	Production	(%)	
1. Rice									
Chuquisaca	741	1.7	1,408	2.3	399	0.3	671	0.4	
La Paz	5,709	13.1	2,979	4.8	11,062	9.2	11,938	6.5	
Cochabamba	4,000	9.2	4,132	6.7	8,640	7.2	8,835	4.8	
Oruro	0	0	0	0	0	0	0	0	
Potosi	0	0	0	0	0	0	0	0	
Tarija	266	0.6	224	0.4	269	0.2	445	0.2	
Santa Cruz	27,273	62.6	45,612	73.9	72,888	60.9	120,935	65.6	
Beni	4,600	10.6	5,800	9.4	21,347	17.8	34,434	18.7	
Pando	980	2.2	1,570	2.5	5,134	4.3	7,104	3.9	
Total	43,569	100	61,725	100	119,739	100	184,362	100	
2. Mize									
Chuquisaca	78,043	29.9	91,774	27.2	73,011	20.9	105,115	19.0	
La Paz	19,712	7.6	14,954	4.4	16,787	4.8	18,552	3.3	
Cochabamba	44,168	16.9	45,352	13.4	66,576	19.1	94,305	17.0	
Oruro	0	0	0	0	218	0.1	38	0	
Potosi	11,919	4.6	14,132	4.2	20,301	5.8	29,736	5.4	
Tarija	32,194	12.3	28,185	8.4	49,835	14.3	83,736	15.1	
Santa Cruz	66,908	25.7	133,563	39.6	103,758	29.7	193,869	35.0	
Beni	7,000	2.7	8,150	2.4	13,613	3.9	20,902	3.8	
Pando	900	0.3	1,080	0.3	4,830	1.4	7,685	1.4	
Total	260,844	100	337,190	100	348,929	100	553,938	100	
3. Wheat									
Chuquisaca	21,150	30.0	12,917	32.0	25,823	27.7	19,091	28.2	
La Paz	4,101	5.8	877	2.2	5,561	6.0	4,832	7.1	
Cochabamba	21,358	30.3	13,367	33.1	28,998	31.1	19,293	28.5	
Oruro	273	0.4	17	0	1,548	1.7	1,572	2.3	
Potosi	13,657	19.4	8,260	20.5	22,881	24.6	16,084	23.7	
Tarija	9,245	13.1	4,008	9.9	6,853	7.4	5,003	7.4	
Santa Cruz	723	1.0	901	2.2	1,461	1.6	1,855	2.7	
Beni	0	0	0	0	0	0	0	0	
Pando	0	0	0	0	0	0	0	0	
Total	70,507	100	40,347	100	93,125	100	67,730	100	

Note: (1) Planted area; ha

(2) Production; ton

Source: Estudio de Pronostico Agropecuario, 1985 MACA

Table A.6 Main Agricultural Production and Planted Area by Department (2)

Year Crops/Dept.	1983				1985			
	Area	(%)	Production	(%)	Area	(%)	Production	(%)
4. Potato								
Chuquisaca	15,740	14.6	38,684	12.2	25,642	12.9	94,673	13.1
La Paz	18,740	17.3	61,703	19.5	58,733	29.6	219,956	30.5
Cochabamba	27,322	25.3	92,387	29.2	48,733	24.6	183,525	25.5
Oruro	5,591	5.2	3,629	1.1	17,602	8.9	51,455	7.1
Potosi	31,654	29.3	98,302	31.1	37,490	18.9	136,018	18.9
Tarija	7,665	7.1	20,262	6.4	8,006	4.0	27,505	3.8
Santa Cruz	1,214	1.1	1,487	0.5	2,062	1.0	7,596	1.1
Beni	0	0	0	0	0	0	0	0
Pando	0	0	0	0	0	0	0	0
Total	108,157	100	316,454	100	198,268	100	720,728	100
5. Sugarcane								
Chuquisaca	537	0.8	4,025	0.1	183	0.2	5,433	0.2
La Paz	316	0.4	2,845	0.1	1,150	1.5	25,283	0.8
Cochabamba	0	0	0	0	9	0	37	0
Oruro	0	0	0	0	0	0	0	0
Potosi	0	0	0	0	0	0	0	0
Tarija	10,500	14.8	646,000	23.5	16,828	21.7	935,907	29.6
Santa Cruz	58,600	82.9	2,072,915	75.4	56,328	72.5	2,083,262	66.0
Beni	700	1.0	22,000	0.8	2,989	3.8	102,098	3.2
Pando	60	0.1	180	0	231	0.3	5,836	0.2
Total	70,713	100	2,747,965	100	77,718	100	3,157,856	100
6. Cotton								
Chuquisaca	0	0	0	0	0	0	0	0
La Paz	0	0	0	0	0	0	0	0
Cochabamba	0	0	0	0	0	0	0	0
Oruro	0	0	0	0	0	0	0	0
Potosi	0	0	0	0	0	0	0	0
Tarija	0	0	0	0	560	14.8	335	19.0
Santa Cruz	3,700	100	3,221	100	3,236	85.2	1,428	81.0
Beni	0	0	0	0	0	0	0	0
Pando	0	0	0	0	0	0	0	0
Total	3,700	100	3,221	100	3,796	100	1,763	100

Note: (1) Planted area; ha

(2) Production; ton

Source: Estudio de Pronostico Agropecuario, 1985 MACA

Table A.6 Main Agricultural Production and Planted Area by Department (3)

Crops/Dept.	1983				1985			
	Area	(%)	Production	(%)	Area	(%)	Production	(%)
7. Soy bean								
Chuquisaca	2,154	6.5	2,640	5.1	1,207	2.0	1,914	2.3
La Paz	0	0	0	0	0	0	0	0
Cochabamba	0	0	0	0	0	0	0	0
Oruro	0	0	0	0	0	0	0	0
Potosi	0	0	0	0	0	0	0	0
Tarija	4,986	15.0	9,177	17.7	3,731	6.2	5,499	6.6
Santa Cruz	25,997	78.5	40,035	77.2	55,580	91.8	75,851	91.1
Beni	0	0	0	0	0	0	0	0
Pando	0	0	0	0	0	0	0	0
Total	3,137	100	51,852	100	60,518	100	83,264	100
8. Grape								
Chuquisaca	1,310	36.1	7,860	34.5	1,785	37.0	8,448	40.2
La Paz	380	10.5	2,280	10.0	1,238	25.6	3,173	15.1
Cochabamba	475	13.1	2,375	10.4	400	8.3	1,550	7.4
Oruro	0	0	0	0	0	0	0	0
Potosi	520	14.3	3,470	15.2	820	17.0	4,843	23.0
Tarija	830	22.9	6,215	27.3	580	12.0	2,991	14.2
Santa Cruz	110	3.0	605	2.7	5	0.1	26	0.1
Beni	0	0	0	0	0	0	0	0
Pando	0	0	0	0	0	0	0	0
Total	3,625	100	22,805	100	4,828	100	21,031	100
9. Apple								
Chuquisaca	470	25.5	2,785	32.2	459	43.3	1,239	62.2
La Paz	90	4.9	360	4.2	20	1.9	130	6.5
Cochabamba	440	23.9	1,770	20.5	300	28.3	150	7.5
Oruro	0	0	0	0	0	0	0	0
Potosi	280	15.2	1,500	17.3	150	14.1	280	14.0
Tarija	380	20.7	1,520	17.6	100	9.4	160	8.0
Santa Cruz	180	9.8	720	8.3	32	3.0	34	1.7
Beni	0	0	0	0	0	0	0	0
Pando	0	0	0	0	0	0	0	0
Total	1,840	100	8,655	100	1,061	100	1,993	100

Note: (1) Planted area; ha

(2) Production; ton

Source: Estudio de Pronostico Agropecuario, 1985 MACA

Table A.7 Comparative of Main Crops Productivity with Andean Groups

Items	Country	Venezuela	Ecuador	Colombia	Peru	Bolivia
1. Average Yield (t/ha)						
a. Rice		3.5	3.0	4.5	3.8	1.6
b. Wheat		0.7	1.0	1.5	0.9	0.7
c. Mize		1.4	1.2	-	1.8	1.2
d. Potatoes		13.6	12.6	13.6	6.5	6.1
e. Sugarcane		71.0	68.2	80.0	155.6	41.0
2. Input of Fertilizer Quantity (kg/ha)		129.0	80.1	67.6	76.4	4.2
3. Number of Tractor for Agriculture		41,380 * 129	8,800 579	27,000 192	6,200 499	3,060 4,448

Note: * Means agricultural area for utilization per tractor.

Source: (1) Diagnostico y Programa 1982-1984, MACA

(2) Junta Acuerdo de Cartagena, 1975

Table A.8 Distribution of Irrigation Area in the Country

Classification	Area (ha)
1. Irrigation area under control by the MACA	10,000
a) Dept. Cochabamba "LA ANGOSTURA"	6,500
b) Dept. Oruro "TACAGUA"	3,500
2. Small-scale irrigation system under control by the farmer's organization	68,000
a) Micro irrigation system in the Altiplano	5,000
b) Northern and southern region in the Altiplano	5,000
c) A part of the valley in the Dept. of the La Paz	4,000
d) A part of the valley in the Dept. of the Cochabamba	21,000
e) Dept. of the Chuquisaca	15,000
f) Dept. of the Potosi	8,000
g) Dept. of the Tarija	3,000
h) Subtropical region	7,000
3. Micro irrigation system by the Servicio Nacional de Desarrollo de Comunidades	21,000
4. Villamontes irrigation project by the CBAF	500
5. ABAPO-IZOZOG irrigation project in the Dept. Santa Cruz	450
6. INGAVI irrigation project in the Dept. La Paz	50
Total	100,000

Source: Diagnostico y Programa, 1982-1984, MACA

Table A.9 Expected Production of Main Agricultural Products
in the National Development Plan

unit: 1,000 ton

Products	Year	1989/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	89-2000 *(%)
1. Cereals		954	999	1,056	1,106	1,160	1,227	1,285	1,344	1,418	1,481	1,576	165.2
Rice		141	145	149	153	158	162	167	172	177	182	187	132.3
Mize		521	536	551	566	583	599	616	633	651	669	688	132.0
Wheat		108	129	162	187	214	253	281	309	351	381	441	133.0
Others		184	189	194	200	205	213	221	230	239	249	260	141.0
2. Tuber Crops		1,188	1,222	1,255	1,291	1,328	1,365	1,404	1,443	1,483	1,525	1,572	132.3
Potato		650	668	686	705	726	746	768	789	811	834	857	132.0
Others		538	554	569	586	602	619	636	654	672	691	715	133.0
3. Vegetables		200	207	214	223	230	241	252	261	273	285	298	149.0
Onion		37	38	40	41	42	43	44	45	47	48	50	135.0
Tomato		40	41	42	43	45	46	48	49	51	52	54	135.0
Others		123	128	132	139	143	152	160	167	175	185	194	157.7
4. Fruit		756	779	803	827	853	880	908	938	971	1,000	1,034	136.7
Grape		18	19	20	20	21	21	22	23	23	24	24	133.3
Others		738	760	783	807	832	859	886	915	948	976	1,010	138.8
5. Industrial		3,183	3,318	3,465	3,616	3,770	3,927	4,088	4,252	4,420	4,591	4,767	149.7
Cotton		3	4	5	7	9	12	15	19	24	29	34	894.0
Sugarcane		2,966	3,050	3,135	3,223	3,313	3,406	3,501	3,599	3,700	3,804	3,911	131.8
Soybeans		190	240	300	360	420	480	540	600	660	720	780	410.5
Others		24	24	25	26	28	29	32	34	36	38	42	175.0
6. Coffe & Tea		29	30	32	36	39	43	48	54	60	67	75	258.6
7. Livestock		508	532	560	585	621	656	693	736	782	837	895	175.2
8. Others		395	413	431	450	472	497	523	550	578	609	641	152.3
Total		7,216	7,504	7,820	8,137	8,476	8,838	9,204	9,581	9,989	10,400	10,852	150.5

Note: * Increased rate during the 1989 - 2000

Source: Estrategia de Desarrollo Economico y Social 1989 - 2000. Ministerio de Planeamiento y Coordinación 1989

Table A.10 Investment Program by Departmental and Industrial Sector

unit: Million US\$

Sector	Hydro- carbon	Electricity	Mining	Agricultural	Industrial	Transport	Urbanization	Health	Sanitation	Communication	Other	Education	Total	(%) #1
1. Department														
Santa Cruz	461	106	1	72	0	40	0	7	70	0	0	0	757	12.2
La Paz	6	44	0	45	6	53	11	30	156	1	0	0	351	5.7
Cochabamba	21	20	0	76	2	4	0	6	87	0	0	0	216	3.5
Oruro	0	19	99	68	11	7	0	0	3	0	0	0	207	3.3
Taraji	35	31	0	97	10	22	0	1	5	2	0	0	202	3.3
Beni	0	128	0	3	0	3	0	0	44	0	0	0	178	2.9
Chquisaca	27	5	0	51	4	21	0	0	1	0	0	0	110	1.8
Potosi	2	3	2	40	0	1	0	6	25	0	0	0	80	1.3
Pando	0	0	0	10	1	1	0	2	2	0	0	0	16	0.3
2. Other #2														
(A)	8	331	0	295	72	1,236	225	85	0	168	1	133	2,553	41.2
(B)	1,185	28	56	0	0	0	0	0	0	2	0	0	1,272	20.5
(C)	183	75	0	0	0	0	0	0	0	0	0	0	258	4.2
Total	1,927	790	158	757	105	1,389	237	137	394	172	1	133	6,200	100

Note: *(1) % means participated rate of department

*(2) Other means other investments

(A): National investment

(B): Multidepartmental investment

(C): Bidepartmental investment

Source: Estrategia de Desarrollo economico y Social, 1989 - 2000

Table A.11 Change of Population by Province

Province	Year	1979	(%)	1985	(%)	1986	(%)	1987	(%)
1. Cercado		57,475	31	87,001	32	89,741	32	92,567	33
2. Arce		32,846	18	46,976	17	48,455	17	49,981	17
3. Aviles		13,549	7	18,173	7	18,745	7	19,385	7
4. Mendez		24,829	13	33,189	13	34,884	13	35,982	12
5. Gran Chaco		43,453	23	63,463	23	65,522	23	65,461	23
6. O'Conor		15,052	8	20,596	8	21,243	8	21,912	8
Total		187,204	100	270,027	100	278,590	100	285,288	100

Source: (1) Boletín Demográfico Departamental Tarija, 1976

(2) Plan Quinquenal desarrollo Tarija 1988 - 1992, CODETAR 1988

Table A.12 Change of Population by Main Cities

Cities	Year	1976	1987	Increased rate 1976-1987 (%)	Remarks (Province)
1. Bermejo		12,625	19,211	3.5	Arce
2. Padcaya		921	1,401	3.5	Aviles
3. San Lorenzo		2,289	3,416	3.4	Mendez
4. Concepcion		1,239	1,764	3.0	Cercado
5. Villamontes		6,926	10,762	3.7	Gran Chaco
6. Yacuiba		14,854	23,082	3.7	Gran Chaco
7. Entre Rios		2,281	3,321	3.3	O'Conor
8. Tarija		38,916	65,565	4.5	Cercado
Total Average		80,048	125,522	3.6	-

Source: Same as the Table 2.5.1 (1)

Table A.13 Population Forecast of Tarija Department

Year	Population						Population of Economic Activity (PEA)
	Urban	(%)	Rural	(%)	Total	(%)	
1976	80,479	43.0	106,726	57.0	187,204	100.0	60,897
1988	137,700	46.5	158,185	53.5	295,885	100.0	101,045
1992	177,994	51.0	171,004	49.0	348,998	100.0	119,483
1995	227,454	55.8	180,173	44.2	407,627	100.0	139,483
2000	319,363	60.2	210,784	39.8	530,147	100.0	181,045
* (%)	7.3		2.4		4.9		4.9

Note: * means increased rate during the 1988-2000

Source: Plan Quinquenal desarrollo Tarija 1988 - 1992, CODETAR 1988

Table A.14 Agricultural Production of main Crops in Tarija Department

Year Crops	1986			1987			1988		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
1. Mize	32,828	66,183	1.6	35,783	83,391	1.7	39,003	83,856	1.6
2. Wheat	6,378	5,296	0.8	6,616	5,624	0.9	6,863	5,834	0.9
3. Potato	7,858	27,500	3.5	8,151	32,064	4.0	8,455	42,275	5.0
4. Beans	970	1,358	1.4	980	1,372	1.4	995	1,393	1.4
5. Tomato	445	2,981	6.7	449	3,088	6.7	456	3,055	6.7
6. Onion	1,145	7,099	6.2	1,156	7,167	6.2	1,173	7,273	6.2
7. Grape	762	6,123	8.0	850	6,730	7.9	936	7,407	7.9
8. Peach	728	5,900	8.1	730	5,988	8.2	735	6,048	8.2

Note: (1) Area; ha

(2) Production; ton

(3) Yield; t/ha

Source: Departamentode Planificacion Sectorial MACA-Tarija, 1989.

Table A.15 Food Consumption per Capita

Unit: kg/year

	Cereales	Tuber	Beans	Vegetables	Fruits	Remarks
National	167.0	180.0	6.4	25.0	15.0	1976-1985 Max. Quan.
Argentina	150.1	110.8	6.8	70.1	108.1	1979 and 1985 Quan.

