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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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REPUBLIC OF NICARAGUA

INSTITUTO NICARAGUENSE DE
ACUEDUCTOS Y ALCANTARILLADOS

THE STUDY
ON
WATER SUPPLY PROJECT
IN
MANAGUA

MAIN REPORT

SEPTEMBER 1993

Kokusai Kogyo Co., Ltd., Tokyo

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Preface

In response to a request from the Government of the Republic of Nicaragua, the Government of Japan decided to conduct a Study on the Project of Water Supply in Managua and entrusted the study to the Japan International Cooperation Agency (JICA)

JICA sent to Nicaragua a study team headed by Mr.Kunio Fujiwara, Kokusai Kogyo Co., Ltd., on three occasions between December 1991 and July 1993.

The team held discussions with the officials concerned of the Government of Nicaragua, and conducted field surveys at the Study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Nicaragua for their close cooperation extended to the team.

September, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President,
Japan International Cooperation Agency

September 1993

Mr. Kensuke Yanagiya
President,
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to submit you the development study report on the Water Supply Project in Managua, the Republic of Nicaragua. The report contains the study results on the evaluation of groundwater resources in the catchment area of 880km2 including Managua City, groundwater development plan for Managua Water Supply and the groundwater management plan.

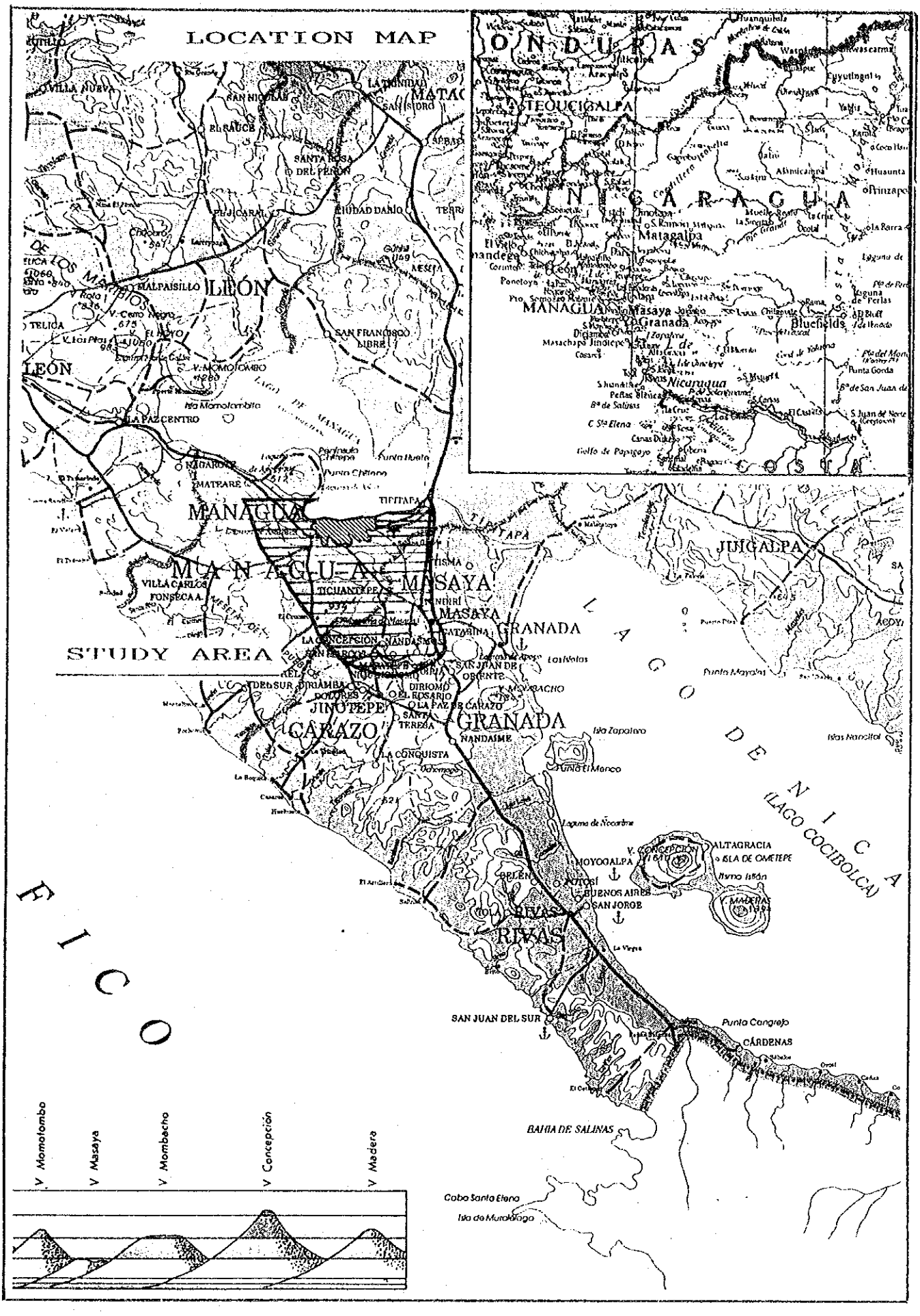
The final report consists of hydrogeological map and four separate volumes of Summary, Main and Supporting Reports and Data Book. The Summary Report states concisely the whole study results. The Main Report describes the results of the study and analysis. The Supporting Report contains method / specification of the field surveys and design drawings of water supply facilities of the project. The Data Book contains the results of the field survey, well inventory and computer outputs.

We hope that implementation of the proposed groundwater development scheme would greatly contribute to improve the water supply conditions in the capital city of the Republic of Nicaragua.

We wish to take this opportunity to express our sincere gratitude to your Agency and the Japanese Embassy in Nicaragua. We also wish to express our deep gratitude to the authorities concerned of the Government of Nicaragua for the close cooperation and assistance extended to us during our investigation and study.

Very truly yours,

Kunio Fujiwara
Team Leader,
The Study on Water Supply
Project in Managua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Masaya
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Bluefields
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MASAYA
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JINOTEPE
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RIVAS
JUIGALPA
LAGO DE NICARAGUA
(LAGO COCIBOLCA)
OCEANO PACIFICO
ISLA DE OMETEPE
ALTAGRACIA
MOYOGALPA
BUENOS AIRES
SAN JORGE
SAN JUAN DEL SUR
CÁRDENAS
BAHIA DE SALINAS
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ABBREVIATIONS

