

**THE REPUBLIC OF GUATEMALA
MINISTRY OF AGRICULTURE,
CATTLE AND FOOD RESOURCES**

**FEASIBILITY STUDY
ON THE MONJAS IRRIGATION PROJECT**


FINAL REPORT



**VOLUME II :
APPENDIX 1**

JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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国際協力事業団

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VOLUME II: APPENDIX

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1 . INTRODUCTION

1. INTRODUCTION

1.1 Work Flow of the Study

Table A.1.1-1 Overall Study Schedule

Fig. A.1.1-1 Overall Work Flow of the Study

Fig. A.1.1-2 Work Flow of Dam Plan

Table A.1.1-1 Overall Study Schedule

Work item	Year Month	1987						1988				
		JUL	AUG	SEPT	OCT	NOV	DEC	JUN	FEB	MAR	APR	MAY
Preparatory work												
Study in WORK I												
Field survey work												
(1) Explanations and discussion on Inception Report												
(2) Installation of water gauge												
(3) Field survey												
(a) Meteorology and hydrology												
(b) Topography												
(c) Hydrogeology and geology												
(d) Soil												
(e) Irrigation and drainage												
(f) Land use and land tenure												
(g) Agricultural survey												
(h) Agro/regional economy and institution												
(i) Operation and maintenance of water utilization facilities												
(j) Construction material and its cost												
(k) Others												
(4) Extraction and arrangement of the point at issue												
(5) Orientation of basic development concept												
(6) Preparation of Field Report												
Home office work												
(1) Analysis of result of field survey work												
(2) Establishment of basic development concept												
(3) Preparation of Interim Report												
Study in WORK II												
Field survey work												
(1) Explanation and discussion on Interim Report												
(2) Collection and assortment of supplementary data												
(3) Field survey												
(a) Hydrogeology												
(b) Soil												
(c) Land use												
(d) Irrigation and drainage												
(e) Dam plan/Cost estimate & construction plan												
(f) Facilities plan												
(g) Agricultural survey												
(h) Agro/regional economy and institution												
(4) Establishment of development alternatives												
Home office work												
(1) Establishment of development plan												
(2) Preliminary design of facilities												
(3) Construction plan												
(4) Maintenance and operation plan												
(5) Calculation of project cost and benefit												
(6) Project evaluation												
(7) Overall evaluation												
(8) Project implementation plan												
(9) Preparation of Draft Final Report												
Field explanation												
(1) Field explanation of Draft Final Report.												
Domestic correction work												
(1) Preparation of Final Report												

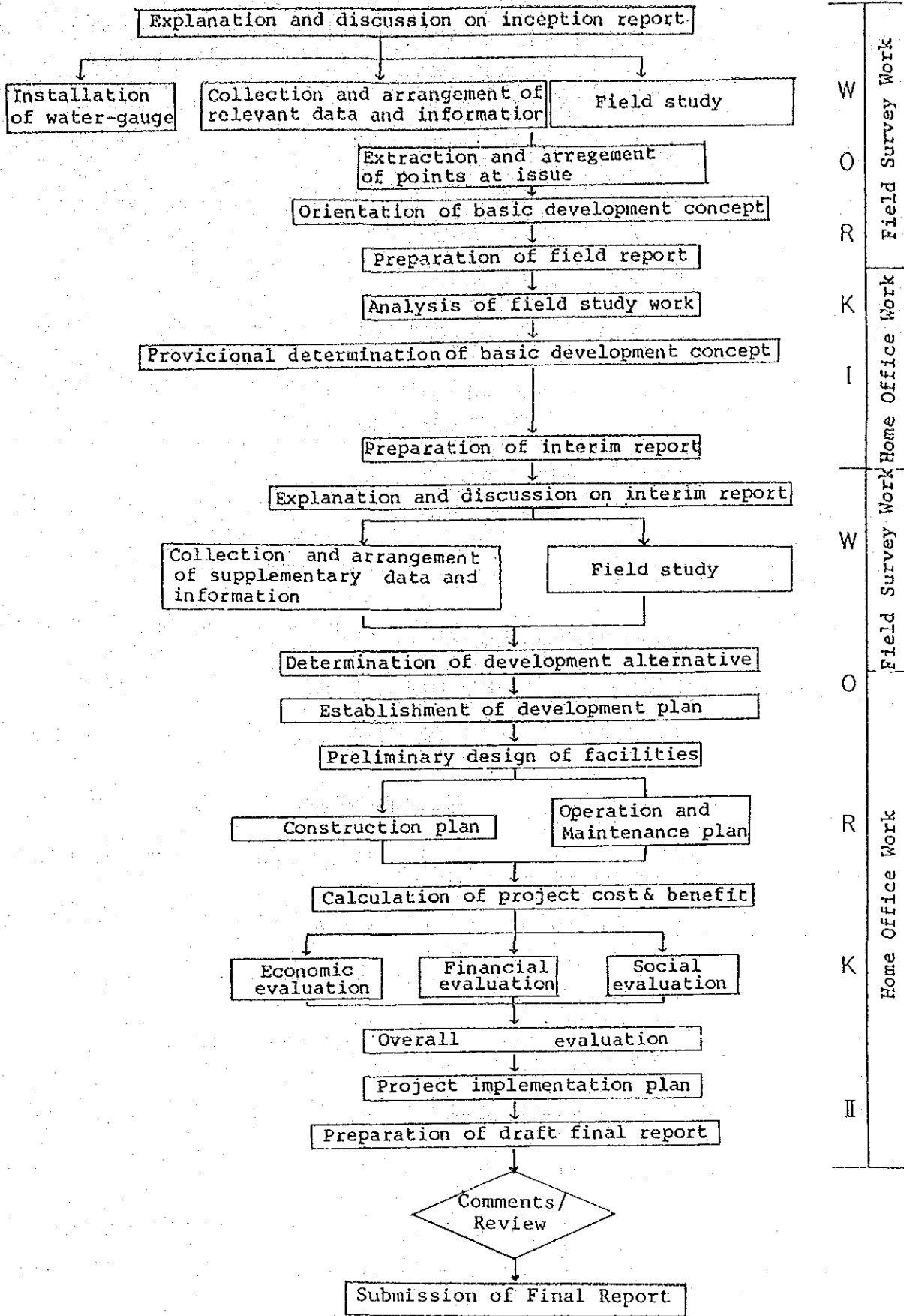


Fig. A.1.1-1 Overall Work Flow of the Study

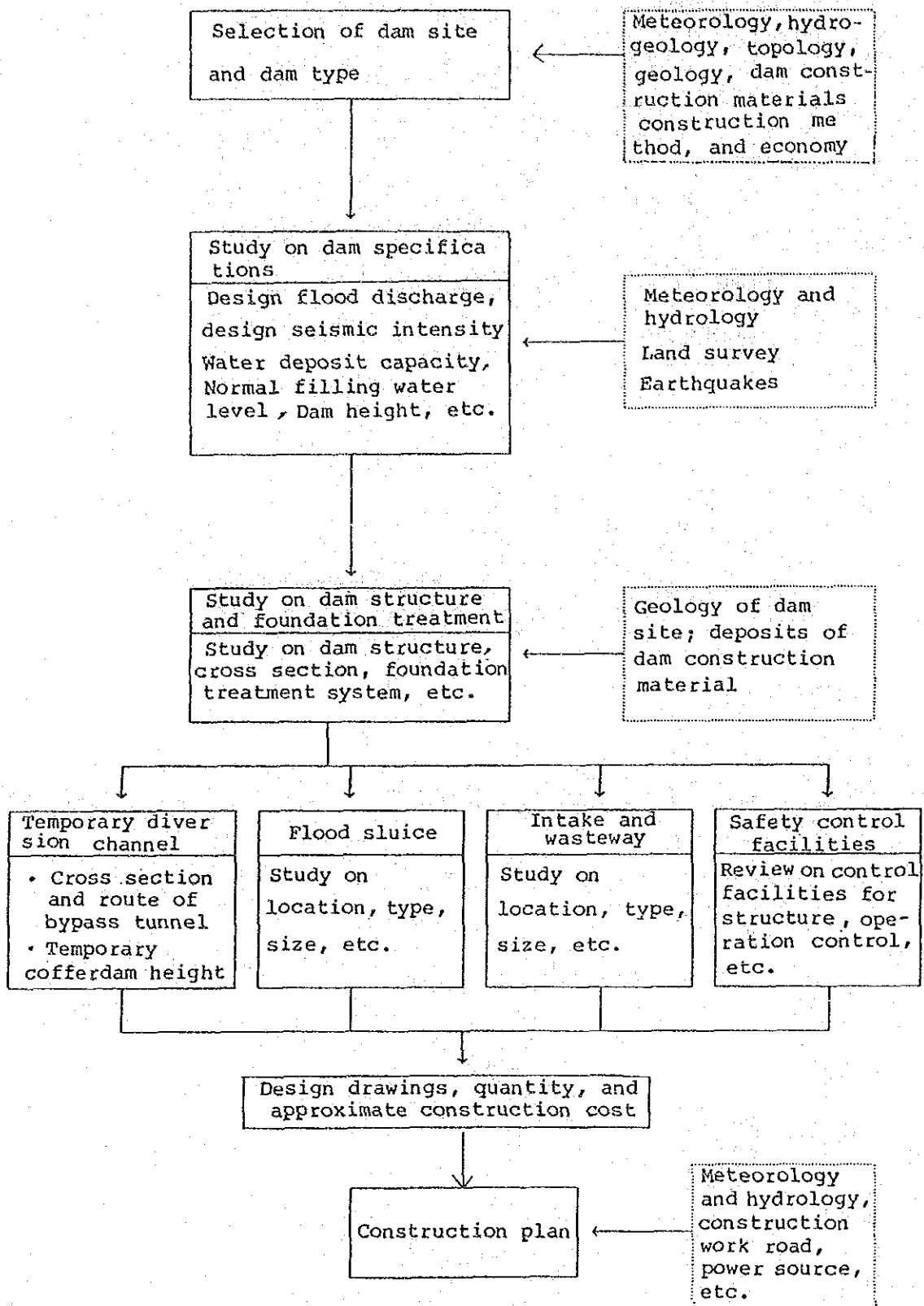


Fig. A.1.1-2 Work Flow of Dam Plan

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2. SOCIO-ECONOMIC BACKGROUND

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2.3.1 Background

2.3.2 Fundamental Objects of the Plan

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2. SOCIO-ECONOMIC BACKGROUND

2.1 General Feature of the Republic

2.1.1 Physical Feature of the Republic

The Republic is located in latitude 13°45' to 17°44' north and from longitude 88°13' to 92°14' west. The northern and western end of the Republic are defined by the Republic border with Mexico. The southern and eastern ends of the Republic face to the Pacific Ocean and Belize and the Caribbean Sea, respectively. Honduras and El Salvador are located in the southeast of the Republic. The Republic extends approximately 108,889 Km².

Many volcanos such as Tajumulco (4,220m), the highest mountain in Central America, Tacana, Acatenango, etc. are distributed in the volcanic range which is ranged along the Pacific coast of the Republic. Branches of the Sierra Madre range like the Cuchumatanes, etc. ranges in the north of the Sierra Madre range. One half of the southern part of the Republic is mountainous. Other half of the Republic in the north which is located in the Yucatan Peninsula is plain and covered with forest. Rivers flowing into the Caribbean Sea from the mountain area have generally moderate slope and long course, on the other hand, rivers flowing into the Pacific Ocean have steep slope.

The climate of the Republic ranges from the tropical zone in the low land area to the temperate zone in the mountain area, since the country is located in the low latitude and mountainous. There are dry and wet seasons in a year. Wet season starts on May and ends on October and most of rainfall is concentrated in the wet season.

2.1.2 Political System and Regional Administration

The political systems of the Republic is a constitutional republican form. In 1986, civil government was authorized and new constitution became effective. Mr. Cerezo was inaugurated as a President and emphasized the union with liberalism countries such as U.S.A. and Central American countries as foreign policy.

Regional administration is divided into 22 departments which are under the rule of governor. Departments consists of 330 municipalities such as 31 cities (ciudad), 30 towns (villa) and 269 villages (pueblo).

2.1.3 Population

The total population of the Republic is approximately 8.195 million and 37.5% of this concentrate in cities. Average population density of the country is 75 person/Km² (at mid-year 1986; *Algunas Cifras acerca de Guatemala 1986*, INE 1987). Recent rate of population growth has reached 2.8% (Table A.2.1.3-1).

Approximately 42% of indigenous, 58% of white and mixed blood are racial formation of the Republic (INE, 1987).

Recent rate of natality and mortality have been decreased. Average rate of natality and mortality between 1980 and 1985 are 4.2% and 1.05%, respectively (Table A.2.1.3-2). Expected life at birth has increased year by year and average life span between 1980 and 1985 has reached 59 years old (INE, 1987). Number of child birth has decreased however, average number of child birth is 6.1 person which is one of the highest among South and Central American countries (CEPAL 1986).

Economically active population is amounted to 2.6 million which is account for 32% of the total population of the Republic (Table A.2.1.3-3). Agriculture, hunting, forestry and fishing sector occupy the biggest share which reaches 56% of the total economically active population (Table A.2.1.3-4). Rate of unemployment has increases especially the rate of wholly unemployment has reached the high level over 10% in 1985. The total rate of unemployment which is the sum of the rate of wholly unemployment (14.5%) and the rate of underemployment (29.7%) reached 44.2% (Table A.2.1.3-5).

The living standard is an upward tendency and food situation is being improved, however necessary carolic intake is not sufficient. The proportion against necessary carolic intake between 1979 and 1981 is estimated 97.6% (Table A.2.1.3-6). The rate of illiteracy reaches 56.4% (INE, 1986).

According to the projections of total population, increasing rate of population will decrease year by year, however total population of the Republic will be estimated to exceed 10 million in 1995, 12.22 million in 2000 and 20 million in 2025 (Table A.2.1.3-7).

2.2 NATIONAL ECONOMY AND AGRICULTURE

2.2.1 National Economy

(1) Outline of National Economy

The Republic has high potential of productivity due to diversificated natural conditions and the largest population among five countries of the Central America. A variety of agricultural production is produced due to fertile soil and various climate spread all over the country and hold first place of the exportation of the country. Accordingly, national economy of the Republic is directly affected by outputs and movement of international market of agricultural productions.

(2) Economic Growth

The rate of economic growth of the Republic for last six years shows negative rate of growth except in 1984. The decrease of exportation, the policy of retrenchment and the decrease of actual income influence basically such as aggravation of economic conditions.

The gross domestic product (GDP) in 1985 is estimated approximately 9.69 billion US dollars and GDP per-capita is estimated about 1,220 US dollars. The GDP per-capita reached about 1,490 US dollars in 1980 which was the peak for last 6 years, however it has been on the decrease since 1980. The accumulated negative rate reaches 18.8% (Table A.2.2.1-1).

Agriculture, hunting, forestry and fishing sector, wholesale and retail trade, restaurants and hotel sector and manufacturing sector occupy the greater part and agriculture, hunting, forestry and fishing sector reaches about 25% of the total GDP (Table A.2.2.1-2).

(3) Foreign Trade

The exportation of the Republic increases double in the latter half of the 1970's, however dropping of international price and decreasing of demand of traditional export products such as cotton, meat, cardamom, etc. and stagnant of the Central American Common Market (CACM) owing to the world wide depression caused decreasing of the exporting of the Republic in 1981.

While the importation increased continuously up to 1981 however, due to strengthen of foreign exchange control and import control in addition to the decrease of domestic demand the import decreases 17% in amount in 1982 comparing with 1981. Moreover, the trend of decreasing of importation is continuing due to the depreciation in foreign exchange rate which became double in 1985. Recent balance of visible trade shows deficiency (Table A.2.2.1-3).

Coffee which occupy the biggest share of export product accounts for 43% of the total export amount followed by cotton, banana and cardamom in due order. Raw materials occupy most share of import items and account for more than 50% of the total import amount (Table A.2.2.1-4), 38% of total exportation is shared to the U.S.A. and others are CACM, EEC and Japan in due order. Importation from the U.S.A. occupy also the biggest share which account for 37% of the total followed by CACM, West Germany, Venezuela and Japan in due order. Recently, the proportion of trade between the Republic and CACM has decreased especially in amount of the exportation (Table A.2.2.1-5).

(4) Balance of Payments

The balance of payments in the Republic which sustained a big surplus in the latter half of the 1970's was shifted in deficiency and continued up to 1982. However, global balance has been shifted in surplus after 1983 owing to the decrease of trade balance (service) loss and short-term capital loan procured for the deficiency of current balance (Table A.2.2.1-6).

(5) International Reserves and External Debt

The international reserves which started decreasing in the latter half of the 1970's has increases since 1983. The international reserves in 1985 reached 323 million US dollar (Table A.2.2.1-7). And 514.9 million US dollar was published by Guatemala Bank.

The external debt has increases in order to load for public investment and reached 2,644 million US dollar in 1985, however, decreased 4.3% in 1986 in comparison with 1985 (Table A.2.2.1-8).

The debt service ratio (DSR) reached 16% in 1984 and be estimated 30% in 1985 (Progreso Economico y Social en America Latina, BID, 1986).

(6) Foreign Exchange

The Government of the Republic determined to change the value of Quetzal against the US dollar which was kept long time in order to open the free exchange market and the multiple rate of exchange on November 1984. This determination was made in order to take a countermeasure against the export business, shortage of foreign currencies reserve and black market of foreign exchange which has been active since 1981. There are three kind of exchange rates namely an official rate, a bank rate (free rate) and a bid rate. The bank rate which was Q 1.5/US\$ in the early of 1985 devaluated to Q 4/US\$ on September, 1985 and have been upvaluated since that time. The present bank rate on September 1987 is about Q 2.7/US\$.

(7) Domestic Investment

The public investment have been retrenched due to the tight financing policy of the Government. In comparison with public investment in 1981, that on 1985 reduced about 70%. The private investment also have been reduced due to several reason such as low productivity, instability of foreign exchange, incertain policy, etc. The investment ratio toward all economic activity have been reduced from 13% of GDP in 1981 to 8% of that in 1985 (Table A.2.2.1-9).

(8) Balance of Government Finance

The deficit government finance has been sumed up year and year recently. The total deficit in 1981 reached to 638 million quetzales. However, the enlargement of financial dificit ended in 1982 due to the expenditure damping policy by the Government.

The tax revenue accounts for 79% of the annual revenue in 1985 and the indirect tax accounts for 81% of the tax revenue. The annual revenue which has trend of decreasing since 1980 recovered and amounted to 862 million quetzales in 1985 (Table A.2.2.1-10).

(9) National Budget

The national budget in 1987 is described as follow:

	(million quetzales)
Total budget	2,556.2
Total revenue	
Current revenue	1,992.7
Capital revenue	633.5

Tax revenue amounted to 1,667 million quetzales which is estimated increasing of 25.2% occupies the current revenue. The characteristic structure of total revenue in the Republic that the share of direct tax revenue is extremely small. Indirect tax of which the value added tax 715.4 million quetzales (42.9%) like commodity tax (IVA) and export and import tax 6,283 million quetzales (37.7%), reached 80.6% of the total tax revenue. On the other hand, the direct tax amounted to 233.6 million quetzales shares only 14.0% of the total tax revenue.

The capital revenues consists of the foreign debt and the national bond. The former is made up of soft loan from Inter-American Development Bank (IADB) amounted to 289.7 million quetzales and the latter is restained and amounted to 343.8 million quetzales which is the main reason of 29.8% decrease of the public debt in comparing with 1987.

Total Expenditure

	(million quetzales)
Current Expenditure	1,426.5
Capital Expenditure (Public Investments)	616.5
Liabilities	513.2

Inflation, rising of government employee's salary, etc. oblige the second year democratic government to increase the current expenditure. The capital expenditure is kept as much as that of 1986 and be planned to appropriate for public investment of local government in order to propel the separation of local government from the central in accordance with the National Reorganization Programme after the Socio-economic Reform Programme in 1986.

In order to expand regional educational and social welfare sufficiencies, budget of Ministries of Education and Public Health and Social Welfare are increased as much as that of Ministry of National Defense. The budget of Ministry of Public Finance includes parliament of liabilities.

	(million quetzales)
National Congress	8.0
Judicial	12.5
Presidential Office	44.8
Foreign Affairs	30.3
National Defense	265.8
Interior	87.3
Public Finance	1,052.3
Education	332.7
Public Health and Social Welfare	219.9
Labor and Social Security	5.0
Economics	6.1
Agriculture, Livestock and Food	112.4
Communication and Public Works	306.9
Energy and Mining	41.4
Specific Affair	1.2
Culture and Sport	22.2
Urban and Regional Development	12.7
Public Prosecutor	1.6
Financial Audit	5.8
TOTAL	2,556.2

(10) Price Index

The increasing of the rate of consumer price index which decreased once in 1982 has increased 18.7% and 36.9% in 1985 and 1986, respectively.

Commodity items which soared in price were foods, drinks, clothes, shoes, furniture and kitchen utensils. The wholesale price index during this period has shown similar trend. Due to the devaluation of foreign exchange rate in 1984, price of construction materials were soared about 84.9% (Table A.2.2.1-11).

The rate of inflation which had undergone a relatively constant change has exceeded more than 30% of 1985 (Table A.2.2.1-12).

This rapid inflation and the rate of unemployment which exceed more than 10% are causes of a fall of actual wages and a decrease of individual consumption. As a result, the consumption level per capital has fallen to the level of the early half of 1970's.

2.2.2 Agriculture

Agriculture is basic economical activity of the Republic and accounts for 25% of GDP and employs about 56% of population of economic activities. The importance of agriculture is related to following items:

- Acquisition of foreign currencies (agricultural products account for more than 60% of total export amount of the Republic);
- Bearing the fiscal revenue (agricultural products exportation account for 88.9% of total export tax in 1984);
- Food supply for the people; and
- Stable income for farmers.

Moreover, agricultural activity contributes to the other economical activities as follows:

- Development of service sector related with agricultural production and distribution of agricultural products,
- Improvement of foreign trade,
- Development of agricultural credit system, and
- Development of agricultural processing.

In the Republic, about 3,148 thousand ha of the land (1983) is utilized for agricultural purpose which corresponds to about 29% of total national land. Of these agricultural land, about 1,330 thousand ha which corresponds to about 42% of agricultural land is cultivated annual crops, 484 thousand ha corresponds to about 15% for perennial crops and the balance of 1,334 thousand ha is pasture.

The irrigated area is 74 thousand ha which corresponds to only 2.4% of total agricultural land (Table A.2.2.2-1).