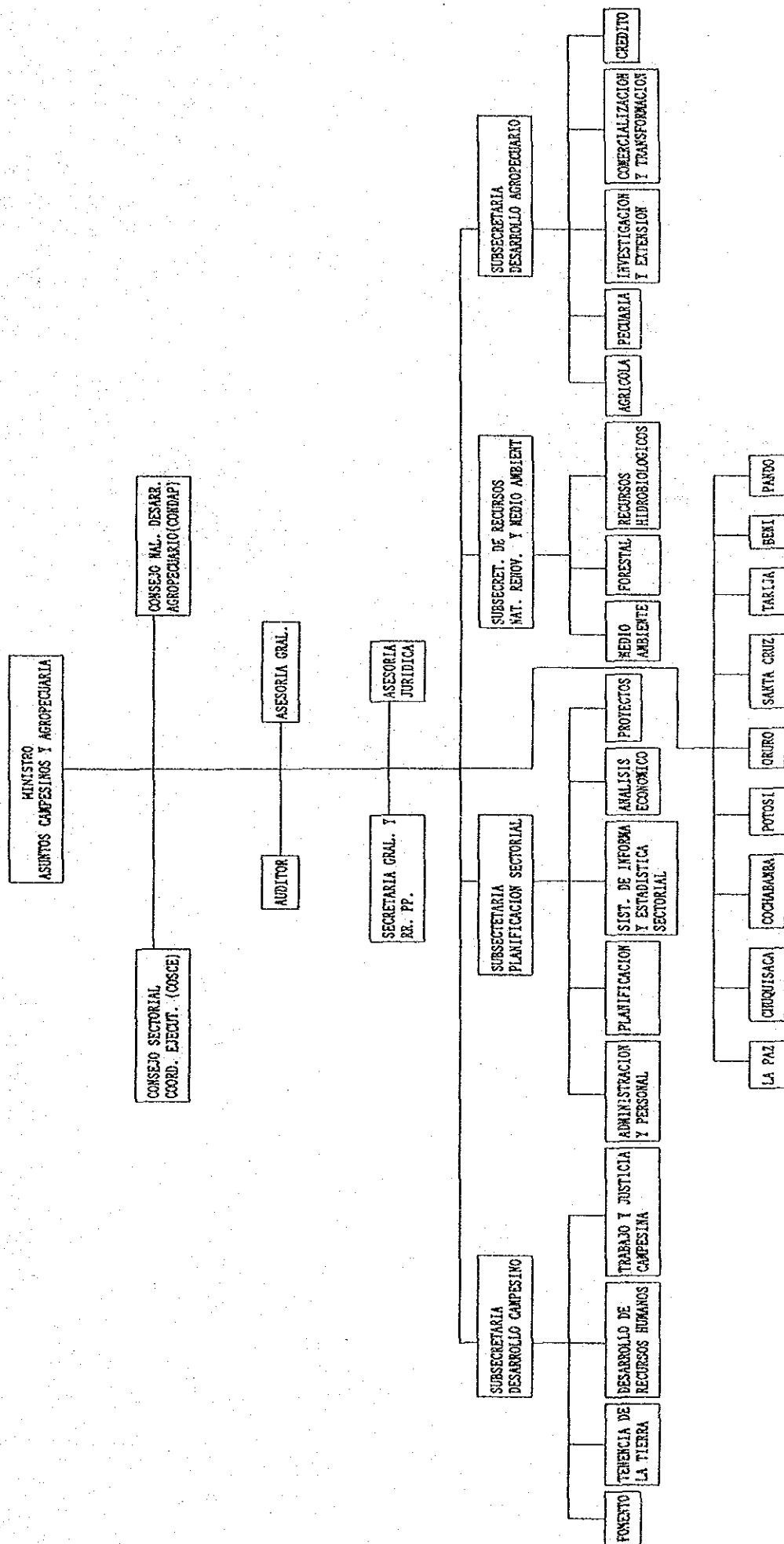


Fig. A.1 Organization of MACA

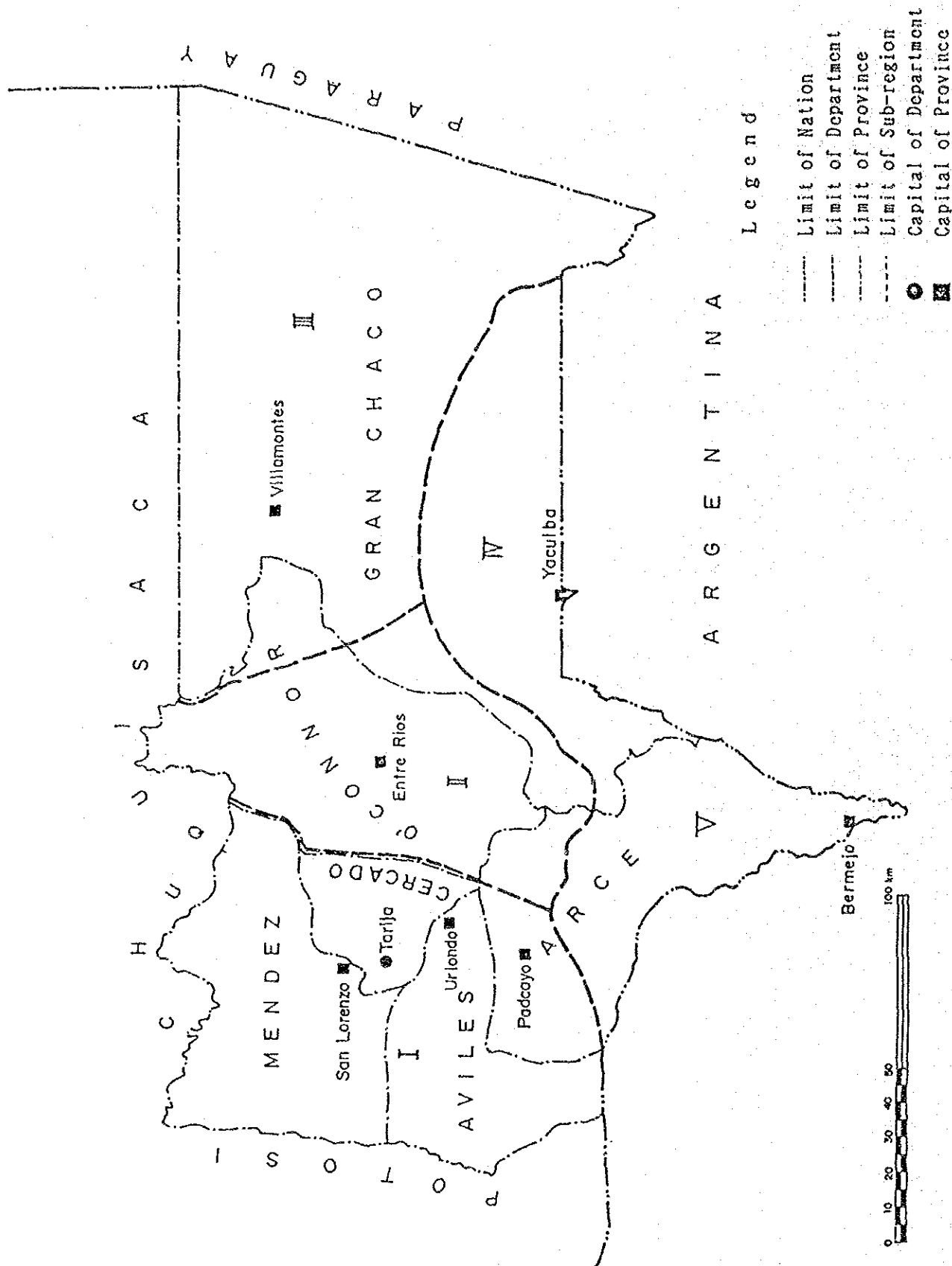


Fig. A.2 Administrative Division of Tarija Department

ANNEX B METEOROLOGY
AND HYDROLOGY

ANNEX B METEOROLOGY AND HYDROLOGY

CONTENTS

	page
B.1 General	B- 1
B.2 Meteorology	B- 1
2.1 General Meteorology	B- 1
2.2 Rainfall	B- 1
2.3 Rainfall Analysis	B- 1
B.3 Hydrology	
3.1 Water level Observation	B- 1
3.2 Runoff Analysis	B- 2
3.3 Flood Analysis	B- 2
3.3.1 Annual Maximum Daily Rainfall	B- 2
3.3.2 Design Flood Discharge	B- 2

LIST OF TABLES

	page
Table B.1.1 Summary of Meteorological and Hydrological Station ...	B- 7
Table B.2.1 Monthly Mean Temperature at El Tejar Uni. Station	B- 8
Table B.2.2 Monthly Mean Maximum-Temperature	B- 8
Table B.2.3 Monthly Mean Minimum-Temperature	B- 8
Table B.2.4 Monthly Extreme Maximum-Temperature	B- 9
Table B.2.5 Monthly Extreme Minimum-Temperature	B- 9
Table B.2.6 Monthly Mean Evaporation	B- 10
Table B.2.7 Monthly Mean 24hr Wind Velocity (at 0.5 m height)	B- 10
Table B.2.8 Monthly Mean Relative Humidity	B- 10
Table B.2.9 Monthly Mean Sunshine Hour	B- 11
Table B.2.10 Monthly Precipitation	B- 11
Table B.2.11 Maximum Daily Precipitation	B- 11
Table B.2.12 Monthly Mean Temperature at AASAAN Station	B- 12
Table B.2.13 Monthly Mean Maximum-Temperature	B- 13
Table B.2.14 Monthly Mean Minimum-Temperature	B- 13
Table B.2.15 Monthly Extreme Maximum-Temperature	B- 14
Table B.2.16 Monthly Extreme Minimum-Temperature	B- 14
Table B.2.17 Monthly Mean 24hr Wind Velocity	B- 15
Table B.2.18 Monthly Mean Relative Humidity	B- 15
Table B.2.19 Monthly Precipitation	B- 16
Table B.2.20 Maximum Daily Precipitation	B- 16

	page
Table B.2.21 Monthly Precipitation at Alto Cajas Station	B- 17
Table B.2.22 Monthly Precipitation at Yesera Norte Station	B- 17
Table B.2.23 Monthly Precipitation at San Pedro Station	B- 18
Table B.2.24 Monthly Precipitation at Junacas Station	B- 18
Table B.2.25 Monthly Precipitation at Gamoneda Station	B- 19
Table B.2.26 Monthly Precipitation at San Agustin Station	B- 19
Table B.2.27 Monthly Precipitation at Santa Ana Station	B- 20
Table B.2.28 Monthly Precipitation at La Cabana Station	B- 20
Table B.2.29 Correlation of Monthly Precipitation	B- 21
Table B.2.30 Supplemented Precipitation of Alto Cajas Station	B- 22
Table B.2.31 Supplemented Precipitation of Yesera Norte Station ...	B- 22
Table B.2.32 Supplemented Precipitation of San Pedro Station	B- 22
Table B.2.33 Supplemented Precipitation of Junacas Station	B- 22
Table B.2.34 Supplemented Precipitation of Gamoneda Station	B- 23
Table B.2.35 Supplemented Precipitation of San Agustin Station	B- 23
Table B.2.36 Supplemented Precipitation of Santa Ana Station	B- 23
Table B.2.37 Supplemented Precipitation of La Cabana Station	B- 23
Table B.2.38 Areal Rainfall of Santa Ana River Basin	B- 24
Table B.3.1 Monthly Mean Discharge recorded at Santa Ana Gauging Station	B- 24
Table B.3.2 Supplemented Runoff Discharge and Runoff Coefficient .	B- 24
Table B.3.3 Maximum daily Rainfall and its Probable Rainfall	B- 25
Table B.3.4 Direct Runoff Increments for Computing Design Flood ..	B- 26
Table B.3.5 Peak of Triangle Hydrograph	B- 26
Table B.3.6 Composed Flood Discharge	B- 27

LIST OF FIGURES

	page
Figure B.1.1 Location of Meteorological and Hydrological Station ..	B- 28
Figure B.3.1 Correlation between Accumulative Rainfall and Accumulative Runoff	B- 29
Figure B.3.2 Supplemented Runoff at Santa Ana Gauging Station	B- 29
Figure B.3.3 Rainfall Distribution	B- 30
Figure B.3.4 Composed Hydrograph	B- 30
Figure B.3.5 Estimation of re employed in Rational Formula	B- 31

ANNEX B METEOROLOGY AND HYDROLOGY

B.1 General

The locations of meteorological and hydrological observatory in the study area and its neighborhood are shown on Fig. B.1.1. Also that, the contents and the period of observation are given in Table B.1.1.

B.2 Meteorology

2.1 General Meteorology

General meteorology in the study area is not observed. Accordingly, they of El Tejar university and Tarija airport are shown on Table B.2.1 to B.2.20.

2.2 Rainfall

Monthly rainfalls recorded at the stations in the Santa Ana river basin including the study area, the stations of El Tejar and AASANA are given in Table B.2.21 to B.2.28.

2.3 Rainfall Analysis

(1) Correlation Analysis

Since the rainfall data recorded at the station in the Santa Ana River basin are insufficient and lacking observation period at some station, the insufficient data are supplemented by the correlation between each station.

The correlation between each station is calculated with a linear equation based on the monthly rainfall data. The equations and coefficients of correlation are shown in Table B.2.29. And the supplemented rainfall data are shown in Table B.2.30 to B.2.37.

(2) Areal Rainfall

Since the river basin of the Santa Ana River at the water level observatory is large (238.79km^2) and the rainfall in the basin is not uniform due to the isohyetal map of the Valle Central, the average rainfall of the basin is calculated by Thiessen method. The Santa Ana River basin is divided into seven sub-area by Thiessen method where the rain gauge stations are located, and the areal rainfall is shown in Table B.2.38.

B.3 Hydrology

3.1 Water level Observation

The water gauging station which is located in the Santa Ana River basin is at the Chaco Bridge. The discharge recorded at the station is shown in Table B.3.1.

3.2 Runoff Analysis

On the basis of the correlation between the recorded discharge and the areal rainfall mentioned above, the discharge which has not recorded is calculated. Since the accumulative discharge and the accumulative areal rainfall of the each hydrology year show the good correlation as shown in Fig B.3.1, the lacking discharge will be calculated. The supplemented discharge and runoff coefficient are shown in Fig. B.3.2 and Table B.3.2.

3.3 Flood Analysis

3.3.1 Annual Maximum Daily Rainfall

Annual maximum daily rainfall, probable rainfall and maximum experienced rainfall at rain gauge stations in the Santa Ana River basin and its surrounding area is shown in Table B.3.3.

3.3.2 Design Flood Discharge

In order to design the dam, the design flood discharge at the proposed site should be estimated. There are some methods to estimate the flood discharge. Since the recorded rainfall data are taken daily (24 hours), only peak flood discharge should be estimated, the design flood discharge will be estimated by rational formula, SCS method and Kadoya's method.

(1) Rational Formula

The rational formula is shown in the following equation:

$$Q_p = f * r * A / 3.6$$

where,

Q_p: peak flood discharge (m³/sec)

A : catchment area (km²)

r : average rainfall intensity in the catchment within the lag time of flood (mm/hr)

f : peak runoff coefficient

1) Lag time of flood (Tc)

There are some formulas to estimate lag time of flood but in this report it is estimated by following equations which are used in Bolivia

a) Grandotti formula

$$T_c = \frac{4 * \text{sqrt}(A) + 1.5 * L}{25.3 * J * L}$$

where, Tc : lag time (hr)

L : distance from the mechanically farthest point
in the catchment area to the dam site (km)

J : average gradient of a river bed

A : catchment area (km²)

b) USCE formula

$$T_c = 0.3 * (L / J^{0.25})^{0.76}$$

c) Ventura formula

$$T_c = 0.127 * (A / J)^{0.5}$$

d) USDA formula

$$T_c = 0.948 * (L^3 / H)^{0.385}$$

e) US Navy formula

$$T_c = L / V$$

$$V = 3 \text{ (ft/sec)} ; J = 2 \text{ to } 4 \%$$

f) Rziha formula

$$W = 72 * (H / L)^{0.6}$$

$$T_c = L / W$$

g) US Bureau

$$T_c = 1.22 * (L_F * L / J)^{0.382}$$

where, L_F : distance from central point of the catchment
area to the damsite

The lag times which are estimated by each equation are as follows.

Formula	A (km ²)	H (m)	L (km)	L _F (%)	J	T _c (hr)
a) Grandotti						4.7
b) USCE		995	36.8		0.027	9.2
c) Ventura						12.0
d) USDA	243.38					4.3
e) US Navy						11.2
f) Rziha		660	10.35		0.064	0.7
		335	26.45		0.013	5.1
						sum. 5.8
		ft	mil	mil	ft/mil	
g) Us Bureau		3,264	22.87	10.5	142.7	3.8

From the results mentioned above, the Rziha formula which shows medium value is adopted and the lag time will be estimated to be $T_c = 5.8$ (hr).

- 2) Average rainfall intensity in the catchment area within the lag time of flood (r)

Since the available rainfall data is daily data (24hr), rainfall intensity is estimated by the following equation:

$$r = \frac{R_{24}}{24} * \left(\frac{24}{T_c} \right)^n$$

where, r : average rainfall intensity (mm/hr)

R_{24} : daily rainfall

T_c : Lag time (hr)

n : constant (0.33 to 0.67, adopted to be 0.5)

The rainfall intensity which is estimated by the above equation is as follows.

Probable year (yr.)	10	50	100	200	500
Rainfall intensity (mm/hr)	6.9	10.4	12.2	14.3	17.3

- 3) Peak runoff coefficient (fp) and catchment area (A)

The Santa Ana river basin is in a mountainous area which is composed of sand stone and mud rock in the Paleozoic period. Though an agricultural land and a forest can be seen in the sector along the river, generally, the vegetation of the basin is low. Since the peak runoff coefficient in the basin is estimated to be 0.6 to 0.8, the coefficient of $f_p = 0.7$ is adopted in the study. The catchment area ($C.A = 243.38 \text{ km}^2$) is measured by means of the topo-

graphical map with a scale of 1:50,000 edited by I.G.M. (Military Geographical Institute)

4) Peak flood discharge (Q_p)

Peak flood discharge is estimated by applying the values mentioned above to the rational formula. The peak flood discharge of each probable year is as follows.

Probable year (yr)	10	50	100	200	500
Peak flood discharge (m^3/sec)	327	492	577	676	819

(2) SCS Method

For the distribution of rainfall, the basic patterns such as front peak type, middle peak and rear peak type are considered. In general, it is said that the rainfall distribution of the rear peak type gives a peak discharge for flood runoff. With the rainfall intensity mentioned above, the 24-hour rainfall is distributed as the first of 70% and the latter of 30% as shown in Fig. B.3.3. Peak discharges for the direct runoff discharge and incremental runoff are shown in Table B.3.4 and Table B.3.5. Composed hydrograph is as shown in Table B.3.6 and Fig. B.3.4. As the results, the peak runoff discharge is estimated to be $663 m^3/s$.

(3) Kadoya's Method

Dr. Kadoya has shown average effective rainfall intensity in the catchment area within the lag time for flood as follows.

$$t_p = C \cdot A^{0.22} \cdot r_e^{-0.35}$$

Where, Q_p : catchment area (km^2)

r_e : average effective rainfall intensity (mm/hr)

C : constant which is varied by condition of catchment

natural hill : $C = 250 - 350$

pasture : $C = 190 - 210$

rural area : $C = 130 - 150$

Since " r_e " is mean effective rainfall intensity in the catchment area within the lag time for flood, it must be satisfy simultaneously both relationships between rainfall of duration t , and between effective rainfall intensity and lag time of flood t_p , i.e. " r_e " at $t = t_p$. As is depicted in Fig. B.3.5, the relationships between effective rainfall intensity and lag time of flood is drawn. Then, a curve is drawn through the points plotted in terms of duration vs. 200-year probable effective rainfall inten-

sity. Finally, the discharge can be obtained from the equation mentioned above by substitution of "re" located at the intersection of the above two lines.

From the Fig. B.3.5,

$$re = 9.56 \text{ (mm/hr)}$$

$$tp = 380 \text{ (min)}$$

$$\begin{aligned} Qp &= 1/3.6 \times 9.56 \times 243.38 \\ &= 646 \text{ (m}^3\text{/s)} \end{aligned}$$

Though the 200-year probable flood discharge was calculated by three methods, the obtained values are nearly equal.