ALMA	:	Alcaldía de Managua (City Office of Managua) DGU : Dirección General de Urbanismo (Urban Planning Division)
BAVINIC	:	Banco de la Vivienda Nicaraguense (Nicaraguan Housing Bank)
CSE	:	Consejo Supremo Electoral (Electoral Supreme Council)
INAA	:	Instituto Nicaraguense de Acueductos y Alcantarillados (Nicaraguan Institute of Waterworks and Sewerage)
INEC	:	Instituto Nacional de Estadísticas y Censos (National Institute of Statistics and Census)
IRENA	:	Ínstituto de Recursos Naturales y del Ambiente (Institute of Natural Resources and the Environment)
INETER	:	Instituto Nicaraguense de Estudios Territoriales (Nicaraguan Institute of Territorial Studies)
INRA	:	Instituto Nicaraguense de Reforma Agraria (Nicaraguan Institute of Agrarian Reform)
MAG	:	Ministerio de Agricultura y Ganadería (Ministry of Agriculture and Livestock)
MCT	:	Ministerio de Constructión y Transporte (Ministry of Construction and Transport)
MPP	:	Ministerio de Planificación y Presupuesto (Ministry of Planning and Budget)
BID	:	Banco Interamericano de Desarrollo (Inter-American Development Bank)
UNICEF	:	(United Nations Childreñs Fund)
UN	:	United Nations

CHAPTER 1 INTRODUCTION

1.1 General

This Report was prepared in accordance with the stipulations contained in the Scope of Work as agreed upon between the "Instituto Nicaragüense de Acueductos y Alcantarillados (INAA)" and the Japan International Cooperation Agency (JICA) for the conduct of the "Study on the Water Supply Project in Managua".

The Study Area is the hydrogeological basin (about 880 km^2) of Managua, about 200 km^2 of which in the northern part is occupied by the urban area of the capital city Managua.

1.2 Outline of the Study

1.2.1 Background of the Project

Managua, the capital city of the Republic of Nicaragua, has nearly one third of the total population of the country with a remarkable population increase ratio of 7%. Within the last decade, the population of the capital city doubled from 0.5 million to over 1 million.

Since the water supply system was initially constructed to serve a population of several hundred thousand, very frequent improvement or expansion of the system has been required to catch up with the rapidly increasing water demand, which has made the maintenance of the supply facilities very difficult.

In addition, since the groundwater, including the water of Asososca crater lake, has been the sole source of the city water supply, overpumping is causing the draw down of water level, which will lead to deterioration of the water quality, if affected by the contaminated water from Lake Managua.

Therefore, a drastic rehabilitation of the water supply system as well as the development of a new water source have become very important and urgent subjects in Managua.

In order to cope with the above situation, a water supply program targeting 1994 was formulated in 1989 through the detailed design study assisted by WB and USSR.

For the acceleration of the program implementation, and also for the preparation of a development plan for new water supply sources to be used after 1994, the Nicaraguan Government requested economic and technical assistance to the Japanese Government in October 1989.

In response to this request, JICA executed the project formulation study in September 1990, then dispatched a preliminary study team in March 1991. The "scope of work" related to the study on rehabilitaion of water supply system and groundwater development was agreed upon in March 1991. However, since the loan for the rehabilitation of the city water supply system was pledged by the BID, "the scope of work" was amended in October 1991, focusing mainly on groundwater development.

1.2.2 Objectives of the Study

The three major objectives of the Study are:

To evaluate the groundwater potential in the Study area, and formulate a groundwater development plan

To prepare a concrete plan for a partial expansion/ improvement of the water supply system including the design of facilities, and

To carry out technology transfer to the counterpart personnel in the course of the Study.

1.2.3 Study Area

The Study area was expanded from 530 Km^2 to about 880 km^2 in accordance with the request from INAA and INETER, and in order to cover the entire hydrogeological basin of Managua for the groundwater potential study.

1.2.4 Study Team

The Study was practically implemented by a joint study team composed of JICA Study Team members, and representatives from INAA and INETER. JICA organized a study team consisting of a team leader and 9 experts in various fields.

For the smooth conduct of the study and effective transfer of technology, INAA provided counterpart personnel from its professional staff, and INETER also provided coordinating counterpart of hydrogeology specialists. The JICA study team members and the counterpart members are shown in Fig. 1.2.1 and are listed below.

JICA Study Team

Name	Speciality
FUJIWARA Kunio	Team Leader/Hydrogeologist
KANDA Atsuo	Co-Team Leader/Hydrogeologist
YAMAGUCHI Masahiro	Hydrologist/Computer specialist
TANAKA Masatoshi	Geophysicist/Hydrologist
AOYAMA Takashi	Geophysicist
SUEMATSU Kakuji	Geologist/Drilling Supervisor
NAOTSUKA Akira	Water Supply Engineer
ARAKAWA Shuji	Water Supply Engineer
KINA Masaharu	City Planner/Architect
OBARA Masaru	Socio-Economist

INAA

Gustavo MARTINEZ	Vice Minister of INAA/Chief of INAA Team/Hidrogeologist
Francisco SAAVEDRA	Chief of Operation and Maintenance/Advisor/Water Supply Engineer
Carlos VALLE G.	Chief Counterpart/Hydrogeologist
Walter MAYORGA	Water Supply Engineer
Mario CALDERA	Water Quality Analyst
Santos MARTINEZ	Drilling Supervisor
Fernando VARGAS	Chief of Information and Statistics/Socio-Economist
Juan Carlos VALLE	Geophysicist
Donaldo R. UGARTE	Assistant Engineer

INETER

William MONTIEL F. FERNANDEZ	Hydrogeologist
Luis Sandor PALACIOS R. RUIZ	Hydrogeologist

1.3 Study Description

1.3.1 Study Components and Sequence

Basically, this Study is to develop groundwater as a water supply source to meet the rapidly increasing water demand in the capital city of Nicaragua. Therefore, the major purposes of the Study are to evaluate the groundwater potential in Managua City and its surrounding area, and to plan groundwater development in this area to meet the water demand after 1994 without causing serious problems such as excessive water level drawdown and water quality deterioration.

Consequently, the Study comprises the following 3 major components:

1) Groundwater development study component including such sub-components as

   - Hydrogeology
   - Meteorology, hydrology and water quality
   - Evaluation of groundwater development potential

2) Water demand study component with sub-components of

   - Existing condition of groundwater use
   - Water demand projection

3) Water plan study component with sub-components of

   - Water supply policy and design criteria
   - Groundwater development (Well construction) plan
   - Facilities design

The field surveys for these components were completed within 11 months from December 1991 and followed up by the detailed analytical work and the report preparation in Japan until July 1993.

The study flowchart along with the work items are presented in Fig. 1.3.1 and the work schedule is shown in Fig. 1.3.2. A brief description follows.

Phase I : Basic research 3.5 months from December 1991 to March 1992

The first field surveys were conducted to attain basic understanding of the Study components. Progress Report (1) was prepared in Managua.

Phase II : Detailed research Phase: 5.5 months from June to November 1992

The detailed field surveys on hydrological and hydrogeological components including test well construction were conducted in this Phase. The supplementary field survey and the comprehensive analysis on components 2) and 3) mentioned above were also conducted in this period. The results obtained were presented in Progress Report (2).

Phase III : Analysis and planning 9 months from November 1992 to July 1993

Overall analysis on hydrology and hydrogeology of the area was made resulting in the evaluation of groundwater potential and the preparation of the draft of hydrogeological map. Combined with the output of the components 2) and 3), a draft of the groundwater development plan was prepared and presented in the Interim Report.