The national irrigation has been operated from 1965 and the irrigated area increased rapidly. Actually, the irrigated area of about 15,000 ha is operated in 25 districts. The majority of irrigated districts are located in Zacapa, Jutiapa, El progreso and Jutiapa departments, east and southeast of the country (Table A.2.2.2-2).

According to the agricultural census, number of small-scale farmers who own farms less than 7 ha corresponds to about 88% of total number of farm families. However, these farmers hold only 16.5% of the nation's agricultural lands. On the other hand, the number of large-scale farmers who owns more than 45 ha is only 2.6% of total farm families however, they own 65% of total agricultural land (Table A.2.2.2-3).

Concerning planted areas of main crops, maize occupy 40% of the total upland field and account for 50% of annual crops on upland field. Coffee account for 50% of perennial crops on upland field. Planted area of maize and coffee have not changed recently, however planted area of kidney beans and sorghum have increased. Planted area of cotton shows trend of decrease (Table A.2.2.2-4).

The production volume of main crops such as maize, kidney beans, coffee are 1196 thousand tons, 101 thousand tons, 184 thousand tons, respectively (Table A.2.2.2-5). The production of maize, kidney beans, sorghum and rubber show increasing trend and cotton shows decreasing trend.

Yields of main crops such as maize, kidney beans, coffee are 1,770 kg/ha, 640 kg/ha, 700 kg/ha, respectively (Table A.2.2.2-6). The yield of maize has been increased little however, concerning kidney beans, sorghum, etc. the yields have been decreased.

Basic crops for domestic consumption such as maize, rice, kidney beans, and wheat are imported partly due to increasing of domestic demand. The total import amount of basic crops has no change in spite of decreasing of total import amount in the Republic. The importation of wheat shares the biggest amount and accounts for about 30% of the total food importation (Table A.2.2.2-7). Import volume of basic crops like wheat, corn are 136 thousand tons and 15 thousand tons, respectively, in 1985 and corresponds to 260% and 1.3% of domestic production, respectively (Table A.2.2.2-8).

Exportation amount of agricultural products accounted for more than two-third of the total exportation amount of the Republic. Exportation amount of coffee occupied 60% of the total amount of export and reached 411 million quetzales which corresponded to 40% of the total amount of export in 1985. Other crops which are relatively big amount of export are banana, cotton, cardamom, sugar, vegetables, in due order. Exportation amounts of coffee, cardamom have shown trend of increasing recently while that of cotton, vegetables, fruits have shown decreasing trend (Table A.2.2.2-9). Exportation of basic crops are maize and kidney beans however quantities are very small (Table A.2.2.2-10).

Main livestock products are beef cattle and swine. In 1984, about 316 thousand heads of beef cattles and 310 thousand heads of swine were slaughtered (Table A.2.2.2-11). The total amount of export of meat reached 8,962 million quetzales in 1985. The trend of meat exportation has decreased recently (Boletin Estadistico, Banco de Guatemala, 1986).

Various indexes of agricultural products have trend of decreasing especially an index of the food production per capita have fallen since 1983 which is lower than the level between 1974 and 1976 (Table A.2.2.2-12).

The low productivity and variation of production by year are caused by lack of proper production system and adjustment of agricultural foundation. Lack of capital, lack of proper agricultural credit, petty farming, lack of technical assistance are became serious problems.

2.3 National Development Plan

2.3.1 Background

The new government authorized on December, 1985 is propeling National Reorganization Programme as a national movement under the slogan of social reformation and equal opportunity in order to improve the living situation of low and middle class people. At the same time, the new government is establishing a draft of national development plan and public investment plan from 1987 to 1991.

2.3.2 Fundamental Objects of the Plan

The National Development Plan (1987-1991) is not announced officialy at present, however according to data obtained, it can be said that the plan has fundamental objects to satisfy the basic needs for the people by utilizing resources and people's self-effort. In order to establish the strategy, followings are planned policies:

- The extention, protection and restructure of production,
- The separation of economics and politics from the central government,
- The reorganization for the people's participation,
- The policy for adjustment of national aim, and
- The unity of nation.

2.3.3 Development Plan in Agricultural Sector

Outline of development plan in agricultural sector is stated below:

(1) Analisys of problems

1) External problems

The exportation of agricultural products has shown comparatively high rate in agricultural sector till 1979. However, the exportation of agricultural products has been affected much by world economy which has been in critical situation since 1980's as well as in regional economy such as CACM.

Much reliance of import production materials causes export instability and reduces foreign exchange holding. This obstruct the economic development and causes recession.

2) Internal problems:

Agricultural sector faces increase of unemployment and recession due to the augmentation of umbalance which means the increase of petty and tenant farm. This phenomena induce the urbanism and increase poor people.

The increase of production cost due to a price hike of production material reduces the actual income of farmer. As the result of this, no-agricultural income is necessary for farmer.

(2) Fundamental objectives in Agricultural Sector.

The fundamental objective in agricultural sector is to improve the farmer's living condition. For this object, several slogans are announced as follows:

- Increase of production and productivity,
- Fair distribution of income, and
- Most effective utilization of natural resources.

Other main objects which are related to the national development plan are as follows:

- Increase of income in agricultural sector,
- Fair distribution of profit to the poor,
- Increase of actual income in rural region by balancing the supply and demand of labour,
- Development of food production system, and
- Diversification and extension of agricultural sector and agricultural export product through agricultural processing.

(3) Policy

Policies to be carried out by the national development plan in agricultural sector are as follows:

- Reserve of land and water resources,
- Organizing of small and medium-scale farms,
- Technical development and popularization,
- Fair distribution of capital,
- Stabilization of agricultural production prices,
- Improvement of infrastructures for agricultural production,
- Promotion of agricultural processing,
- Promotion of exportation, and
- Reinforcement of food production system, etc.

(4) Strategy

In order to promote the agricultural policy stated previous item (3), following are executed by the Government.

- Increasing of employment opportunity, agricultural wage, and agricultural income in rural area.
- Activation of agricultural economy based on agricultural products processing.
- Urbanization of rural areas for absorption surplus labour force.

In addition, the diversification of agriculture, the promotion of exportation of agricultural products, and the intensify of agricultural extension services are also considered agricultural policy promotion strategy.

Ministry of Agriculture, Cattle and Food Resources has executed above mentioned strategy by various methods, however, high priority has been placed on the construction of irrigation facilities. Several irrigation project have proved the high productivity by running intensified agriculture.

Promotion of effective land use and water resources use by extending of irrigation area and constructing of irrigation facilities is the quite important for the realization of strategies stated above.

Table A.2.1.3-1 Total Population

(Thousands of persons, at mid-year)

Year	1980	1981	1982	1983	1984	1985
Total population	7.006	7.202	7.403	7.610	7.823	8.041
Annual growth rate (%)	2.9	2.8	2.8	2.8	2.8	2.8

Source : Boletín Estadístico. Banco de Guatemala, 1986

Table A.2.1.3-2 Average Annual Rate of Natality and Mortality

(Per thousands inhabitants)

Year	1960-65	1965-70	1970-75	1975-80	1980-85
Natality	47.8	45.6	44.6	44.3	42.7
Mortality	18.3	15.9	13.4	12.0	10.5

Source : Anuario Estadístico de América Latina y el Caribe. CEPAL, 1986

Table A.2.1.3-3 Employment

(Thousands of person)

Description	1980	1981	1982	1983	1984	1985	1986
Economically active population	2.183	2.251	2.314	2.378	2.445	2.513	2.584
Employment	1.502	1.519	1.467	1.432	1.447	1.437	1.442

Source : Análisis Económico No.666. FADES, 1987

Table A.2.1.3-4 Economically Active Population, 1980

(Percentage of total)

Economic Activity	
Agriculture, hunting, forestry and fishing	56.2
Mining and quarrying	0.2
Manufacturing	11.1
Electricity, gas and water	0.5
Construction	5.3
Wholesale and retail trade, restaurants and hotels	9.3
Transport, storage and communications	2.7
Financing, insurance, real estate and business services	1.3
Community, social and personal services	13.6

Source : Anuario Estadístico de América Latina y el Caribe, CEPAL, 1986

Table A.2.1.3-5 Unemployment

(Average annual rate)

	1980	1981	1982	1983	1984	1985	1986
Wholly unemployment	2.2	1.5	6.3	10.3	9.4	12.3	14.5
Underemployment	29.0	31.0	30.3	29.5	31.4	30.5	29.7
Total unemployment	31.2	32.5	36.6	39.8	40.8	42.8	44.2

Source : Analisis Económico No.666, FADES, 1987

Table A.2.1.3-6 Relative Availability of Calories

(Percentage of three - year average)

1974-76	1975-77	1977-79	1978-80	1979-81
95.0	92.9	94.2	94.2	97.6

Source : Anuario Estadístico de América Latina y el Caribe, CEPAL, 1986

Table A.2.1.3-7 Projection of Total Population
(Thousands of persons, at mid-year)

1990	1995	2000	2005	2010	2015	2020	2025
9.197	10.621	12.222	13.971	15.827	17.752	19.706	21.668

Source : Anuario Estadístico de América Latina y el Caribe, CEPAL, 1986

Table A.2.2.1-1 Gross Domestic Product, 1986

(Dollar)

Description	1960	1970	1980	1981	1982	1983	1984	1985 ^{1/}
Total (Millions)	3.474.2	5.936.1	10.287.4	10.356.3	9.988.4	9.722.5	9.795.3	9.685.7
Growth rate (%)			3.7	0.7	-3.6	-2.7	0.7	-1.1
Per-capita	886.0	1.140.2	1.488.1	1.456.2	1.385.1	1.291.7	1.265.5	1.216.5
Growth rate (%)			5.7	-2.1	-6.3	-5.4	-2.0	-3.0

1/ Preliminary estimates

Source : Boletín Estadístico de la OEA, OEA, 1986

Table A.2.2.1-2 Gross Domestic Product of
Economic Activities, at Market Prices
(Millions of Quetzales at constant 1958 price)

Description	1980	1981	1982	1983	1984	1985
Total GDP	3.107	3.128	3.017	2.940	2.954	2.925
Agriculture, hunting, forestry and fishing	772	781	758	745	757	750
Mining and quarrying	15	9	11	9	8	6
Manufacturing	517	501	475	466	468	467
Construction	98	117	103	76	54	49
Electricity, gas and water	53	53	52	52	54	56
Transport, storage and communications	216	211	201	200	206	207
Wholesale and retail trade, restaurants and hotel	839	844	797	764	773	745
Finance, insurance and real estate	107	109	110	107	106	109
Dwellings	138	142	145	149	152	155
Government services	163	170	177	185	189	191
Personal services	189	190	188	186	187	188

Source : Boletín Estadístico, Banco de Guatemala, 1986

Table A.2.2.1-3 Balance of Foreign Trade

(Millions of Quetzales)

Year	1981	1982	1983	1984	1985
Export (FOB)	1.226	1.120	1.159	1.122	1.021
Import (CIF)	1.673	1.388	1.135	1.278	1.175
Balance	-447	-268	24	-156	-154

Source : Estadísticas Cambiarias, Banco de Guatemala, 1986

Table A.2.2.1-4 Export and Import of Principal Products, 1985

(Millions of Quetzales)

Export (FOB)		Import (CIF)	
Total	1.060 ^{1/}	Total	1.175
Coffee	452	Consumer goods	225
Cotton	73	Raw materials and products	622
Sugar	47	Fuel and Lubricants	121
Banana	72	Construction materials	50
Meat	10	Machinery, equipment and tools	154
Cardamon	61	Various	4
Petroleum	12		

1/ : Adjusted numbers

Source : La Economía y las Finanzas de Guatemala en Cifras 1983-85.

Banco de Guatemala, 1986

Table A.2.2.1-5 Export and Import of Principal Countries, 1985

(Millions of Quetzales)

Export (FOB)		Import (CIF)	
Total	1.060	Total	1.175
Central America	208	Central America	90
USA	407	USA	435
EEC	147	Japan	68
Japan	36	Venezuela	79
		Federal Republic of Alemania	87

Source : La Economía y las Finanzas de Guatemala en Cifras 1983-85.

Banco de Guatemala, 1986

Table A.2.2.1-6 Balance of Payments

(Millions of Quetzal)

Year	1981	1982	1983	1984	1985
I Balance of current account	-572	-399	-224	-377	-246
Trade balance (goods)	-249	-114	36	-50	-17
Exports (FOB) ^{1/}	1,291	1,170	1,092	1,132	1,060
Imports (FOB)	-1,540	-1,284	-1,056	-1,182	-1,077
Trade balance (services)	-411	-348	-290	-356	-249
Transfers balance	91	63	31	29	20
II Capital account balance	375	389	313	416	314
Long-term capital	407	350	293	146	122
Short-term capital	0	20	39	254	207
Errors and omissions	-32	19	-19	16	-15
III Global balance	-198	-11	89	39	69

1/ : Adjusted numbers

Source : Boletín Estadístico, Banco de Guatemala, 1986

Table A.2.2.1-7 International Reserves

(Millions of Dollar)

1983	1984	1985
232.1	296.5	323.0

Note : Unless otherwise indicated, the data includes the reserves in gold.

Source : Boletín Estadístico de la OEA, OEA, 1986

Table A.2.2.1-8 External Debt

(Millions of Dollar)

1981	1982	1983	1984	1985	1986
1,305	1,560	2,130	2,463	2,644	2,530

Source : CEPAL, 1986

Table A.2.2.1-9 Gross Domestic Investment

(Millions of Quetzal at constant 1958 price)

Year	1980	1981	1982	1983	1984	1985
Private investment	207	210	172	169	213	172
Gross fixed capital formation	224	202	199	152	156	160
Increase in stocks	-17	8	-26	17	57	12
General government investment	149	199	159	106	79	62
Total Gross Domestic Investment	355	410	331	275	292	235

Source : Boletín Estadístico, Banco de Guatemala, 1986

Table A.2.2.1-10 Balance of Governmental Finance

(Millions of Quetzales)

Description	1980	1981	1982	1983	1984	1985
Total Revenue	748	742	731	743	669	862
Growth Rate (%)	12	-1	-1	2	-10	29
Current Revenue	747	741	730	741	666	861
Tax Revenue	678	652	626	573	498	679
Direct Tax	101	110	108	134	86	126
Indirect Tax	578	542	519	439	412	553
Non-Tax Revenue	69	89	104	168	168	182
Capital Revenue	1	2	1	2	2	1
Total Expenditure	1,116	1,380	1,142	1,038	1,030	1,056
Growth Rate (%)	31	24	-17	-9	-1	3
Current Expenditure	678	760	710	721	766	807
Capital Expenditure	439	621	432	317	264	249
Overall Deficit (-) or Surplus	-368	-638	-410	-295	-361	-193
Growth Rate (%)	-102	-73	36	28	-22	47

Source : Boletín Estadístico de la OEA, OEA 1986

Table A.2.2.1-11 Growth Rate of Price Indexes

(Percent)

Description	1980	1981	1982	1983	1984	1985	1986
Consumer prices	10.7	11.4	0.2	4.6	3.4	18.7	36.9
Wholesale prices	16.0	11.7	-5.8	0.9	5.6	22.7	43.7
Construction material prices							
Imported	15.4	23.9	-30.1	10.5	7.6	84.9	16.2
National	12.1	3.4	-5.0	-0.2	5.0	8.4	28.0

Source : Boletin Estadistico, Banco de Guatemala, 1986

Table A.2.2.1-12 Inflation

(Percent)

Description	1980	1981	1982	1983	1984	1985	1986
Consumer price index (1972=100)	246.0	270.6	281.3	299.6	325.3	445.7	601.7
Inflation rate	10.5	10.0	3.9	6.6	8.5	37.0	35.0
Inflation rate ^{1/}	9.1	8.7	-2.0	15.4	5.2	31.5	41.7

1/ : CEPAL, 1986

Source : Boletin Economia No.9, IIES, 1986

Forecasted Consumer Price Indexes

(Percent)

	1987	1988	1989	1990	1991	1992~
Inflation rate (march-april 1983=100)	12.3	11.2	10.0	8.9	7.9	7.0

Source : SEGEPLAN based on data of INE

Table A.2.2.1-13 Price Escalation

(1) Wholesale Price Index							(Percent)
Year	Japan	U.S.A.	Germany, F.R.	France	U.K.	Average	Guatemala ¹⁾
1982	1.8	2.0	5.8	11.4	7.8		-5.8
1983	- 2.2	1.3	1.5	8.8	5.4		0.9
1984	- 0.3	2.4	2.9	8.9	6.2		5.6
1985	- 1.1	- 0.5	2.2	4.4	5.5		22.7
1986	- 9.3	- 2.9	- 3.0	- 2.9	4.5		43.7
Average	- 2.2	0.5	1.9	6.1	5.9	2.4	13.4

(2) Consumer Price Index							(Percent)
Year	Japan	U.S.A.	Germany, F.R.	France	U.K.	Average	Guatemala ¹⁾
1982	2.8	6.2	5.3	11.8	8.6		0.2
1983	1.9	3.2	3.3	9.6	4.6		4.6
1984	2.3	4.3	2.4	7.4	5.0		3.4
1985	2.0	3.6	2.2	5.8	6.1		18.7
1986	0.6	1.9	- 0.2	2.7	3.4		36.9
Average	1.9	3.8	2.6	7.5	5.5	4.3	12.8

Source : IMF International Financial Statistics

¹⁾ Boletín Estadístico, Banco de Guatemala, 1986

Foreign Currency = 3.3 %

Table A.2.2.2-1 Agricultural and Irrigated Area

	1961-1965	1980	1983
Arable land	1,125	1,270	1,330
Land under Permanent Crops	317	480	484
Permanent Pasture Land	1,039	1,334	1,334
Irrigated Area	38	68	74

Source : Anuario Estadístico de América Latina y el Caribe, CEPAL, 1986

Table A.2.2.2-2 National Irrigated Area by Zone

Zone	Unit	Area (ha)
I	3	680
IV	3	3,410
V (EL Progreso Dep., etc.)	9	2,432
VI (Jutiapa Dep., etc.)	4	1,927
VII (Zacapa Dep., etc.)	6	6,608
Total	25	15,057

Note : exclude Mini-Irrigation Projects

Source : Boletín Estadístico Agropecuario, No.13, DIRVA, 1985

Table A.2.2.2-3 Number and Area by each Farm Size, 1979

(Percent)

	Number	Area
Microfincas (less than 0.7ha)	31.4	1.3
Subfamiliares (0.7 - 7ha)	56.7	15.2
Familiares (7 - 45ha)	9.3	19.0
Multifamiliares medianas (45 - 896ha)	2.5	44.2
Multifamiliares grandes (more than 896ha)	0.1	20.3

Source : III Censo Nacional Agropecuario, INE, 1982

Table A.2.2.2-4 Harvested Area of Principal Crops

(Thousands of hectares)

Crop	Year	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Maize		659	681	669	570	691	660	675
Rice		13	15	17	12	16	15	17
Kidney Beans		65	82	102	115	167	170	157
Wheat		32	32	30	33	32	32	32
Sorghum		35	41	31	48	65	67	70
Coffee		258	258	258	258	258	258	263
Cotton		102	79	60	56	62	67	35
Sugar Cane		70	80	70	70	70	70	—
Banana		7	7	7	8	8	8	8
Rubber		8	15	15	8	8	16	16
Cardamon		23	24	21	30	33	33	35

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-5 Production of Principal Crops

(Thousands of ton)

Crop	Year	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Maize		902	997	1,100	988	1,198	1,088	1,196
Rice		28	34	50	46	45	38	48
Kidney Beans		58	93	102	89	111	118	101
Wheat		46	42	43	55	51	53	51
Sorghum		78	86	77	82	89	101	101
Coffee		172	167	168	168	180	179	184
Cotton		128	78	47	61	63	64	37
Sugar Cane		5,963	6,828	6,008	6,018	6,100	6,300	—
Banana		407	386	414	268	374	429	431
Rubber		10	12	12	12	12	16	16
Cardamon		5	5	6	8	7	7	8

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-6 Yield of Principal Crops

(Per hectare)

Crop		1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Maize	(t)	1.37	1.47	1.64	1.73	1.73	1.65	1.77
Rice	(t)	2.18	2.19	2.88	3.71	2.81	2.64	2.76
Kidney Beans	(kg)	890	1.130	1.100	780	670	690	640
Wheat	(t)	1.46	1.33	1.44	1.66	1.58	1.61	1.60
Sorghum	(t)	2.25	2.12	2.52	2.10	1.36	1.52	1.45
Coffee	(kg)	660	640	650	650	700	700	700
Cotton	(kg)	1.250	990	780	1.090	1.020	950	1.050
Sugar Cane	(t)	85.7	85.7	85.7	85.4	87.1	90.0	—
Banana	(t)	54.9	52.6	55.8	35.1	48.6	55.8	52.6
Rubber	(kg)	1.250	790	800	1.540	1.510	990	990
Cardamon		220	220	230	260	220	220	230

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-7 Import of Basic Crops (Value)

(Thousands of Quetzal)

Product	1980	1981	1982	1983	1984	1985
Corn	13.2	11.7	0.8	0.7	1.0	2.7
Rice	2.2	1.7	0.1	0.1	0.2	0.5
Kidney Beans	1.3	2.8	0.0	0.0	0.0	0.2
Wheat	24.4	24.6	19.4	21.7	24.5	24.9

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-8 Import of Basic Crops (Volume)

(Thousands of ton)

Product	1980	1981	1982	1983	1984	1985
Corn	82.2	65.6	3.2	3.8	5.2	14.9
Rice	4.5	3.6	0.2	0.2	0.6	0.7
Kidney Beans	2.4	3.5	0	0	0	0.5
Wheat	115.9	118.1	97.1	111.6	124.1	135.5

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-9 Export of Principal Agricultural Products

(Millions of Quetzal)

Product	Year	1981	1982	1983	1984	1985
Coffee		295	359	351	361	411
Cotton		131	79	46	70	60
Banana		51	63	40	57	63
Cardamon		34	30	31	59	59
Plants, seeds and flowers		11	10	9	11	11
Sugar		85	27	127	75	44
Vegetables		31	37	27	24	21
Fresh, dried and prepared fruits		22	11	8	8	6

Source : Boletin Estadistico, Banco de Guatemala, 1986

Table A.2.2.2-10 Export of Basic Crops (Volume)

(Thousands of ton)

Product	Year	1980	1981	1982	1983	1984	1985
Corn		16.2	0.1	20.0	2.7	0.0	10.0
Kidney Beans		1.0	0.1	0.0	0.1	1.2	0.2