Table B.1.1 Summary of Meteorological and Hydrological Station

Station	Location		Alti.	Content					Observation Period							
	S.L	W.L		Co	Tp	P	E	L	45	60	65	70	75	80	85	90
1. ALTO CAJAS	21°18'	64°28'	2,440			o			1977 -1988							
2. YESERA NORTE	21°21'	64°33'	2,320			o			1976 -1988							
3. SAN PEDRO B.V	21°26'	64°40'	2,195			o			1979 -1988							
4. GAMONEDA	21°30'	64°37'	2,155			o			1979 -1988							
5. SANTA ANA	21°31'	64°34'	1,935			o	o		1977 -1988							
6. JUNACAS	21°26'	64°27'	2,370		o				1969 -1988							
7. SAN AGUSTIN NORTE	21°30'	64°49'	2,120			o			1979 -1988							
8. LA CABAÑA	21°34'	64°36'	1,870			o			1976 -1985							
9. LADERA CENTRO	21°39'	64°32'	2,080			o			1979 -1988							
10. TARIJA-AASANA	21°33'	64°43'	1,860	o					1946 -1988							
11. EL TEJAR UNI.	21°32'	64°43'	1,851	o		o			1975 -1988							

Note) Co: General Meteorological Station
 Tp: Self-recording Rain Gauge Station
 P : Rain Gauge Station
 E : Evaporation Gauge Station
 L : Self-recording Water Gauge Station

Table B.2.1 Monthly Mean Temperature at El Tejar Uni. Station

Station: EL TEJAR UNIVERSIDAD												(UNIT: °C)	
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1970	21.2	20.3	20.0	19.5	16.6	13.9	13.5	15.0	18.0	18.9	19.4	21.6	18.2
1971	21.4	19.6	20.6	17.5	14.6	13.2	14.2	15.6	19.5	17.2	19.3	20.9	17.8
1972	20.3	20.2	20.2	17.6	17.5	15.6	14.6	15.4	18.8	19.0	20.6	21.2	18.4
1973	22.8	22.1	20.5	20.4	15.1	14.3	13.6	13.4	16.8	19.8	19.3	20.1	18.2
1974	21.7	20.3	21.4	17.4	15.7	13.8	14.7	15.8	17.1	18.3	21.1	20.7	18.2
1975	20.4	20.5	20.6	18.6	15.2	13.9	11.6	14.7	17.4	18.8	19.9	21.1	17.7
1976	21.0	20.2	19.5	17.0	14.2	12.2	13.8	14.8	15.8	19.2	20.0	21.6	17.4
1977	21.0	21.8	21.1	17.8	15.5	13.6	16.1	15.0	18.6	19.8	21.2	21.5	18.6
1978	21.1	21.2	21.0	17.9	15.6	13.6	15.8	12.6	16.0	20.2	20.8	19.6	18.0
1979	19.8	19.8	18.8	16.4	15.3	12.7	13.7	17.6	15.6	20.0	19.6	21.0	17.5
1980	19.8	20.2	20.3	18.9	16.0	13.6	14.0	15.4	15.6	18.7	19.4	21.0	17.7
1981	21.7	20.8	20.2	18.4	17.4	13.2	11.7	16.2	16.3	18.7	21.4	21.5	18.1
1982	21.3	21.1	20.4	18.6	15.2	14.9	15.1	16.6	19.0	19.8	20.4	20.3	18.6
1983	21.4	20.6	20.8	20.0	16.7	12.0	12.2	14.6	14.5	18.3	18.1	20.2	17.5
1984	20.0	20.6	20.2	17.2	16.4	13.9	15.0	12.8	17.2	20.8	19.8	19.6	17.8
1985	19.6	20.7	21.0	18.5	15.9	13.6	12.7	13.0	16.5	19.2	19.6	20.0	17.5
1986	20.9	19.7	19.7	19.0	15.7	14.0	12.4	16.0	16.2	16.3	20.6	22.6	17.8
1987	23.0	19.8	19.6	17.9	14.6	13.0	16.1	13.9	14.7	18.6	20.4	20.1	17.6
1988	21.2	18.6	20.6	18.6	12.6	12.3	11.4	15.8	16.6	18.5	20.4	20.9	17.3
MEAN	21.0	20.4	20.3	18.3	15.6	13.5	13.8	15.0	16.9	19.0	20.1	20.8	17.9

Table B.2.2 Monthly Mean Maximum-Temperature

Station: EL TEJAR UNIVERSIDAD												(UNIT: °C)	
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1970	27.8	27.3	26.9	27.4	26.7	24.1	24.4	25.0	27.4	27.4	26.9	29.0	26.7
1971	28.2	25.5	27.1	25.8	24.8	24.2	26.1	26.9	29.9	24.5	26.7	28.8	26.5
1972	27.3	27.3	26.8	26.2	28.0	27.5	25.4	26.4	28.7	28.8	27.5	27.9	27.3
1973	29.7	28.8	26.5	27.8	23.6	24.8	24.9	22.8	26.7	28.0	26.9	26.8	26.4
1974	28.0	25.9	26.0	23.8	25.8	24.2	24.6	25.7	25.7	25.1	29.3	26.7	25.9
1975	25.9	26.1	25.7	25.6	23.8	23.3	22.1	24.4	25.3	26.2	26.8	28.0	25.3
1976	27.1	26.0	25.5	24.8	22.6	21.5	24.2	24.6	23.4	27.9	27.3	28.5	25.3
1977	27.3	28.3	27.4	24.9	23.7	23.9	26.6	24.5	26.9	28.0	27.8	28.3	26.5
1978	28.0	27.5	28.0	24.0	24.4	23.6	26.3	22.6	26.3	28.0	28.3	24.8	26.1
1979	25.5	26.0	24.1	23.5	24.5	21.8	23.8	28.2	25.0	28.2	27.1	27.8	25.5
1980	25.8	27.0	27.1	27.5	26.9	24.3	24.6	25.1	25.5	26.4	26.9	28.2	26.3
1981	27.3	26.6	26.6	25.0	28.0	24.6	22.0	26.3	25.9	27.3	28.6	28.7	26.4
1982	28.2	27.5	26.9	24.8	25.2	27.2	27.6	26.9	27.4	27.8	27.5	26.4	27.0
1983	27.4	26.4	27.8	27.5	25.6	23.5	22.8	25.2	23.3	27.5	25.3	27.1	25.8
1984	25.8	27.0	25.8	24.0	28.0	26.6	26.5	23.4	26.7	28.8	26.3	25.9	26.2
1985	26.2	26.9	28.0	26.0	25.6	24.1	23.5	21.8	24.8	27.0	26.2	26.2	25.5
1986	27.5	25.8	25.6	27.2	26.7	26.3	24.1	26.2	24.8	24.8	27.9	26.8	26.1
1987	27.3	27.4	27.4	25.3	24.9	24.4	28.0	25.4	25.6	26.6	27.6	26.8	26.4
1988	27.8	24.5	27.4	25.1	21.2	23.6	22.4	27.0	25.4	26.8	28.7	26.8	25.6
MEAN	27.3	26.7	26.7	25.6	25.3	24.4	24.7	25.2	26.0	27.2	27.3	27.3	26.1

Table B.2.3 Monthly Mean Minimum-Temperature

Station: EL TEJAR UNIVERSIDAD												(UNIT: °C)	
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1970	14.5	13.3	13.1	11.6	6.5	3.7	2.5	5.0	8.6	10.4	11.8	14.3	9.6
1971	14.7	13.7	14.2	9.2	4.3	2.1	2.2	4.4	9.1	9.8	11.9	13.0	8.1
1972	13.3	13.0	13.6	9.1	7.0	3.8	3.8	4.5	8.8	9.3	13.6	14.6	9.6
1973	15.9	15.4	14.5	13.1	6.6	3.8	2.2	4.0	7.0	11.5	11.8	13.4	9.9
1974	15.3	14.7	13.0	10.9	5.6	3.3	4.8	5.9	8.4	11.4	12.9	14.7	10.1
1975	15.0	14.9	14.1	11.0	6.7	4.5	1.0	5.0	9.4	11.5	13.0	14.2	10.0
1976	14.8	14.4	13.5	9.3	6.0	2.9	3.4	4.9	8.2	10.4	12.6	14.7	9.8
1977	14.8	15.4	14.8	10.8	7.3	3.3	5.6	5.4	10.4	11.6	14.7	14.7	10.7
1978	14.2	15.0	14.1	11.8	6.9	3.6	5.4	2.7	5.7	11.5	13.3	14.4	9.9
1979	14.1	13.6	13.4	9.2	6.1	3.6	3.6	6.9	6.3	11.7	12.2	14.3	9.6
1980	13.8	13.4	13.5	10.3	5.2	2.8	3.5	5.6	5.6	11.0	11.9	13.8	9.2
1981	16.1	15.1	13.9	11.8	6.7	1.9	1.4	6.1	6.7	10.1	14.2	14.4	9.9
1982	14.4	14.7	14.0	12.5	5.3	2.6	2.8	6.4	10.5	11.7	13.6	14.2	10.2
1983	15.4	14.8	13.7	12.4	7.8	0.6	1.6	3.9	5.7	9.1	10.8	13.2	9.1
1984	14.1	14.3	14.5	10.3	4.9	1.2	3.4	2.3	7.0	12.8	13.3	13.4	9.3
1985	12.9	14.5	14.1	11.0	6.2	3.2	1.9	4.1	0.4	11.5	12.8	13.8	9.5
1986	14.4	13.6	13.9	10.8	4.7	1.8	0.8	5.8	7.5	9.8	13.2	18.8	9.6
1987	18.7	12.2	11.8	10.5	4.4	1.6	4.2	2.4	3.8	10.5	13.3	13.5	8.9
1988	14.6	12.6	13.8	12.0	3.9	1.0	0.3	4.5	7.8	10.1	12.1	15.0	9.0
MEAN	14.8	14.1	13.8	10.9	5.9	2.7	2.9	4.7	7.7	10.8	12.0	14.3	9.6

Table B.2.4 Monthly Extreme Maximum-Temperature

Station: EL TEJAR UNIVERSIDAD													(UNIT: °C)
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1970	31.5	32.5	32.0	31.2	32.5	32.3	31.5	33.0	35.5	34.8	35.8	34.2	35.8
1971	34.8	32.0	32.2	32.7	30.8	30.5	30.5	32.3	37.0	32.6	32.6	36.0	37.0
1972	32.5	32.3	32.6	32.8	33.5	34.5	32.8	34.0	34.8	35.5	36.0	32.5	36.0
1973	36.0	36.5	33.0	33.0	31.2	31.2	33.8	34.0	34.3	35.0	33.6	33.6	35.5
1974	33.5	30.0	30.5	30.0	32.0	31.4	32.0	34.0	35.0	32.5	36.0	37.0	37.0
1975	33.0	32.0	31.0	33.0	30.0	30.0	30.5	34.0	33.5	35.0	37.5	35.5	37.5
1976	33.5	33.0	32.2	32.0	29.0	28.6	31.0	31.8	36.0	36.0	34.2	34.6	36.0
1977	36.0	31.5	33.5	32.5	30.6	32.0	32.0	34.0	35.0	39.0	36.5	35.0	39.0
1978	34.5	31.6	32.3	31.0	32.2	31.0	34.0	33.0	34.0	36.0	37.0	29.0	37.0
1979	30.0	29.0	30.5	30.0	33.0	33.5	33.5	37.0	37.0	34.5	36.0	36.0	37.0
1980	31.5	34.0	32.0	35.5	34.5	32.0	34.5	33.5	36.0	34.0	33.5	35.5	36.0
1981	32.5	31.0	31.2	31.5	32.0	31.5	32.5	34.0	35.5	34.0	33.5	33.5	35.5
1982	32.0	32.0	31.0	32.0	33.0	33.5	32.5	35.0	34.0	38.0	35.5	29.5	38.0
1983	33.5	33.5	33.5	34.0	34.0	34.0	33.5	36.0	36.0	34.0	29.5	31.0	36.0
1984	29.5	31.5	33.5	32.5	36.0	33.0	33.0	33.2	36.5	35.4	32.0	30.4	36.5
1985	31.2	31.0	35.0	35.5	32.5	30.0	32.5	33.5	32.5	33.0	33.5	30.5	35.5
1986	31.2	30.0	31.0	33.5	34.5	33.5	30.5	32.7	33.7	33.5	34.5	29.0	34.5
1987	30.0	31.5	32.5	34.5	33.5	32.0	34.0	34.4	38.7	36.0	33.8	33.5	38.7
1988	33.4	28.9	33.0	30.7	31.4	31.7	34.6	36.5	36.6	33.7	37.0	32.8	37.0
MEAN	32.5	31.7	32.2	32.5	32.4	31.9	32.6	34.0	35.3	34.9	34.6	33.1	

Table B.2.5 Monthly Extreme Minimum-Temperature

Station: EL TEJAR UNIVERSIDAD													(UNIT: °C)
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1970	11.0	7.0	8.0	7.2	-1.0	-3.0	-5.0	-2.8	2.0	3.8	6.0	10.3	-5.0
1971	9.0	9.5	8.9	-1.5	-2.0	-5.0	-4.3	-4.0	4.0	3.2	8.0	5.5	-5.0
1972	10.0	8.0	9.0	2.8	1.5	0.5	-3.0	-1.5	-2.0	1.0	6.6	11.2	-3.0
1973	11.2	12.0	12.0	8.0	0.5	-1.5	-3.5	-2.0	-1.0	6.2	5.4	9.1	-3.5
1974	10.5	11.0	6.5	2.0	0.0	-2.8	-3.5	-4.0	0.0	3.0	6.0	9.5	-4.0
1975	11.0	9.0	12.0	4.5	1.5	0.0	-6.0	-2.5	5.0	7.0	7.0	9.0	-6.0
1976	12.0	9.0	6.5	2.0	1.0	-3.5	-2.5	-0.5	-0.8	5.0	9.0	10.5	-3.5
1977	12.0	13.5	9.0	4.5	2.0	-2.5	0.0	-1.0	5.0	5.5	10.0	10.5	-2.5
1978	9.5	12.5	8.5	5.0	1.5	0.0	0.5	-9.5	-1.0	6.5	9.2	10.5	-9.5
1979	10.0	8.0	11.0	2.0	-3.0	-2.0	-2.0	2.0	-2.5	6.0	5.0	8.0	-3.0
1980	10.5	9.5	9.5	3.5	1.0	-3.5	-3.5	-1.0	-1.0	1.5	2.5	9.5	-3.5
1981	12.5	12.5	8.0	4.0	2.0	-3.0	-7.5	1.0	-4.5	2.0	7.0	10.0	-7.5
1982	9.0	11.5	8.0	8.0	-1.0	-5.0	-2.4	-1.5	7.0	6.0	6.0	10.5	-5.0
1983	12.0	11.0	8.0	4.5	1.0	-4.5	-4.5	-2.0	-1.5	1.0	3.5	10.5	-4.5
1984	11.5	12.0	10.0	3.5	-1.5	-3.5	-3.0	-3.5	0.0	6.0	9.5	10.5	-3.5
1985	7.5	12.0	11.0	4.0	-0.5	-3.0	-4.5	-7.4	0.0	3.5	9.0	8.5	-7.4
1986	11.0	11.5	10.5	3.0	-2.0	-4.0	-4.5	-0.5	1.4	4.5	8.0	9.5	-4.5
1987	13.0	7.5	6.5	6.0	-1.5	-5.1	-3.4	-5.4	-0.2	2.4	9.0	8.9	-5.4
1988	9.1	7.5	10.0	7.0	0.4	-4.0	-6.6	-0.8	3.0	2.0	5.0	11.5	-6.6
MEAN	10.6	10.2	9.1	4.2	0.0	-2.9	-3.6	-2.5	0.7	4.0	6.9	9.7	

Table B.2.6 Monthly Mean Evaporation

Station: EL TEJAR UNIVERSIDAD (UNIT: mm/month)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	170	134	143	111	83	81	121	120	157	168	143	144	1,575
1978	139	141	142	103	95	76	127	145	195	222	203	191	1,779
1979	148	150	130	131	117	103	114	160	170	208	191	191	1,813
1980	166	137	152	134	122	101	132	145	147	187	181	178	1,782
1981	159	142	136	129	146	90	103	124	159	167	165	133	1,653
1982	143	130	126	113	108	115	117	148	173	174	177	167	1,691
1983	161	142	169	139	123	98	118	144	158	203	160	174	1,789
1984	132	151	147	110	104	85	118	115	155	168	144	154	1,583
1985	149	140	149	126	83	74	95	102	115	150	142	129	1,454
1986	132	115	111	107	92	79	91	123	123	129	135	63	1,300
1987	111	121	142	98	96	79	114	119	136	104	151	163	1,436
1988	132	118	130	98	80	75	84	131	136	171	180	146	1,481
MEAN	134	125	129	108	97	82	104	120	141	157	138	139	1,488
MAX.	170	151	169	139	146	115	132	160	195	222	203	191	1,813
MIN.	111	115	111	98	80	74	84	102	115	104	135	63	1,300

Table B.2.7 Monthly Mean 24hr Wind Velocity (at 0.5 m height)

Station: EL TEJAR UNIVERSIDAD (UNIT: Km/hr)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1976									2.1	2.7	2.4	2.1
1977	1.4	0.9	0.9	1.0	1.0	0.9	1.6	1.3	1.8	1.7	1.3	0.9
1978	0.6	0.6	0.5	0.5	0.7	0.8	2.0	3.8	4.4	4.7	3.6	2.5
1979	1.8	1.9	2.2	2.6	2.6	2.8	2.9	3.5	4.3	3.9	3.3	2.9
1980	2.0	2.1	2.2	2.7	2.3	2.5	3.3	3.4	4.1	3.8	3.2	2.8
1981	2.1	1.7	1.5	1.7	1.5	1.8	2.0	2.2	2.8	2.6	2.2	1.6
1982	1.4	1.2	1.1	1.5	1.4	1.7	1.5	2.1	2.4	2.2	2.0	1.6
1983	2.3	2.2	2.4	2.4	2.4	2.5	2.9	3.0	3.7	3.1	2.3	2.2
1984	1.4	1.6	1.4	1.5	1.2	1.6	1.8	2.1	2.3	2.0	1.5	1.6
1985	1.6	1.2	0.4	1.4	1.0	1.2	1.8	2.3	1.7	1.8	1.1	0.5
1986	0.2	0.3	0.9	1.0	1.1	1.1	1.4	2.1	1.9	1.5	1.9	0.5
1987	0.6	1.0	1.4	2.0	2.1	1.5	2.1	2.6	2.8	3.0	2.4	2.1
1988	1.4	1.3	1.1	1.0	1.5	1.4	1.7	2.2	2.5	3.0	2.7	1.9
MEAN	1.4	1.3	1.3	1.6	1.6	1.6	2.1	2.5	2.8	2.8	2.3	1.8
MAX.	2.3	2.2	2.4	2.7	2.6	2.8	3.3	3.8	4.4	4.7	3.6	2.9
MIN.	0.2	0.3	0.4	0.5	0.7	0.8	1.4	1.3	1.7	1.5	1.1	0.5

Table B.2.8 Monthly Mean Relative Humidity

Station: EL TEJAR UNIVERSIDAD (UNIT: %)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1972	61	61	68	60	53	46	48	45	46	47	57	63	55
1973	62	64	70	63	58	51	49	51	47	50	54	57	56
1974	60	69	66	69	63	46	51	48	46	58	47	51	56
1975	78	83	81	78	71	52	36	42	42	49	51	72	61
1976	72	66	69	59	59	52	48	46	57	50	52	58	57
1977	66	64	66	65	60	53	40	50	54	51	59	61	57
1978	63	65	61	64	58	57	45	47	44	50	57	67	57
1979	68	67	74	62	56	55	52	46	50	56	63	69	60
1980	72	69	72	66	60	62	55	58	51	62	57	62	62
1981	77	72	71	67	58	53	57	50	51	56	66	66	62
1982	70	70	72	70	57	46	48	53	56	57	60	68	61
1983	69	68	62	64	60	54	56	49	52	48	59	60	58
1984	72	70	70	66	56	51	46	52	52	59	64	67	60
1985	64	70	66	65	62	57	54	58	60	56	61	69	62
1986	63	70	74	67	59	54	54	55	58	57	61	73	62
1987	74	70	70	70	63	65	57	61	59	64	69	72	66
1988	76	76	77	76	70	61	61	54	58	58	55	70	66
MEAN	69	69	70	67	60	54	50	51	52	55	58	65	60

Table B.2.9 Monthly Mean Sunshine Hour

Station: EL TEJAR UNIVERSIDAD (UNIT: hour)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	6.7	5.8	5.6	6.2	7.6	8.7	8.8	8.1	7.8	7.4	6.2	5.7	7.1
1978	6.2	6.3	6.5	5.7	8.4	7.0	9.2	7.8	8.7	8.1	7.0	4.8	7.1
1979	4.2	6.4	3.7	6.7	7.8	7.1	8.1	9.5	7.6	7.7	7.0	5.8	6.8
1980	5.6	6.4	6.3	7.6	8.9	7.1	7.3	8.1	8.4	6.8	6.8	7.2	7.2
1981	4.5	5.8	6.8	6.6	9.4	8.4	8.3	7.8	7.2	6.1	6.7	5.5	6.9
1982	5.4	5.2	5.2	6.0	7.8	8.8	8.9	8.4	8.1	8.1	6.3	7.0	7.1
1983	6.8	5.8	6.9	6.8	7.2	7.4	6.6	8.2	6.6	7.8	5.6	7.1	6.8
1984	4.8	5.7	5.1	5.9	7.8	7.8	7.7	7.9	8.5	6.8	5.8	7.0	6.7
1985	6.0	5.7	6.8	6.3	7.2	6.4	7.6	6.8	6.7	7.5	6.3	5.0	6.5
1986	7.4	6.7	5.4	7.6	8.0	8.0	8.2	8.2	6.9	6.8	7.5	5.2	7.2
1987	4.9	7.6	7.2	5.1	6.8	7.1	7.0	7.8	7.6	7.1	6.9	6.5	6.8
1988	5.0	4.5	5.7	6.0	5.5	6.0	7.0	8.6	6.0	7.1	7.4	4.6	6.1
MEAN	5.5	6.0	5.9	6.4	7.7	7.5	7.9	8.1	7.5	7.3	6.6	6.0	6.9