After a discussion on the Interim Report with the INAA personnel concerned, a further analysis was made to finalize the groundwater development plans and the monitoring plan. Two types of groundwater development plan were prepared to cope with the demand of the year 2000, including a preliminary facilities design as a case study.

Incorporating INAA's comments on the Draft Final Report, this Final Report was prepared in September, 1993.

Fig. 1. represents the flow chart of the Study.

1.3.2 Technology applied

The following technologies were applied in this Study.

(a) Methods in hydrogeological investigation

(Phase I)

- Aerial photograph interpretation (topography and geology)
- Geological reconnaissance survey
- Geophysical prospecting (geoelectric sounding)
- Review of existing drilling data (lithology and pumping rate)
- Interview survey on groundwater use

(Phase II)

- Supplemental geoelectric sounding to confirm geological formation
- Test drilling and geophysical logging
- Pumping test to determine the hydraulic parameters of aquifers

(b) Methods in hydrological survey

(Phase I)

- Installation of monitoring equipment (automatic water level recorder, gauging staff, rainfall gauge), and start of monitoring
- Discharge measurement of springs and perennial rivers
- Simultaneos groundwater leveling in dry season
- Water quality analysis

(Phase II)

- Monitoring of groundwater level, river water level and precipitation
- Discharge measurement of springs and rivers in wet season
- Water quality analysis including tritium isotope dating method

(c) Preparation of database system

- Collection and arrangement of hydrological/ hydrogeological data
- Design and coding of a database program and processing of arranged data

(d) Computer simulation of groundwater flow and formulation of the groundwater development plan

(e) Review of Managua water supply system

- Data collection and arrangement on water demand projection based on Managua City Plan and population projection

- Survey of major existing water supply facilities

(f) Determination of the development scale

- Discussion on priorities of supply zones
- Projection of population and water demand by zone
- Consideration of the safety groundwater yield

(g) Case Study on partial expansion of the water supply system

- Topographic survey for water conveyance system of the target and alternative sites
- Design of the wells, storage tank and conveyance pipeline to the existing reservoir with independent functions of intake and conveyance pumps
- Cost estimation for above construction