Source : Informe de Produccion, Exportacion, Importacion, Precios y Caracteristicas de los Principales Productos Agropecuarios, Banco de Guatemala, 1986

Table A.2.2.2-11 Slaughtered Number of Animals

(Thousands of animals)

Animal	Year	1980	1981	1982	1983	1984
Cattle		323	325	292	316	316
Hog		336	314	312	316	316
Sheep		20	17	15	17	19
Goat		1.9	1.3	1.4	1.5	1.5

Source : Anuario Estadístico. INE, 1987

Table A.2.2.2-12 Agricultural Production Indexes

(Base year at 1974 - 1976 = 100)

	Year	1980	1981	1982	1983	1984
Agricultural Production		123	123	118	113	112
Agricultural Crops		114	113	110	107	106
Livestock Production		153	160	153	144	145
Food Production		125	128	128	126	125
Per Capital Food Production		107	102	104	99	96

Source : Anuario Estadístico de América Latina y el Caribe, CEPAL, 1986

3 . PRESENT CONDITIONS OF THE STUDY

3. PRESENT CONDITIONS OF THE STUDY AREA

3.1 Socio-economic Condition

Table A.3.1-1 Projection of Departmental
Population

Table A.3.1-2 Departmental Revenues

Table A.3.1-3 Departmental Expenditures

Table A.3.1-4 Balance of Fiscal Accounts
(1985)

Table A.3.1-5 Principal Items of Fiscal
Revenues (1985)

Table A.3.1-6 Principal Items of Fiscal
Expenditures
(1985)

Table A.3.1-1 Projection of Departmental Population

(Thousands of person)

Year	1985	1990	1995	2000
Total country	7.963	9.197	10.621	12.221
Jalapa Department	165	186	212	241
Jutiapa Department	313	347	387	433

Source : Proyecciones Departamentales de Población 1980-2000.
SEGEPLAN, 1985

Table A.3.1-2 Departmental Revenues

(Thousands of Quetzal)

Year	1980	1981	1982	1983	1984	1985
Total country	52.480	58.766	66.674	71.911	73.692	70.119
Jalapa Department	464	637	563	678	586	696
Jutiapa Department	907	1.009	1.270	1.337	1.512	1.572

Source : Finanzas Municipales 1985. INE. 1987

Table A.3.1-3 Departmental Expenditures

(Thousands of Quetzal)

Year	1980	1981	1982	1983	1984	1985
Total country	52.378	56.968	64.760	74.264	72.912	70.235
Jalapa Department	467	646	534	660	630	675
Jutiapa Department	925	975	1.271	1.348	1.518	1.563

Source : Finanzas Municipales 1985. INE. 1987

Table A.3.1-4 Balance of Fiscal Accounts (1985)

(Thousands of Quetzal)

Description	Revenues	Expenditure	Balance
Total country	70.119	70.235	- 116
Jalapa Department	696	675	20
Jutiapa Department	1.572	1.563	9
Monjas Municipality	65.7	67.2	- 1.5

Source : Finanzas Municipales 1985. INE.1987

Table A.3.1-5 Principal Items of Fiscal Revenues (1985)

(Percent)

Description	Current revenues	Water Charge	Commercial revenues	Extraordinary revenues
Jalapa Department	25	16	8	38
Jutiapa Department	23	17	5	40
Monjas Municipality	27	24	8	32

Source : Finanzas Municipales 1985. INE.1987

Table A.3.1-6 Principal Items of Fiscal Expenditures (1985)

(Percent)

Description	Salaries and Wages	Supplement of Salaries and Wages	Administrative Service	Extraordinary Expenditure
Jalapa Department	34	8	13	33
Jutiapa Department	29	7	8	44
Monjas Municipality	48	12	12	13

Source : Finanzas Municipales 1985. INE.1987

3.2 Natural Conditions

3.2.1 Topography

Fig. A.3.2.1-1 Bird's - eye View

Fig. A.3.2.1-2 Contour Line Map and Topographic
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Fig. A.3.2.1-3 Slope Map

Fig. A.3.2.1-4 Slope Direction Map

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Fig. A.3.2.2-2 10-day Precipitation at La Ceibita

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Fig. A.3.2.2-4 Probability Analysis of Hourly
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3.2.3 Hydrology

(1) Hydrology

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(2) Water Quality

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3.2.4 Geology, Hydrogeology and Seismology

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(3) Seismology

- Table A.3.2.4-8 Seismographical Record (1978 to 1982)
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3.2.5 Soils and Land Capability Classification

(1) Soils

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Fig. A.3.2.5-15 Base-saturation of Each Soil Order
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(2) Land Capability Classification

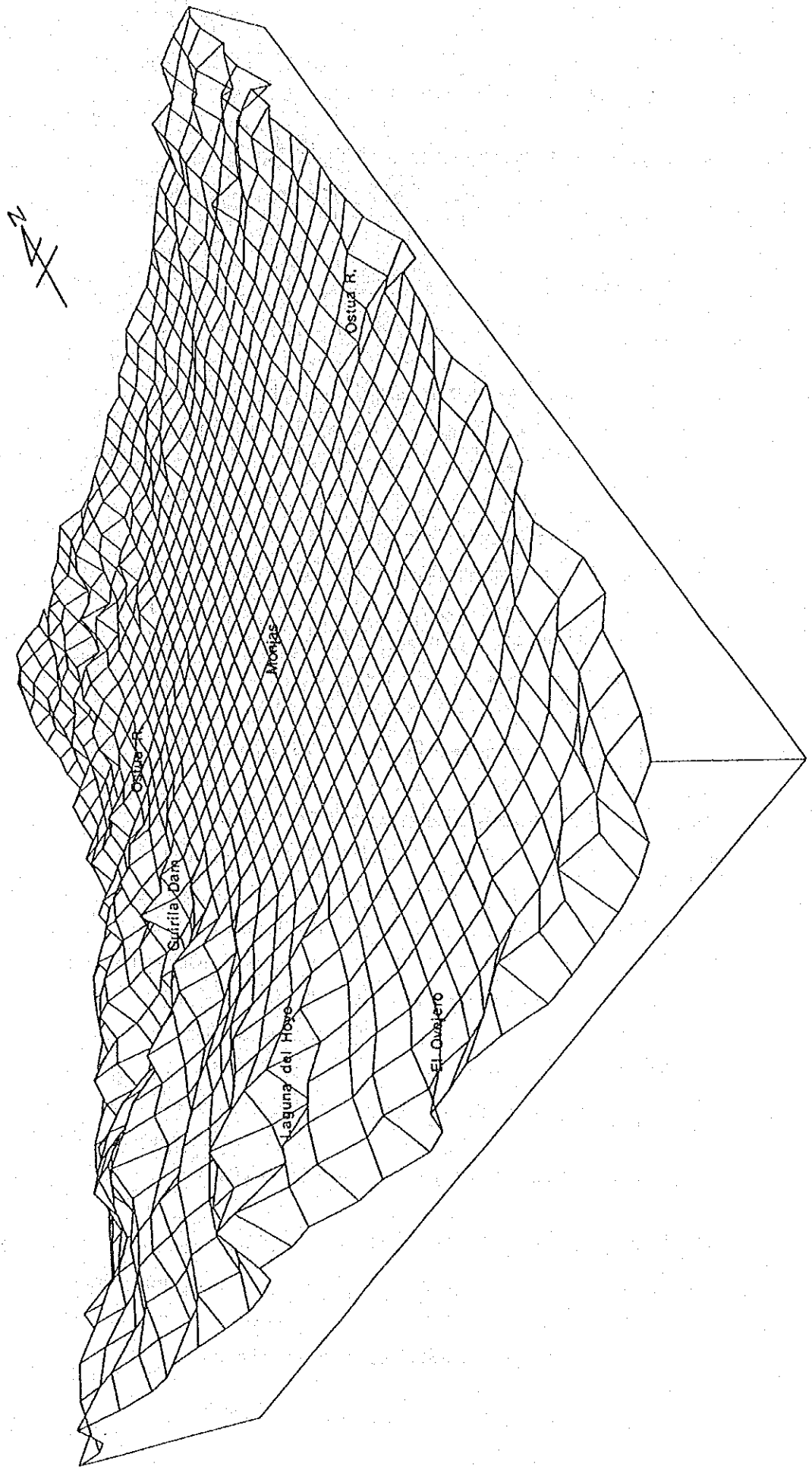
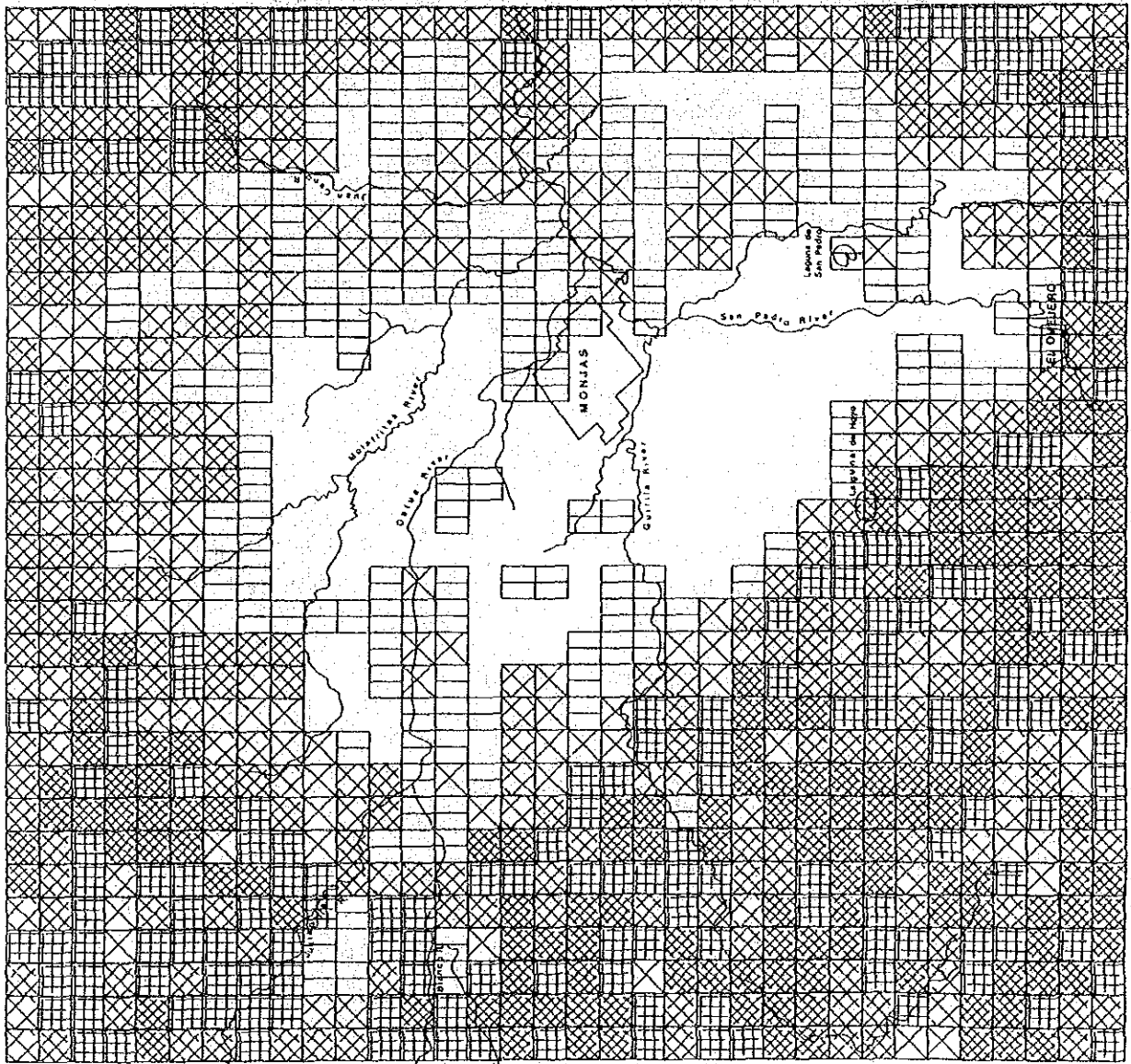


Fig. A.3.2.1-1 Bird's - eye View



LEGEND

SLOPE (grade)	SLOPE PROPORTION (%)
0-4	18.2
4-9	14.6
9-16	11.5
16-21	8.0
21-31	16.7
31-41	15.7
41-	15.3

Fig. A.3.2.1-3 Slope Map



Fig. A.3.2.1-4 Slope Direction Map

Table A.3.2.2-1 Monthly and Annual Precipitation at Agro Santiago

mm

HYDRO YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'58 ~ '59	—	484.40	358.80	236.80	310.50	230.00	5.60	4.80	0.00	3.40	4.00	45.90	1,684.20
'59 ~ '60	148.50	272.10	173.40	250.60	148.90	313.50	11.00	4.00	6.00	4.00	0.00	39.40	1,371.40
'60 ~ '61	316.60	453.50	220.00	228.40	176.00	249.40	51.70	0.00	2.30	103.50	137.00	67.00	2,055.40
'61 ~ '62	84.50	192.00	252.00	164.00	182.00	26.00	121.50	0.00	0.00	0.00	0.00	27.00	1,049.00
'62 ~ '63	81.00	255.00	149.00	79.00	79.00	205.00	7.00	5.00	2.00	7.00	0.00	133.00	1,002.00
'63 ~ '64	101.00	216.50	376.50	101.00	322.50	87.00	24.50	0.00	0.00	0.00	10.00	55.00	1,294.00
'64 ~ '65	81.50	384.00	476.00	214.00	298.00	68.00	12.00	0.00	0.00	0.00	0.00	3.00	1,516.50
'65 ~ '66	164.00	397.00	229.00	286.00	372.00	104.00	0.00	0.00	0.00	18.00	17.00	59.00	1,646.00
'66 ~ '67	232.00	408.00	273.00	205.00	67.00	169.00	0.00	0.00	18.00	0.00	0.00	65.00	1,437.00
'67 ~ '68	50.00	247.00	144.00	79.00	84.00	201.00	7.00	5.00	0.00	0.00	0.00	12.00	829.00
'68 ~ '69	87.00	395.00	283.00	95.50	281.00	0.00	0.00	80.00	1.00	0.00	19.00	44.00	1,285.50
'69 ~ '70	367.00	326.00	219.00	295.00	403.00	119.00	4.00	0.00	0.00	0.00	0.00	0.00	1,733.00
'70 ~ '71	196.00	235.00	136.00	364.00	340.00	110.00	17.00	0.00	0.00	0.00	0.00	0.00	1,398.00
'71 ~ '72	0.00	413.00	95.00	508.00	98.00	261.00	35.00	25.00	—	—	—	—	—
MEAN	145.30	334.20	241.80	221.90	225.90	152.30	21.16	8.84	2.25	10.45	18.23	42.33	1,384.70

Table A.3.2.2-2 Monthly and Annual Precipitation at La Ceibita

mm

HYDRO YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'63 ~ '64	0.00	0.00	178.00	155.30	148.90	31.00	28.80	0.00	0.00	0.00	0.00	26.20	568.10
'64 ~ '65	—	—	—	—	124.50	5.00	—	—	2.50	6.70	—	—	138.70
'65 ~ '66	—	106.90	244.60	142.20	66.20	69.80	—	—	—	—	13.30	31.60	813.30
'66 ~ '67	91.80	327.70	187.70	256.30	128.40	90.00	1.60	—	—	—	75.30	66.20	1,225.00
'67 ~ '68	14.40	105.50	86.60	205.20	117.30	68.70	1.00	1.70	—	—	—	32.20	632.60
'68 ~ '69	136.50	58.50	184.60	97.60	158.80	211.40	35.30	—	—	—	—	9.90	892.60
'69 ~ '70	130.50	275.10	164.90	179.50	258.90	95.40	2.30	—	0.80	—	—	45.80	1,154.20
'70 ~ '71	58.90	77.80	323.80	199.30	188.50	96.90	—	2.20	0.40	1.10	5.30	7.70	971.90
'71 ~ '72	114.40	116.00	127.00	22.50	—	—	—	—	1.00	—	4.90	—	385.80
'72 ~ '73	39.50	139.30	99.20	73.80	80.70	11.90	33.30	—	—	—	1.50	1.70	480.70
'73 ~ '74	—	—	126.30	184.60	184.50	198.60	20.90	1.20	1.90	—	49.40	2.40	769.80
'74 ~ '75	261.60	243.70	71.90	192.80	136.80	18.00	—	—	1.90	2.90	—	4.80	934.30
'75 ~ '76	52.30	75.10	—	138.10	232.60	253.30	36.30	—	—	—	—	43.80	831.10
'76 ~ '77	233.20	369.30	160.30	82.30	209.20	60.90	17.20	—	—	—	—	20.10	1,152.80
'77 ~ '78	114.20	173.90	40.10	125.30	140.40	26.10	—	3.50	—	—	23.10	1.90	648.50
'78 ~ '79	93.20	147.20	186.30	194.10	238.70	84.10	4.30	4.10	—	—	0.60	50.90	993.50
'79 ~ '80	114.20	260.50	148.40	223.60	131.20	192.90	0.70	5.30	16.30	0.50	—	17.00	1,950.60
'80 ~ '81	115.30	279.40	194.80	125.50	170.40	7.50	18.60	0.30	0.80	—	8.50	3.90	930.00
'81 ~ '82	33.60	210.60	208.90	105.80	178.70	284.00	—	1.10	—	—	1.40	14.30	988.40
'82 ~ '83	123.70	132.20	137.50	16.90	160.20	68.80	8.90	0.30	0.60	12.30	24.20	17.80	703.40
'83 ~ '84	70.40	272.60	170.70	175.40	253.60	103.00	52.40	9.40	—	1.00	6.10	7.30	1,121.90
'84 ~ '85	250.80	273.60	130.50	107.30	212.90	53.20	5.10	2.50	—	—	—	—	1,043.90
'85 ~ '86	40.50	140.10	144.90	195.50	186.20	101.80	18.50	2.70	—	0.20	—	—	830.10
'86 ~ '87	89.70	133.70	159.30	82.50	140.00	90.70	3.80	—	—	—	—	—	—
MEAN	105.60	186.60	157.10	148.10	189.30	94.44	12.56	1.63	1.31	1.23	6.92	18.66	926.50

Table A.3.2.2-3 Precipitation over Ostua River at Casa de Tablas

HYDRO YEAR	mm												
	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'63 ~ '64	—	—	233.99	110.93	290.72	76.75	25.26	0.00	0.00	0.00	8.17	49.74	795.56
'64 ~ '65	50.25	—	—	—	203.35	13.99	9.86	0.00	0.46	1.23	—	—	279.09
'65 ~ '66	153.55	369.11	213.33	259.05	316.02	97.73	0.00	—	—	—	10.32	58.98	1,478.89
'66 ~ '67	206.34	393.30	257.37	214.36	78.24	154.55	0.29	0.00	14.71	0.00	13.79	65.21	1,398.16
'67 ~ '68	43.49	221.10	133.50	102.09	90.06	176.79	5.90	4.40	0.00	0.00	0.00	15.70	793.03
'68 ~ '69	96.08	333.42	265.01	95.86	258.64	38.69	6.47	65.89	0.82	0.00	15.52	37.76	1,213.66
'69 ~ '70	323.71	316.69	209.10	273.87	376.82	114.69	3.69	0.00	0.15	0.00	0.00	8.37	1,627.09
'70 ~ '71	170.92	206.25	170.36	333.87	314.11	107.59	13.89	0.40	0.07	0.20	0.97	1.41	1,320.04
'71 ~ '72	20.95	358.66	100.85	4.12	—	—	—	—	—	—	—	—	—
MEAN	133.20	314.10	192.80	198.60	246.40	109.50	8.16	10.03	2.32	0.20	7.82	3.32	1,270.00

Table A.3.2.2-4 10-day Precipitation at Agro Santiago

	mm														
	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	MEAN
J B	—	0.00	8.00	0.20	0.00	2.00	0.00	0.00	0.00	14.00	0.00	1.00	0.00	0.00	1.79
A M	—	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.32
N L	—	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
F B	—	3.00	0.00	14.10	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72
E M	—	0.00	0.00	72.50	0.00	2.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00	0.00	7.12
B L	—	0.10	4.00	18.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62
M B	—	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.77
A M	—	0.00	0.00	90.00	0.00	0.00	10.00	10.00	7.00	0.00	0.00	0.00	0.00	0.00	3.23
R L	—	0.00	0.00	97.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	13.00	0.00	0.00	9.23
A B	—	12.90	22.90	22.00	27.00	5.00	7.00	0.00	22.00	65.00	0.00	20.00	0.00	0.00	15.68
P M	—	14.00	4.50	15.00	0.00	94.00	41.00	0.00	22.00	0.00	8.00	0.00	0.00	0.00	15.27
R L	—	19.00	12.00	30.00	0.00	34.00	7.00	3.00	15.00	0.00	4.00	24.00	0.00	0.00	11.38
M B	—	27.50	2.50	32.50	26.00	0.00	12.00	0.00	104.00	10.00	4.00	0.00	28.00	0.00	18.81
A M	—	88.50	160.60	25.60	0.00	56.00	0.00	36.00	72.00	20.00	58.00	174.00	95.00	0.00	65.47
Y L	—	32.50	153.60	27.00	35.00	45.00	49.50	68.00	58.00	20.00	25.00	169.00	75.00	0.00	81.04
J B	183.60	91.60	91.50	42.00	78.00	70.50	83.00	144.00	39.00	78.00	71.00	123.00	50.00	168.00	94.01
U M	257.00	55.60	210.50	138.00	67.00	90.00	87.00	109.00	77.00	67.00	94.00	38.00	120.00	57.00	104.80
N L	38.80	124.90	151.50	12.00	110.00	56.00	214.00	144.00	292.00	102.00	230.00	165.00	85.00	190.00	135.40
J B	129.50	11.00	70.50	85.00	11.00	184.00	219.00	125.00	90.00	11.00	165.00	134.00	20.00	15.00	90.71
U M	103.00	57.40	85.50	128.00	46.00	69.00	143.00	28.00	142.00	41.00	64.00	40.00	46.00	33.00	72.99
L L	126.30	105.00	64.00	39.00	92.00	123.50	114.00	78.00	41.00	92.00	54.00	45.00	70.00	47.00	77.91
A B	63.30	135.60	43.50	19.00	25.00	25.00	55.00	90.00	25.00	25.00	46.00	118.00	122.00	121.00	65.24
U M	48.50	48.00	100.00	9.00	25.00	50.00	72.00	65.00	100.00	25.00	16.00	137.00	145.00	55.00	63.32
G L	125.00	87.00	84.90	145.00	29.00	28.00	87.00	131.00	80.00	29.00	33.50	40.00	97.00	332.00	93.31
S B	45.00	44.40	100.00	100.00	20.00	71.00	87.00	69.00	0.00	15.00	109.50	200.00	133.00	53.00	75.49
E M	102.30	84.50	40.00	48.00	47.00	87.00	121.00	106.00	35.00	57.00	106.50	70.00	53.00	0.00	58.56
P L	162.60	20.00	36.00	24.00	12.00	164.50	90.00	197.00	32.00	12.00	83.00	133.00	154.00	45.00	81.79
O B	183.00	149.30	74.00	14.00	51.00	81.00	53.00	64.00	84.00	69.00	0.00	50.00	5.00	155.00	72.31
C M	45.00	90.60	99.50	10.00	77.00	8.00	15.00	30.00	76.00	55.00	0.00	45.00	47.00	80.00	48.29
T L	22.00	73.80	75.90	2.00	70.00	0.00	0.00	10.00	9.00	77.00	0.00	24.00	58.00	16.00	31.75
N B	0.50	0.00	47.00	119.00	0.00	21.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	4.00	13.89
O M	5.10	0.00	4.80	2.50	0.00	1.50	5.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	1.55
V L	0.00	11.00	0.10	0.00	7.00	0.00	7.00	0.00	0.00	7.00	0.00	0.00	17.00	31.00	5.72
D B	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	0.00	0.00	0.00	2.63
E M	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	0.00	15.00	4.50
C L	0.00	4.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	10.00	1.71