Table B.2.10 Monthly Precipitation

Station: EL TEJAR UNIVERSIDAD (UNIT: mm/month)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1978	77.9	139.3	67.1	47.9	0.0	0.0	0.0	0.0	0.0	38.8	74.8	206.7	652.5
1979	104.2	87.7	93.0	19.4	0.0	6.2	21.0	9.2	0.0	62.4	81.1	125.8	610.0
1980	147.1	81.6	101.2	15.9	13.8	0.0	0.0	3.3	0.0	47.9	24.9	81.7	517.4
1981	168.8	131.7	77.5	56.3	0.0	0.0	0.4	7.2	3.8	35.9	111.8	142.5	735.1
1982	163.1	71.8	79.7	55.0	6.8	0.0	0.0	0.0	2.5	22.1	31.1	235.9	668.0
1983	67.9	59.2	6.2	8.7	0.8	0.0	1.5	0.0	6.5	19.4	86.9	92.2	349.3
1984	169.7	158.8	149.3	2.0	0.0	0.0	0.0	23.8	0.4	49.2	84.6	119.6	757.4
1985	142.1	147.7	34.4	38.4	0.0	0.0	1.5	10.5	6.0	14.7	101.0	214.6	710.9
1986	87.3	211.6	91.8	24.5	1.0	0.0	0.0	0.0	7.6	20.6	211.8	188.6	844.8
1987	190.9	85.7	57.5	20.5	0.8	0.0	0.3	0.0	0.2	47.8	93.2	68.6	565.5
1988	195.9	105.0	118.9	80.1	0.7	0.0	2.0	0.0	1.5	17.8	20.8	206.0	728.7
MEAN	137.7	116.4	79.7	31.7	2.2	0.6	2.4	4.9	2.6	34.2	83.7	152.9	649.1
MAX.	195.9	211.6	149.3	80.1	13.8	6.2	21.0	23.8	7.6	62.4	211.8	235.9	844.8
MIN.	67.9	59.2	6.2	2.0	0.0	0.0	0.0	0.0	0.0	14.7	20.8	68.6	349.3

Table B.2.11 Maximum Daily Precipitation

STATION: EL TEJAR UNIVERSITY (UNIT: mm/day)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1978	21.8	35.0	13.3	26.8	0.0	0.0	0.0	0.0	0.0	17.0	22.5	38.3	38.3
1979	20.0	27.0	17.3	10.2	0.0	6.0	17.5	8.7	0.0	19.2	28.5	32.0	32.0
1980	21.8	24.6	26.6	13.0	10.8	0.0	0.0	1.8	0.0	9.0	9.5	46.0	46.0
1981	49.5	36.0	23.0	27.0	0.0	0.0	0.4	6.7	3.0	17.0	25.0	49.5	49.5
1982	58.0	19.0	14.2	32.5	3.4	0.0	0.0	0.0	2.3	12.0	10.0	55.5	58.0
1983	22.2	16.0	3.6	8.0	0.0	0.0	1.5	0.0	6.5	19.0	29.7	30.0	30.0
1984	27.5	41.0	36.0	1.2	0.0	0.0	0.0	23.0	0.4	14.2	20.0	47.3	47.3
1985	91.5	30.1	17.5	31.0	0.0	0.0	1.5	4.6	3.2	4.8	22.0	41.7	91.5
1986	38.0	34.0	20.3	14.2	1.0	0.0	0.0	0.0	6.6	11.2	40.0	64.0	64.0
1987	80.0	53.3	30.0	11.8	0.8	0.0	0.3	0.0	0.2	26.8	16.2	30.6	80.0
1988	56.0	15.3	25.4	47.4	0.5	0.0	2.0	0.0	1.0	9.4	10.3	66.5	66.5
MAX.	91.5	53.3	36.0	47.4	10.8	6.0	17.5	23.0	6.6	26.8	40.0	66.5	91.5

Table B.2.12 Monthly Mean Temperature at AASAAN Station

Station: TARIJA-AASANA (UNIT: °C)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1951	20.5	19.8	20.4	16.3	15.8	14.4	15.9	14.1	18.0	20.8	22.2	21.7	18.3
1952	22.0	20.2	21.6	16.8	16.6	10.2	12.7	15.2	17.3	19.8	20.8	21.4	17.9
1953	23.2	20.9	20.9	17.6	16.0	12.8	11.1	16.2	18.2	20.3	20.9	21.9	18.3
1954	22.2	20.4	19.4	19.3	16.1	13.4	12.1	15.2	19.1	20.7	21.9	21.6	19.5
1955	22.4	21.4	19.5	18.4	15.7	13.3	10.6	14.6	18.6	18.9	20.6	22.1	18.0
1956	19.9	20.2	21.9	19.0	13.5	10.6	13.0	13.6	20.0	19.9	19.7	20.7	17.7
1957	22.3	20.2	20.8	17.1	16.8	12.0	10.5	15.6	16.8	21.0	20.1	22.7	18.0
1958	21.4	22.1	20.3	18.7	15.9	13.2	14.8	11.8	18.0	18.6	20.7	21.4	18.1
1959	20.7	22.2	20.7	19.2	15.5	13.2	14.2	14.9	17.8	21.0	20.5	21.7	18.5
1960	20.8	20.6	18.9	17.3	12.0	13.8	12.5	15.4	17.0	21.9	19.7	21.7	17.6
1961	23.0	20.1	21.0	19.5	15.8	11.6	12.6	17.3	17.0	20.9	22.3	20.9	18.6
1962	20.7	20.0	19.7	18.1	13.8	8.6	7.0	10.8	16.7	17.9	21.6	20.9	16.3
1963	21.9	19.6	19.5	18.0	15.1	12.2	14.2	15.0	18.4	21.0	21.5	21.4	18.2
1964	20.3	21.7	21.0	19.6	15.8	11.2	10.2	15.7	16.5	19.3	20.6	21.6	17.8
1965	20.6	21.5	18.2	17.6	15.2	14.7	14.1	16.1	18.1	21.3	21.2	22.1	18.4
1966	21.2	21.6	20.6	18.9	14.7	15.2	11.0	10.7	15.4	19.7	22.3	20.7	17.7
1967	20.3	21.6	19.4	19.3	19.6	12.5	14.4	17.2	19.2	22.7	20.4	21.4	19.0
1968	20.9	20.6	19.4	16.3	14.1	13.7	14.6	16.9	18.4	22.5	22.0	23.6	18.6
1969	23.0	21.5	22.1	19.7	17.6	13.6	13.7	15.1	20.4	19.3	21.8	19.9	19.0
1970	20.9	20.3	19.5	19.0	16.4	13.5	14.1	16.1	19.5	20.9	21.0	22.4	18.6
1971	21.9	19.3	20.4	17.8	14.9	13.8	13.6	16.2	20.3	18.1	20.5	22.2	18.3
1972	21.2	21.0	20.4	18.2	18.1	16.7	15.4	16.7	19.0	20.7	21.8	21.8	19.3
1973	23.2	22.5	20.8	20.9	15.9	15.5	13.6	14.3	17.8	21.1	21.4	21.3	19.0
1974	22.9	21.0	20.4	17.9	17.3	15.3	15.9	17.4	18.9	19.2	23.2	21.4	19.2
1975	21.2	22.1	21.0	20.0	17.2	16.2	14.0	17.2	18.5	20.0	20.7	21.9	19.2
1976	21.6	21.0	20.0	18.6	15.8	13.3	15.9	15.7	15.6	20.5	20.6	21.8	18.4
1977	20.9	22.1	20.0	18.1	15.9	14.9	17.3	15.3	19.0	20.0	21.4	21.2	18.8
1978	21.1	22.1	20.9	18.1	15.9	14.9	17.3	15.3	19.0	20.0	21.4	21.2	18.9
1979	19.9	20.3	18.4	16.6	15.8	13.2	14.0	18.5	16.9	22.0	21.0	21.2	18.2
1980	19.9	21.0	20.9	19.6	17.2	13.7	15.8	16.9	17.4	20.3	21.5	23.4	19.0
1981	22.3	22.0	21.3	19.5	18.8	13.4	12.5	17.2	16.3	19.5	20.9	20.5	18.7
1982	19.7	20.1	19.5	18.1	14.9	16.2	15.2	17.2	19.3	20.2	21.2	20.9	18.5
1983	21.8	20.9	21.0	20.0	16.7	11.8	13.0	15.0	15.4	19.4	18.6	20.6	17.9
1984	20.5	21.2	20.8	17.1	17.1	11.8	15.1	13.3	17.8	21.6	20.2	20.5	18.1
1985	20.0	20.5	21.0	18.7	16.5	14.4	13.2	14.0	17.5	21.0	20.6	20.6	18.2
1986	21.3	19.8	20.0	19.6	16.2	14.6	12.9	16.6	17.2	18.4	21.8	20.8	18.3
1987	21.0	19.8	20.2	18.2	14.3	12.6	16.2	14.6	15.8	19.2	21.1	20.8	17.8
1988	21.6	18.8	20.7	18.9	12.4	12.2	11.2	15.9	16.8	18.4	20.1	20.7	17.3
MEAN	21.3	20.8	20.3	18.5	15.9	13.4	13.6	15.4	17.9	20.2	21.0	21.4	18.3

Table B.2.13 Monthly Mean Maximum-Temperature

Station: TARIJA-AASANA													(UNIT: °C)
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1967	26.2	26.8	24.3	25.4	26.7	28.2	22.8	26.5	26.7	29.5	25.7	27.1	25.7
1968	26.1	25.8	25.6	23.1	21.1	20.6	23.0	24.6	25.9	29.7	28.4	30.8	25.4
1969	29.9	28.5	29.7	28.3	26.2	24.0	24.6	23.9	29.4	26.3	28.1	26.1	27.1
1970	27.3	26.8	25.3	26.2	25.6	22.7	23.6	25.0	27.4	27.5	27.3	28.5	26.1
1971	27.9	25.2	26.4	25.6	25.1	22.7	24.1	25.6	26.4	25.0	26.0	28.0	25.7
1972	26.3	26.8	25.8	25.3	26.7	27.3	25.1	26.2	27.6	27.9	27.4	27.8	26.7
1973	29.5	29.1	26.2	27.4	23.8	25.5	23.4	22.8	25.2	27.4	26.9	26.8	26.8
1974	28.8	27.1	26.3	23.9	26.3	24.5	25.0	25.3	26.4	24.9	28.8	27.2	26.2
1975	26.6	27.2	26.8	26.3	24.8	25.0	22.8	24.7	25.5	26.2	26.8	27.5	25.9
1976	26.9	26.1	25.4	24.2	23.4	22.6	24.7	24.5	23.1	28.3	27.1	27.7	25.3
1977	26.9	28.4	27.8	25.1	23.5	24.6	26.8	24.3	26.7	27.2	27.7	27.1	26.3
1978	27.2	26.4	26.8	23.5	23.9	23.6	25.1	22.1	25.8	28.4	27.5	24.9	25.4
1979	25.3	25.9	23.2	23.0	23.7	28.7	22.9	28.2	24.9	27.4	27.3	27.0	25.8
1980	25.3	26.7	26.5	27.2	26.1	23.4	21.9	25.0	25.9	27.1	27.5	28.3	25.9
1981	28.0	27.5	27.1	26.1	28.1	23.3	22.2	25.8	23.1	25.9	27.8	27.4	26.0
1982	26.3	26.5	25.5	24.7	25.1	26.2	27.2	27.4	27.7	28.2	28.3	27.1	26.7
1983	28.2	27.1	28.5	28.0	25.9	23.1	23.4	25.0	23.8	28.3	25.7	27.6	26.2
1984	26.1	27.6	26.5	23.3	27.9	23.2	25.3	22.9	26.8	29.2	26.4	25.6	25.9
1985	26.3	26.6	28.0	26.3	26.4	24.7	23.4	22.9	25.3	29.3	27.1	26.8	26.1
1986	27.7	25.8	25.9	27.7	27.1	26.5	24.2	26.7	25.7	26.0	29.5	26.5	26.6
1987	26.3	27.1	27.9	25.9	23.8	23.4	27.2	25.4	25.6	26.6	27.8	27.5	26.1
1988	28.2	24.5	27.1	25.0	28.5	22.9	21.8	26.7	24.9	26.8	28.1	26.8	25.3
MEAN	27.2	26.8	26.5	25.5	25.8	23.7	24.1	25.0	25.9	27.4	27.4	27.3	26.0

Table B.2.14 Monthly Mean Minimum-Temperature

Station: TARIJA-AASANA													(UNIT: °C)
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1963	14.1	13.8	13.2	10.2	8.6	3.0	3.8	5.4	9.6	12.9	13.0	13.4	10.1
1964	14.2	14.2	13.5	11.8	7.8	1.2	0.0	4.8	7.2	10.8	12.4	13.3	9.3
1965	14.1	14.2	11.7	10.6	5.1	5.0	2.5	3.9	7.3	10.5	11.8	14.2	9.2
1966	14.5	14.6	12.6	10.4	5.6	3.6	0.3	0.4	6.2	11.0	12.6	13.6	8.8
1967	13.6	14.5	13.3	11.1	9.1	2.2	3.6	5.6	8.4	12.8	11.8	13.7	10.0
1968	13.4	13.9	12.3	8.7	4.5	3.7	2.8	6.2	6.6	12.4	13.6	14.4	9.4
1969	13.9	14.3	12.9	10.8	6.5	1.1	0.6	1.4	6.7	8.5	13.4	12.6	8.6
1970	13.6	12.3	12.3	9.5	4.8	1.2	0.7	3.0	7.7	10.2	11.2	13.0	8.3
1971	13.9	12.4	13.0	8.3	2.8	0.8	0.6	3.1	7.5	8.4	10.7	12.8	7.9
1972	12.9	12.3	12.5	8.6	6.1	2.6	2.3	3.2	7.8	9.1	13.7	14.2	8.8
1973	14.9	14.4	13.5	12.1	5.7	2.6	0.4	2.6	5.8	10.4	11.8	13.4	9.8
1974	13.8	12.9	11.9	9.5	3.7	1.2	2.6	4.2	6.1	9.7	11.2	12.8	8.3
1975	13.2	13.4	12.7	10.1	4.8	2.6	-0.1	3.1	7.2	9.9	11.6	12.5	8.4
1976	13.4	13.1	11.9	7.5	4.6	1.4	2.3	3.9	6.1	10.3	11.8	12.8	8.3
1977	13.0	14.6	13.8	10.4	5.9	2.6	4.0	3.9	8.9	10.4	13.4	13.3	9.5
1978	13.4	14.3	13.3	11.0	5.0	2.6	3.5	3.8	7.6	12.1	13.7	13.5	9.5
1979	14.3	13.2	13.1	9.6	6.4	3.7	3.1	7.4	5.7	12.3	12.9	14.5	9.7
1980	13.3	14.0	14.2	11.2	5.5	3.9	4.8	7.2	7.1	12.1	12.2	13.5	9.9
1981	15.1	13.5	12.3	11.1	6.5	1.0	1.1	6.6	6.5	10.5	14.0	13.8	9.3
1982	13.1	13.6	13.5	11.5	4.7	6.2	3.3	6.9	10.9	12.2	14.2	14.8	10.4
1983	15.5	14.7	13.6	11.9	7.5	3.2	2.5	4.9	6.9	10.4	11.6	13.7	9.7
1984	13.8	14.8	15.0	11.0	6.3	0.3	5.0	3.7	8.9	14.1	14.1	13.9	10.1
1985	13.6	14.4	13.9	11.1	6.6	4.2	3.0	5.2	9.5	12.8	14.2	14.4	10.2
1986	15.0	13.9	14.0	11.6	5.2	2.6	1.6	6.9	8.7	10.8	14.1	15.2	10.0
1987	15.6	12.5	12.6	10.6	5.6	1.7	5.2	3.7	6.0	11.9	14.4	14.6	9.5
1988	15.6	13.1	14.4	12.8	4.4	1.4	0.5	5.0	8.6	9.9	12.1	14.6	9.4
MEAN	14.0	13.7	13.1	10.5	5.7	2.5	2.3	4.5	7.5	11.0	12.8	13.7	9.3

Table B.2.15 Monthly Extreme Maximum-Temperature

Station: TARIJA-AASANA (UNIT: °C)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	MAX.
1967	33.5	32.0	29.4	30.2	32.0	30.0	31.0	32.5	34.0	34.0	34.0	38.2	38.2
1968	32.0	29.0	33.0	30.0	28.2	31.0	30.0	30.5	34.0	36.0	37.3	35.0	37.3
1969	34.2	33.3	37.0	34.4	34.4	33.0	34.0	33.2	34.4	35.0	37.0	30.0	37.0
1970	31.0	32.0	30.6	29.5	33.0	32.0	31.0	32.3	35.0	35.6	36.0	35.0	36.0
1971	33.5	31.8	31.4	32.0	30.1	30.0	30.0	32.0	35.0	36.5	32.6	34.6	35.5
1972	31.6	31.0	31.0	33.3	33.0	33.0	32.0	34.0	35.0	34.0	36.2	31.0	38.2
1973	34.2	34.0	31.8	31.4	32.0	31.0	32.0	34.6	34.5	36.2	33.6	33.6	36.2
1974	32.4	31.0	30.6	27.0	32.0	31.0	36.0	34.4	36.4	31.4	35.8	33.4	36.4
1975	34.1	32.0	32.0	35.0	31.3	31.0	31.1	32.4	33.4	33.8	32.3	34.0	35.0
1976	31.0	32.4	31.3	31.6	31.0	30.0	31.4	33.2	36.3	36.0	34.0	32.6	36.3
1977	33.3	31.6	35.0	33.0	32.0	32.0	32.0	34.0	35.4	39.3	36.0	34.6	39.3
1978	33.1	30.6	31.0	30.2	32.3	30.0	33.6	33.0	32.6	36.0	36.0	30.0	36.0
1979	30.0	30.0	29.0	31.0	30.0	31.4	33.0	33.6	37.0	34.8	35.0	37.0	37.0
1980	33.0	35.0	31.0	37.4	33.0	31.0	33.4	33.4	36.7	35.0	34.0	35.8	37.4
1981	33.0	31.0	33.0	30.6	33.0	30.4	32.6	33.0	33.8	33.0	32.6	33.4	33.8
1982	31.2	32.0	30.5	30.4	33.2	31.6	31.4	36.2	34.0	37.4	37.4	30.4	37.4
1983	32.2	34.7	35.1	35.0	35.2	33.2	32.8	35.0	36.2	34.5	30.7	32.5	36.2
1984	31.6	32.6	34.1	29.0	36.2	33.2	31.4	32.4	34.7	35.2	32.0	31.2	36.2
1985	31.0	31.0	34.0	36.2	32.6	30.2	32.6	33.6	33.5	34.7	35.8	30.6	36.2
1986	32.0	30.2	30.6	34.0	34.2	33.0	30.0	32.6	33.5	35.6	36.0	29.6	36.0
1987	30.2	31.7	33.3	35.7	32.0	31.0	33.3	34.5	36.0	37.3	35.0	33.6	37.3
1988	34.0	29.0	32.6	30.6	31.0	30.4	33.2	36.0	36.0	36.4	36.6	32.6	36.6
MEAN	32.4	31.7	32.2	32.2	32.4	31.3	32.2	33.5	34.9	35.3	34.8	33.2	