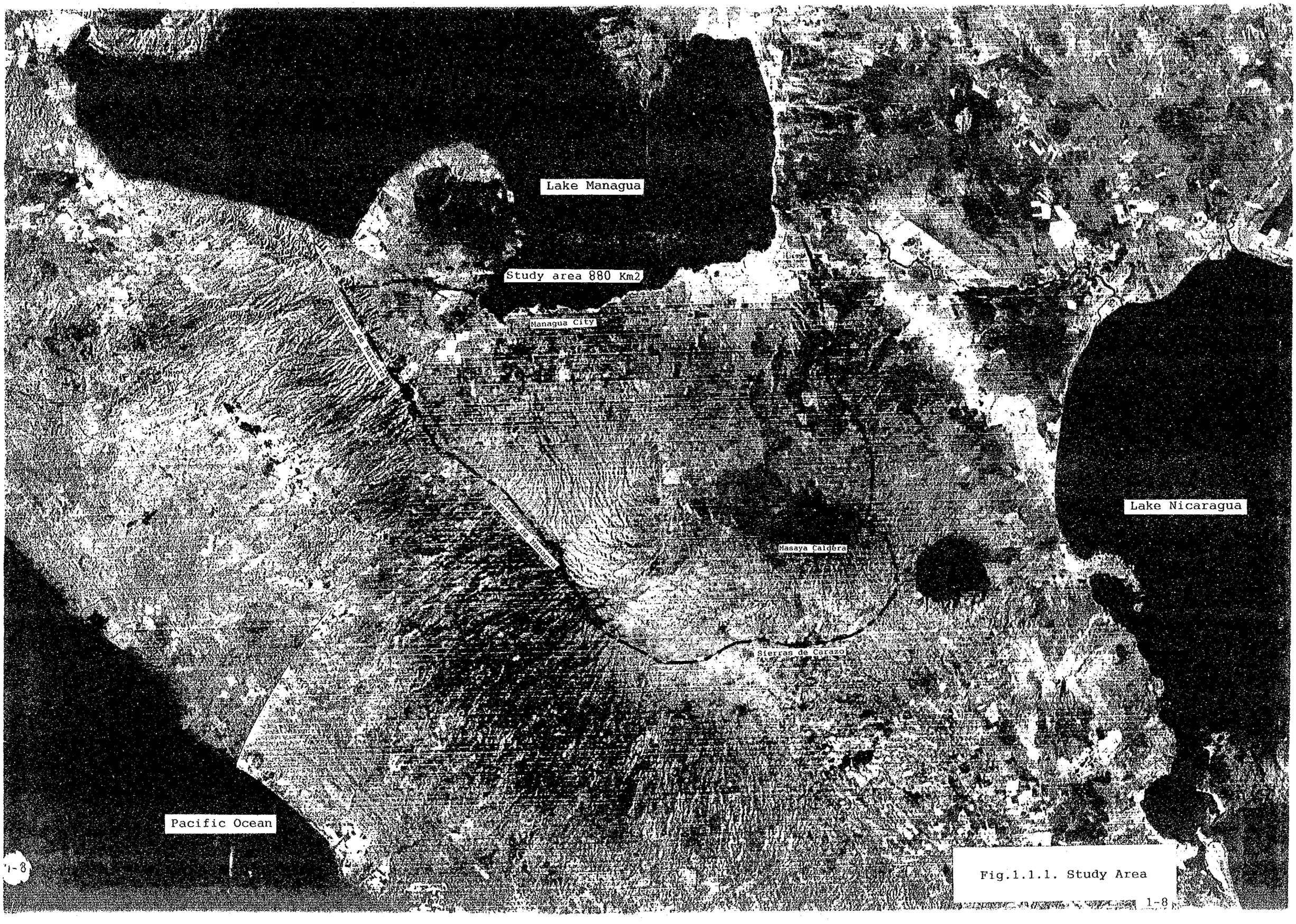


Fig.1.1.1. Study Area

Study Flow Chart

Fig. 1.3.1 Study Flow Chart

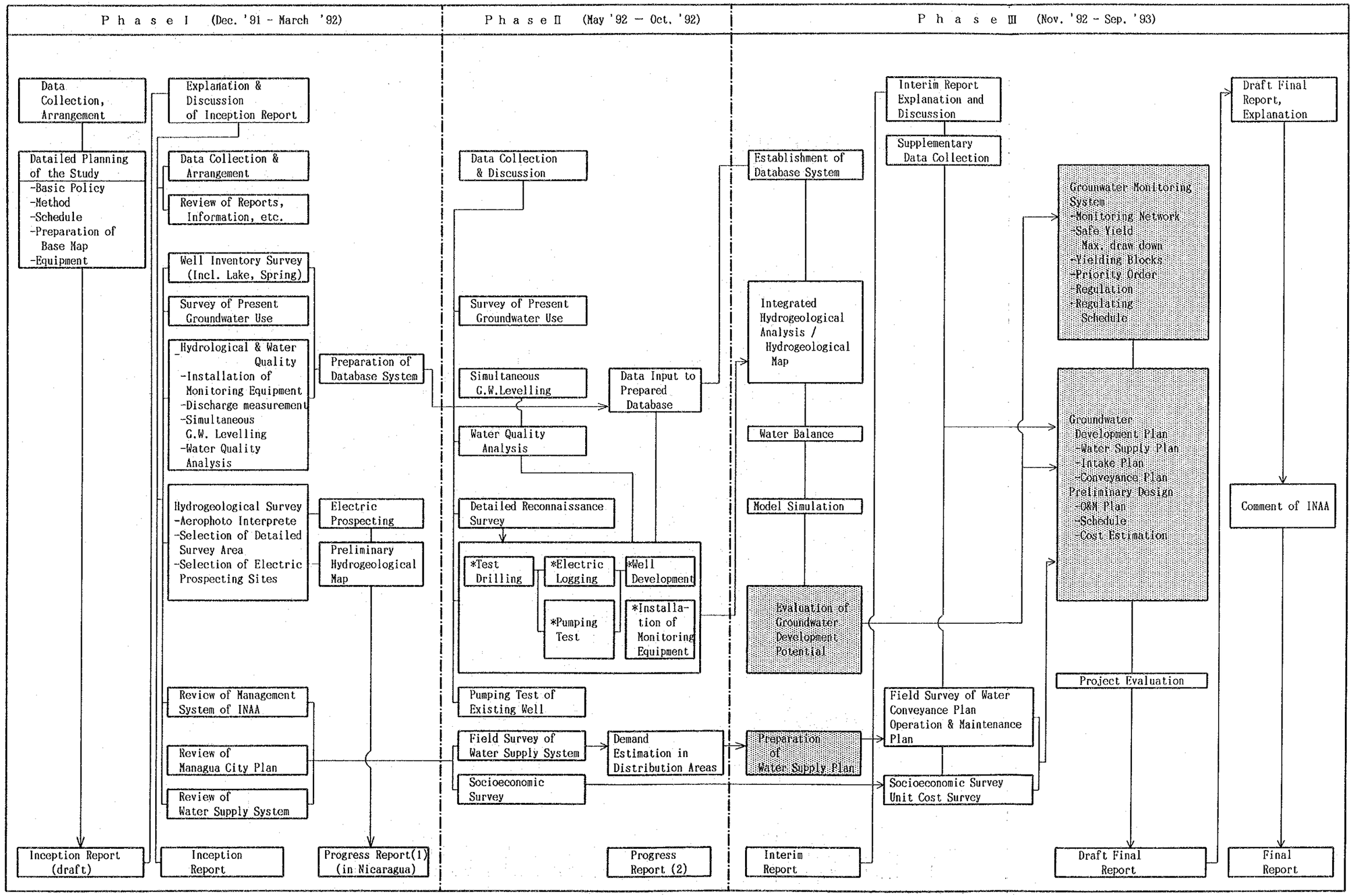
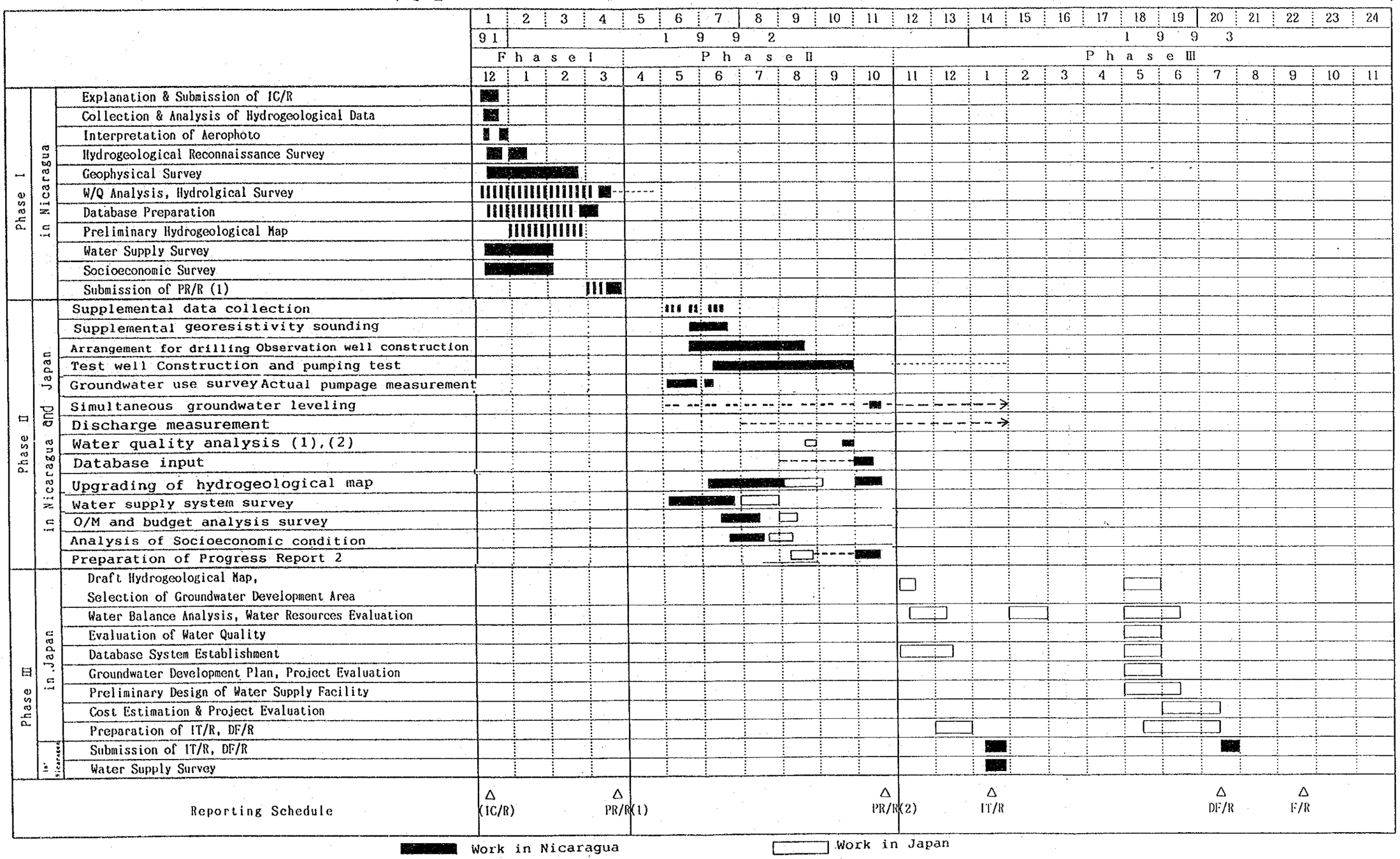


Fig-1-3-2. Work Schedule

Fig. 1.3.2 Work Schedule



Chapter 2 SOCIOECONOMIC AND SECTORAL BACKGROUND

2.1 General

Nicaragua is situated in the Central American isthmus, bordered by Honduras, Costa Rica, the Atlantic Ocean and the Pacific Ocean. The total area of the country covers 130,682 km2, of which 10,333 km2 are water surface area, mostly comprised of the two big lakes of Managua (Xolotlan) and Nicaragua (Cocibolca).