Table A.3.2.2-6 10-day Precipitation over Ostua River Catchment Area at Casa de Tablas

		mm									
		'63	'64	'65	'66	'67	'68	'69	'70	'71	MEAN
J	B	0.00	0.00	0.00	0.00	11.44	0.00	0.82	0.00	0.07	1.76
A	M	—	—	—	—	3.27	—	—	—	—	0.47
N	L	—	—	0.46	—	—	—	—	0.15	—	0.09
F	B	—	—	0.77	—	—	—	—	—	—	0.11
E	M	—	—	—	—	—	—	—	—	—	—
B	L	—	—	0.46	—	—	—	—	—	0.20	0.09
M	B	—	—	—	—	—	—	4.90	—	0.64	0.79
A	M	—	8.17	—	5.72	—	4.90	—	—	—	1.98
R	L	—	—	—	10.60	13.79	—	10.62	—	0.33	5.05
A	B	—	5.72	—	23.63	53.39	5.77	16.34	1.17	1.41	15.35
P	M	—	37.66	—	17.98	11.82	6.58	—	7.20	—	11.61
R	L	—	6.36	—	12.37	—	3.35	21.42	—	—	6.21
M	B	—	9.80	—	92.51	8.17	7.06	—	61.24	—	17.35
A	M	—	—	88.19	63.05	18.98	50.45	156.47	86.59	16.06	59.97
Y	L	—	40.45	65.36	50.78	16.34	38.47	167.24	63.09	4.89	55.83
J	B	44.12	—	131.03	44.90	73.16	65.55	120.21	41.27	140.40	88.07
U	M	63.84	—	96.60	83.70	55.75	79.97	48.01	100.68	59.70	73.53
N	L	128.03	—	141.48	264.70	92.19	137.90	148.47	64.30	158.69	148.00
J	B	30.04	—	113.51	81.58	17.54	136.52	125.64	28.71	13.35	68.36
U	M	48.91	—	25.36	135.73	33.50	71.27	37.29	65.16	38.56	56.97
L	L	31.98	—	74.28	40.06	82.46	57.22	46.17	76.49	48.94	57.20
A	B	64.79	—	85.94	44.00	28.66	46.25	111.00	105.35	4.12	61.02
A	M	75.99	—	58.76	91.60	46.10	18.42	119.32	133.98	—	77.45
G	L	149.94	—	116.32	18.76	29.33	31.19	43.55	94.54	—	77.66
S	B	70.70	17.98	58.60	7.74	27.71	99.50	192.90	120.66	—	82.26
E	M	6.05	103.62	94.07	33.93	46.90	99.42	64.07	53.60	—	63.33
P	L	—	78.77	165.35	36.57	15.45	59.72	119.85	139.85	—	76.70
O	B	22.36	0.82	58.59	74.35	59.65	12.57	50.15	13.53	—	36.50
C	M	2.90	13.17	30.97	72.42	48.84	16.77	44.07	40.47	—	33.70
T	L	—	—	8.17	7.78	68.30	9.35	20.47	53.59	—	20.96
N	B	—	—	—	0.29	0.18	5.33	1.02	—	—	0.85
O	M	—	4.09	—	—	—	0.35	2.67	—	—	0.89
V	L	—	5.72	—	—	5.72	0.79	—	13.89	—	3.27
D	B	—	—	—	—	—	28.62	—	—	—	4.09
E	M	—	—	—	—	0.31	36.77	—	—	—	5.30
C	L	—	—	—	—	4.09	—	—	0.40	—	0.64

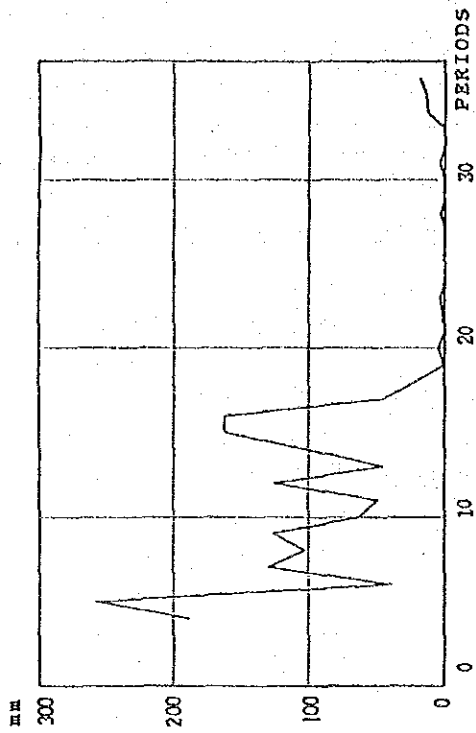
Table A.3.2.2-7 Yearly Maximum Precipitation & Intensity at La Ceibita

YEAR	Cumulative (mm)					Intensity (mm/hr)					Remark
	1 hr	2 hrs	3 hrs	6 hrs	12 hrs	1 hr	2 hrs	3 hrs	6 hrs	2 hrs	
1963	25.2	36.6	47.9	49.6	49.6	25.2	18.3	16.0	8.3	4.1	
1965	26.0	38.3	39.3	44.1	47.9	26.0	19.2	13.1	7.4	4.0	
1966	22.0	33.9	37.2	39.5	44.8	22.0	17.0	12.4	6.6	3.7	
1967	30.1	51.6	52.0	59.4	76.6	30.1	25.8	17.3	9.9	6.4	
1968	40.2	44.8	46.8	47.0	49.5	40.2	22.4	15.6	7.8	4.1	
1969	35.0	47.0	47.0	47.0	47.0	35.0	23.5	15.7	7.8	3.9	
1970	27.5	47.3	48.5	50.2	54.0	27.5	23.7	16.2	8.4	4.5	
1972	24.3	28.0	30.6	33.0	33.4	24.3	14.0	10.2	5.5	2.8	
1973	27.0	45.5	50.1	56.4	90.2	27.0	22.8	16.7	9.4	7.5	
1974	22.5	42.2	46.3	51.6	51.9	22.5	21.1	15.4	8.6	4.3	
1975	25.0	42.1	45.9	53.6	61.7	25.0	21.1	15.3	8.9	5.1	
1976	51.2	58.7	81.8	87.9	88.1	51.2	29.4	27.3	14.7	7.3	
1977	49.6	49.7	49.7	49.7	49.7	49.6	24.9	16.6	8.3	4.1	
1978	50.4	59.8	63.5	71.9	71.9	50.4	29.9	21.2	12.0	6.0	
1979	47.9	73.9	73.9	73.9	73.9	47.9	37.0	24.6	12.3	6.2	
1980	26.6	33.6	40.9	46.4	61.3	26.6	16.8	13.6	7.7	5.1	
1981	34.9	34.9	34.9	34.9	51.6	34.9	17.5	11.6	5.8	4.3	

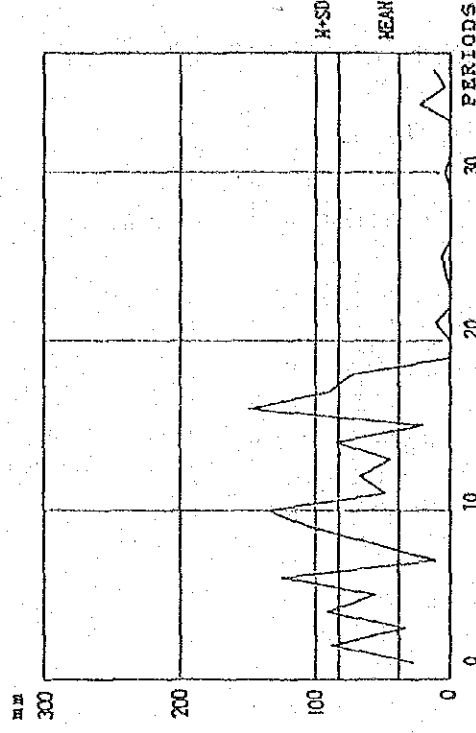
Table A.3.2.2-8 Probability Analysis of Yearly Maximum Hourly Precipitation at La Ceibita

YEAR	1 hr	2 hrs	3 hrs	6 hrs	12 hrs	Remarks
2	31.0	21.7	15.6	8.5	4.7	
5	40.4	26.9	19.5	10.5	5.9	
10	47.1	30.3	22.2	11.8	6.7	
20	53.7	33.5	24.7	13.0	7.4	
30	57.7	35.3	26.2	13.7	7.8	
40	60.6	36.5	27.2	14.1	8.0	
50	62.9	37.5	28.1	14.5	8.3	
80	67.7	39.6	29.8	15.2	8.7	
100	69.9	40.6	30.6	15.6	8.9	
200	77.3	43.6	33.1	16.6	9.5	
500	87.5	47.6	36.6	18.0	10.4	

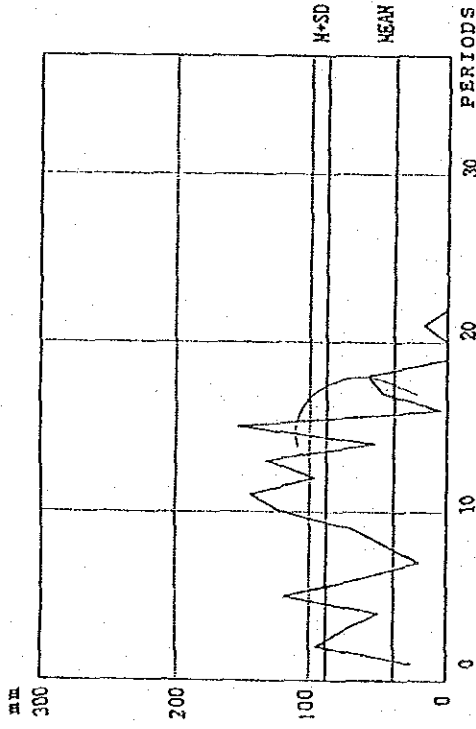
DURATION (MAY 1958-APR. 1959)



DURATION (MAY 1959-APR. 1960)



DURATION (MAY 1970-APR. 1971)



DURATION (MAY 1971-APR. 1972)

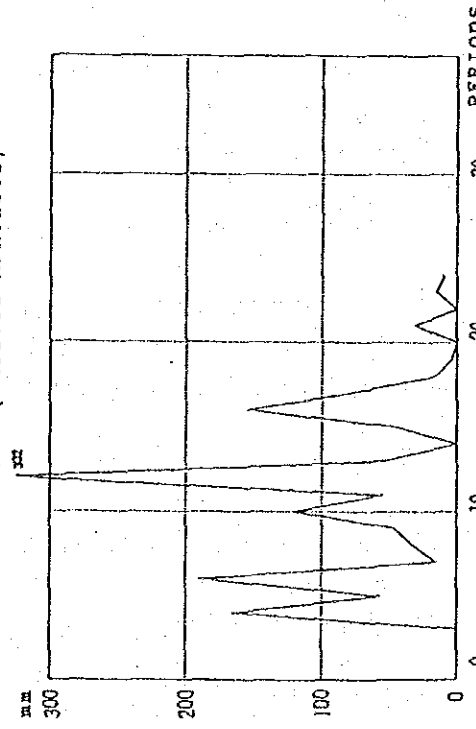
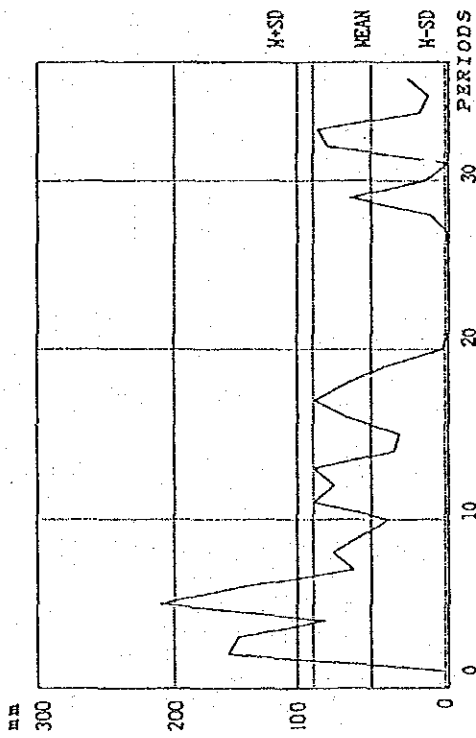
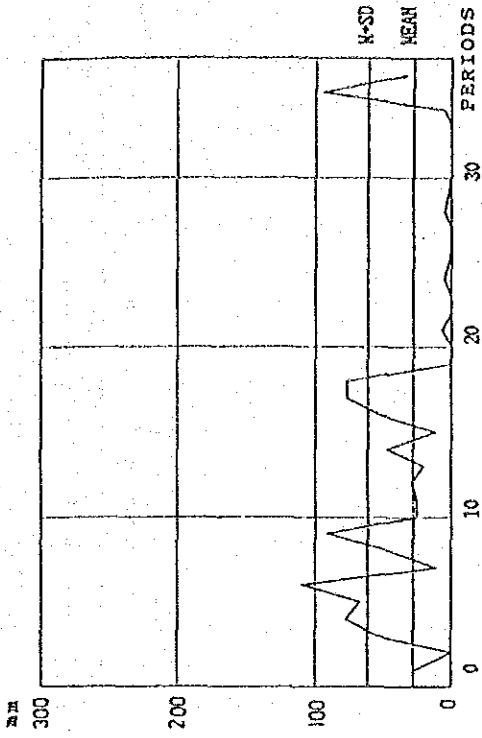


Fig. A.3.2.2-1 10-day Precipitation at Agro Santiago

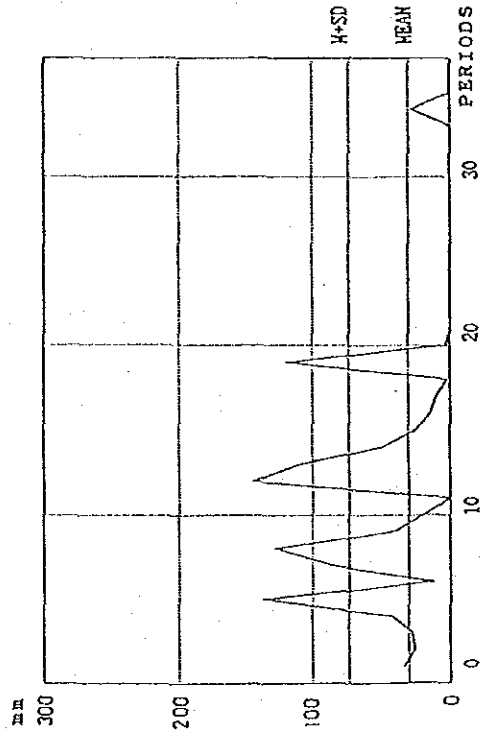
DURATION (MAY 1960-APR. 1961)



DURATION (MAY 1962-APR. 1963)



DURATION (MAY 1961-APR. 1962)



DURATION (MAY 1963-APR. 1964)

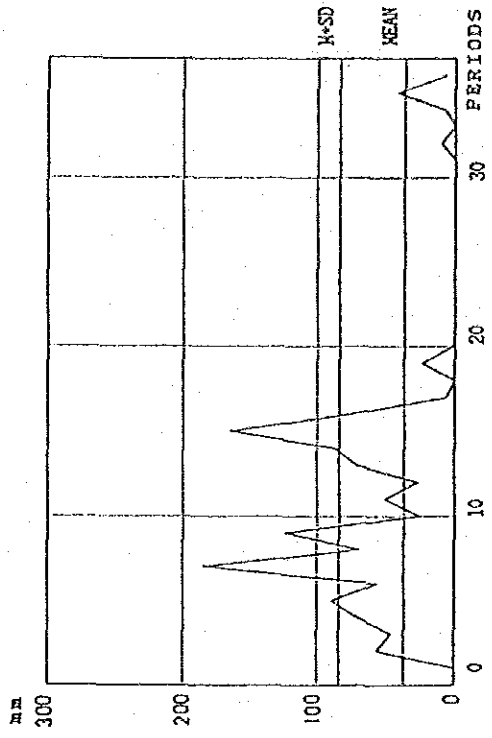
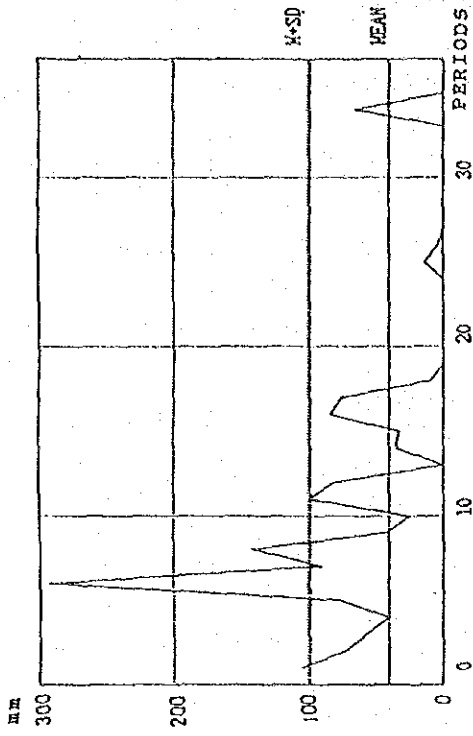
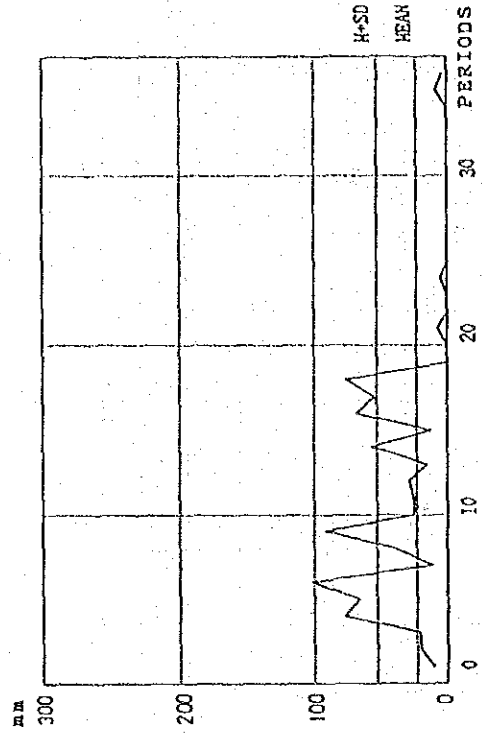


Fig. A.3.2.2-1 10-day Precipitation at Agro Santiago (con't)

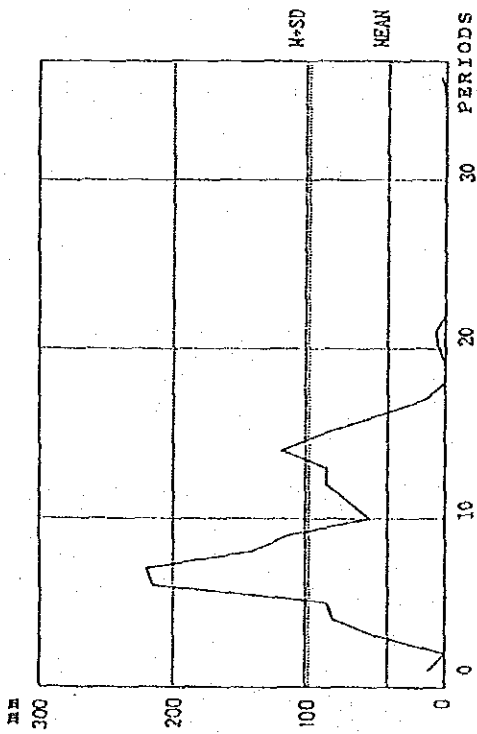
DURATION (MAY 1966-APR. 1967)



DURATION (MAY 1967-APR. 1968)



DURATION (MAY 1964-APR. 1965)



DURATION (MAY 1965-APR. 1966)

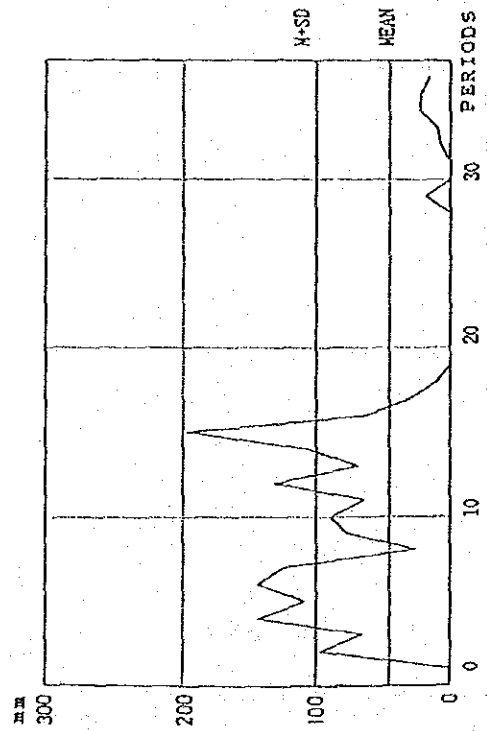


Fig. A.3.2.2-1 10-day Precipitation at Agro Santiago (con't)