Table B.2.16 Monthly Extreme Minimum-Temperature

Station: TARIJA-AASANA (UNIT: °C)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	MIN.
1963	8.0	9.0	9.0	2.2	3.0	-3.0	-1.5	-2.5	-4.6	5.5	3.0	0.5	-4.6
1964	10.3	11.0	7.5	3.5	-0.1	-2.5	-4.5	-3.0	0.0	5.0	10.0	6.5	-4.5
1965	10.2	11.0	8.0	1.2	0.4	-1.5	-3.3	-3.0	2.6	5.0	5.7	7.5	-3.3
1966	11.0	9.3	7.5	3.3	0.0	-3.5	-4.2	-8.0	-4.0	7.0	8.0	7.4	-8.0
1967	9.0	10.0	10.0	3.0	3.0	-4.6	-1.0	0.6	2.0	7.0	6.7	12.0	-4.6
1968	9.5	11.2	7.0	1.0	0.0	-2.8	-2.6	0.6	0.8	6.0	10.0	10.0	-2.8
1969	10.1	8.0	8.0	4.0	-1.0	-5.0	-6.0	-4.0	-3.0	1.0	10.0	7.0	-6.0
1970	10.6	4.0	7.6	6.0	-3.0	-5.0	-7.4	-3.0	1.3	4.4	6.0	6.5	-7.4
1971	7.4	9.0	8.0	-2.0	-2.0	-6.0	-6.0	-5.0	3.5	2.0	6.0	5.0	-6.0
1972	9.0	7.4	8.0	2.8	1.0	0.0	-4.2	-2.0	-3.0	1.0	7.0	11.0	-4.2
1973	11.0	11.0	10.0	7.0	-0.2	-3.0	-5.0	-2.4	-2.0	6.5	5.4	9.1	-5.0
1974	10.2	10.0	6.0	1.0	-2.0	-4.0	-6.1	-5.0	-1.0	1.4	5.0	7.6	-6.1
1975	9.3	7.4	10.0	3.0	0.4	-3.0	-7.8	-4.7	3.0	5.3	6.2	7.4	-7.8
1976	11.0	9.6	5.0	1.0	0.0	-5.1	-4.4	-3.2	-2.0	3.0	7.0	10.0	-5.1
1977	11.5	12.0	8.0	3.0	0.6	-4.0	-3.0	-3.5	3.0	5.0	9.0	9.0	-4.0
1978	8.0	11.0	7.0	4.0	0.0	-2.0	2.0	-7.9	0.0	7.4	10.0	9.5	-7.9
1979	11.3	8.4	11.0	3.0	-2.0	-1.6	-2.2	3.0	-3.0	6.0	7.0	8.0	-3.0
1980	6.0	10.4	11.2	5.0	2.0	-1.0	-2.0	-1.0	0.2	3.5	3.4	8.5	-2.0
1981	11.9	11.5	10.2	4.4	3.2	-4.0	-7.4	1.5	-4.2	3.0	1.4	9.7	-7.4
1982	9.2	10.6	6.4	7.6	0.2	-5.0	-1.4	-1.2	8.0	7.8	7.6	11.3	-5.0
1983	13.0	11.5	8.6	3.2	1.6	-4.6	-3.5	-1.0	0.0	2.4	5.5	8.2	-4.6
1984	8.0	12.5	12.7	5.2	-1.4	-4.6	-1.6	-2.0	3.0	8.3	11.0	12.0	-4.6
1985	9.5	12.4	11.6	4.5	1.2	1.8	-0.4	-0.2	4.4	6.5	11.4	9.5	-0.4
1986	12.3	12.4	11.5	4.0	-1.7	-1.5	-3.3	-1.5	4.6	5.6	9.0	11.0	-3.3
1987	14.0	8.0	7.8	7.0	-1.2	-5.6	0.0	-3.6	1.5	7.2	10.5	10.2	-5.6
1988	9.4	9.6	11.0	8.2	0.0	-4.5	6.2	0.3	4.0	4.0	7.0	12.0	-4.5
MEAN	10.1	9.9	8.8	3.7	0.1	-3.3	-3.1	-2.4	0.6	4.9	7.3	9.0	

Table B.2.17 Monthly Mean 24hr Wind Velocity

Station: TARIJA-AASANA (UNIT: Km/day)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1951	133	89	89	178	133	133	44	44	133	222	178	178
1952	133	133	133	89	89	133	44	89	178	222	178	133
1953	178	133	133	133	133	133	178	178	266	266	266	266
1954	222	178	222	222	222	178	266	222	400	355	311	311
1955	266	222	222	178	222	178	266	266	266	311	266	266
1956	266	266	266	266	222	222	266	222	311	266	89	222
1957	133	178	133	222	133	178	178	222	266	266	311	266
1958	178	178	178	178	89	89	133	178	222	178	178	178
1959	222	133	133	133	89	133	89	178	222	266	222	222
1960	133	178	178	133	133	133	89	178	222	222	222	178
1961	178	133	222	133	89	133	133	178	222	266	178	178
1962	178	178	133	133	133	44	89	89	133	178	178	178
1963	178	178	178	133	133	133	133	133	311	266	311	178
1964	222	178	178	178	133	89	133	222	178	266	222	222
1965	178	133	178	178	133	44	178	222	266	266	311	222
1966	178	178	178	178	133	178	133	178	266	266	222	222
1967	222	178	222	178	133	222	178	266	266	266	266	178
1968	178	133	178	178	133	133	133	178	222	266	222	222
1969	266	178	178	178	133	133	133	178	266	266	266	178
1970	178	178	178	178	133	178	133	133	311	355	355	266
1971	266	178	222	178	133	266	133	266	311	266	311	222
1972	222	222	222	222	178	89	222	266	355	355	311	266
1973	178	222	178	222	178	133	133	222	266	311	311	311
1974	178	222	178	222	178	133	133	222	266	311	311	311
1975	178	133	133	133	133	155	160	222	297	258	289	222
1976	195	178	178	155	133	151	195	280	240	329	275	209
1977	173	169	178	178	147	115	275	200	226	266	244	204
1978	115	186	178	178	173	102	191	204	266	297	226	222
1979	200	173	160	164	107	124	98	160	253	218	138	169
1980	142	178	89	147	89	93	231	218	284	262	253	231
1981	169	191	195	169	129	164	151	200	266	311	302	213
1982	209	209	178	186	133	182	124	231	302	311	315	244
1983	200	169	200	173	204	182	244	210	293	222	222	178
1984	133	133	133	160	138	160	204	222	262	222	231	209
1985	182	133	200	151	84	129	178	178	271	266	173	173
1986	155	89	138	133	107	89	111	133	231	355	226	89
1987	124	133	186	133	204	133	284	178	253	222	222	178
1988	142	129	124	71	98	107	111	151	218	231	173	98
MEAN	184	168	173	167	139	140	161	193	250	270	244	211
MAX.	266	266	266	266	222	266	284	280	400	355	355	311
MIN.	115	89	89	71	84	44	44	44	133	178	89	89

Table B.2.18 Monthly Mean Relative Humidity

Station: TARIJA-AASANA (UNIT: %)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1973	62	64	70	63	58	51	49	51	47	50	54	57	56
1974	60	69	66	69	53	46	51	48	46	58	47	51	55
1975	65	63	63	60	50	48	47	46	48	50	53	58	54
1976	63	65	66	57	55	49	44	44	53	45	52	58	54
1977	64	62	64	61	58	48	36	45	53	50	60	62	56
1978	61	55	63	67	59	43	46	52	60	53	60	72	58
1979	72	70	80	70	61	60	56	48	51	52	60	64	62
1980	75	65	68	63	57	52	32	41	36	51	50	48	53
1981	63	63	60	57	48	42	46	36	39	47	56	61	52
1982	64	64	65	62	51	36	39	42	45	46	52	60	52
1983	60	63	58	58	48	48	44	44	48	46	43	58	52
1984	69	69	71	67	48	51	28	41	47	52	64	66	56
1985	61	70	66	57	57	55	59	51	49	47	73	67	59
1986	61	71	75	64	51	47	46	48	54	49	71	65	59
1987	72	65	62	65	60	51	38	49	41	51	62	67	57
1988	72	72	71	73	67	60	54	47	56	51	48	68	62
MEAN	65	66	67	63	55	49	45	46	48	50	57	61	56

Table B.2.19 Monthly Precipitation

Station: TARIJA-ASANA													(UNIT: mm)
Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1946	270.0	174.0	78.0	11.0	10.0	0.0	0.0	7.0	21.0	28.0	18.0	50.0	667.0
1947	289.0	225.0	33.0	28.0	6.0	0.0	0.0	19.0	0.0	41.0	123.0	106.0	878.0
1948	206.0	165.0	57.0	8.0	6.0	0.0	0.0	0.0	3.0	27.0	65.0	84.0	621.0
1949	179.0	141.0	83.0	15.0	0.0	3.0	0.0	1.0	16.0	21.0	80.0	71.0	590.0
1950	141.0	137.0	73.0	0.0	0.0	0.0	0.0	0.0	4.0	48.0	14.0	32.0	447.0
1951	163.1	76.9	14.1	39.8	0.0	0.0	0.0	0.0	0.0	14.5	0.0	113.0	421.4
1952	132.1	37.8	41.5	0.0	0.0	0.0	0.0	0.0	24.6	22.1	97.8	41.7	397.6
1953	111.4	90.0	69.9	3.0	4.0	0.0	0.0	0.0	10.0	41.0	104.2	102.7	536.2
1954	119.1	282.9	176.2	10.0	0.0	0.0	0.0	0.0	3.0	7.5	212.0	106.7	918.2
1955	66.0	198.7	116.5	0.0	0.0	0.0	0.0	0.0	0.0	9.3	71.0	36.1	497.6
1956	186.3	192.0	17.0	0.0	0.0	0.0	0.0	5.1	23.2	100.0	70.0	70.0	671.6
1957	105.0	128.0	89.0	8.0	0.0	0.0	0.0	3.4	5.3	68.4	35.4	116.3	558.8
1958	187.4	83.6	93.6	5.2	0.0	0.0	3.0	0.0	9.0	67.4	64.6	131.9	645.7
1959	63.5	144.3	36.1	31.0	0.0	0.0	0.0	0.0	2.3	35.0	53.0	234.0	599.2
1960	194.0	113.2	100.2	17.6	0.0	0.0	0.0	0.0	6.8	20.8	47.2	197.5	705.1
1961	68.0	242.5	106.0	77.0	2.0	0.0	0.0	0.0	2.0	80.0	13.6	120.1	711.2
1962	86.0	135.3	52.2	41.0	0.0	0.0	0.6	0.0	0.0	22.8	67.2	127.8	532.9
1963	167.8	143.4	90.6	95.5	5.1	4.0	0.0	0.0	0.0	8.1	17.0	140.5	678.0
1964	176.4	99.4	58.3	1.0	1.0	0.0	0.0	0.0	3.5	41.6	77.7	46.3	505.2
1965	177.7	99.4	65.9	25.0	0.0	0.0	0.0	0.0	0.0	12.1	10.8	115.4	506.3
1966	176.0	39.9	87.9	13.5	12.1	0.0	0.0	0.0	0.0	11.0	56.6	275.0	672.0
1967	50.0	80.9	57.9	26.1	0.0	0.0	0.0	0.1	25.8	49.9	87.2	267.7	646.6
1968	139.4	189.1	43.3	21.0	9.0	0.0	0.0	35.0	4.0	11.0	120.3	29.2	601.3
1969	48.6	219.8	18.6	13.0	0.0	0.0	0.0	0.0	0.0	19.0	140.3	157.3	616.6
1970	155.5	98.6	181.6	47.0	1.4	0.0	0.0	0.0	34.0	39.0	3.0	145.0	697.1
1971	161.7	211.9	52.5	17.0	0.0	0.0	0.0	1.0	0.0	30.0	112.0	103.6	689.7
1972	96.2	128.6	85.5	13.1	6.0	22.0	0.0	1.0	4.4	19.2	60.0	107.8	543.8
1973	150.6	88.1	161.1	29.8	27.6	0.0	0.0	2.0	0.0	17.8	17.6	80.5	575.1
1974	104.2	170.9	87.0	78.2	0.0	0.0	0.0	0.0	0.0	24.4	18.0	191.3	674.0
1975	209.4	130.0	23.0	19.2	0.0	0.0	0.0	0.0	25.3	13.6	85.1	157.1	662.7
1976	153.4	63.9	110.3	0.0	1.0	0.0	0.0	2.9	6.3	1.0	49.5	111.8	500.1
1977	167.8	55.2	59.0	1.4	6.5	0.0	0.0	2.0	17.1	66.5	61.1	120.3	564.9
1978	141.7	115.8	49.6	58.3	0.0	0.0	0.0	0.0	1.0	38.6	77.2	239.1	721.3
1979	117.0	90.2	91.8	11.7	0.0	9.5	21.0	0.0	0.0	61.1	78.5	135.3	616.1
1980	145.4	95.5	133.1	13.6	10.5	0.0	0.0	3.5	0.0	45.2	24.4	69.4	540.6
1981	95.6	91.8	62.3	48.1	0.2	0.0	0.0	0.0	4.5	37.4	133.8	146.9	620.6
1982	135.6	43.6	64.3	35.7	3.5	0.0	0.0	0.0	1.8	30.0	24.2	182.0	520.7
1983	57.9	64.5	5.6	7.9	4.0	0.0	1.1	0.4	7.6	13.5	76.0	71.4	309.9
1984	144.5	134.6	146.9	1.8	0.0	0.0	0.0	20.0	0.6	41.6	65.4	121.2	676.6
1985	140.9	165.1	37.2	51.4	0.0	0.0	1.3	9.8	5.7	50.7	88.8	195.2	746.1
1986	69.2	180.3	74.3	27.6	0.0	0.0	0.0	0.0	7.7	21.4	118.4	203.0	701.9
1987	208.5	105.3	36.0	16.2	0.2	0.0	0.0	0.0	0.0	36.0	95.8	85.9	563.9
1988	181.6	94.4	128.0	48.5	0.4	0.8	1.4	0.0	1.9	14.0	12.2	175.3	659.3
MEAN	142.0	129.5	75.5	23.6	2.7	0.9	0.7	2.6	6.7	32.7	65.8	126.0	609.5
MAX.	209.0	282.9	181.6	95.5	27.6	22.0	21.0	35.0	34.0	100.0	212.0	275.0	918.2
MIN.	48.6	37.8	5.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	29.2	309.9

Table B.2.20 Maximum Daily Precipitation

STATION: TARIJA-ASANA												(UNIT: mm/day)	
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1978	51.0	31.0	13.0	35.0	0.0	0.0	0.0	0.0	1.0	17.6	26.0	49.0	51.0
1979	34.6	23.0	27.8	9.7	0.0	5.0	20.0	0.0	0.0	16.7	31.4	28.5	34.6
1980	21.6	31.8	29.0	7.0	6.0	0.0	0.0	3.0	0.0	10.0	16.6	39.7	39.7
1981	20.7	24.0	26.9	13.3	0.2	0.0	2.0	7.0	1.9	20.0	64.4	38.8	64.4
1982	36.0	13.5	18.4	23.5	2.4	0.0	0.0	0.0	0.2	16.3	8.7	41.0	41.0
1983	12.0	24.3	2.0	3.4	2.0	0.0	0.7	0.8	7.0	11.8	34.0	23.0	34.0
1984	19.2	41.2	38.8	1.0	0.0	0.0	0.0	19.6	0.6	15.0	20.0	59.0	59.0
1985	84.7	32.2	14.2	30.4	0.0	0.0	1.3	7.8	4.1	5.0	20.6	37.8	84.7
1986	19.8	40.5	25.0	17.0	0.0	0.0	0.0	0.0	6.0	13.0	37.5	42.0	42.0
1987	97.8	69.8	21.2	12.9	0.2	0.0	0.0	0.0	0.0	19.2	23.6	19.8	97.8
1988	37.2	13.6	29.6	40.1	0.3	0.6	1.0	0.0	1.0	11.0	4.4	29.8	40.1
MAX.	97.8	69.8	38.8	40.1	6.0	5.0	20.0	19.6	7.0	20.0	64.4	59.0	97.8

Table B.2.21 Monthly Precipitation at Alto Cajas Station

STATION: ALTO CAJAS													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	35.0	86.0	106.3	.....
1978	36.0	239.8	104.5	57.9	0.0	0.0	0.0	0.0	0.0	15.8	77.6	112.1	643.7
1979	151.0	93.0	83.5	52.8	2.4	30.0	12.6	2.3	0.0	51.6	88.9	104.9	673.0
1980	74.1	157.6	72.9	7.6	7.3	9.2	0.0	4.9	0.0	23.8	63.8	69.7	490.9
1981	193.6	119.9	54.0	77.0	6.8	0.0	0.0	8.9	0.0	0.0	51.0	126.2	637.4
1982	69.1	57.2	119.7	44.6	0.0	0.0	0.0	0.0	14.1	22.7	38.2	72.5	428.1
1983	75.4	24.8	12.5	7.5	6.4	0.0	4.0	0.0	0.0	5.5	57.2	24.7	218.0
1984	180.2	57.5	230.7	14.8	0.0	0.0	0.0	32.2	3.0	58.0	53.4	61.2	691.0
1985	59.5	212.2	59.8	39.0	0.0	5.0	12.7	6.5	14.6	12.3	142.6	18.9	583.1
1986	44.6	108.8	79.4	63.9	9.5	0.0	0.0	0.0	6.7	25.9	63.5	114.3	516.6
1987	111.4	26.8	37.0	35.3	0.0	0.0	0.0	0.0	0.0	13.0	164.4	111.7	499.6
1988	105.5	105.8	147.1	45.9	11.4	0.0	0.0	0.0	0.0	3.0	41.7	126.2	586.6
MEAN	99.1	109.4	91.0	40.6	4.0	4.0	2.7	5.0	3.5	21.1	76.6	85.7	542.5
MAX.	193.6	239.8	230.7	77.0	11.4	30.0	12.7	32.2	14.6	58.0	164.4	126.2	691.0
MIN.	36.0	24.8	12.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	38.2	18.9	218.0

Maximum Daily Precipitation

STATION: ALTO CAJAS													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45.6	45.6
1978	10.2	56.5	30.0	18.7						12.6	16.9	34.0	56.5
1979	52.4	34.8	21.0	22.3	2.4	21.0	5.4	2.3		23.4	53.2	34.0	53.2
1980	33.4	36.5	16.0	5.6	7.3	9.2		2.6		11.3	25.0	36.2	36.5
1981	30.2	27.5	19.5	22.6	6.8			8.9			22.0	51.0	51.0
1982	23.0	24.0	26.0	12.0					10.7	16.5	18.0	17.4	26.0
1983	17.0	18.5	5.6	7.5	6.4		4.0			3.5	20.0	16.0	20.0
1984	25.4	26.5	48.3	6.5				24.0	3.0	18.6	19.5	19.0	48.3
1985	24.5	72.6	22.0	17.5		5.0	8.5	6.5	14.6	8.0	40.6	10.4	72.6
1986	10.2	30.4	12.0	35.4	9.5				.....	.....	.....	20.4	35.4
1987	18.0	16.4	11.5	14.3						8.0	40.0	.....	40.0
1988	37.0	32.0	24.0	12.0	6.4					3.0	.....	.....	37.0
MAX.	52.4	72.6	48.3	35.4	9.5	21.0	8.5	24.0	14.6	23.4	53.2	51.0	72.6

Table B.2.22 Monthly Precipitation at Yesera Norte Station

STATION: YESERA NORTE													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	182.6	125.6	122.9	45.3	13.2	0.6	0.0	25.7	27.6	32.2	84.8	66.4	726.9
1978	67.3	211.8	94.6	67.4	0.0	0.0	0.0	0.0	0.0	46.5	97.2	166.6	751.4
1979	194.4	80.3	143.1	25.2	2.6	12.5	20.3	0.0	2.0	59.1	63.7	150.4	753.6
1980	113.3	98.5	96.2	31.0	8.6	0.9	0.0	14.5	0.0	54.2	48.6	101.3	567.1
1981	204.0	236.7	92.5	65.4	0.0	1.0	2.5	4.0	10.0	8.5	57.5	188.6	871.5
1982	100.8	88.7	152.3	45.0	4.4	0.0	0.0	0.0	4.3	29.4	60.5	201.0	686.4
1983	120.5	83.1	28.6	14.8	5.5	2.3	5.5	2.5	14.3	26.1	75.4	32.5	411.1
1984	326.2	60.4	326.4	0.0	0.0	0.0	0.0	32.2	0.0	58.4	104.7	93.6	1,001.9
1985	76.8	261.0	66.8	34.0	5.0	0.0	1.5	14.2	17.5	8.2	148.5	127.2	760.7
1986	50.1	273.2	74.4	65.0	0.0	0.0	0.0	0.0	17.0	36.0	74.6	236.5	826.8
1987	165.2	65.7	38.5	70.6	0.0	0.0	0.0	0.0	0.0	19.3	151.3	88.5	599.1
1988	140.2	157.5	233.7	50.4	14.8	8.4	0.0	0.0	11.0	56.0	29.0	178.3	879.3
MEAN	145.2	145.2	122.5	42.8	4.5	2.1	2.5	7.8	8.6	36.2	83.0	135.9	736.3
MAX.	326.2	273.2	326.4	70.6	14.8	12.5	20.3	32.2	27.6	59.1	151.3	236.5	1,001.9
MIN.	50.1	60.4	28.6	0.0	0.0	0.0	0.0	0.0	0.0	8.2	29.0	32.5	411.1