The country is divided into three Macro-Regions: Pacific, Central and Atlantic, with climatic characteristics ranging from tropical savannah to tropical humid forests and highland climate. The average yearly temperature is 27 degrees centigrade and the average yearly rainfall is 1,300mm.

Administratively, the country is divided into Regions, Departments and Municipalities. The basic political-administrative unit of the country is the Municipality. Municipal authorities are autonomous of the Central Government and are elected by popular, direct and secret vote for a six-year term (Articles 175, 176, 177, 178 of the 1987 Constitution).

In practice, the country is divided into 9 Regions, 16 Departments and 142 Municipalities. Two of the 9 Regions are regarded as autonomous due to their peculiar ethnic and sociocultural characteristics: the North Atlantic Autonomous Region (RAAN) and the South Atlantic Autonomous Region (RAAS).

The Central Government organization rests upon four independent branches: Legislative, Executive, Judicial and Electoral (Article 129 of the 1987 Constitution). The Legislative Power is exercised by the National Assembly comprised of 90 Representatives and 90 Alternates, who are elected by popular, direct and secret vote for a six-year term (Articles 132 and 136 of the 1987 Constitution).

The Judicial Power is administered through Tribunals of Justice, of which the highest is the Supreme Court of Justice. The latter is composed of a minimum of seven members who are appointed by the National Assembly for a six-year term. The President of the Republic appoints one member of the Supreme Court of Justice as its President (Articles 158, 159, 162, and 163 of the 1987 Constitution).

The Electoral Power has exclusive jurisdiction over elections, plebiscites and referenda, being in charge of the organization, direction and supervision of electoral processes. The Electoral Power is composed of the Supreme Electoral Council and other supporting agencies. The National Assembly appoints the five members of the Supreme Electoral Council, one of whom is selected as its President, for a six-year term (Articles 168, 169, 170, 172 of the 1987 Constitution).

The duties of the Executive Power are discharged by the President of the Republic, who is the Chief of State, the Chief of Government, and the Supreme Chief of the Armed Forces. The President and the Vice-President of the Republic are elected by direct, secret vote, where a simple majority of votes decides the winners for a six-year term (Articles 144, 146 and 148 of the 1987 Constitution).

2.2 Economic Characteristics

2.2.1 Nicaragua

The economically active population (EAP) was estimated at 1,331,200 in 1990, representing 34% of the total estimated population of 3,858,900. Between 1988 and 1990, while the total population grew at a 2.14% annual rate, the EAP grew at 4.46% annual rate (Table 2.2.1).

Tables 2.2.1 and 2.2.2 show the sectoral distribution of employment of the economically active population in 1990, which is as follows.

Sectoral Employment	Percentage
Primary sector	33
Secondary sector	20
Tertiary sector	47

Within the secondary sector, manufacturing employed 16%, while within the tertiary sector, commerce employed 16% and other services 19%. In 1990, 160,000 persons were unemployed (12% of EAP) and 599,600 persons were under-employed (45% of EAP), showing that well over half of the EAP of the country faced serious employment problems (Table 2.2.2).

Measured in constant 1980 Cordobas, the overall gross domestic product (GDP) decreased from 17,936.2 Million in 1988 to 16,666.9 Million in 1990, equivalent to a 2.4% yearly contraction rate. The per capita GDP in 1990 was estimated at 4,319 Cordobas, having declined at a 5.2% yearly rate since 1988. Table 2.2.1 shows the GDP composition to be roughly the following.

GDP Composition	Percentage
Primary sector	25
Secondary sector	25
Tertiary sector	50

(1) Primary Sector

Agricuture in Nicaragua is recognized to have a dual structure composed of commercial farms for exports on one hand, and farms for the domestic market on the other. Cropping area in 1990 was distributed as follows.

Type of Farms	Cropping Area (Mz.)	%
For exports	299,000	38
For domestic market	471,000	62

Main export crops were coffee 106,000Mz., cotton 64,000Mz., sugar cane 66,000Mz., sesame 51,000Mz. and banana 3,000Mz., which generated US$170 Million, that is, 59% of total exports in 1990, when agriculture comprised 15% of GDP. On the other hand, main crops for domestic consumption were corn 223,000Mz., beans 130,000Mz., and rice 54,000Mz. in 1990 (Table 2.2.3).

Livestock activities center around cattle, which was estimated at 1,600,000 heads in 1988. Cattle slaughtered in 1989 numbered 210,900 heads, producing 66.8 million lb. of beef, of which 37 million lb. were exported. Livestock accounted for 8% of the GDP in 1989.

Shrimp and lobster were two promising non-traditional export products. Even though catch and exports of these two products declined in 1990, their rate of decline was less than the

contraction rate for fish (Table 2.2.4). The export values of these two products ranged from US$9 Million to US$12 Million between 1988 and 1990. Given the high demand for shrimp and lobsters in the international market, export values of these two products are wide open for future expansions.

(2) Secondary Sector

Manufacturing was badly hit by the armed conflict, which destroyed plants, raw materials, final goods, caused loss of markets, and discouraged investments in plants. Manufacturing comprised around 20% of the GDP in 1990.

Located in Managua were 37 manufacturing firms which were main causes of pollution in the Managua Lake. Important manufacturing types in terms of production values in 1990 were foodstuff 20%, chemicals 18%, beverage 13%, metal products 10%, and tabacco 8% (Table 2.2.5).

(3) Tertiary Sector

The tertiary sector in Nicaragua employed nearly half of the EAP and accounted for half of the GDP in 1990 (Table 2.2.1 & 2.2.2). In terms of employment, commerce occupied 16% of EAP, Central Government 6%, transport and communications 4%, finance 2% and other services 19%.

The relative weight of the tertiary sector in the GDP and employment seems to be exaggerated for the present stage of development of the Nicaraguan economy. The high employment rates in commerce and other services suggest that these may in reality be cases of additional under-employment, taken as non-optimal employment by the people who are unable to find suitable jobs in the primary and secondary sectors.

(4) International Trade

Nicaraguan exports increased from US$235.7 Million in 1988 to US$321.3 Million in 1990, that is, an overall 10.9% annual growth rate. During the same period, traditional export products decreased from 85% to 81%, with the corresponding growth in non-traditional export products.

Traditional export products were coffee, cotton, sugar, beef, banana and gold. Between 1988 and 1990, exports of coffee and cotton declined both in absolute and relative terms, while

sugar exports increased six-fold and beef exports three-fold. Coffee, cotton, sugar and beef accounted for 63% of total exports in 1990 (Table 2.2.6).