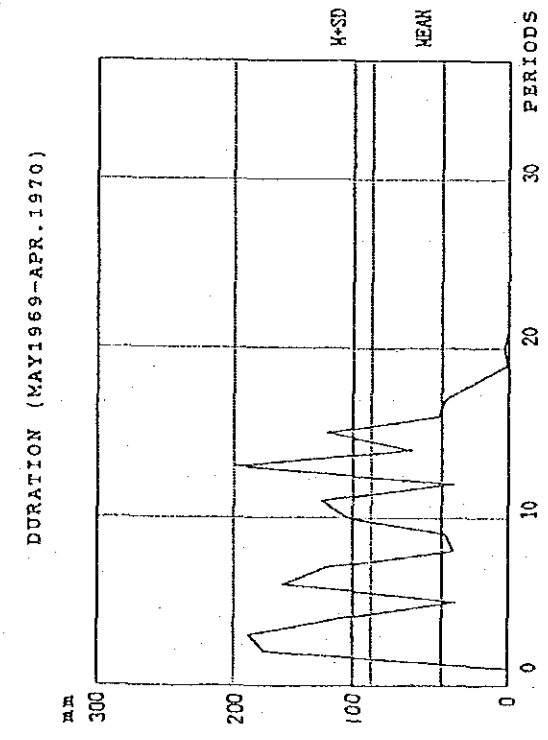
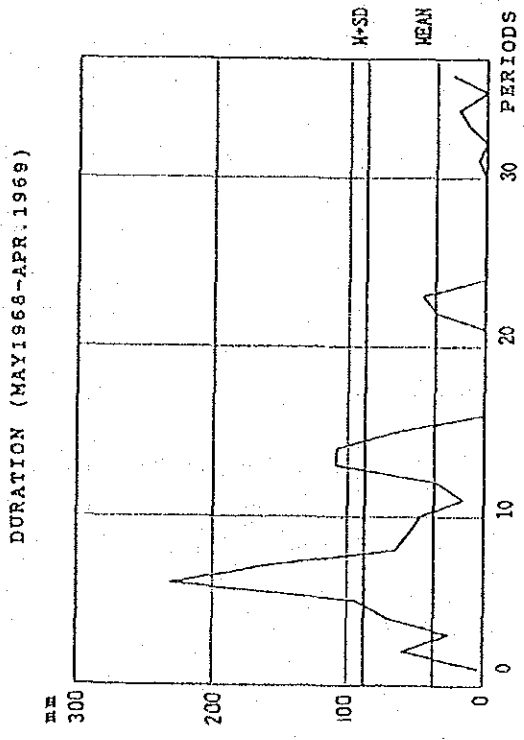
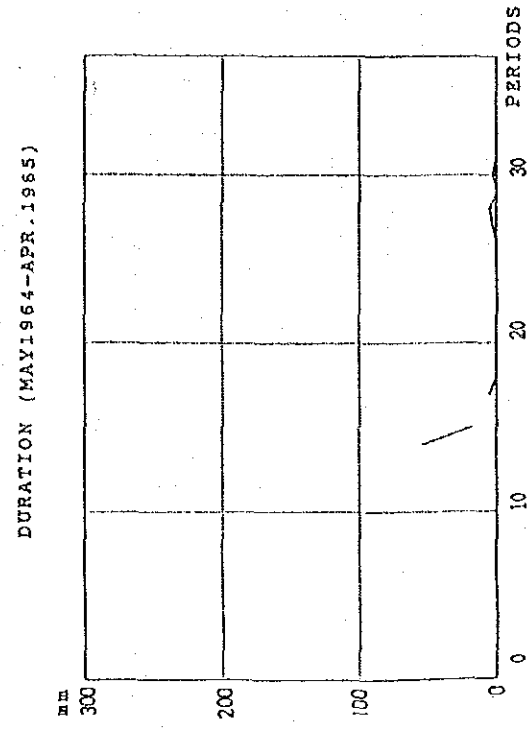
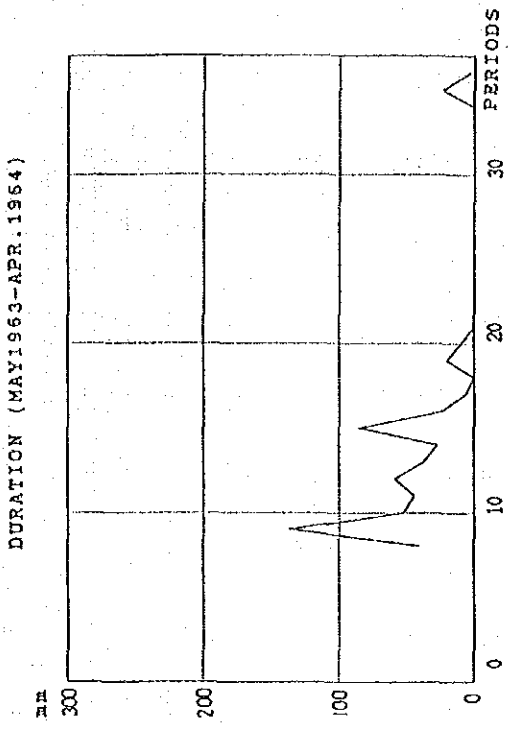


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita

Fig. A.3.2.2-1 10-day Precipitation at Agro Santiago (con't)

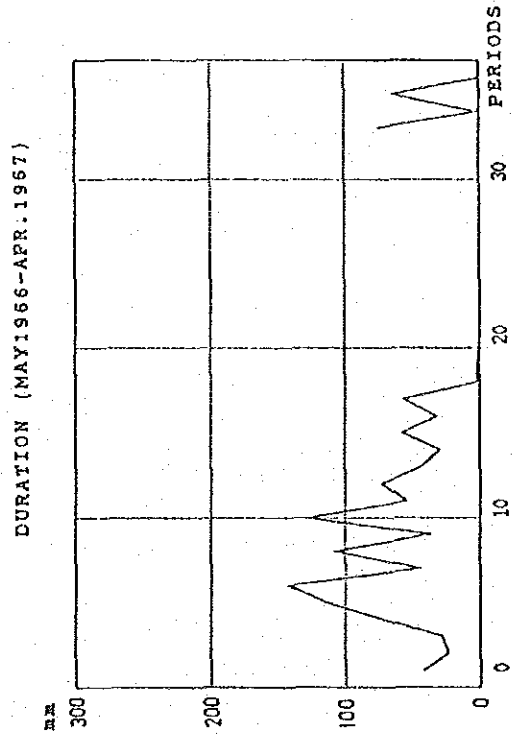
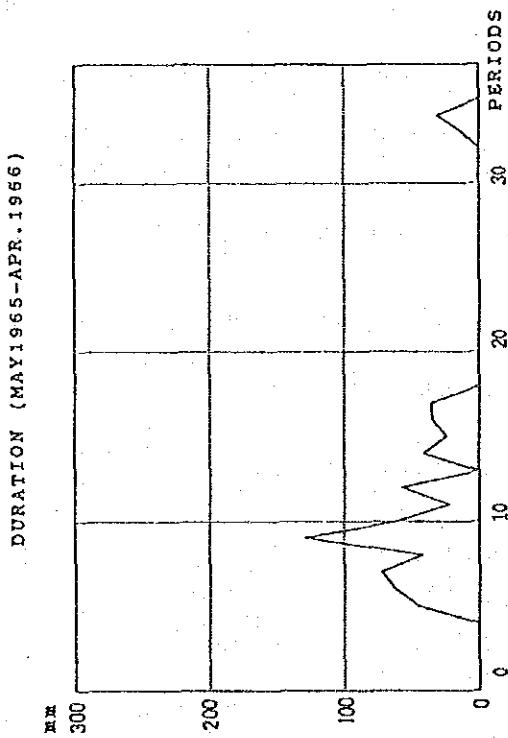
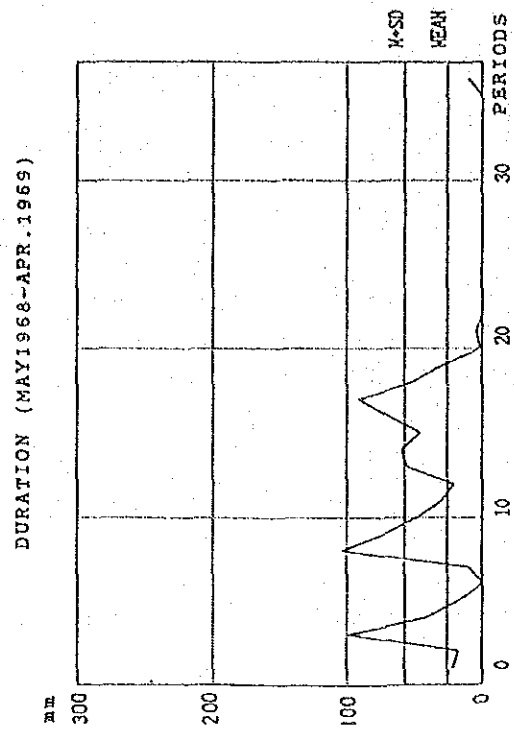
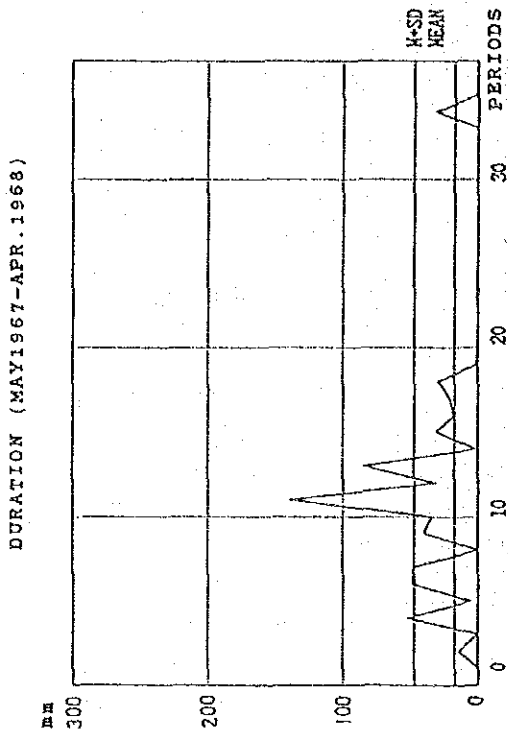
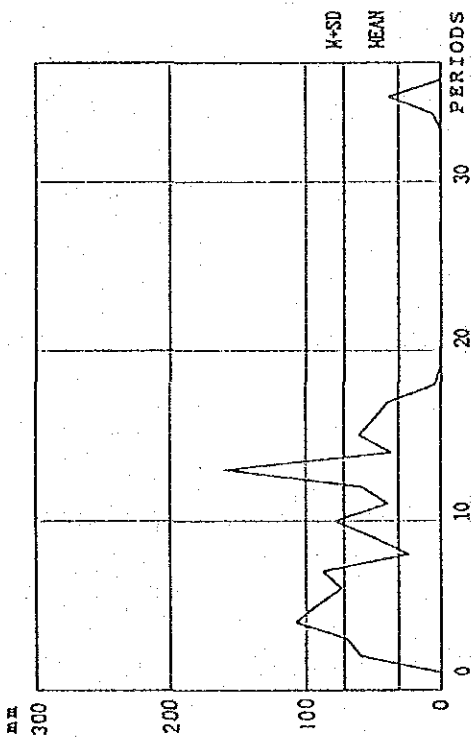
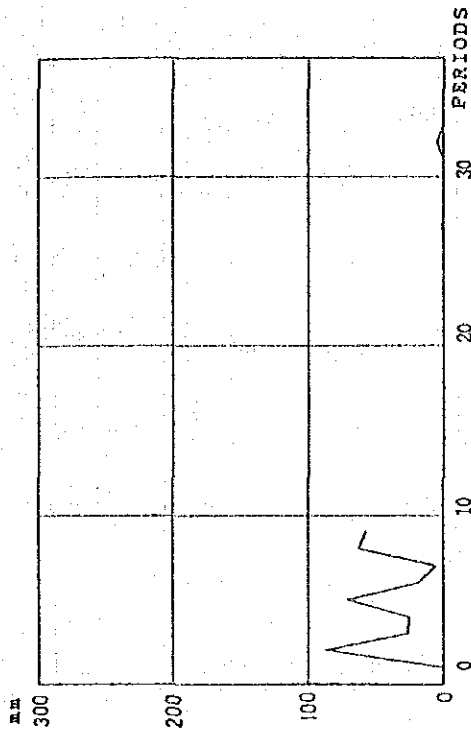


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

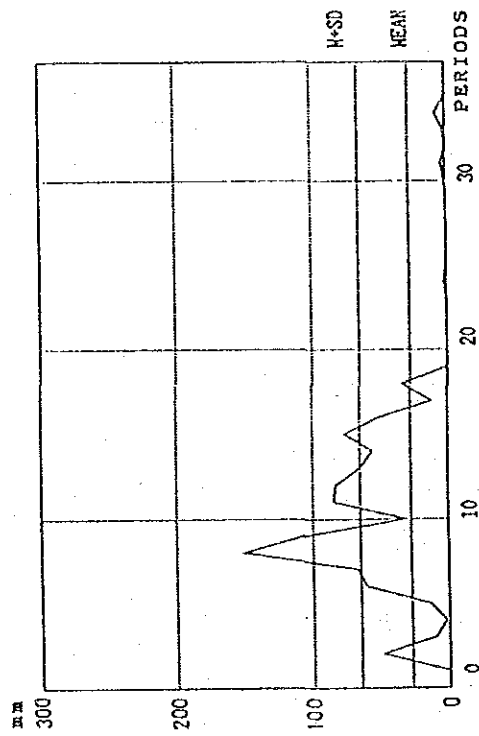
DURATION (MAY1969-APR.1970)



DURATION (MAY1971-APR.1972)



DURATION (MAY1970-APR.1971)



DURATION (MAY1972-APR.1973)

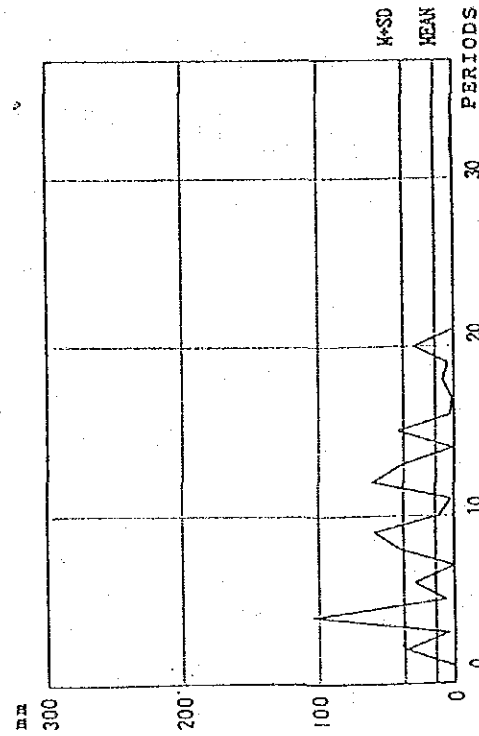


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

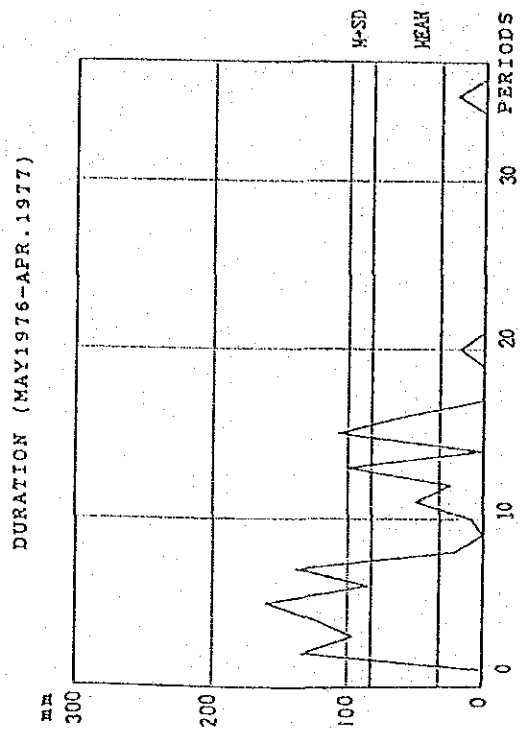
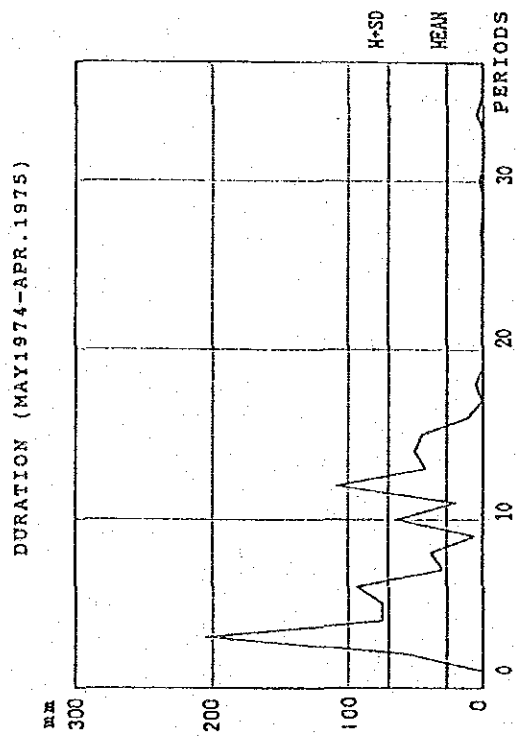
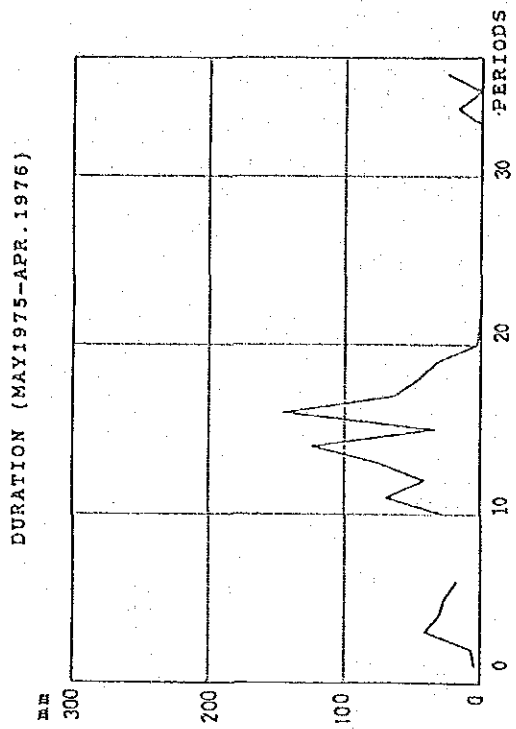
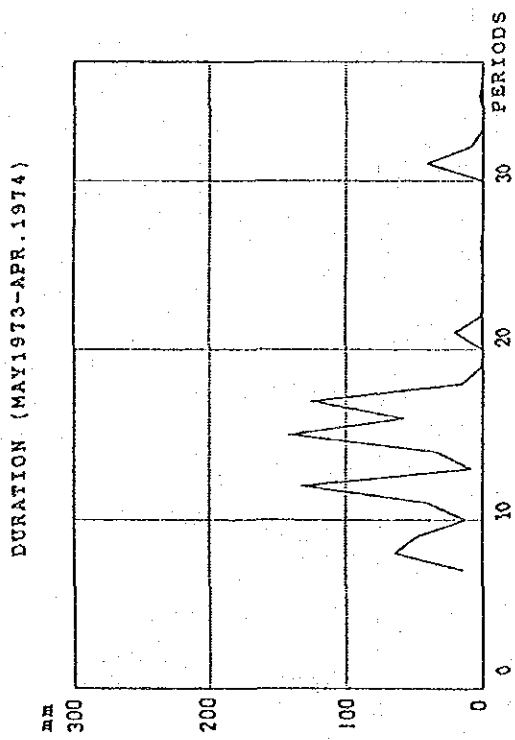
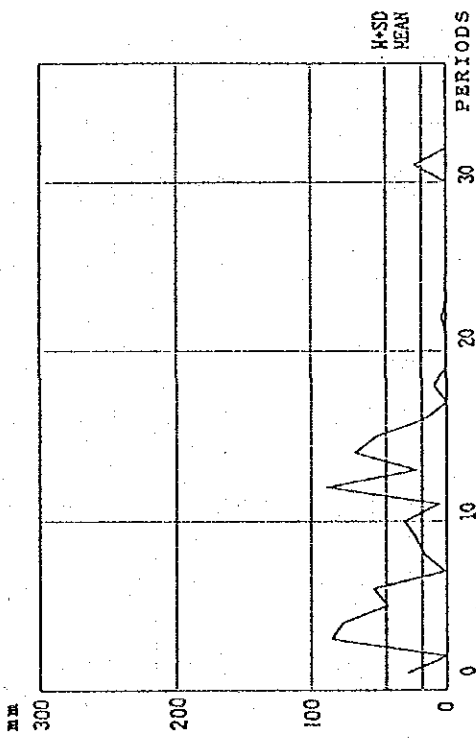
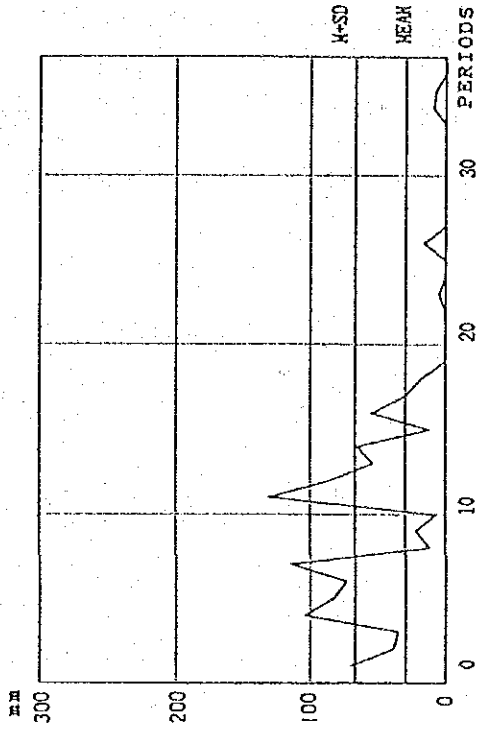