Maximum Daily Precipitation

STATION: YESERA NORTE													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	33.7	37.0	42.0	10.0	9.0	0.6		19.0	10.5	16.0	30.0	12.3	42.0
1978	11.0	38.0	15.2	20.0						21.4	15.0	24.3	38.0
1979	53.2	26.3	24.0	9.4	1.5	12.5	10.0		2.0	20.0	19.4	28.3	53.2
1980	25.3	34.2	25.0	11.0	8.0	0.5		10.3		19.0	17.5	42.3	42.3
1981	50.0	73.0	34.0	15.3		1.0	2.5	4.0	3.5	4.0	15.0	55.2	73.0
1982	24.0	20.0	23.0	19.0	2.4				2.3	14.2	28.0	40.2	40.2
1983	35.2	27.0	10.0	4.0	3.3	2.3	5.5	1.5	11.0	20.0	18.0	12.0	35.2
1984	49.0	19.3	97.0					32.2		33.5	28.5	22.3	97.0
1985	19.3	64.0	27.5	20.0	3.0		1.5	14.0	5.3	8.2	46.0	40.0	64.0
1986	11.0	60.5	30.5	55.0					8.0	20.0	22.5	68.0	68.0
1987	40.2	26.5	21.0	20.4						16.3	46.2	24.0	48.2
1988	36.0	24.0	53.0	28.0	8.6	5.0			11.0	46.0	13.0	33.0	53.0
MAX.	53.2	73.0	97.0	55.0	9.0	12.5	10.0	32.2	11.0	46.0	46.2	68.0	97.0

Table B.2.24 Monthly Precipitation at Junacas Station

STATION: JUNACAS (UNIT: mm)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	113.0	.....
1978	91.0	180.0	58.0	47.0	0.0	0.0	0.0	0.0	0.0	10.0	31.0	107.0	624.0
1979	288.0	91.0	125.0	0.0	0.0	37.0	23.0	0.0	4.5	45.0	127.5	70.0	811.8
1980	191.4	92.0	96.5	10.0	2.0	0.0	0.0	4.0	0.0	12.5	24.0	35.0	467.4
1981	223.0	120.1	49.8	56.0	0.0	0.0	0.0	2.0	0.0	14.0	62.0	96.0	622.9
1982	43.1	53.2	166.8	13.0	0.0	0.0	0.0	0.0	39.0	57.0	26.0	129.0	627.1
1983	158.5	112.0	5.0	21.0	0.0	0.0	0.0	0.0	0.0	11.0	40.7	65.3	413.5
1984	305.5	117.0	204.0	12.0	0.0	0.0	0.0	35.0	0.0	37.0	92.0	113.0	915.5
1985	76.0	140.0	16.0	22.0	0.0	20.0	0.0	18.0	30.0	0.0	189.0	133.0	644.0
1986	74.0	259.0	115.0	15.0	0.0	0.0	0.0	0.0	0.0	21.0	34.0	208.0	720.0
1987	257.0	103.0	24.0	37.0	0.0	0.0	0.0	0.0	0.0	57.1	95.0	0.0	573.1
1988	147.0	169.0	147.0	82.0	0.0	0.0	0.0	0.0	0.0	23.0	16.0	116.0	700.0
MEAN	168.6	130.6	91.6	28.6	0.2	5.2	2.1	5.4	6.7	26.1	67.0	90.0	630.9
MAX.	305.5	259.0	204.0	82.0	2.0	37.0	23.0	35.0	39.0	57.1	189.0	208.0	915.5
MIN.	43.1	53.2	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	413.5

Maximum Daily Precipitation

STATION: JUNACAS (UNIT: mm/day)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	53.0	53.0
1978	22.0	60.0	32.0	17.0						10.0	24.0	19.0	60.0
1979	70.0	11.0	21.0			37.0	15.0		4.5	45.0	82.0	24.0	82.0
1980	30.0	20.0	33.0	10.0	1.0			4.0		12.5	19.0	12.2	33.0
1981	57.0	46.5	35.0	22.0				2.0		12.0	31.0	41.0	57.0
1982	12.0	20.0	38.2	6.0					39.0	19.0	26.0	35.0	39.0
1983	45.0	41.0	4.0	21.0						11.0	16.5	50.0	50.0
1984	45.0	72.0	59.0	12.0				35.0		21.0	25.0	27.0	72.0
1985	26.0	36.0	16.0	16.0		20.0		18.0	30.0		36.0	35.0	36.0
1986	23.0	35.0	36.0	15.0						21.0	18.0	35.0	36.0
1987	30.0	29.0	24.0	25.0						25.0	30.0		30.0
1988	36.0	40.0	35.0	16.0						23.0	16.0	27.0	40.0
MAX.	70.0	72.0	59.0	25.0	1.0	37.0	15.0	35.0	39.0	45.0	82.0	53.0	82.0

Table B.2.23 Monthly Precipitation at San Pedro Station

STATION: SAN PEDRO DE BUENA VISTA (UNIT: mm)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45.2	154.0	.....
1980	88.8	68.8	101.5	8.8	4.7	0.0	0.0	0.0	0.0	36.2	21.1	73.3	403.2
1981	151.8	164.8	67.6	27.0	0.2	0.1	2.0	18.3	3.5	23.2	70.7	117.3	646.5
1982	65.1	28.5	92.2	21.0	3.4	0.0	0.0	0.4	22.2	21.7	28.7	130.7	433.9
1983	67.3	35.7	7.6	12.0	0.0	0.0	0.0	0.0	8.0	12.0	47.5	70.7	260.8
1984	180.7	88.4	205.4	4.3	0.0	0.0	0.0	20.0	0.9	45.4	82.9	105.6	733.6
1985	84.6	178.7	17.4	32.0	0.0	0.0	0.0	7.6	1.6	15.2	72.6	186.3	596.0
1986	122.1	217.8	79.0	24.3	0.0	0.0	0.0	0.0	0.2	7.4	112.4	160.5	723.7
1987	206.8	53.5	55.0	20.5	0.0	0.0	0.0	0.0	0.6	2.6	26.7	20.4	386.1
1988	159.9	46.8	170.0	40.7	0.2	0.0	0.0	0.0	0.4	8.5	33.1	168.3	627.9
MEAN	127.5	98.1	88.4	21.2	0.9	0.0	0.2	5.1	4.2	19.1	64.1	118.8	537.7
MAX.	206.8	217.8	205.4	40.7	4.7	0.1	2.0	20.0	22.2	45.4	112.4	186.3	733.6
MIN.	67.3	28.5	7.6	4.3	0.0	0.0	0.0	0.0	0.0	2.6	21.1	20.4	260.8

Maximum Daily Precipitation

STATION: SAN PEDRO DE BUENA VISTA (UNIT: mm/day)

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22.0	34.5	34.5
1980	40.0	25.0	24.0	3.6	2.4					11.0	7.3	35.2	40.0
1981	37.1	71.4	25.3	15.2	0.2	0.1	2.0	17.2	2.6	7.2	21.0	23.5	71.4
1982	21.0	6.9	23.4	12.3	3.1			0.4	9.3	6.0	16.7	50.1	50.1
1983	22.0	19.0	2.0	11.0									22.0
1984	.....	17.2	60.0	2.5				20.0	0.9	22.0	20.3	34.0	60.0
1985	26.5	32.7	4.8	20.0				4.7	1.3	0.3	20.0	37.9	37.9
1986	38.0	47.9	.....	15.3					0.2	0.3	44.3	40.8	47.0
1987	43.0	20.4	40.0	14.9					0.4	1.7	5.2	15.1	43.0
1988	40.6	10.3	53.1	33.4	0.2				0.4	5.4	10.5	35.3	53.1
MAX.	43.0	71.4	50.0	33.4	3.1	0.1	2.0	20.0	9.3	22.0	44.3	50.1	71.4

Table B.2.25 Monthly Precipitation at Gamoneda Station

STATION: GAMONEDA													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.4	131.0	.....
1980	105.7	85.4	53.0	31.3	25.1	0.9	0.1	1.6	0.1	44.0	20.4	47.7	416.1
1981	145.2	155.0	64.8	42.4	1.5	0.0	0.2	11.6	2.3	10.6	55.9	72.1	501.6
1982	129.1	72.6	84.4	31.7	4.7	0.0	0.0	0.1	15.9	16.0	38.2	149.5	541.2
1983	75.2	48.3	2.6	10.7	0.8	0.0	3.0	0.2	8.6	12.0	35.1	66.9	263.4
1984	235.6	83.6	170.2	1.5	0.1	0.0	0.0	18.2	0.6	41.6	89.8	136.9	778.1
1985	98.3	170.4	9.8	34.4	0.0	0.0	0.1	12.7	5.8	2.2	99.8	120.5	546.0
1986	79.7	191.3	83.6	24.3	0.0	0.0	0.0	0.0	3.9	6.0	87.7	149.1	625.6
1987	183.9	62.0	22.3	23.6	0.6	0.1	0.0	0.0	0.4	16.4	79.5	41.2	430.9
1988	178.5	94.6	184.0	42.3	0.0	0.0	0.0	0.0	0.2	7.6	31.2	96.4	554.8
MEAN	135.8	107.1	68.4	28.9	3.6	0.1	0.4	4.9	4.2	17.4	57.6	101.1	527.6
MAX.	235.6	191.3	170.2	42.4	25.1	0.9	3.0	18.2	15.9	44.0	99.8	149.5	778.1
MIN.	75.2	48.3	2.6	1.5	0.0	0.0	0.0	0.0	0.1	2.2	20.4	41.2	263.4

Maximum Daily Precipitation

STATION: GAMONEDA													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.7	24.0	24.0
1980	22.0	26.0	9.3	10.2	25.0	0.9	0.1	1.6	0.1	9.2	6.8	11.5	26.0
1981	34.3	55.5	20.0	16.5	1.5		0.2	11.5	1.2	4.0	21.3	15.7	55.5
1982	35.8	16.5	20.0	17.2	2.9			0.1	12.5	8.1	18.2	37.4	37.4
1983	14.0	12.3	0.9	8.3	0.5		3.0	0.1	8.5	11.0	12.5	12.7	14.0
1984	35.8	26.5	55.0	0.0	0.1			18.2	0.6	18.3	23.7	33.5	55.0
1985	30.2	41.2	4.5	32.2			0.1	18.0	5.8	2.2	33.1	37.0	41.2
1986	23.9	41.2	30.2	16.0					2.9	4.5	26.5	27.3	41.2
1987	53.5	31.5	11.5	17.4	0.6	0.1			0.4	8.5	21.0	20.4	53.5
1988	56.1	20.3	23.5	25.7					0.2	7.6	23.5	18.3	56.1
MAX.	56.1	55.5	55.0	32.2	25.0	0.9	3.0	18.2	12.5	18.3	33.1	37.4	56.1

Table B.2.26 Monthly Precipitation at San Agustin Station

STATION: SAN AGUSTIN NORTE													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.7	132.6	.....
1980	44.5	80.0	22.2	61.6	25.1	0.1	0.0	0.0	0.0	41.0	13.0	21.7	309.1
1981	181.0	89.8	27.5	59.2	0.5	0.0	0.0	10.0	0.0	12.0	4.0	68.0	452.0
1982	50.5	24.0	44.5	1.5	1.0	0.0	0.0	2.5	4.0	18.5	14.5	102.0	263.0
1983	40.0	22.0	0.0	4.5	0.0	0.0	0.0	0.0	10.0	11.5	15.5	26.0	129.5
1984	159.0	38.0	111.0	0.0	0.0	0.0	0.0	10.0	0.0	55.0	69.0	53.5	495.5
1985	73.5	82.5	2.0	70.5	0.0	0.0	0.0	6.5	5.5	0.0	50.5	46.5	345.5
1986	27.5	65.5	39.0	6.5	0.0	0.0	0.0	0.0	5.0	0.0	0.0	85.0	228.5
1987	79.5	24.5	15.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	49.5	58.0	231.5
1988	29.5	32.0	39.0	78.0	1.0	0.0	0.0	0.0	0.0	0.0	26.0	52.0	257.5
MEAN	76.1	50.9	33.4	31.3	3.1	0.0	0.0	3.2	2.7	15.9	28.4	64.5	309.5
MAX.	181.0	89.8	111.0	78.0	25.1	0.1	0.0	10.0	10.0	55.0	69.0	132.6	495.5
MIN.	27.5	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.7	129.5

Maximum Daily Precipitation

STATION: SAN AGUSTIN NORTE													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.0	39.0	39.0
1980	11.0	39.0	10.2	30.8	25.1	0.1				20.0	10.0	11.0	39.0
1981	40.0	32.0	15.0	21.0	0.5			18.0		9.0	3.0	33.0	40.0
1982	10.0	9.5	10.5	1.5	1.0			2.5	4.0	10.0	9.5	39.0	39.0
1983	10.0	18.0		4.5					10.0	11.5	6.5	10.5	18.0
1984	35.0	11.0	55.5					10.0		30.0	30.0	18.5	55.5
1985	25.0	30.5	2.0	40.0				6.5	5.5		20.0	15.5	40.0
1986	8.5	20.0	20.5	8.5					5.0			20.5	20.5
1987	20.0	16.0	10.5							5.0	30.0	.....	30.0
1988	9.0	15.5	6.5	10.5	1.0						15.0	16.5	16.5
MAX.	40.0	39.0	55.5	40.0	25.1	0.1	0.0	10.0	10.0	30.0	30.0	39.0	55.5

Table B.2.27 Monthly Precipitation at Santa Ana Station

STATION: SANTA ANA (Pto. Carretera al Chaco)													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65.5	.....
1978	121.7	140.5	55.3	28.6	0.0	0.0	0.0	0.0	0.0	46.7	48.7	123.4	564.9
1979	131.5	68.0	67.3	1.0	5.5	7.0	5.0	2.0	0.0	50.6	30.4	116.4	485.5
1980	81.6	82.2	34.3	53.1	37.5	0.0	0.0	0.0	0.0	0.0	28.3	46.3	363.3
1981	195.2	109.3	44.8	24.6	0.0	0.0	0.0	2.1	2.0	10.1	45.0	48.8	481.0
1982	98.8	16.2	34.7	5.3	0.0	0.0	0.0	0.0	0.3	11.8	7.0	305.0	479.1
1983	97.7	30.8	0.0	0.7	0.0	0.0	0.4	0.0	0.6	11.5	23.7	1.6	167.0
1984	83.3	21.9	118.1	0.0	0.0	0.0	0.0	25.0	0.0	31.1	57.4	94.3	431.1
1985	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1986	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1987	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1988	191.9	60.2	165.2	43.2	0.0	0.0	0.0	0.0	0.0	17.6	54.4	144.3	676.8
MEAN	125.2	66.1	65.0	19.6	5.4	0.9	0.8	3.6	0.4	22.4	36.9	100.0	446.2
MAX.	195.2	140.5	165.2	53.1	37.5	7.0	5.8	25.0	2.0	50.6	57.4	305.0	676.8
MIN.	81.6	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	1.6	167.0

Table Maximum Daily Precipitation

STATION: SANTA ANA (Pto. Carretera al Chaco)													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.3	20.3
1978	21.3	31.2	18.2	9.2	.....	.....	.....	.....	.....	15.3	26.8	26.2	31.2
1979	47.9	22.1	18.4	0.7	4.1	7.0	5.0	2.0	.....	36.0	14.9	29.0	47.9
1980	17.2	27.2	10.0	19.5	37.5	.....	.....	.....	.....	.....	8.6	16.4	37.5
1981	43.2	30.1	16.3	8.7	.....	.....	.....	2.1	1.7	10.1	16.8	18.1	43.2
1982	32.4	5.3	9.6	2.9	.....	.....	.....	.....	0.3	6.8	4.8	98.6	98.6
1983	22.4	9.6	.....	0.7	.....	.....	0.4	.....	0.6	11.5	8.6	1.6	22.4
1984	17.3	4.7	28.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	28.3
1985	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1986	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1987	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	72.0	16.7	72.0
1988	67.0	9.6	39.0	35.0	.....	.....	.....	.....	.....	7.6	36.0	47.0	67.0
MAX.	67.0	31.2	39.0	35.0	37.5	7.0	5.8	2.1	1.7	36.0	72.0	98.6	98.6

Table B.2.28 Monthly Precipitation at La Cabana Station

STATION: SANTA ANA (LA CABANA)													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	134.0	29.0	23.0	0.0	0.0	19.0	0.0	0.0	0.0	71.0	41.0	90.0	407.0
1980	82.5	107.4	58.0	34.4	10.7	0.0	0.0	0.0	0.0	47.0	12.2	48.2	401.2
1981	176.2	171.2	0.0	0.0	0.0	0.0	0.0	5.0	0.0	19.2	107.9	59.6	539.1
1982	86.4	30.0	66.7	25.0	0.0	0.0	0.0	0.0	67.0	48.0	35.0	162.6	520.7
1983	92.5	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	79.7	63.3	299.0
1984	212.7	60.3	50.8	0.0	0.0	0.0	0.0	45.0	0.0	40.4	25.0	51.7	493.9
1985	65.7	113.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
MEAN	121.4	81.1	28.5	8.5	1.5	2.7	0.0	7.1	9.6	34.4	43.0	67.9	380.1
MAX.	212.7	171.2	66.7	34.4	10.7	19.0	0.0	45.0	67.0	71.0	107.9	162.6	539.1
MIN.	65.7	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	12.2	48.2	299.0

Table Maximum Daily Precipitation

STATION: SANTA ANA (LA CABANA)													(UNIT: mm/day)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1979	60.0	20.0	20.0	.....	.....	19.0	.....	.....	.....	32.0	20.0	26.0	60.0
1980	30.0	40.5	20.3	10.2	10.7	.....	.....	.....	.....	20.0	12.2	20.0	40.5
1981	62.0	45.3	.....	.....	.....	.....	.....	5.0	.....	13.5	27.2	30.5	62.0
1982	19.5	30.0	40.2	25.0	.....	.....	.....	.....	67.0	48.0	20.0	49.0	67.0
1983	35.0	48.5	.....	.....	.....	.....	.....	.....	.....	15.0	30.5	19.5	48.5
1984	49.2	22.4	35.6	.....	.....	.....	.....	45.0	.....	25.4	25.0	27.2	49.2
1985	50.5	48.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50.5
MAX.	62.0	48.5	40.2	25.0	10.7	19.0	0.0	45.0	67.0	48.0	30.5	49.0	67.0

Table B.2.29 Correlation of Monthly Precipitation

Station	Alto Cajas	Yesera Norte	San Pedro	Junacas	Gamoneda	San Agus.	Santa Ana	La Cabana	Tarija AASANA	Tejar Uni.
Alto Cajas	*****	4.739	6.573	5.739	6.642	2.333	5.124	7.622	13.751	14.390
	*****	1.235	0.885	1.033	0.862	0.541	0.669	0.667	0.827	0.878
	*****	0.818	0.832	0.656	0.687	0.641	0.503	0.562	0.549	0.566
Yesera Norte	5.231	*****	2.439	2.543	3.503	2.550	2.616	6.625	8.857	9.929
	0.662	*****	0.696	0.820	0.663	0.381	0.551	0.508	0.680	0.719
	0.818	*****	0.808	0.772	0.841	0.658	0.606	0.644	0.689	0.716
San Pedro	11.536	9.088	*****	6.950	4.606	5.025	-0.279	5.383	8.078	9.016
	0.714	1.161	*****	1.002	0.878	0.464	0.779	0.755	0.941	1.016
	0.632	0.808	*****	0.733	0.884	0.584	0.583	0.682	0.840	0.849
Junacas	12.080	11.609	7.093	*****	6.914	5.373	7.403	7.983	14.174	15.457
	0.635	0.942	0.731	*****	0.716	0.395	0.548	0.566	0.705	0.736
	0.656	0.772	0.733	*****	0.807	0.581	0.512	0.649	0.648	0.650
Gamoneda	8.508	5.382	0.656	2.384	*****	2.151	-1.530	4.069	6.754	7.008
	0.797	1.269	1.007	1.126	*****	0.538	0.787	0.765	0.991	1.083
	0.687	0.841	0.884	0.807	*****	0.686	0.620	0.721	0.812	0.841
San Agustin	13.065	16.823	12.604	14.137	11.259	*****	2.555	9.818	19.731	20.909
	1.184	1.726	1.259	1.471	1.275	*****	1.053	0.982	1.193	1.315
	0.641	0.658	0.584	0.581	0.686	*****	0.634	0.645	0.497	0.524
Santa Ana	18.884	20.818	18.233	18.308	18.039	9.171	*****	12.753	18.932	18.326
	0.751	1.099	0.748	0.934	0.788	0.603	*****	0.724	0.854	0.925
	0.503	0.606	0.583	0.512	0.620	0.634	*****	0.599	0.611	0.695
La Cabana	13.749	13.858	9.761	9.696	9.301	4.482	2.876	*****	15.919	15.304
	0.842	1.269	0.904	1.147	0.942	0.657	0.827	*****	0.877	0.984
	0.562	0.644	0.682	0.649	0.721	0.645	0.599	*****	0.600	0.680
Tarija AASANA	11.588	10.138	0.092	5.635	2.852	4.927	0.331	4.452	*****	2.703
	0.664	1.012	0.892	0.918	0.820	0.417	0.716	0.684	*****	1.009
	0.549	0.689	0.840	0.648	0.812	0.497	0.611	0.600	*****	0.932
Tejar Uni.	10.349	7.523	-0.643	4.704	1.663	4.141	-2.968	1.684	0.960	*****
	0.645	0.997	0.835	0.883	0.776	0.398	0.751	0.691	0.924	*****
	0.566	0.716	0.849	0.650	0.841	0.524	0.695	0.680	0.932	*****