Imports, on the other hand, decreased from US$807.1 Million in 1988 to US$664.7 Million in 1990, whereby trade deficits declined from US$571 Million to US$343 Million. Imports were classified into consumption goods, petroleum, intermediate goods and capital goods, which accounted for 28%, 19%, 24%, and 28%, respectively, of total imports in 1990 (Table 2.2.7).

(5) Foreign Debt

The Nicaraguan foreign debt increased from US$7.2 Billion in 1988 to US$8.7 Billion in 1990, that is, a 6.2% annual growth rate. The foreign debt consisted of 93% medium and long-term debt and 7% short-term debt. Around two-thirds of total debt was incurred by the Central Government, about one-fifth by the Central Bank, and the remainder by other public sectors and the financial system (Table 2.2.8).

Creditors were mostly bilateral organizations which held around 65% of total debt, while multilateral agencies accounted for 12%, commercial banks for roughly 15% and the remainder comprised by suppliers and short-term debt (Table 2.2.8).

(6) Central Government Finances

The Central Government incurred fiscal deficits amounting to more than 300 Million Cordobas Oro in 1988 and 1990, and around 30 Million Cordobas Oro in 1989. During these three years, tax revenues amounted to more than 90% of the Central Government income, while capital income comprised less than 2% of total income (Table 2.2.9).

Current expenses exceeded total income and comprised between 92% and 95% of total expenditures. Within current expenditures, Goods & Services accounted for 60% to 70%, Salaries & Wages for 13% to 20%, and the remainder was comprised by Transfer payments and Interests. Salaries & Wages and Transfer payments showed increasing trends, while other categories of income and expenditures showed declining trends (Table 2.2.9).

Table 2.2.10 shows a more detailed breakdown of the Central Government income during the 1988-1990 period. Tax income comprised more than 90%, broken down into direct tax: 20%-25%,

tax on goods and services: 50%-60%, and import tax: 7%-14%. The most important direct tax was income tax with around 20%, while among taxes on goods and services, consumption tax accounted for 34%-46%, and sales tax for 10%-12% of tax revenues.

2.2.2 The Study Area

Within the Study Area, main cities are Managua and Masaya, with a combined population of well over one million. As the Study Area is the most urbanized area of the country, an estimated 65% of the labor force are employed in the tertiary sector, 31% in the secondary sector, and 4% in the primary sector. In urban Managua in 1989, the top three employments were services 39%, commerce 24% and manufacturing 21%.

Manufacturing is especially strong in the Study Area, having been estimated that 80% of the nation's industrial firms are located in Managua. Manufacturing plants of all sizes are predominantly located in the following six zones.

1. Carretera Norte	Textiles
2. Acahualinca	Food processing
3. Sarretera Sur	Chemicals, textiles
4. Cuesta Heroes y Martires	Chemicals, petroleum
5. Carretera Nueva a Leon	Metal mechanics, food
6. Carretera a Masaya	Chemicals, pharmaceutical

In addition, small manufacturing plants are scattered all over the residential areas.

Typically, 90% of industrial plants employ less than 4 workers, thereby falling under the category of small scale manufacturing, which accounts for 13% of industrial employment. On the other hand, less than 10% of industrial firms employ more than 25 workers. Predominant industry types are food processing 49% and clothing 25%.

2.3 Social Conditions

In 1985, there were 533,446 households, with an average household size of 6.2 persons. They were housed in 507,984 units of dwellings, giving an average of 6.5 persons per dwelling. The

dwellings were located 53% in urban areas and 47% in rural areas. Managua Department accounted for 146,012 units of dwellings, or 29% of the country, located 86% in urban areas and 14% in rural areas (Table 2.3.1). Dwelling shortage is estimated at 400,000 units in Nicaragua. In addition, housing demand is estimated to grow by 20,000 units per year.

Dwelling units in Managua City were estimated at 118,000 in 1987 and 157,607 in 1991, the latter figure without District 7, where 7,000 dwelling units were assumed to be located. Managua is particularly affected by the housing shortage, due to the high migration rate from rural areas into the capital city.

The high rural-urban migration into Managua gave rise to "progressive" and "spontaneous" settlements, with all the implications on the expanded demand for basic services, especially water supply. While progressive settlements have been receiving some kind of assistance, such as water supply by public standposts, spontaneous settlements consist of illegal land occupation in areas generally considered as unsuitable for housing development. The 1991 population was estimated at 126,942 persons in progressive settlements, and 139,148 persons in spontaneous settlements.

Regarding available water supply types, 49% of dwellings in Nicaragua had water supplied by house connections from public systems, 9% by public standposts, 20% by wells and 22% by other water supply systems. In Managua Department, 69% of dwellings had water supply by house connections, 19% by public standposts, 4% by wells and 8% by other systems. The corresponding figures for urban Managua were 74% by house connections, 20% by public standposts, 1% by wells and 5% by other systems (Table 2.3.1).

Similarly, with regards to toilet facilities available to dwelling units, 52% of houses in Nicaragua had flush toilets, 23% had latrines and 25% had no toilet facilities. In urban areas, flush toilets increased to 55% and latrines to 41%, while dwellings without toilet facilities decreased to 4% (Table 2.3.1).

Likewise, dwellings with electricity amounted to 63% for the whole country and 92% for urban areas. In Managua Department, 88% of houses had electricity, and this percentage went up to 95% of dwellings in urban areas (Table 2.3.1).

The above described deficiency in the quality and coverage of water supply and sanitation, even in urban areas, adversely affects the people's health. This situation is evidenced by the high incidence of intestinal disorders such as acute diarrhea, which was the top cause of infant mortality in 1989. The rate of infant mortality per thousand live birth increased from 61.0 in 1986 to 71.8 in 1989. Eighty percent of infant mortality occurred within the first year of birth (Nicaraguan Report for the UNCED).

2.4 National Development Plan

The 1992-1996 Medium-term Development Plan

The present Government, which was elected in February 1990 for a six-year term, has recently formulated the development strategy for the 1992-1996 period, to build upon the achievements of the first two years. These achievements include pacification of the country, control of hyperinflation, stabilization of the exchange rate, deregulation and liberalization of the private sector, and foreign debt rescheduling.

2.4.1 Objectives

The 1992-1996 Development Plan categorized objectives into those for the short-run and for the medium-term.

(1) Short-run objectives 1992-1993

1) Consolidation of economic and political stability
2) Transition from stability to sustained development
3) Employment generation
4) Preservation and rational use of natural resources
5) Public sector institutional reform
6) Foreign debt rescheduling

(2) Medium-term objectives 1994-1996

1) Definition of the legal and institutional framework for the private sector
2) Export based growth
3) Improvement of human resources
4) Institutional reform
5) Promotion of domestic savings and investments

6) Consolidation of democracy

2.4.2 Growth Target and General Strategy

The GDP growth target by year during the four-year period of the Development Plan is shown below.