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

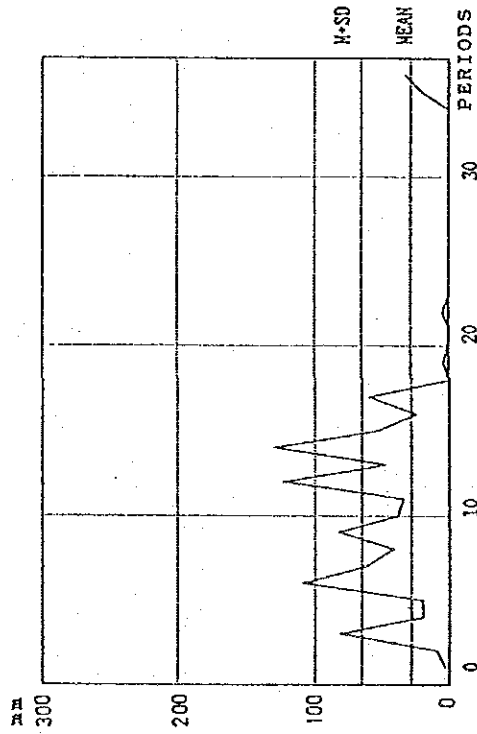
DURATION (MAY 1977-APR. 1978)



DURATION (MAY 1979-APR. 1980)



DURATION (MAY 1978-APR. 1979)



DURATION (MAY 1980-APR. 1981)

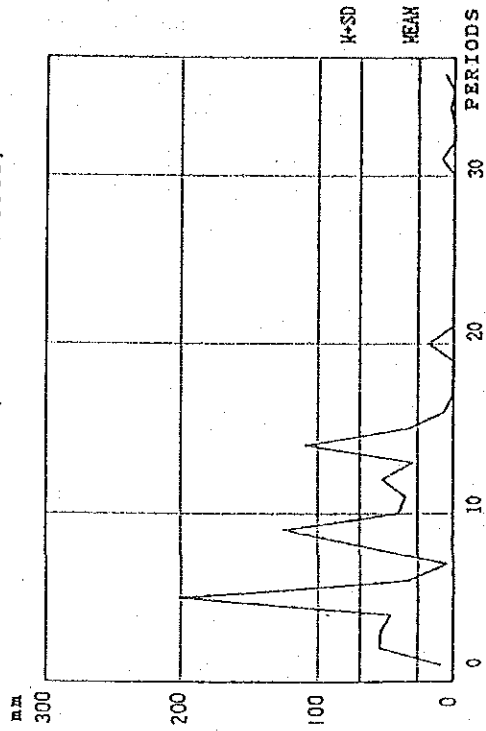
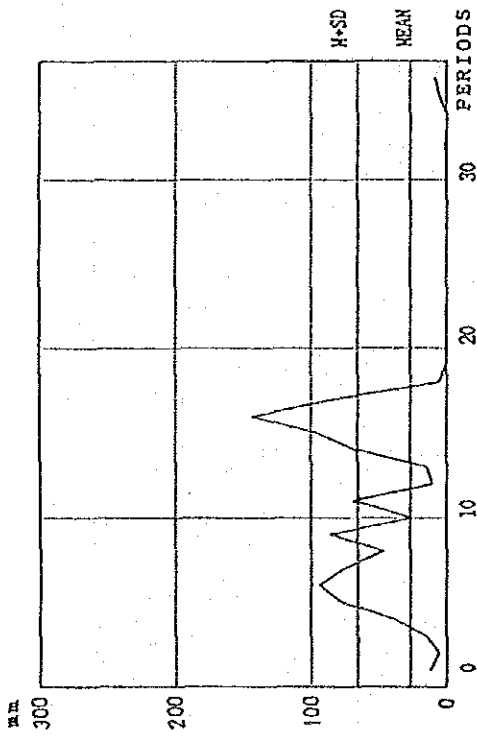
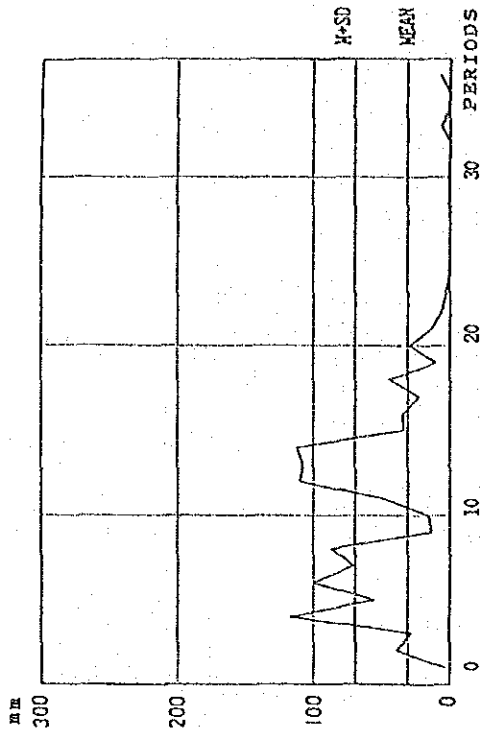


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

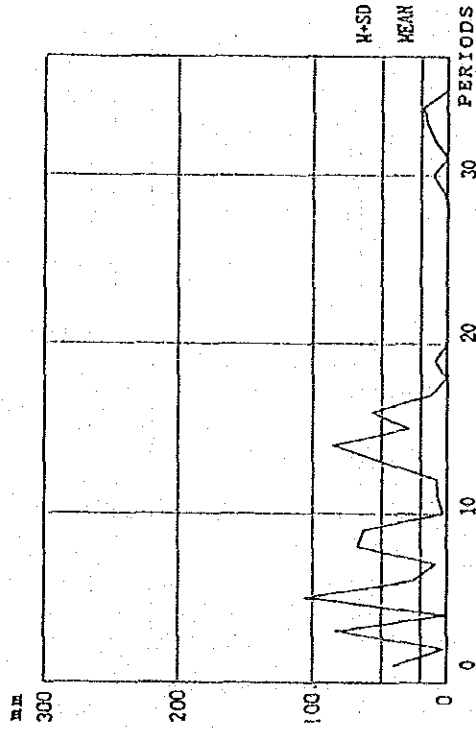
DURATION (MAY1981-APR.1982)



DURATION (MAY1983-APR.1984)



DURATION (MAY1982-APR.1983)



DURATION (MAY1984-APR.1985)

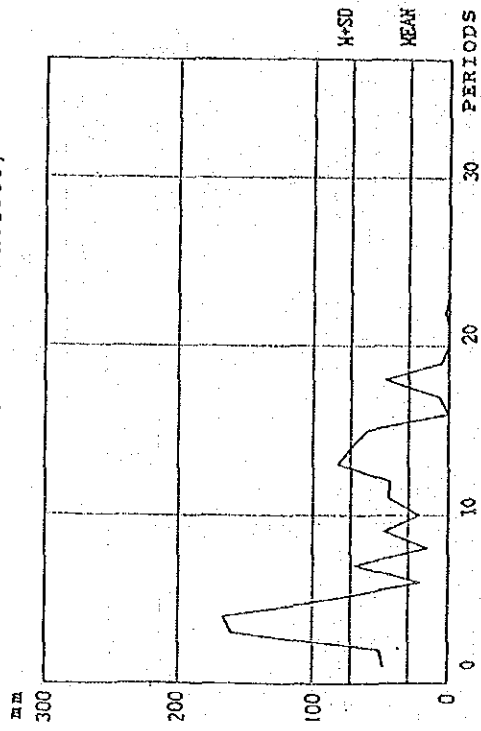


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

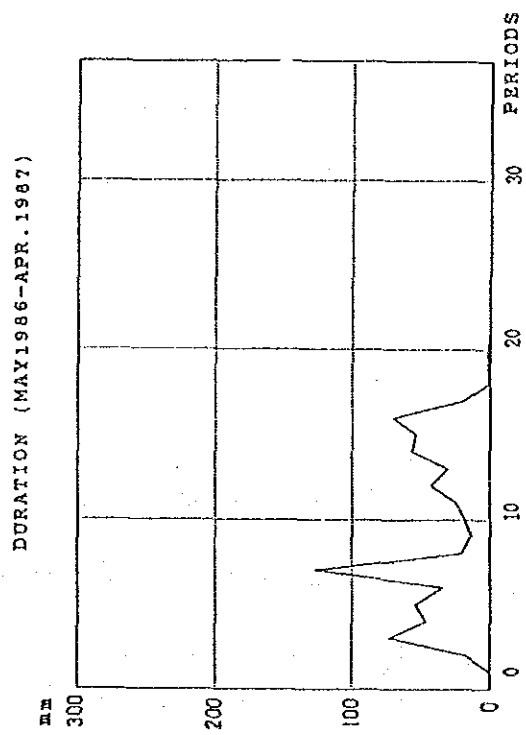
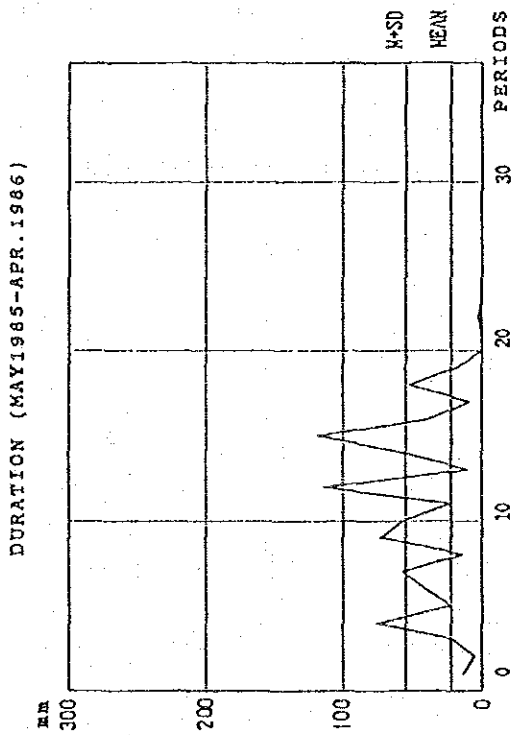
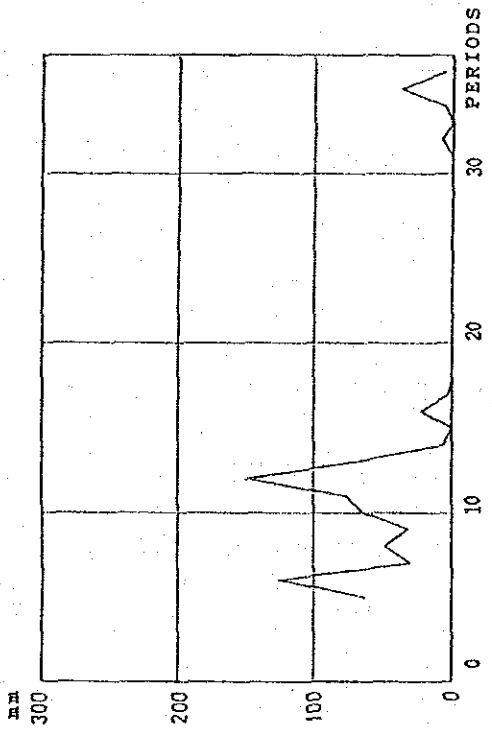
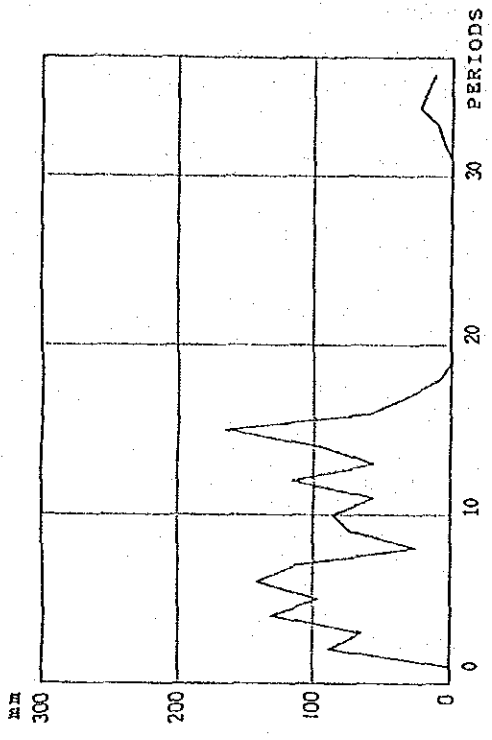


Fig. A.3.2.2-2 10-day Precipitation at La Ceibita (con't)

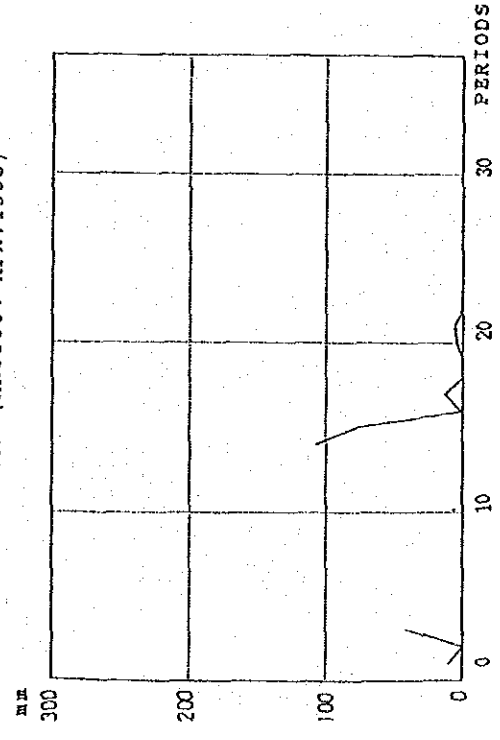
DURATION (MAY 1963-APR. 1964)



DURATION (MAY 1965-APR. 1966)



DURATION (MAY 1964-APR. 1965)



DURATION (MAY 1966-APR. 1967)

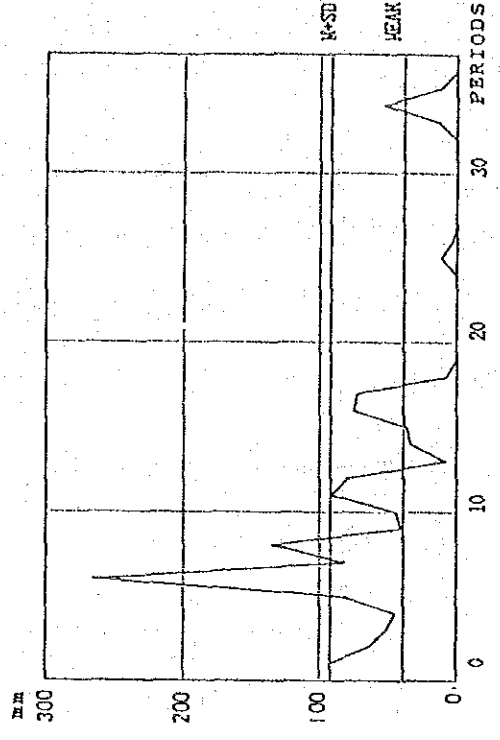
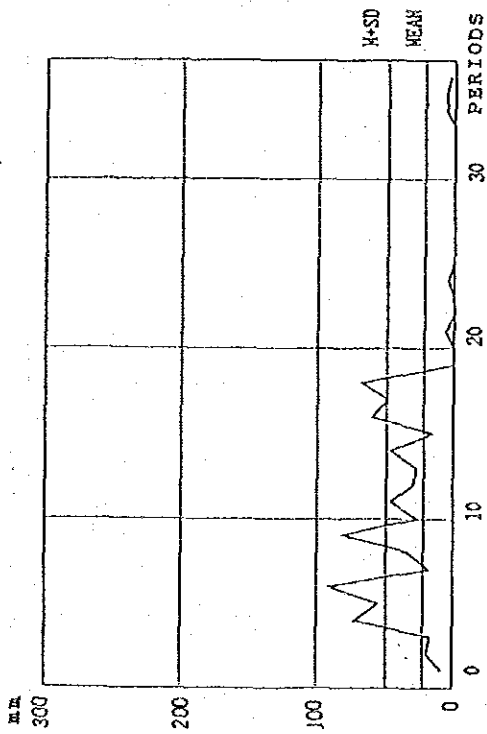
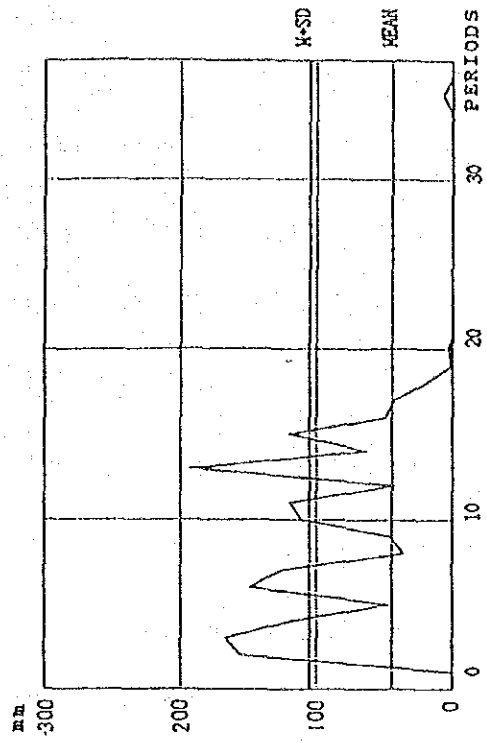


Fig. A.3.2.2-3 Precipitation over Ostua River at Casa de Tablas

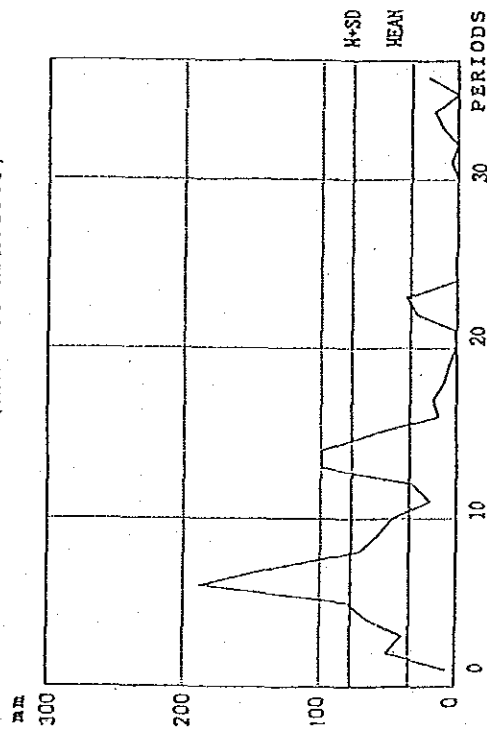
DURATION (MAY 1967-APR. 1968)



DURATION (MAY 1969-APR. 1970)



DURATION (MAY 1968-APR. 1969)



DURATION (MAY 1970-APR. 1971)

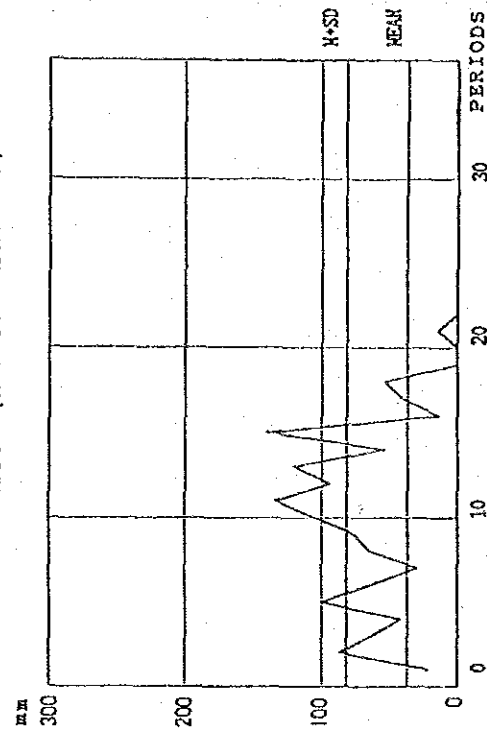


Fig. A.3.2.2-3 Precipitation over Ostua River at Casa de Tablas (con't)

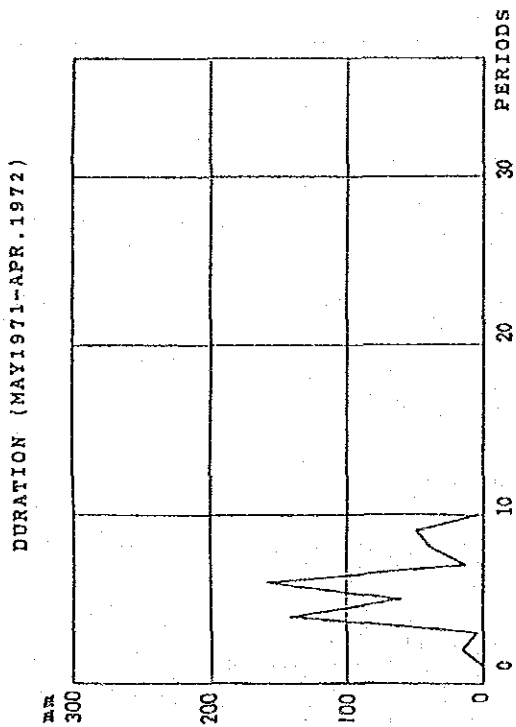


Fig. A.3.2.2-3 Precipitation over Ostua River at Casa de Tablas (con't)