Upper : a

Middle: b $Y = a + b \cdot X$ Lower : r^2

Table B.2.30 Supplemented Precipitation of Alto Cajas Station

STATION: ALTO CAJAS													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	126.1	88.4	86.6	35.2	14.0	5.6	0.0	22.2	23.5	35.0	85.0	106.3	627.9
1978	36.0	239.8	104.5	57.9	0.0	0.0	0.0	0.0	0.0	15.8	77.6	112.1	643.7
1979	151.0	93.0	83.5	52.0	2.4	30.0	12.6	2.3	0.0	51.6	88.9	104.9	673.0
1980	74.1	157.6	72.9	7.6	7.3	9.2	0.0	4.9	0.0	23.8	63.8	69.7	490.9
1981	193.6	119.9	54.0	77.0	6.8	0.0	0.0	8.9	0.0	0.0	51.0	126.2	637.4
1982	59.1	57.2	119.7	44.6	0.0	0.0	0.0	0.0	14.1	22.7	38.2	72.5	428.1
1983	75.4	24.8	12.5	7.5	6.4	0.0	4.0	0.0	0.0	5.5	57.2	24.7	218.0
1984	180.2	57.5	230.7	14.8	0.0	0.0	0.0	32.2	3.0	58.0	53.4	61.2	691.0
1985	59.5	212.2	59.8	39.0	0.0	5.0	12.7	6.5	14.6	12.3	142.6	18.9	583.1
1986	44.6	108.8	79.4	63.9	9.5	0.0	0.0	0.0	6.7	25.9	63.5	114.3	516.6
1987	111.4	26.8	37.0	35.3	0.0	0.0	0.0	0.0	0.0	13.0	164.4	111.7	499.6
1988	105.5	105.8	147.1	45.9	11.4	0.0	0.0	0.0	0.0	3.0	41.7	126.2	586.6
MEAN	101.4	107.7	90.6	40.1	4.8	4.2	2.4	6.4	5.2	22.2	77.3	87.4	549.7
MAX.	193.6	239.8	230.7	77.0	14.0	30.0	12.7	32.2	23.5	58.0	164.4	126.2	691.0
MIN.	36.0	24.8	12.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	38.2	18.9	218.0

Table B.2.31 Supplemented Precipitation of Yesera Norte Station

STATION: YESERA NORIE													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	182.6	125.6	122.9	45.3	13.2	0.6	0.0	25.7	27.6	32.2	84.8	66.4	726.9
1978	67.3	211.8	94.6	67.4	0.0	0.0	0.0	0.0	0.0	46.5	97.2	166.6	751.4
1979	194.4	80.3	143.1	25.2	2.6	12.5	20.3	0.0	2.0	59.1	63.7	150.4	753.6
1980	113.3	98.5	96.2	31.0	8.6	0.9	0.0	14.5	0.0	54.2	48.6	101.3	567.1
1981	204.8	236.7	92.5	65.4	0.0	1.0	2.5	4.0	10.0	8.5	57.5	188.6	871.5
1982	100.8	88.7	152.3	45.0	4.4	0.0	0.0	0.0	4.3	29.4	60.5	201.0	686.4
1983	120.5	83.1	28.6	14.8	5.5	2.3	5.5	2.5	14.3	26.1	75.4	32.5	411.1
1984	326.2	60.4	326.4	0.0	0.0	0.0	0.0	32.2	0.0	58.4	104.7	93.6	*****
1985	76.8	261.0	66.8	34.0	5.0	0.0	1.5	14.2	17.5	8.2	148.5	127.2	760.7
1986	50.1	273.2	74.4	65.0	0.0	0.0	0.0	0.0	17.0	36.0	74.6	236.5	826.8
1987	165.2	65.7	38.5	70.6	0.0	0.0	0.0	0.0	0.0	19.3	151.3	88.5	599.1
1988	140.2	157.5	233.7	50.4	14.8	8.4	0.0	0.0	11.0	56.0	29.0	178.3	879.3
MEAN	145.2	145.2	122.5	42.8	4.5	2.1	2.5	7.8	8.6	36.2	83.0	135.9	736.3
MAX.	326.2	273.2	326.4	70.6	14.8	12.5	20.3	32.2	27.6	59.1	151.3	236.5	*****
MIN.	50.1	60.4	28.6	0.0	0.0	0.0	0.0	0.0	0.0	8.2	29.0	32.5	411.1

Table B.2.32 Supplemented Precipitation of San Pedro Station

STATION: SAN PEDRO DE BUENA VISTA													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	129.5	89.9	88.0	34.0	11.6	2.9	0.0	20.3	21.6	24.9	61.5	48.7	532.9
1978	49.3	149.9	68.3	49.3	0.0	0.0	0.0	0.0	0.0	34.8	70.1	118.4	540.1
1979	137.7	58.3	102.0	20.0	4.2	11.1	16.6	0.0	3.8	43.6	45.2	154.9	597.4
1980	88.8	68.8	101.5	8.8	4.7	0.0	0.0	0.0	0.0	36.2	21.1	73.3	403.2
1981	151.8	164.8	67.6	27.0	0.2	0.1	2.0	18.3	3.5	23.2	70.7	117.3	646.5
1982	85.1	28.5	92.2	21.0	3.4	0.0	0.0	0.4	22.2	21.7	28.7	130.7	433.9
1983	67.3	35.7	7.6	12.0	0.0	0.0	0.0	0.0	8.0	12.0	47.5	70.7	260.8
1984	180.7	88.4	205.4	4.3	0.0	0.0	0.0	20.0	0.9	45.4	82.9	105.6	733.6
1985	84.6	178.7	17.4	32.0	0.0	0.0	0.0	7.6	1.6	15.2	72.6	186.3	596.0
1986	122.1	217.8	79.0	24.3	0.0	0.0	0.0	0.0	0.2	7.4	112.4	160.5	723.7
1987	206.8	53.5	55.0	20.5	0.0	0.0	0.0	0.0	0.6	2.6	26.7	20.4	386.1
1988	159.9	46.8	170.0	40.7	0.2	0.0	0.0	0.0	0.4	8.5	33.1	168.3	627.9
MEAN	122.0	98.4	87.8	24.5	2.0	1.2	1.6	5.6	5.2	23.0	56.0	112.9	540.2
MAX.	206.8	217.8	205.4	49.3	11.6	11.1	16.6	20.3	22.2	45.4	112.4	186.3	733.6
MIN.	49.3	28.5	7.6	4.3	0.0	0.0	0.0	0.0	0.0	2.6	21.1	20.4	260.8

Table B.2.33 Supplemented Precipitation of Junacas Station

STATION: JUNACAS													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	152.3	105.5	103.3	39.7	13.4	3.0	0.0	23.6	25.2	28.9	72.1	113.0	680.0
1978	91.0	180.0	58.0	47.0	0.0	0.0	0.0	0.0	0.0	10.0	31.0	107.0	524.0
1979	288.0	91.0	125.0	0.0	0.0	37.0	23.0	0.0	4.5	45.0	127.5	70.8	811.8
1980	191.4	92.0	96.5	10.0	2.0	0.0	0.0	4.0	0.0	12.5	24.0	35.0	467.4
1981	223.0	120.1	49.8	56.0	0.0	0.0	0.0	2.0	0.0	14.0	62.0	96.0	622.9
1982	43.1	53.2	166.8	13.0	0.0	0.0	0.0	0.0	39.0	57.0	26.0	129.0	527.1
1983	158.5	112.0	5.0	21.0	0.0	0.0	0.0	0.0	0.0	11.0	40.7	65.3	413.5
1984	305.5	117.0	204.0	12.0	0.0	0.0	0.0	35.0	0.0	37.0	92.0	113.0	915.5
1985	76.0	140.0	16.0	22.0	0.0	20.0	0.0	18.0	30.0	0.0	189.0	133.0	644.0
1986	74.0	259.0	115.0	15.0	0.0	0.0	0.0	0.0	0.0	21.0	34.0	208.0	726.0
1987	257.0	103.0	24.0	37.0	0.0	0.0	0.0	0.0	0.0	57.1	95.0	0.0	573.1
1988	147.0	169.0	147.0	82.0	0.0	0.0	0.0	0.0	0.0	23.0	16.0	116.0	700.0
MEAN	167.2	128.5	92.5	29.6	1.3	5.0	1.9	6.9	8.2	26.4	67.4	98.8	633.8
MAX.	305.5	259.0	204.0	82.0	13.4	37.0	23.0	35.0	39.0	57.1	189.0	208.0	915.5
MIN.	43.1	53.2	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	413.5

Table B.2.34 Supplemented Precipitation of Gamoneda Station

STATION: GAMONEDA													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	124.6	86.8	85.0	33.5	12.3	3.9	0.0	20.5	21.8	24.9	59.7	47.5	520.5
1978	48.1	143.9	66.2	48.2	0.0	0.0	0.0	0.0	0.0	34.3	67.9	114.0	522.6
1979	132.4	56.7	98.4	20.2	5.2	11.8	17.0	0.0	4.8	42.7	38.4	131.0	558.6
1980	105.7	85.4	53.8	31.3	25.1	0.9	0.1	1.6	0.1	44.0	20.4	47.7	416.1
1981	145.2	155.0	84.8	42.4	1.5	0.0	0.2	11.6	2.3	10.6	55.9	72.1	581.6
1982	128.1	72.6	84.4	31.7	4.7	0.0	0.0	0.1	15.9	16.0	38.2	149.5	541.2
1983	75.2	48.3	2.6	10.7	0.8	0.0	3.0	0.2	8.6	12.0	35.1	66.9	263.4
1984	235.6	83.6	170.2	1.5	0.1	0.0	0.0	18.2	0.6	41.6	89.8	136.9	778.1
1985	90.3	170.4	9.8	34.4	0.0	0.0	0.1	12.7	5.8	2.2	99.8	120.5	546.0
1986	79.7	191.3	83.6	24.3	0.0	0.0	0.0	0.0	3.9	6.0	87.7	149.1	625.6
1987	183.9	62.9	22.3	23.6	0.6	0.1	0.0	0.0	0.4	16.4	79.5	41.2	430.9
1988	178.5	94.6	104.0	42.3	0.0	0.0	0.0	0.0	0.2	7.6	31.2	96.4	554.8
MEAN	127.3	104.3	72.1	28.7	4.2	1.4	1.7	5.4	5.4	21.5	58.6	97.7	528.3
MAX.	235.6	191.3	170.2	48.2	25.1	11.8	17.0	20.5	21.8	44.0	99.8	149.5	778.1
MIN.	48.1	48.3	2.6	1.5	0.0	0.0	0.0	0.0	0.0	2.2	20.4	41.2	263.4

Table B.2.35 Supplemented Precipitation of San Agustin Station

STATION: SAN AGUSTIN NORTE													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	72.1	50.4	49.4	19.8	7.6	2.8	0.0	12.3	13.1	14.8	34.9	27.8	305.0
1978	28.2	83.2	38.6	28.2	0.0	0.0	0.0	0.0	0.0	20.3	39.6	66.0	304.1
1979	76.6	33.1	57.1	12.2	3.5	7.3	10.3	0.0	3.3	25.1	33.7	132.6	394.8
1980	44.5	80.0	22.2	61.5	25.1	0.1	0.0	0.0	0.0	41.0	13.0	21.7	309.1
1981	181.0	89.8	27.5	59.2	0.5	0.0	0.0	10.0	0.0	12.0	4.0	68.0	452.0
1982	50.5	24.0	44.5	1.5	1.0	0.0	0.0	2.5	4.0	18.5	14.5	102.0	263.0
1983	40.0	22.0	0.0	4.5	0.0	0.0	0.0	0.0	10.0	11.5	15.5	26.0	129.5
1984	159.0	38.0	111.0	0.0	0.0	0.0	0.0	10.0	0.0	55.0	69.0	53.5	495.5
1985	73.5	82.5	2.0	70.5	0.0	0.0	0.0	6.5	5.5	0.0	58.5	46.5	345.5
1986	27.5	65.5	39.0	6.5	0.0	0.0	0.0	0.0	5.0	0.0	0.0	85.0	228.5
1987	79.5	24.5	15.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	49.5	58.0	231.5
1988	29.5	32.0	39.0	78.0	1.0	0.0	0.0	0.0	0.0	0.0	26.0	52.0	257.5
MEAN	71.8	52.1	37.1	28.5	3.2	0.9	0.9	3.4	3.4	16.9	29.9	61.6	309.7
MAX.	181.0	89.8	111.0	78.0	25.1	7.3	10.3	12.3	13.1	55.0	69.0	132.6	495.5
MIN.	27.5	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.7	129.5

Table B.2.36 Supplemented Precipitation of Santa Ana Station

STATION: SANTA ANA (Pte. Carretera al Chaco)													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	120.5	39.9	42.6	1.3	5.0	0.0	0.0	1.8	12.6	47.9	44.1	65.5	381.2
1978	121.7	140.5	55.3	28.6	0.0	0.0	0.0	0.0	0.0	46.7	48.7	123.4	564.9
1979	131.5	68.0	67.3	1.0	5.5	7.0	5.8	2.0	0.0	50.6	30.4	116.4	485.5
1980	81.6	82.2	34.3	53.1	37.5	0.0	0.0	0.0	0.0	0.0	28.3	46.3	363.3
1981	195.2	109.3	44.8	24.6	0.0	0.0	0.0	2.1	2.0	10.1	45.0	48.8	481.9
1982	98.8	16.2	34.7	5.3	0.0	0.0	0.0	0.0	0.3	11.8	7.0	305.0	479.1
1983	97.7	30.8	0.0	0.7	0.0	0.0	0.4	0.0	0.6	11.5	23.7	1.6	167.0
1984	83.3	21.9	118.1	0.0	0.0	0.0	0.0	25.0	0.0	31.1	57.4	94.3	431.1
1985	101.2	118.5	27.0	37.1	0.0	0.0	1.3	7.3	4.4	9.8	63.9	147.3	517.8
1986	49.9	129.4	54.2	20.1	0.0	0.0	0.0	0.0	5.8	15.7	85.1	145.7	505.9
1987	149.6	75.7	26.1	11.9	0.5	0.0	0.0	0.0	0.0	26.1	68.9	54.6	413.4
1988	191.9	60.2	165.2	43.2	0.0	0.0	0.0	0.0	0.0	17.6	54.4	144.3	676.8
MEAN	118.6	74.4	55.8	18.9	4.0	0.6	0.6	3.2	2.1	23.2	46.4	107.8	455.7
MAX.	195.2	140.5	165.2	53.1	37.5	7.0	5.8	25.0	12.6	50.6	85.1	305.0	676.8
MIN.	49.9	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	1.6	167.0

Table B.2.37 Supplemented Precipitation of La Cabana Station

STATION: SANTA ANA (LA CABANA)													(UNIT: mm)
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1977	119.2	42.2	44.8	5.4	8.9	0.0	0.0	5.8	16.1	49.9	46.2	92.2	430.7
1978	101.4	83.7	33.0	44.3	0.0	0.0	0.0	0.0	5.1	30.9	57.3	168.0	523.7
1979	134.0	29.0	23.0	0.0	0.0	19.0	0.0	0.0	0.0	71.0	41.0	90.0	407.0
1980	82.5	107.4	58.8	34.4	10.7	0.0	0.0	0.0	0.0	47.0	12.2	48.2	401.2
1981	176.2	171.2	0.0	0.0	0.0	0.0	0.0	5.0	0.0	19.2	107.9	59.6	539.1
1982	86.4	30.0	66.7	25.0	0.0	0.0	0.0	0.0	67.0	48.0	35.0	162.6	520.7
1983	92.5	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	79.7	63.3	299.0
1984	212.7	68.3	50.8	0.0	0.0	0.0	0.0	45.0	0.0	40.4	25.0	51.7	493.9
1985	65.7	113.5	29.9	39.6	0.0	0.0	5.3	11.2	8.4	13.5	65.2	144.8	497.1
1986	51.8	127.8	56.0	23.3	0.0	0.0	0.0	0.0	9.7	19.1	85.4	143.3	516.4
1987	147.1	76.5	29.1	15.5	4.6	0.0	0.0	0.0	0.0	29.1	70.0	49.5	421.4
1988	128.7	69.0	92.0	37.6	4.7	5.0	5.4	0.0	5.8	14.6	12.8	124.4	500.0
MEAN	116.5	80.6	40.3	18.8	2.4	2.0	0.9	5.6	9.3	33.1	53.1	99.8	462.5
MAX.	212.7	171.2	92.0	44.3	10.7	19.0	5.4	45.0	67.0	71.0	107.9	168.0	539.1
MIN.	51.8	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	12.2	48.2	299.0

Table B.2.38 Areal Rainfall of Santa Ana River Basin
by Thiessen Method

(UNIT: mm)

Year	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1977	153.8	105.1	102.9	38.7	12.2	1.8	0.0	22.5	24.1	31.8	72.2	65.0	630.1
1978	69.1	182.4	79.1	55.2	0.0	0.0	0.0	0.0	0.0	38.9	77.5	139.8	642.0
1979	170.0	72.7	117.8	19.8	4.8	17.0	17.6	0.3	2.4	51.8	58.3	136.1	668.6
1980	106.7	93.6	78.6	32.4	14.2	0.9	0.0	8.5	0.0	40.9	37.8	76.1	489.7
1981	193.7	186.3	75.6	55.5	0.4	0.6	1.5	5.8	6.1	10.1	52.6	137.9	726.1
1982	93.2	67.0	120.3	32.1	3.2	0.0	0.0	0.2	8.8	26.5	43.6	186.6	581.5
1983	105.4	66.5	17.0	12.0	3.3	1.3	3.5	1.4	10.0	19.3	56.1	36.3	332.1
1984	262.4	62.3	256.6	1.7	0.0	0.0	0.0	27.7	0.2	51.0	91.3	96.2	849.4
1985	78.0	209.4	48.5	36.0	2.7	1.6	1.4	12.3	14.0	10.1	125.3	122.8	662.1
1986	54.8	225.9	72.6	47.4	0.3	0.0	0.0	0.0	11.8	25.7	65.6	194.0	698.1
1987	159.8	60.1	33.2	50.8	0.1	0.0	0.0	0.0	0.1	19.0	118.3	68.0	509.4
1988	142.0	123.4	185.3	52.5	8.5	4.6	0.0	0.0	6.0	35.6	31.5	149.3	738.7
MEAN	132.4	121.2	99.0	36.2	4.1	2.3	2.0	6.6	7.0	30.1	69.2	117.3	627.3

Table B.3.1 Monthly Mean Discharge recorded
at Santa Ana Gauging Station

(UNIT: m³/s)