Year	GDP Growth Target (%)
1992	4.0
1993	4.5
1994	5.0
1995	5.0

The general strategy for development is based on creation of favorable conditions for sustained and equitable growth. These conditions refer to the freedom and responsibility to work, which should be given back to the private sector, be it individuals, families, business or voluntary associations.

The above strategy requires the development of self-help schemes, transition from a state-run economy to a market economy, transition from a militarized society to a civilian society, reduction of an oversized bureaucracy, restriction of Government intervention to strictly indispensable areas, and monetary stability as bases to promote savings and long-term investments.

2.4.3 Sectoral Strategy

High mortality rates in Nicaragua result from diseases associated with contaminated water, especially among children in rural areas. Main problems concerning water supply and sanitation are obsolete infrastructure, pollution of water bodies and human habitat, insufficient water supply especially in Managua City, and high rates of water losses which are estimated at around 50% in the capital city.

The Government strategy for the water supply and sanitation sector consists of the following.

(1) Expanded coverage of water supply in rural areas
(2) Minimization of water losses and contamination, to be achieved by rehabilitation of water supply facilities

(3) Strengthening of administrative capabilities so as to attain financial self-sufficiency
(4) Reduction of illegal connections and expansion of water-meter coverage
(5) Environmental protection through strict regulation and improved sewer system
(6) Mobilization of local resources to implement rural water supply and sanitation works
(7) Provision of facilities for sanitary disposal of wastes from the rural population
(8) Expanded education on personal hygiene and public health

2.5 Water Supply and Sanitation Sector

2.5.1 Service Coverage

Table 2.5.1 shows the water supply coverage by Macro-Region and by urban and rural areas of Nicaragua in 1989. Of the total population, 2,024,111 persons or 53% had water supply services, broken down into 39% by house connections and 14% by public standposts. The coverage was a lot higher in urban areas reaching 78%, of which 64% by house connections and 14% by public standposts. The Pacific Macro-Region, which includes Managua, had the highest coverage among Macro-Regions with 67%, broken down into 52% by house connections and 15% by public standposts.

Table 2.5.2 shows coverage of water supply and sewer services by Region of the country in 1987. Region III, Managua, had an estimated total population of 949,920 persons, of which, 836,325 or 88% was estimated to have water supply service. This percentage of water supply service coverage was estimated to be 98% in urban areas. Sewer service was estimated to cover 61% of the urban population of Region III in 1987.

2.5.2 The Service Institution: INAA

(1) Legal Basis and Functions

The official institution with national jurisdiction over water supply is the Nicaraguan Institute for Waterworks and Sewerage (INAA), which was established by Executive Decree No.20

of July 25, 1979. The Decree conferred INAA autonomy, juridic personality,own assets, indefinite duration, and full capacity and right to contract obligations.

INAA inherited functions formerly performed by the National Waterworks and Sewerage Department (DENACAL) and the Managua Water Corporation (EAM). Executive Decree No. 123 of October 23, 1979 specified INAA responsibilities as planning, implementation, operation and management of municipal and local water supply and sewer systems in the whole country.

More specifically, main INAA functions include the following.

1) To solve water supply and sewerage problems of the country

2) To dictate standards and specifications for the design, construction, operation, maintenance and management of water supply and sewer works

3) To ensure compliance with these standards, and to require amendments in case of violations

4) To examine and approve works to be undertaken by natural and juridic persons in the fields of water supply, use of surface or groundwater, and discharge of waste water

5) To set guidelines for water supply and sewer service charges to be applied by INAA or by other authorities

6) To cooperate with the Ministry of Health in the passage of the National Health Code, and subsequently participate in the quality control of water for different uses

7) To provide technical and financial assistance to dispersed rural communities seeking to solve their water supply and waste disposal problems

8) To obtain loans or to find other means to finance projects, such as bond emission, with prior approval by proper authorities

(2) Organization

INAA has a pyramidal organization divided into five major levels which from top to bottom are decisional-determinative, advisory and support, normative-executive, executive-operative, and operative. The top three levels comprise the Central System, while the remaining two levels comprise eight Regional Subsystems and a number of local Subsystems (Figure 2.5.1).

The functions at the "decisional-determinative" level are discharged by the High Directorate which is headed by a Director and a Deputy Director, who have the ranks of Minister and Vice-Minister, respectively. They are assisted by four Committees, namely, Institutional Development, Budget, Bidding, and Coordination. The top level of the organization sets objectives and policies concerning all aspects of INAA activities, and makes decisions and recommendations.

The "advisory-support" level comprises nine organization units in three sub-levels: five units with the rank of General Division, two with the rank of Specific Division, and two with the rank of Office. The five General Divisions pertain to Organization and Systems, Planning, administrative Services, Human Resources, and Internal Audit. The two Specific Divisions refer to Community Works and Legal Assistance. Finally, the two Offices pertain to Foreign Matters and Public Relations or Press Service.

The "normative-executive" level conforms the core organization units of INAA. The seven General Directorates comprising this level are: Financial, Commercial, Rural Waterworks, Control of Regional Systems, Study and Construction, Operation and Maintenance, and Region III.

The "executive-operative" level pertains to Regional Subsystems comprising the INAA representative offices in each of the nine political-administrative Regions of the country. Each Region has a Regional Delegate who represents the INAA Director and is responsible for the operation and maintenance, commercial matters and management of Regional water supply systems.

The "operative" level pertains to local subsystems, including operation and maintenance, commercial and administrative matters.

(3) Human Resources

As of June 30, 1992, INAA personnel numbered 2,606 employees, down 364 from the peak of 2,970 employees in 1990. The breakdown by category is as follows.

Category	Number	Percentage
Managemente & Staff	364	14
Professionals	113	4
Mid-level Technical	781	30
Laborer	1,348	52

The Central System accounted for 936 employees (36%) and the Regional Subsystems 1,670 (64%). The largest was Region III with 561 or 22% of employees, followed by Region IV with 345 or 13%. Permanent employees comprised 2,207 or 85% and temporary 399 or 15%.

(4) Operating Characteristics

1) Water Supply

INAA is responsible for the operation, maintenance and management of 148 systems supplying water to 170 cities and communities. Water sources of the 148 systems are 107 drilled wells, 15 infiltration galleries, 18 surface water sources and 8 mixed systems. The capital city Managua depends on a mixed system composed of 83 drilled wells and the Asososca crater lake.

The high incidence of illegal connection in Managua City, estimated at 30,000, causes damage to the pipeline, thereby increasing water losses, reducing income, and increasing the risk of contamination. Water quality is regarded poor in 38 (26%) of 148 systems.

2) Sewerage

INAA is also responsible for the operation, maintenance and management of 20 sewer systems, but the service covers only urban areas, mostly concentrated in Region III. Main cities covered by sewer service are Managua, León, Granada, Masaya, Rivas, Chinandega, Corinto, San Juan del Sur, Somoto and Estelí. in the remaining sewer systems, the service is usually available only

along main streets of the cities.

Of the 20 sewer systems, only 8 are equipped with sewage treatment plants, and the remaining 12 discharge raw sewage into water bodies. In general, deficient maintenance makes it necessary urgent improvements in collection network, repair and expansion of sewer lines.