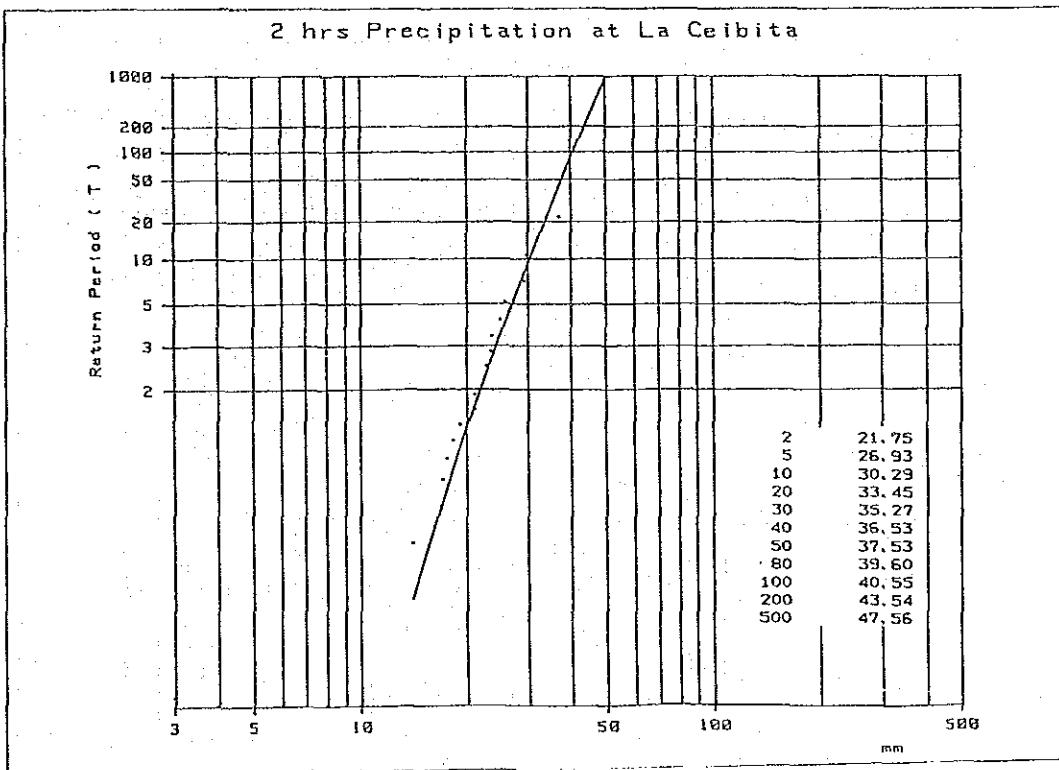
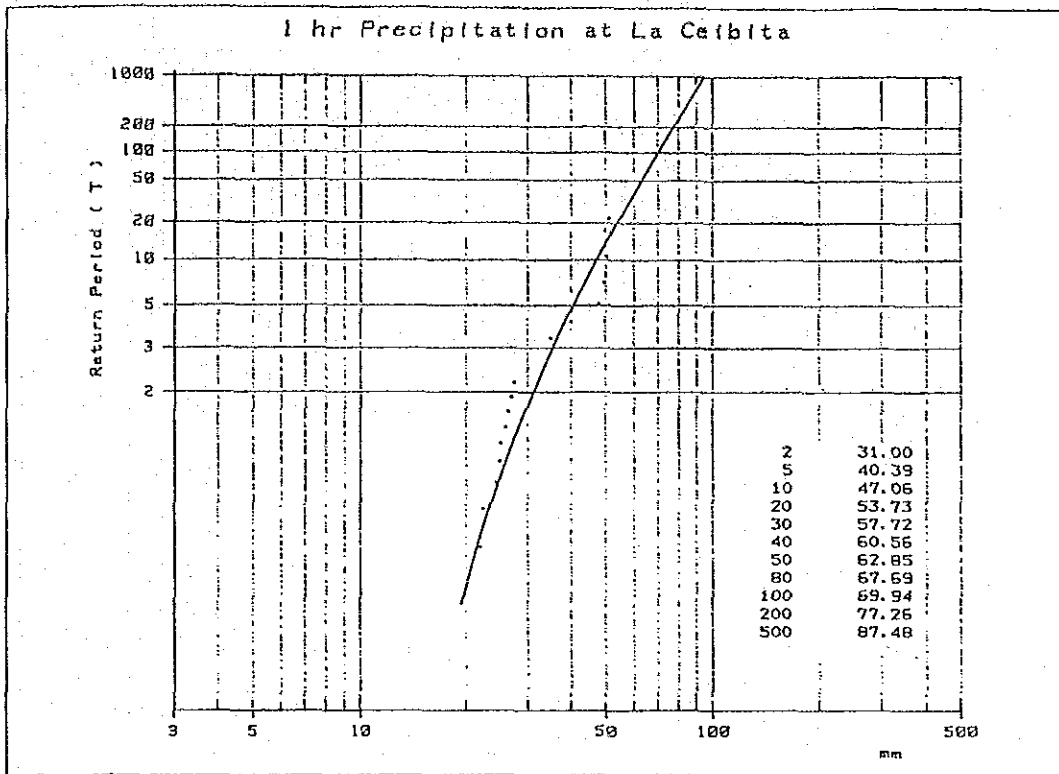


Fig. A.3.2.2-4 Probability Analysis of Hourly Precipitation at La Ceibita

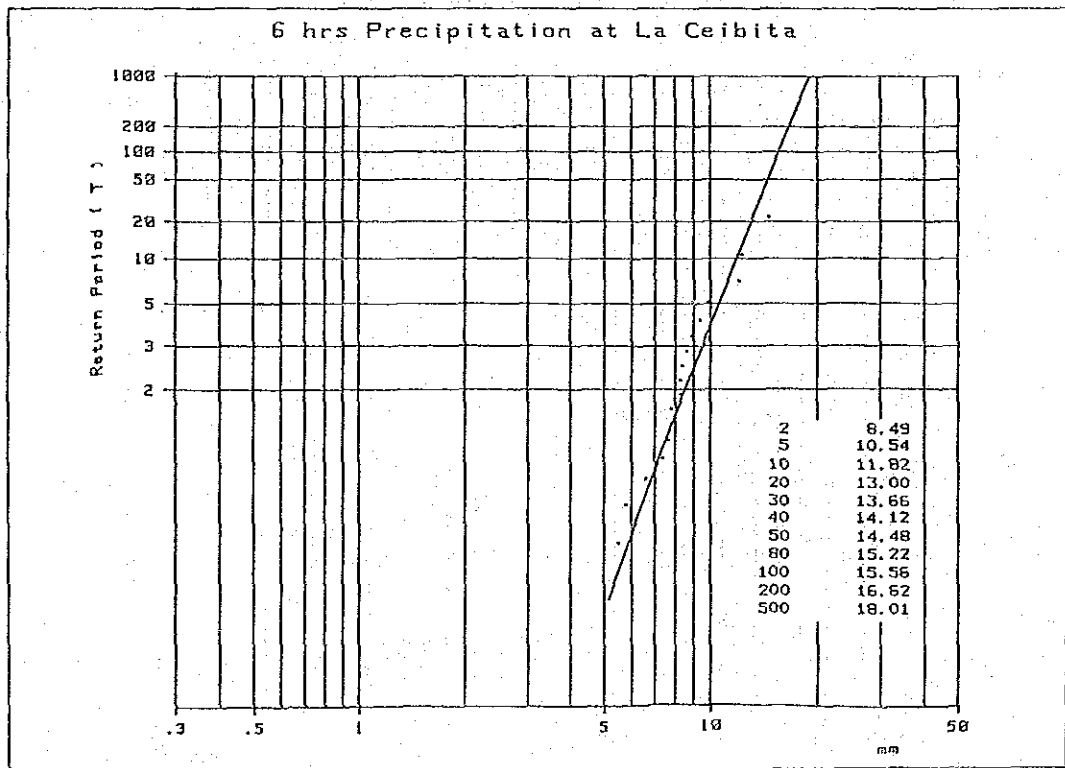
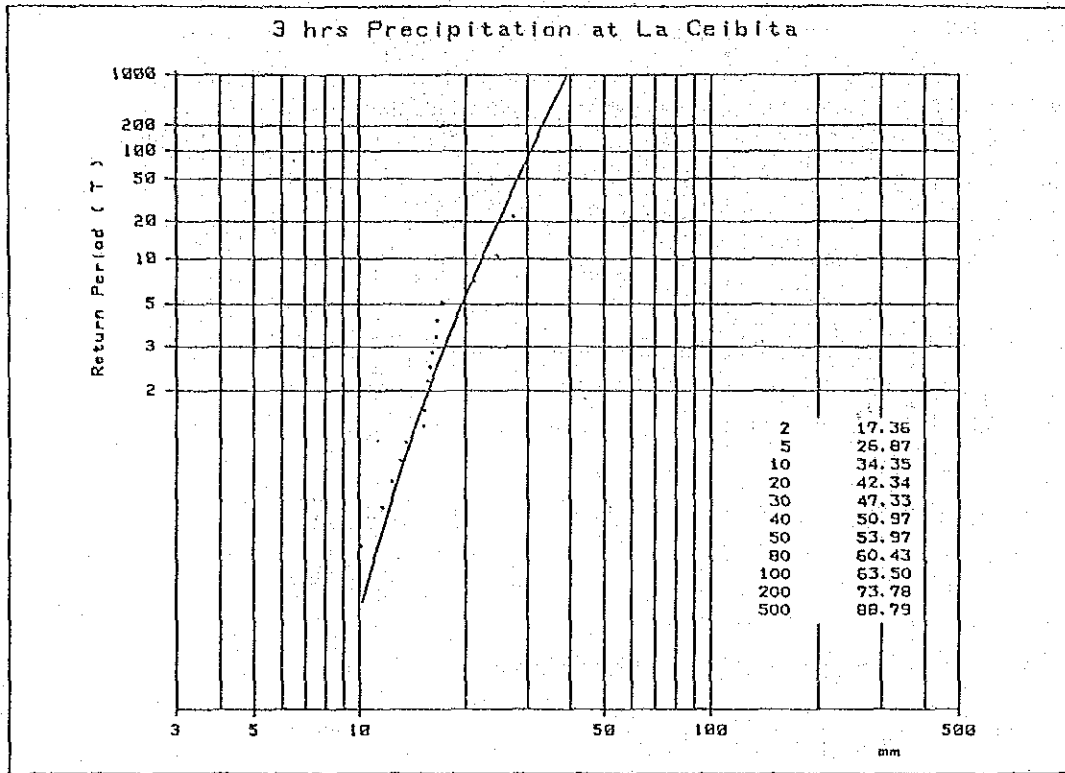


Fig. A.3.2.2-4 Probability Analysis of Hourly Precipitation at La Ceibita (con't)

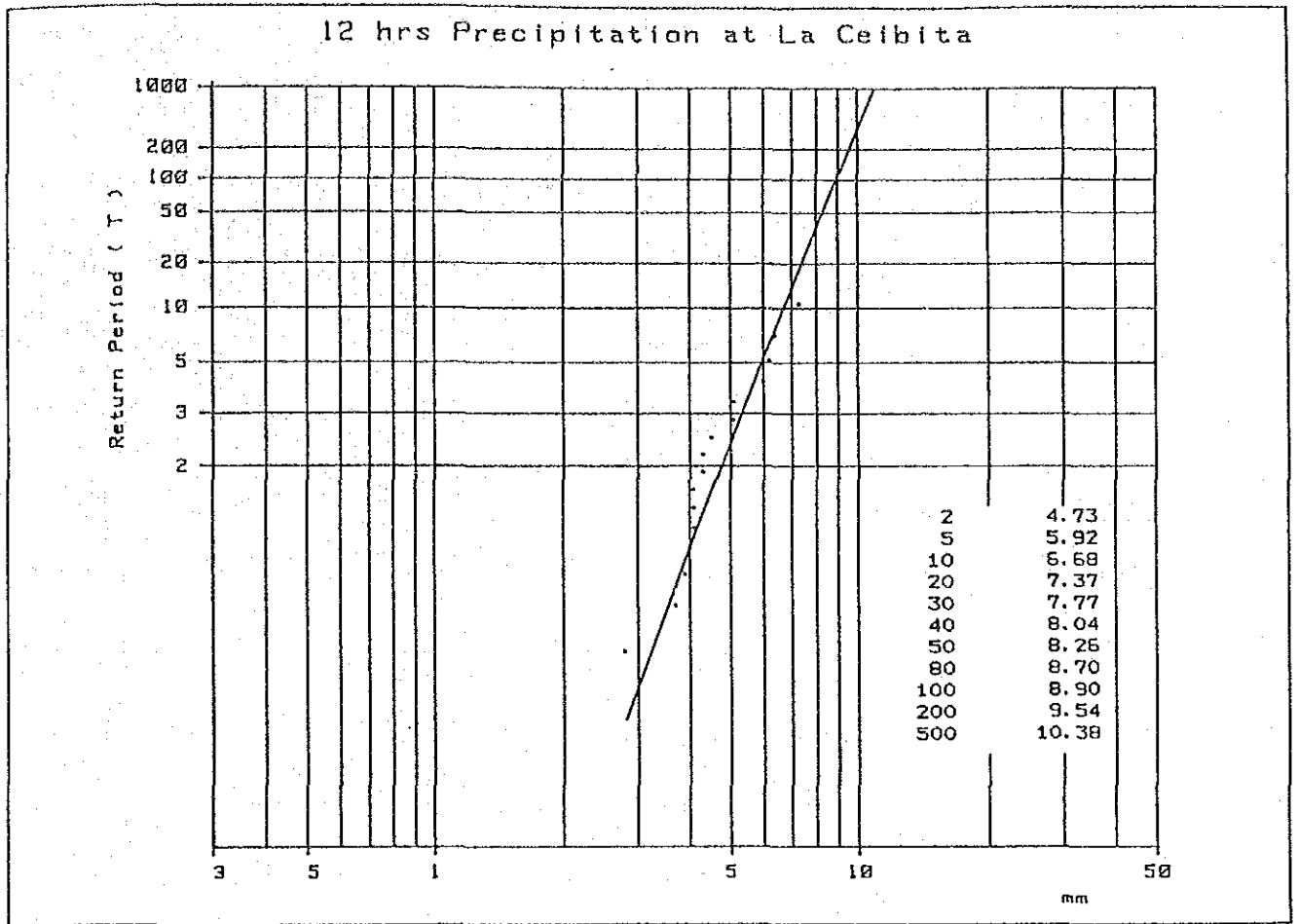


Fig. A.3.2.2-4 Probability Analysis of Hourly Precipitation at La Ceibita (con't)

Table A.3.2.2-9 Monthly Mean Wind Velocity at La Ceibita

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	—	—	—	—	—	—	—	—	—	—	6.7	7.9	—
1971	8.3	7.8	8.5	9.6	6.4	4.8	5.8	4.0	5.1	3.6	4.9	6.1	6.2
1972	6.7	7.9	7.3	7.9	6.4	6.9	7.3	6.1	5.2	5.7	4.0	7.6	6.6
1973	8.3	8.3	7.7	6.0	7.2	4.9	7.0	6.0	1.9	2.8	5.3	5.1	5.9
1974	6.4	8.1	6.2	8.2	10.7	5.0	9.2	8.3	6.4	10.2	6.8	7.0	7.7
1975	7.7	6.7	6.8	8.1	6.3	6.4	6.2	4.5	3.7	4.1	5.1	4.3	5.8
1976	5.8	7.6	6.9	7.2	6.2	3.9	5.9	5.2	4.4	4.7	7.0	6.4	5.9
1977	7.2	7.4	7.0	7.8	6.0	5.3	6.3	4.4	4.3	4.7	5.2	5.5	5.9
1978	7.2	7.6	5.6	7.0	7.2	6.1	3.9	3.7	3.4	3.8	4.4	5.6	5.5
1979	6.4	—	—	—	5.8	5.2	—	—	—	—	—	—	—
AVERAGE	7.1	7.7	7.0	7.7	6.9	5.4	6.5	5.3	4.3	5.0	5.5	6.2	6.2

DATA : INSIVUMEN

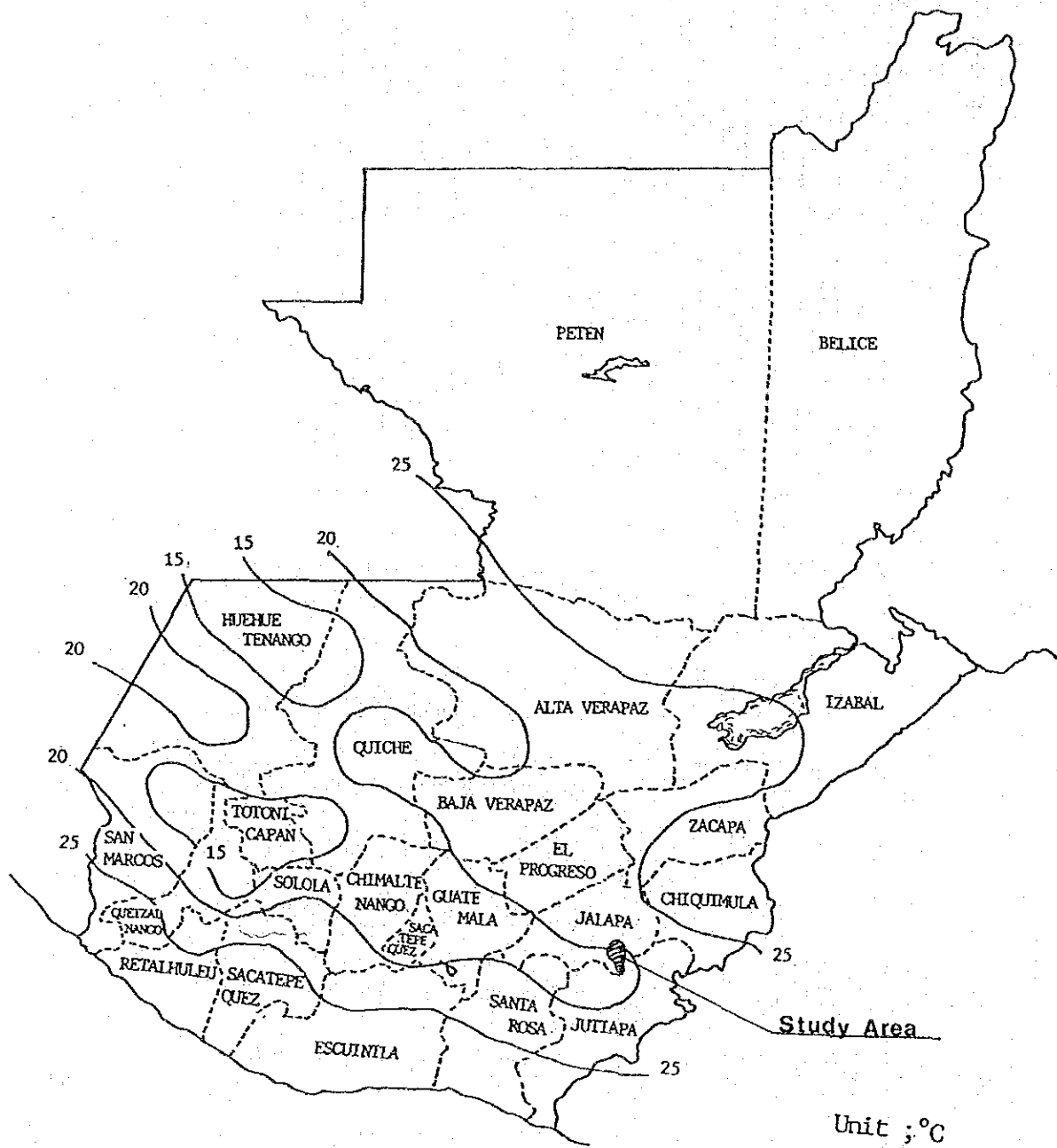


Fig. A.3.2.2-5 Annual Mean Temperature

Table A.3.2.2-10 Monthly Mean Temperature at La Ceibita

MONTH	°C
Jan.	20.2
Feb.	21.1
Mar.	23.5
Apr.	24.0
May.	24.0
Jun.	22.5
Jul.	22.3
Aug.	22.4
Sep.	22.3
Oct.	21.9
Nov.	21.2
Dec.	20.6
Annual average	22.1

Data Source : INSIVUMEH

Table A.3.2.2-11 Monthly Mean Relative Humidity at La Ceibita

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1965	61	57	55	55	62	62	80	82	87	87	82	78	72
1966	75	71	72	75	82	90	87	—	—	—	—	—	—
1967	—	—	—	—	—	—	—	—	—	—	89	85	—
1968	86	80	61	62	72	82	74	75	81	83	78	72	76
1969	68	64	65	66	71	80	77	83	82	81	74	68	73
1970	65	64	56	57	62	68	75	74	79	76	68	63	67
1971	60	59	54	54	63	71	70	76	78	76	72	65	66
1972	69	59	56	56	60	72	67	66	67	67	68	68	64
1973	59	58	58	59	65	73	73	79	81	80	70	65	68
1974	61	58	61	52	66	74	66	64	76	68	62	60	64
1975	61	57	53	54	63	60	62	73	79	80	75	69	65
1976	63	57	54	60	67	80	68	65	71	73	64	58	65
1977	54	55	49	54	59	66	56	63	68	64	64	63	60
1978	58	55	57	57	60	65	72	70	80	—	—	—	—
AVERAGE	65	61	58	59	66	74	71	73	77	76	72	68	68

Table A.3.2.2-12 Maximum and Minimum Relative Humidity at La Ceibita

ANO	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	98 13	96 18	98 14	97 17	95 21	96 23	98 33	96 32	95 35	96 38	92 41	97 23	99 12
1971	97 18	97 14	98 12	98 12	95 13	98 22	97 28	97 46	98 38	98 62	100 40	96 39	100 12
1972	99 32	100 28	100 29	99 26	99 26	96 47	97 43	98 45	97 46	98 38	98 38	95 34	100 26
1973	100 31	100 29	100 13	100 13	97 31	97 28	98 29	100 33	100 39	100 32	100 44	100 20	100 13
1974	100 31	100 29	100 13	87 13	94 31	98 23	96 29	98 33	100 30	97 32	95 44	100 20	100 13
1975	100 15	100 11	99 10	100 8	98 13	98 19	98 14	100 32	98 36	100 32	100 27	100 25	100 8
1976	100 13	100 22	100 14	100 17	99 21	98 29	98 27	98 24	99 27	100 27	98 16	100 12	100 12
1977	100 7	98 11	96 7	96 15	98 12	98 22	96 12	96 22	99 21	97 22	100 18	99 15	100 7
1978	100 11	100 13	98 12	96 18	99 12	98 22	96 30	100 26	98 28	98 31	100 25	100 17	100 11
1979	100 12	100 14	98 15	97 13	100 19	100 29	—	—	—	—	—	—	—

DATA : INSIYUHEI.