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	ANNUAL
76-77	*****	*****	*****	*****	0.278	1.378	0.656	0.320	0.235	0.049	0.000	0.026	*****
77-78	0.011	0.036	0.624	0.653	5.741	0.452	0.569	0.247	0.275	0.078	0.000	0.000	0.688
78-79	0.005	0.147	1.136	3.232	1.511	2.214	0.247	0.159	0.109	0.095	0.019	0.002	0.740
79-80	0.155	0.141	1.741	2.235	1.284	1.160	0.861	0.315	0.032	0.013	0.005	0.036	0.664
80-81	0.096	0.041	0.039	2.864	3.550	0.915	0.629	0.085	0.045	0.025	0.010	0.001	0.674
81-82	0.007	0.158	0.326	1.126	0.713	1.919	0.566	0.111	0.032	0.010	0.000	0.000	0.414
82-83	0.029	0.079	0.523	0.263	0.418	0.008	0.014	0.000	0.000	0.000	0.000	0.000	0.110
83-84	0.000	0.169	0.124	3.627	0.651	3.208	0.969	0.327	0.066	*****	*****	*****	*****
84-85	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
85-86	*****	*****	*****	*****	*****	2.059	*****	*****	0.076	0.045	*****	0.003	*****
86-87	0.011	0.332	2.090	2.973	1.363	0.401	0.286	0.060	0.016	0.003	0.000	0.000	0.627
87-88	0.000	0.758	1.923	3.112	3.514	3.774	1.713	0.228	0.115	0.073	0.042	0.011	1.260
88-89	0.000	0.624	1.552	1.325	0.644	0.721	*****	*****	*****	*****	*****	*****	*****
MEAN	0.031	0.249	1.008	2.141	1.788	1.517	0.651	0.185	0.091	0.039	0.009	0.008	0.638
MAX.	0.155	0.758	2.090	3.627	5.741	3.774	1.713	0.327	0.275	0.095	0.042	0.036	1.260
MIN.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table B.3.2 Supplemented Runoff Discharge and Runoff Coefficient
(D.R = 248.79 Km²)

(Unit: m³/s)

															(Unit: m3/s)		
YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL (MCH)	Rain (mm)	R. Co. (%)		
1977	2.109	0.278	1.378	0.656	0.320	0.235	0.049	0.000	0.026	0.011	0.036	0.624	15.170	630.1	9.7		
1978	0.653	5.741	0.452	0.569	0.247	0.275	0.078	0.000	0.000	0.005	0.147	1.136	23.342	642.0	14.6		
1979	3.232	1.511	2.214	0.247	0.159	0.109	0.095	0.019	0.002	0.155	0.141	1.741	25.347	668.6	15.2		
1980	2.235	1.284	1.160	0.861	0.315	0.032	0.013	0.005	0.036	0.096	0.041	0.039	16.085	489.7	13.2		
1981	2.864	3.550	0.915	0.629	0.085	0.045	0.025	0.010	0.001	0.007	0.158	0.326	22.082	726.1	12.2		
1982	1.126	0.713	1.919	0.566	0.111	0.032	0.010	0.000	0.000	0.029	0.079	0.523	13.437	581.5	9.3		
1983	0.263	0.418	0.008	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.169	0.124	2.544	332.1	3.1		
1984	3.627	0.651	3.208	0.969	0.327	0.066	0.000	0.065	0.000	0.119	0.214	0.494	25.868	849.4	12.2		
1985	1.448	3.887	0.900	0.669	0.051	0.101	0.003	0.029	0.033	0.024	0.293	0.898	21.224	662.1	12.9		
1986	1.015	4.190	2.059	0.878	0.006	0.076	0.045	0.000	0.003	0.011	0.332	2.090	27.474	698.1	15.8		
1987	2.973	1.363	0.401	0.286	0.060	0.016	0.003	0.000	0.000	0.000	0.758	1.923	20.406	509.4	16.1		
1988	3.112	3.514	3.774	1.713	0.228	0.115	0.073	0.042	0.011	0.000	0.624	1.552	30.708	738.7	21.1		
MEAN	2.055	2.258	1.532	0.671	0.159	0.092	0.033	0.014	0.002	0.038	0.249	0.956	20.974	627.3	13.4		

Table B.3.3 Maximum daily Rainfall and its Probable Rainfall

Year	TARIJA AASANA	EL TEJAR UNIV.	ALTO CAJAS	YESERA NORTE	JUNACA	SAN PEDRO	GAMONEDA	SAN AGUSTIN	SANTA ANA	LA CABAN CENTRO	LADERA
1977			45.6	42.0	53.0				20.3		
1978	51.0	38.3	56.5	38.0	60.0				31.2		
1979	34.6	32.0	53.2	53.2	82.0	34.5	24.0	39.0	47.9	60.0	36.0
1980	39.7	46.0	36.5	42.3	33.0	40.0	26.0	39.0	37.5	40.5	55.0
1981	64.4	49.5	51.0	73.0	57.0	71.4	55.5	40.0	43.2	62.0	68.0
1982	41.0	58.0	26.0	40.2	39.0	50.1	37.4	39.0	98.6	67.0	40.4
1983	34.0	30.0	20.0	35.2	50.0	22.8	14.0	18.0	22.4	48.5	40.0
1984	59.0	47.3	48.3	97.0	72.0	60.0	55.0	55.5	28.3	49.2	70.0
1985	84.7	91.5	72.6	64.0	36.0	37.9	41.2	40.0		50.5	72.5
1986	42.0	64.0	35.4	68.0	36.0	47.9	41.2	20.5			60.5
1987	97.8	80.0	40.0	48.2	30.0	43.0	53.5	30.0	72.0		41.5
1988	40.1	66.5	37.0	53.0	40.0	53.1	56.1	16.5	67.0		40.0
Max.	97.8	91.5	72.6	97.0	82.0	71.4	56.1	55.5	98.6	67.0	72.5
Mean	53.48	54.83	43.51	54.51	49.00	46.07	40.39	33.75	46.84	53.96	52.39
S(h)	20.20	18.54	13.61	17.37	15.70	13.01	14.29	11.70	23.90	8.59	13.67
u	44.39	46.48	37.39	46.69	41.94	40.21	33.96	28.48	36.09	50.09	46.24
α	0.064	0.069	0.094	0.074	0.082	0.099	0.090	0.110	0.054	0.149	0.094
Cd	0.817	0.716	0.653	0.668	0.672	0.581	0.756	0.738	1.189	0.308	0.531
Tc	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
10	8.32	8.23	6.38	8.04	7.24	6.56	6.15	5.11	8.15	6.76	7.30
50	10.94	10.63	8.14	10.29	9.27	8.25	8.00	6.62	11.25	7.87	9.07
I 100	12.07	11.67	8.90	11.25	10.14	8.97	8.80	7.28	12.58	8.35	9.84
200	13.19	12.70	9.66	12.22	11.02	9.70	9.60	7.93	13.91	8.83	10.60
500	14.68	14.07	10.66	13.50	12.18	10.66	10.65	8.79	15.67	9.47	11.61
10	393.7	389.5	301.9	380.5	342.6	310.4	291.0	241.8	385.7	319.9	345.5
50	517.7	503.1	385.2	487.0	438.7	390.4	378.6	313.3	532.4	372.4	429.2
Q 100	571.2	552.3	421.2	532.4	479.9	424.5	416.5	344.5	595.3	395.2	465.7
200	624.2	601.0	457.1	578.3	521.5	459.0	454.3	375.3	658.3	417.9	501.6
500	694.7	665.8	504.5	638.9	576.4	504.5	504.0	416.0	741.6	448.2	549.4

Table B.3.4 Direct Runoff Increments for Computing Design Flood

Time (hr)	Inc. Runoff (in)	Qp (ft-s)	Incremental hydrographs		
			Begin T (hr)	Peak T (hr)	End T (hr)
1	0.00	0	0.00	4.50	12.00
2	0.00	0	1.00	5.50	13.00
3	0.00	0	2.00	6.50	14.00
4	0.00	0	3.00	7.50	15.00
5	0.00	0	4.00	8.50	16.00
6	0.00	0	5.00	9.50	17.00
7	0.00	0.0	6.00	10.50	18.00
8	0.00	0.0	7.00	11.50	19.00
9	0.01	84.4	8.00	12.50	20.00
10	0.04	370.7	9.00	13.50	21.00
11	0.06	666.8	10.00	14.50	22.00
12	0.09	977.5	11.00	15.50	23.00
13	0.13	1333.9	12.00	16.50	24.00
14	0.17	1802.1	13.00	17.50	25.00
15	0.24	2470.3	14.00	18.50	26.00
16	0.36	3765.3	15.00	19.50	27.00
17	1.05	10986.0	16.00	20.50	28.00
18	0.37	3847.0	17.00	21.50	29.00
19	0.24	2487.3	18.00	22.50	30.00
20	0.19	1985.0	19.00	23.50	31.00
21	0.16	1716.2	20.00	24.50	32.00
22	0.15	1548.1	21.00	25.50	33.00
23	0.14	1412.3	22.00	26.50	34.00
24	0.13	1310.2	23.00	27.50	35.00

Table B.3.5 Peak of Triangle Hydrograph

Time (hr)	Rainfall			Direct runoff			Inc. loss (mm)
	Inc. (mm)	Acc. (mm)	Acc. (in)	Acc. (in)	Acc. (mm)	Inc. (mm)	
1	3.6	3.6	0.14	0.00	0.00	0.00	3.60
2	3.7	7.3	0.29	0.00	0.00	0.00	3.70
3	3.8	11.1	0.44	0.00	0.00	0.00	3.80
4	4.0	15.1	0.59	0.00	0.00	0.00	4.00
5	4.1	19.2	0.76	0.00	0.00	0.00	4.10
6	4.3	23.5	0.93	0.00	0.00	0.00	4.30
7	4.5	28.0	1.10	0.00	0.00	0.00	4.50
8	4.7	32.7	1.29	0.00	0.00	0.00	4.70
9	5.0	37.7	1.48	0.01	0.21	0.21	4.79
10	5.4	43.1	1.70	0.04	1.11	0.90	4.50
11	5.8	48.9	1.93	0.11	2.73	1.62	4.18
12	6.3	55.2	2.17	0.20	5.11	2.38	3.92
13	7.0	62.2	2.45	0.33	8.36	3.25	3.75
14	8.1	70.3	2.77	0.50	12.74	4.39	3.71
15	9.8	80.1	3.15	0.74	18.76	6.01	3.79
16	13.4	93.5	3.68	1.10	27.92	9.16	4.24
17	34.4	127.9	5.04	2.15	54.66	26.74	7.66
18	11.2	139.1	5.48	2.52	64.02	9.36	1.84
19	7.1	146.2	5.76	2.78	70.08	6.05	1.05
20	5.6	151.8	5.98	2.95	74.91	4.83	0.77
21	4.8	156.6	6.17	3.11	79.09	4.18	0.62
22	4.3	160.9	6.33	3.26	82.86	3.77	0.53
23	3.9	164.8	6.49	3.40	86.29	3.44	0.46
24	3.6	168.4	6.63	3.52	89.48	3.19	0.41

Table B.3.6 Composed Flood Discharge

Time (hr)	01	02	03	04	05	06	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Unit: (cfs/s)
0.0																								0
1.0																								0
2.0																								0
3.0																								0
4.0																								0
5.0																								0
6.0																								0
7.0																								0
8.0																								0
9.0																								0
10.0																								0
11.0																								0
12.0																								0
13.0																								0
14.0																								0
15.0																								0
16.0																								0
17.0																								0
18.0																								0
19.0																								0
20.0																								0
21.0																								0
22.0																								0
23.0																								0
24.0																								0
25.0																								0
26.0																								0
27.0																								0
28.0																								0
29.0																								0
30.0																								0
31.0																								0
32.0																								0
33.0																								0
34.0																								0
35.0																								0
36.0																								0

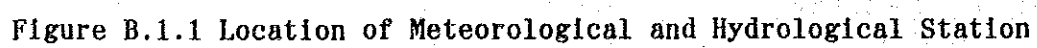


Figure B.3.1 Correlation between Accumulative Rainfall and Accumulative Runoff

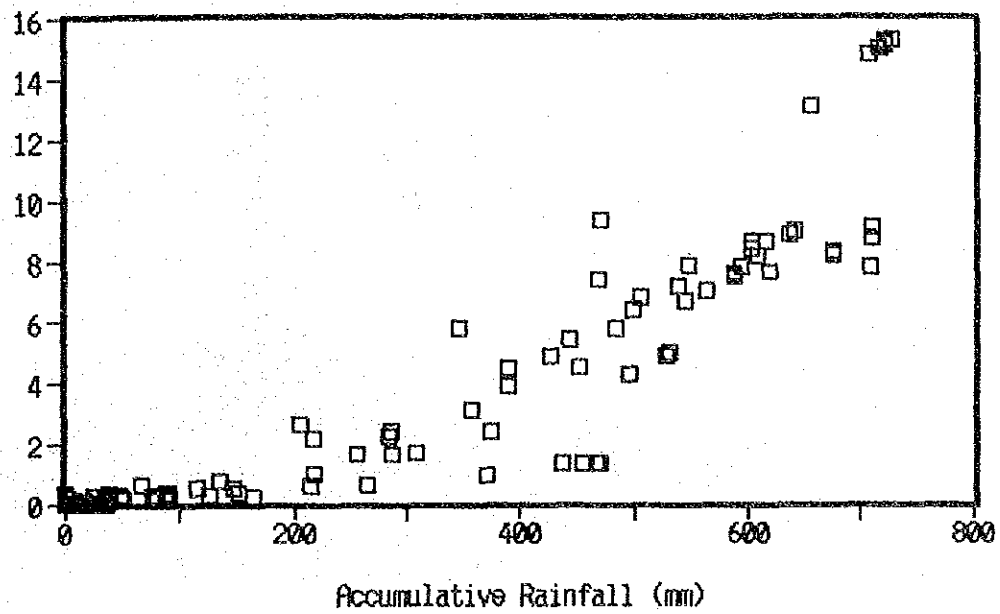


Figure B.3.2 Supplemented Runoff at Santa Ana Gauging Station

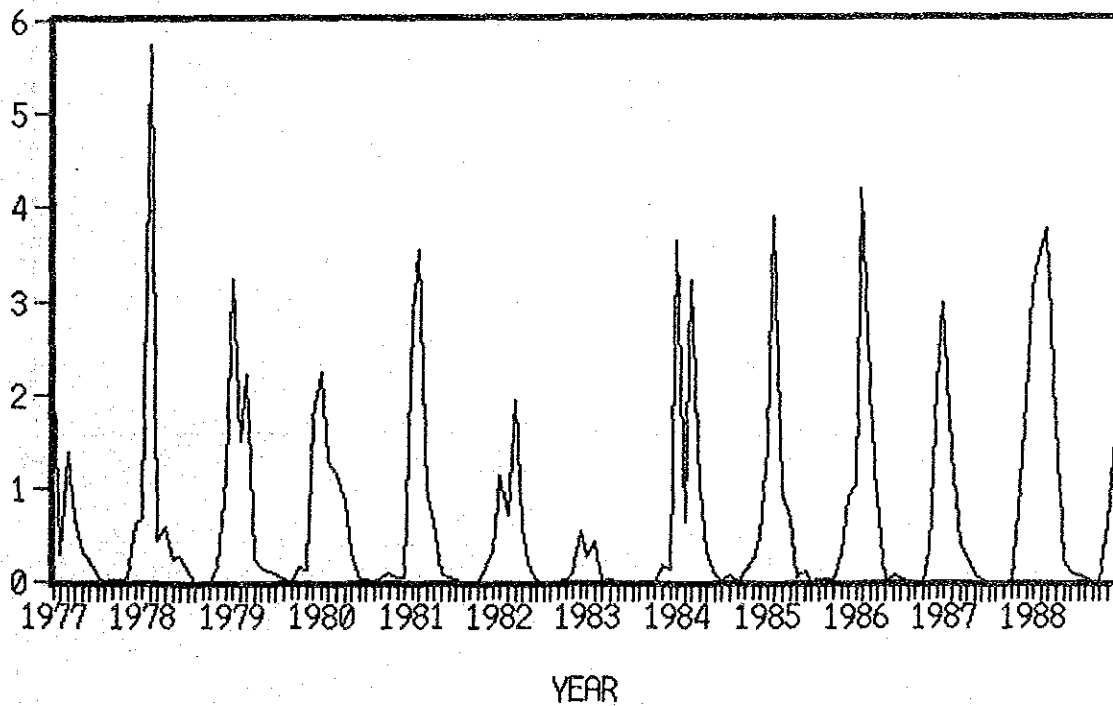


Figure B.3.3 Rainfall Distribution

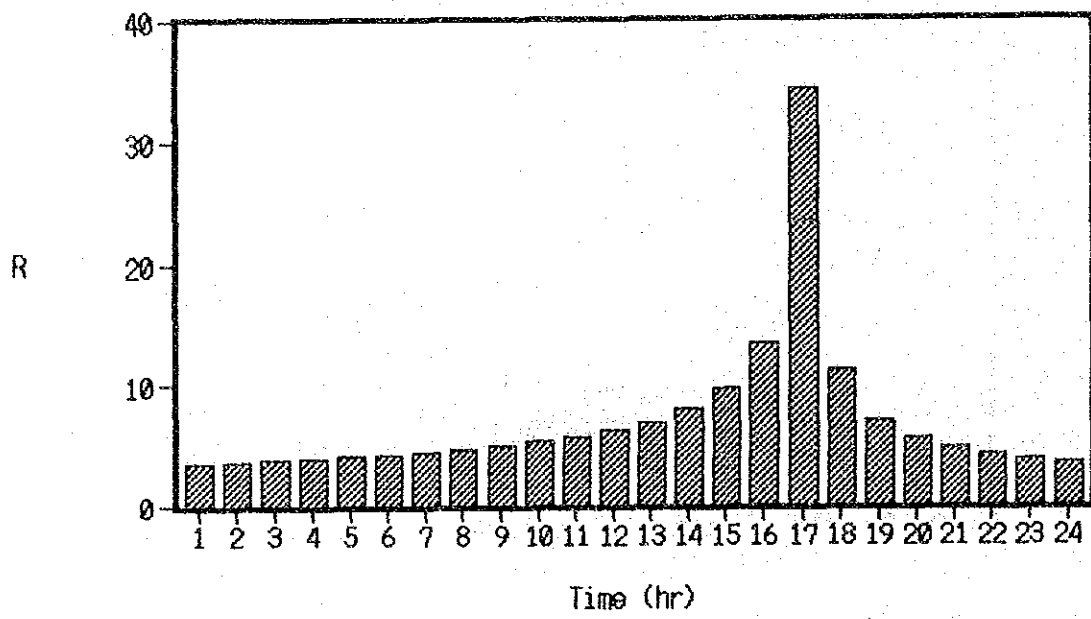


Figure B.3.4 Composed Hydrograph

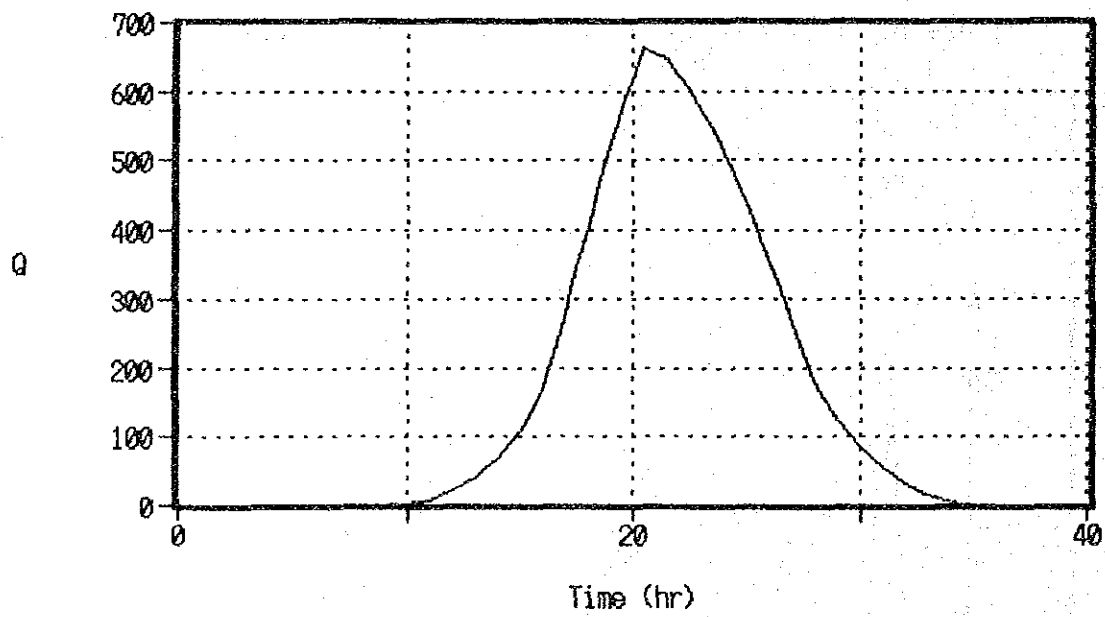


Figure B.3.5 Estimation of r_e employed in Rational Formula