Table A.3.2.2-13 Evaporation at La Ceibita

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1973	5.8	6.0	7.8	7.2	6.0	3.9	4.4	3.8	3.9	—	—	4.5	5.4
1974	4.6	6.1	5.8	7.2	5.7	3.8	4.1	4.2	3.9	3.7	—	4.9	4.9
1975	4.9	6.3	7.2	7.5	6.0	5.8	4.7	4.0	3.8	3.4	4.6	3.8	5.1
1976	4.7	6.2	7.1	6.7	5.8	3.7	4.9	4.5	4.1	4.0	3.4	4.7	5.0
1977	5.0	6.0	7.8	6.6	5.8	4.0	5.2	4.3	4.4	4.4	4.3	4.4	5.2
1978	5.4	6.6	6.8	7.1	6.8	5.1	4.1	4.4	3.5	—	4.4	—	—
AVERAGE	5.2	6.3	7.1	7.0	6.0	4.4	4.6	4.2	3.9	3.9	4.2	4.5	5.1

mm

Table A.3.2.2-14 Daily Mean Solar Radiation

HYDRO YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'70 ~ '71	—	155.2 ‡	153.3	161.7 ‡	149.2	142.8	126.9 ‡	117.0	125.7	146.8	164.1	172.9	146.7 ‡
'71	167.3 ‡	154.7 ‡	160.8 ‡	166.0 ‡	158.6	—	—	—	—	—	—	—	151.6 ‡
'72	—	—	159.6 ‡	154.3	150.5	135.7 ‡	128.9	116.5	130.1	152.1	172.4	167.7 ‡	146.5 ‡
'73	147.2	149.8	158.6 ‡	161.2	148.3	131.6	131.6	121.0 ‡	120.3	148.4	154.4	171.9	145.3 ‡
'74	160.3	150.7	160.9 ‡	157.2 ‡	136.1 ‡	153.0	134.7	116.4	120.4	151.7	167.6 ‡	182.2	149.1 ‡
'75	155.5	160.9 ‡	157.3	160.3	144.1 ‡	132.4	129.1	112.9	117.0	147.2 ‡	176.8 ‡	171.7	147.2 ‡
'76	174.7 ‡	147.9	173.5	167.4	160.0	146.6	124.3	117.8	128.1 ‡	139.7 ‡	167.9 ‡	163.1	150.9 ‡
'77	161.3	153.2	169.1	164.7	162.0	151.2	133.6	119.1	127.4 ‡	152.4	167.7	169.5	152.7 ‡
'78	163.8	162.5	158.5 ‡	170.7 ‡	154.5 ‡	145.0	132.4	122.7	131.7	144.0	158.8	169.5 ‡	150.9 ‡
'79	163.6	160.6	177.8	151.8	135.9 ‡	137.8 ‡	132.0	122.5 ‡	129.3	152.8	181.7 ‡	163.6 ‡	150.8 ‡
'80	170.0	154.6 ‡	168.4	167.1	151.4 ‡	142.8	128.5	118.7	127.8	148.4	171.4	169.9	151.6 ‡
'81	162.5	140.5	169.9	170.4 ‡	125.2	147.7	131.4 ‡	119.8	128.7	145.8	174.6	168.1	149.0 ‡
'82	149.5 ‡	153.9	155.8	174.3	138.5	143.4	133.0	123.5	125.5 ‡	134.7 ‡	164.9	169.4	147.4 ‡
'83	175.3 ‡	167.7	172.5	169.3	161.5	150.8	130.8	122.3	128.9 ‡	146.5 ‡	175.3 ‡	180.5 ‡	156.8 ‡
'84	156.0	165.8	165.4 ‡	167.1	141.2	163.5	140.4	119.6 ‡	127.2 ‡	149.5	169.8	169.1	152.9 ‡
'85	—	165.8 ‡	182.8	175.3 ‡	166.6 ‡	145.0	134.9	118.1	128.5	154.2	172.1	182.5	156.7 ‡
'86	157.9	168.2	166.0	164.6	139.5	146.9	128.8	113.4	—	—	—	—	148.2 ‡
MEAN	159 ‡	156.4	167.9	163.3	147.5	146.6	131.7	118.1	125.0	149.6	167.0	171.8	

w/m²

Table A.3.2.2-15 Sunshine Duration

HYDRO YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'65 ~ '66	—	—	—	—	—	—	—	—	—	8.90	6.90	6.18	7.29 *
'66	6.37	4.46	6.60	7.13	5.84	5.88	7.89	6.10	7.27	—	—	7.85	6.49 *
'67	7.48 *	6.20 *	7.04 *	7.41	5.53	6.23	6.42	6.12	—	—	—	—	6.55 *
'70	—	6.05	5.57	5.90	5.50	6.09	7.17	7.54	8.06	8.41	8.59	8.71	7.04 *
'71	7.25	5.93	6.61 *	1.04 *	6.48 *	—	—	—	—	—	—	—	5.92 *
'72	—	—	6.42	6.20	6.15	6.21	6.93	7.36	8.67	9.23	8.82	7.22	7.31 *
'73	5.13	5.29	6.32	6.24	5.34	4.91	7.33	6.29	7.15	8.91	7.10	8.56	6.70
'74	6.41	5.50	6.96	6.51	4.29	7.66	8.38	7.24	7.11	9.17	8.85	9.07	7.27
'75	5.90	6.67	6.57	6.30	5.15	5.97	6.69	6.88	6.68	9.49	9.26	7.91	6.93
'76	7.67	4.85	7.85	7.36	6.76	6.81	6.82	7.77	9.08	7.85	9.28	7.41	7.47
'77	6.83	5.86	8.15	6.87	7.12	7.72	7.77	7.37	8.38	9.23	8.52	7.76	7.62
'78	7.05	6.80	6.42	7.36	5.89	6.52	7.23	7.82	8.79	8.16	7.50	7.48	7.25
'79	6.50	6.16	7.87	5.49	3.98	5.32 *	7.25	7.73	8.01	8.33	9.32	6.91	6.99 *
'80	7.14	5.66	7.07	6.77	5.62	6.20	6.75	7.41	8.15	8.25	8.69	7.86	7.13
'81	6.47	4.00	6.95	6.79	3.09	6.16	7.45 *	7.17 *	7.76	7.95	9.10	7.89 *	6.69 *
'82	5.04	5.49	5.99	7.82	4.37	6.07	7.34	7.79	7.47	6.72	8.31	7.17	6.84
'83	7.66	6.37	7.00	6.65	6.23	6.65	8.57	7.25	7.7 *	7.70	8.89	8.20	7.25 *
'84	5.30	6.44	6.51	6.50	4.48	7.85	8.37	7.15	8.04 *	8.36	8.51	7.66	7.09 *
'85	—	6.75 *	8.23	7.28 *	6.64	6.07	6.84	6.53	7.89	8.87	9.23	9.23	7.60 *
'86	5.76	7.03	7.01	6.76	4.70	6.69	6.81	6.28	—	—	—	—	6.38 *
MEAN	6.43	5.79	6.91	6.71	5.43	6.46	7.21	7.20	7.69	8.50	8.59	7.83	—

3
3
88

Table A.3.2.2-16 10-day Sunshine Duration

hr

	'66	'67	'70	'71	'72	'72	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	MEAN
J B	8.89	—	7.30	—	9.13	6.97	7.64	6.35	9.58	8.79	8.96	1.65	7.89	7.90	7.90	7.56	8.33 #	8.18	8.53	8.00
A M	6.65	—	7.79	—	7.40	6.67	7.29	7.05	8.75	8.92	8.08	6.92	8.25	8.23	6.95	6.95	7.65	8.11 #	7.43	7.61
N L	6.52	—	8.99	—	9.39	7.70	8.16	7.58	8.92	7.53	9.26	9.32	8.48	7.76	7.48	7.48	7.38	7.85	7.73	8.01
F B	8.39	—	—	—	9.05	9.19	9.51	9.25	7.75	8.91	8.11	8.90	8.56	8.06	8.42	7.23	9.77	9.77	9.34	8.72
E M	8.31	—	—	—	9.34	9.61	9.76	9.76	7.40	9.55	7.41	8.77	7.46	7.64	8.92	7.70	7.18	8.94	8.45	8.45
B L	8.53	—	—	—	9.30	7.69	8.00	9.46	8.53	9.10	9.16	8.81	8.88	8.20	8.85	8.18	8.05	8.19	8.26	8.26
M B	6.25	—	—	—	8.57	8.02	8.58	9.05	8.85	8.73	8.18	10.21	8.78	8.37	9.27	9.10	8.16	8.40	8.48	8.48
A M	6.83	—	—	—	8.53	6.40	9.45	8.65	9.72	8.20	7.21	10.10	8.25	10.04	7.49	8.93	7.99	9.50	8.52	8.52
R L	7.56	—	—	—	9.31	8.73	8.70	9.98	9.27	8.92	7.15	9.21	9.02	8.91	8.19	8.67	9.33	8.82	8.75	8.75
A B	6.10	—	—	—	6.52	8.48	9.23	8.41	8.86	9.18	9.27	7.60	9.13	8.54	7.07	8.54	8.84	10.85	8.41	8.41
P M	6.88	6.70 #	—	—	8.67	9.20	9.50	8.40	8.42	8.20	7.04	8.82	7.09	7.73	7.46	8.47	7.07	9.24	7.91	7.91
R L	5.97	8.88	—	—	8.48	8.03	8.49	8.91	6.93	6.93	6.14	7.90	7.38	5.89	6.95	7.58	7.07	7.15	7.15	7.15
M B	8.54	8.64	—	—	6.93	5.50	6.61	7.95	6.80	9.00	6.34	6.40	5.64	5.53	8.43	6.71	—	8.55	6.94	6.94
A M	8.52	8.83	—	—	3.97	8.64	6.27	6.89	7.38	7.93	6.40	6.94	8.47	8.07	7.47	3.91	—	5.86	6.71	6.71
Y L	6.98	4.98 #	—	—	4.55	7.02	8.12	8.12	6.35	4.68	6.75	7.99	5.06	6.23	7.13	5.55	—	3.14	5.55	5.55
J B	5.05	8.45	5.31	—	4.99	3.03	6.98	4.11	3.56	7.03	3.61	5.96	3.33	5.30	6.27	6.13	7.20 #	8.40	5.35	5.35
U M	4.58	5.70 #	3.42	—	3.58	4.19	8.34	8.20	8.01	6.81	7.06	4.22	3.57	3.05	4.86	4.22	5.73	7.75	5.31	5.31
N L	3.12	—	8.23	7.10	—	7.30	4.28	6.19	4.23	6.91	8.75	7.81	7.19	4.51	6.63	7.99	3.96	6.37	4.94	6.33
J B	5.59	5.40 #	5.05	7.77 #	7.52	7.35	6.22	5.22	5.90	7.69	5.90	6.97	8.23	7.10	7.24	6.95	5.36	8.91	6.14	6.14
U M	6.30	7.15	4.83	5.81 #	7.21	7.18	7.13	8.04	3.70	9.23	5.05	7.89	7.15	6.43	4.90	7.14	7.13	7.43	7.75	7.01
L L	7.79	7.74 #	6.73	6.31	4.09	4.63	7.47	8.45	8.06	7.57	8.49	9.14	5.96	7.29	5.84	6.93	6.98	8.34	7.16	7.04
A B	7.22	7.43	4.71	0.38 #	7.71	5.28	8.30	5.95	7.02	6.43	7.93	5.27	5.13	6.68	7.97	6.02	7.23	7.04	7.98	6.95
U M	6.16	7.39	7.41	0.25 #	5.38	7.90	6.72	6.70	5.76	6.19	7.20	5.43	7.18	7.40	8.34	6.16	6.08	7.57	5.61	6.44
G L	7.94	7.42	5.61	1.86 #	5.98	5.06	4.70	6.28	8.20	7.48	6.99	5.73	6.95	6.35	7.21	5.85	5.21	7.22 #	6.73	6.51
S B	4.71	6.87	5.22	5.29	7.10	3.82	4.91	5.09	6.04	8.48	6.44	4.95	7.56	2.95	5.88	5.82	4.71	7.65	5.40	5.73
E M	7.12	6.08	6.46	0.89	5.10	6.14	3.32	5.57	6.03	6.47	6.18	2.81	4.46	3.38	2.58	6.71	3.41	5.53	4.35	4.82
P L	5.69	3.83	4.81	13.78	6.26	6.06	4.64	4.75	8.21	6.41	5.05	4.77	4.85	2.95	4.88	6.16	5.33	6.55	4.37	5.74
O B	5.71	6.00	7.03	—	4.89	4.31	7.33	5.51	8.03	7.95	7.30	4.23 #	4.41	6.29	4.77	6.50	7.21	7.07	6.19	6.19
C M	5.79	6.04	5.11	—	4.67	5.43	9.19	6.76	5.82	8.06	4.82	5.31	7.31	7.80	6.74	7.20	9.19	6.40	7.29	8.90
T L	6.06	6.61	6.08	—	6.71	4.99	7.14	5.66	8.60	8.92	7.55	8.19	8.32	4.56	6.68	6.28	7.21	6.86	6.81	6.53
N B	7.52	5.41	7.82	—	6.49	6.48	8.74	8.19	7.74	7.95	6.25	8.32	6.83	7.77 #	7.20	7.45	8.72	3.95	8.85	7.17
O M	3.52	6.87	6.32	—	6.99	7.51	7.71	7.13	6.21	7.47	8.18	6.28	6.98	7.59	7.40	6.07	7.69	8.24	5.75	7.09
V L	7.63	7.19	7.57	—	7.71	6.61	8.70	6.75	6.51	7.68	7.25	7.15	7.01	7.03	7.41	8.19	6.70	5.30	7.82	7.38
D B	5.94	5.94	6.03	—	7.47	7.16	7.59	5.94	7.92	7.27	8.29	6.84	6.48	6.30	6.98	8.52	7.59	8.88	7.08	7.02
E M	4.78	4.85	7.24	—	8.83	7.29	5.04	7.08	8.25	8.25	6.70	7.78	7.34	7.00	7.69	5.83	7.05	6.31	4.86	6.94
C L	7.45	9.18	—	—	8.40	8.83	8.88	8.29	8.45	8.40	8.95	8.32	7.65 #	8.63	7.39	6.83	6.41	7.01	7.99	7.99

Table A.3.2.2-17 Monthly Wind Velocity (km/hr)

	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'70 ~ '71	—	—	—	—	—	—	0.71	* 7.87	* 8.33	* 7.81	* 8.52	* 9.00	* 8.18
'71	—	4.79	* 5.83	* 3.96	—	—	4.93	* —	—	—	—	—	4.85
'72	—	—	6.73	6.03	5.14	—	4.01	7.53	8.33	8.31	7.69	8.39	6.90
'73	7.27	5.00	4.78	3.65	4.82	3.36	5.51	6.69	6.89	8.14	6.17	8.26	5.81
'74	6.47	5.08	* 4.99	4.82	4.43	6.09	6.79	7.09	7.73	6.74	6.76	8.09	6.26
'75	6.34	6.40	5.17	4.35	3.68	4.07	5.11	4.31	5.78	7.63	6.94	7.24	5.57
'76	6.16	3.91	5.89	5.25	4.38	4.64	6.93	6.50	7.13	7.33	6.92	7.76	6.06
'77	5.97	5.27	6.23	4.34	4.26	4.64	5.15	5.35	7.14	7.54	7.35	7.00	5.84
'78	7.20	6.07	3.81	3.70	3.28	3.72	4.29	5.53	6.43	* —	—	—	4.84
'79	5.73	* 5.22	4.37	4.74	5.20	3.93	6.74	6.78	* —	—	—	—	5.34
'82	—	—	—	—	—	2.70	—	—	—	—	—	—	2.70
MEAN	6.57	5.31	5.25	4.61	4.40	5.57	6.22	7.08	7.62	6.97	7.79		

Table A.3.2.2-18 10-day Wind Velocity

	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'82	MEAN
J B	—	6.76	—	7.21	6.09	6.83	4.23	6.22	6.99	7.63	—	6.50
A M	—	9.06	—	9.43	7.08	8.17	7.23	8.21	5.38	5.54	—	7.51
N L	—	9.10	—	8.35	6.04	8.14	5.86	6.97	8.87	3.30	* —	7.62
F B	—	8.26	* —	9.18	7.09	6.22	6.64	6.93	9.13	—	—	7.53
E M	—	8.10	—	6.96	6.63	7.05	6.33	7.96	5.13	—	—	6.89
B L	—	8.87	* —	8.90	11.26	6.99	10.17	7.05	8.56	—	—	8.82
M B	—	9.70	—	7.48	6.21	6.77	5.93	7.79	7.36	—	—	7.32
A M	—	7.80	* —	7.34	5.65	6.59	7.48	6.79	8.35	—	—	7.03
R L	—	7.78	* —	8.22	6.61	6.91	7.37	6.24	6.42	—	—	6.96
A B	—	10.00	* —	7.52	7.96	7.26	7.77	9.64	7.18	—	—	7.89
P M	—	10.18	—	9.01	7.43	7.70	7.44	6.04	7.14	—	—	7.85
R L	—	8.59	* —	8.62	9.38	9.32	6.50	7.59	6.69	—	—	8.02
M B	—	—	—	7.28	8.47	7.66	7.52	6.22	9.39	5.88	* —	7.76
A M	—	—	—	6.92	6.38	6.00	5.84	6.16	7.03	5.76	—	6.30
Y L	—	—	—	7.58	4.74	5.46	5.20	5.56	5.37	5.62	—	5.65
J B	—	4.70	* —	5.60	4.84	6.45	4.00	5.06	6.79	4.43	—	5.31
U M	—	4.44	* —	4.27	4.04	5.99	4.03	5.21	6.43	5.13	—	5.01
N L	—	5.19	* —	5.12	6.50	* 6.76	3.70	5.54	4.98	6.10	—	5.37
J B	—	6.55	* 8.10	5.38	4.73	5.58	4.37	5.96	4.26	4.06	—	5.31
U M	—	5.75	* 6.14	5.54	5.23	5.30	6.24	6.81	3.43	4.29	—	5.37
L L	—	5.32	* 6.02	3.55	5.01	4.66	6.95	5.96	3.74	4.73	—	5.08
A B	—	3.76	6.69	3.38	4.93	4.16	6.33	3.96	3.81	5.37	—	4.71
U M	—	4.00	7.30	2.94	6.22	4.37	4.66	4.65	3.84	4.72	—	4.80
G L	—	4.13	* 4.27	4.54	3.46	4.05	4.80	4.40	3.47	4.17	—	4.15
S B	—	—	5.22	6.92	5.03	3.86	4.59	5.20	2.99	5.03	—	4.86
E M	—	—	5.81	4.17	4.58	3.09	4.45	4.00	3.99	6.33	—	4.55
P L	—	—	4.38	3.37	3.69	4.10	4.10	3.58	2.86	4.24	—	3.79
O B	—	—	—	3.36	5.70	3.85	3.71	4.26	2.90	4.08	1.44	3.66
C M	—	—	—	3.43	6.55	4.54	4.56	6.33	4.43	3.33	2.98	4.52
T L	—	—	—	3.29	6.02	3.85	5.56	3.46	3.83	4.35	3.60	4.25
N B	5.55	* 5.16	5.50	5.92	5.41	3.22	10.60	4.47	3.86	6.16	—	5.59
O M	6.73	6.82	2.89	5.20	7.56	7.36	3.84	6.16	4.97	7.93	—	5.83
V L	7.20	* 4.02	3.58	5.40	7.39	4.74	6.36	4.81	4.03	6.14	—	5.16
D B	8.50	—	8.87	7.03	7.89	5.64	8.05	4.06	3.73	6.66	—	6.49
E M	8.13	—	9.11	6.49	6.11	4.43	5.75	4.79	9.25	7.50	—	6.84
C L	6.99	* —	6.69	6.38	7.26	2.99	5.76	7.02	3.79	5.28	* —	5.70

Table A.3.2.2-19 Monthly Mean Temperature (°C)

HYDRO YEAR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	ANNUAL
'65 ~ '66	—	—	—	—	—	—	—	—	21.0 *	23.2 *	21.3 *	26.2 *	22.8 *
'66	23.5	23.0	23.0	22.1	22.6	21.9	19.6	19.1	19.2 *	19.7	19.9	21.6	21.3 *
'67	22.5	21.4	22.1	21.4	20.6	20.6	19.7	19.4	20.0 *	19.8 *	—	—	20.8 *
'68	—	—	—	—	—	—	—	—	20.2 **	21.9	23.5	25.1	22.7 *
'69	24.8	22.3	23.3	22.5	22.4	22.7	21.3	20.3	19.9	19.3	20.5	22.3	21.8
'70	—	23.1	22.5	22.5 *	22.0	22.0	19.5 *	19.6	19.6	20.9	22.1	21.7	21.4 *
'71	23.7 *	22.4	22.5	22.2 *	22.0	22.0	20.3 *	20.4	20.8 *	20.2 *	29.9	23.9	22.6 *
'72	23.9	23.4	23.7	22.2	22.4	22.1	22.0	20.5	20.0	20.3	23.5	24.3 *	22.4 *
'73	23.9	22.6	22.4 *	21.9	22.0	21.5	20.7	18.2 *	20.2	19.9	21.8	22.9	21.5 *
'74	23.0	22.1	22.1	22.5	21.9 *	21.0	20.6	20.4	20.5	21.3	22.9 *	24.7	21.9 *
'75	24.5	23.9 *	23.0	22.6	21.8 *	21.7	20.6	18.8	19.2	19.9	23.0	23.4	21.9 *
'76	23.8	22.7	22.9	23.1	23.0	22.0	21.2	20.9	19.8 *	21.2 *	23.6 *	23.5	22.3 *
'77	24.0	23.0	23.6	23.7	23.2	22.4 *	22.1	21.4	20.3 *	21.3	22.8	23.8	22.7 *
'78	24.0	23.2	22.0 *	22.7 *	21.8 *	21.2	21.9	21.4	20.1	21.1	23.0	23.9 *	22.2 *
'79	23.2	22.9	23.1	23.0	22.6	22.8	21.4	21.0	21.5	21.7	24.2	24.5	22.7
'80	25.5	24.1 *	23.9	23.6	22.1 *	23.1	22.1	20.7	19.7	22.2	24.1	24.4	23.0 *
'81	24.8	23.6	23.7	23.8 *	23.6	23.9	21.2 *	21.9	21.8	22.7	24.3	25.2	22.9 *
'82	25.1 *	24.5	24.1	24.6	23.7	22.8	22.0	22.0	21.7 *	22.9 *	23.8	25.0	23.5 *
'83	24.5 *	22.9	22.3	22.1	21.7	20.9	20.5	19.2	18.7 *	20.9 *	22.0 *	23.3 *	21.6 *
'84	22.2	22.3	21.6 *	21.7 *	21.4	21.4	19.3	19.5 *	18.5	20.2	22.1	22.7	21.1 *
'85	17.7 *	22.7	22.1	21.9	21.8	22.2	20.1	20.2	19.4	20.4	20.8	23.2	21.2 *
'86	23.9	23.3	22.6	23.3	22.8	22.2	22.3	21.6	—	—	—	—	22.3 *
MEAN	23.8	22.9	23.0	22.7	22.4	22.0	21.0	20.5	20.0	20.9	23.1	23.6	23.6