(5) Finances

The Balance Sheets and Income Statements for 1990 and 1991 are shown in Tables 2.5.3, 2.5.4 and 2.5.5. Even though figures for the two years are shown side by side, the inter-year comparison and financial analyses are rather difficult due to the following reasons.

As of December 31, 1990, two currency units were in circulation: (1) Cordoba Oro (1US$=1C$O) put into circulation in August 1990, and (2) Cordoba Corriente (1US$=3,000,000C$C). The Cordoba Corriente was to remain in circulation up to April 30, 1991.

As of December 31, 1990, INAA undertook revaluation of inventory by the method of replacement costs, because historical costs were grossly distorted by the hyperinflation. This gave rise to revaluation profits on assets, but the other side of the coin was currency devaluation losses on liabilities.

The Monetary Adjustment Law was passed on March 3, 1991. This law mandated adjustments in accounting records by applying a variety of correction factors, including the following exchange rates: 1US$=5C$O=5,000,000C$C. As of December 31, 1991, losses from adjustments amounted to C$60,145,633.

In a letter dated September 3, 1991 from the Finance Ministry, the Government of Nicaragua decided to take over payment of all foreign debt held by INAA, which as of May 31, 1991 amounted to C$95,265,946 (US$19,053,182) in principals and C$23,503,645 (US$4,700,729) in interests. Consequently, INAA assets increased by C$118,769,591 (US$23,753,911) due to this political decision which had nothing to do with INAA operating performance.

The above factors make financial comparison and analyses rather difficult between 1990 and 1991. However, some financial

characteristics can be described as follows.

Water rates were increased 240%-340% in May-June 1990, then in November 1991 with partial adjustments in February 1992, and finally in January 1993. These frequent changes in water rates indicate that INAA enjoys the privilege of freely adjusting water rates ro reflect changes in operating costs. Sewer charges were increased from 17% of water charges in 1990 to 30% in 1991. Water sold was 79,006,425 m3 in 1990 and 76,151,000 m3 in 1991.

Water service charges differ according to the following user categories: residential, commercial, industrial, multi-family, public standposts, and government. Each category has its own block structure, and water charges rise with increasing consumption blocks, thereby inducing rational water use.

Accounts Receivable worsened not only in total amount but also in the length of overdue accounts, as shown below.

Overdue Accounts	1990	1991
1 month	33%	28%
2 months	26%	5%
3 months	41%	67%

Allowance for bad debt is based on Accounts Receivable which are more than 180 days overdue.

Although detailed financial information for 1992 is not available, it is certain that INAA made a dramatic financial improvement, since it is known that collection increased to 86% of billings in Managua.

Of the 1990 operating expenses, electricity comprised about one-third, and salary and wages nearly one-fifth of total expenses, as shown below.

Electricity	32.3%
Salary & Wages	19.2%
Maintenance & Repair	16.0%
Fuel & Lubricants	5.5%

2.5.3 Sectoral Perspectives

(1) INAA Policy and Objectives

The general policy framework is the UN sponsored "Health for all in the year 2000", which seeks to provide water supply and sanitation services to the totality of the population in the year 2000. This is quite an ambitious goal, given the present situation where 47% of the population have problems with safe water supply and 81% have problems for adequate disposal of excreta and waste water. Therefore, the goal for the 1990 decade is to surpass 80% coverage in water supply and 50% in sewerage.

Accordingly, INAA set sectoral objectives as follows.

1) Urban Areas

   a) Reduction of unaccounted-for water to reasonable levels
   b) Legalization of 24,000 illicit connections in 62 progressive settlements
   c) Rehabilitation of existing water supply and sewerage systems to improve service quality
   d) Expansion of water supply and sewerage system to improve coverage

2) Marginal Urban and Concentrated Rural Areas

   a) Reduction of unaccounted-for water to reasonable levels
   b) Rehabilitation of existing water supply systems to improve service quality
   c) Expansion of water supply systems and construction of latrine to improve coverage

3) Rural Dispersed Areas

   Expansion of water supply and latrine coverage, with community participation, and preferably as a component of integrated rural development projects

(2) INAA Specific Projects

INAA has a number of specific projects which need to be urgently implemented and include the following.

1) Water Supply in 27 Rural Communities: construction of 16 small scale pump based and 3 gravity waterworks

2) Water Suply in Region I: construction of 53 small scale waterworks, 101 dug wells and 3,430 latrines

3) Water Supply for Rural Matagalpa: construction of 230 water supply systems and 6,519 latrines

4) Five-year Integrated Rural Development Program (PQDRI): construction of 25 small scale waterworks, 350 drilled wells, 150 dug wells and 7,000 latrines

5) National Program for Water Quality Control (PRONCAGUA): water treatment plants in selected water supply systems

6) Water Supply in 17 Communities: expansion and improvement of 17 water supply systems

7) Installed Capacity Maintenance Program of 6 Water Supply Systems: improvement of water supply systems of Masaya, Granada, Diriamba, León, Chinandega and Estelí.

8) Operating Improvement and Rehabilitation Program of Water Supply and Sewer Systems: rehabilitation of 20 water supply systems and 7 sewer systems, including Managua and rural communities

9) Expansion and Improvement of Masatepe Water Supply System

10) Ocotal Sewer System

11) Expansion and Improvement of Bluefields Water Supply Systems: construction of dams, pump stations, treatment plants, conduction and distribution pipelines

12) Increasing Water Sources: drilling of 40 wells per year

13) IV Stage Managua Water System Expansion and Improvement Plan: drilling of 47 wells, construction of 50 km conduction pipeline, 6 storage tanks, 2 pump stations, and improvement of distribution pipeline

14) Managua Sewerage Master Plan: construction of 170 km of sewer network, 6 pump stations, sewage treatment

plants, 9.2 km of secondary pipeline and 3 km of impulsion pipeline

International aid, which has been increasing in the past few years, is essential for the implementation of the above projects. Bilateral assistance has been forthcoming from such countries as Canada, Italy, France, Switzerland and Japan. The types of assistance from these countries range from studies to donation of equipments and project implementation.

On the other hand, multilateral assistance to Nicaragua has been resumed after having been cut off during the first half of the past decade. A case in point is assistance from the Inter-American Development Bank (IDB). As a matter of fact, on February 27 and April 7 of 1992, INAA signed a loan agreement with the IDB for up to US$53.5 million, which together with US$5.0 million from OPEC and US$5.7 million of Nicaraguan funds, make up a US$64.2 million project. The President of IDB, during his official visit to Nicaragua in June 1992, formally pledged the IDB commitment to this project, which is now in the implementation stage.

Table 2.2.1 Selected Economic Indicators

Item	Unit	1988	1989	1990
Population Total	1000 Persons	3,621.6	3,746.5	3,858.9
Economically Active	〃	1,168.0	1,276.9	1,331.2
Gross Domestic Product Total	Mill.1980c$	17,936.2	17,433.5	16,666.9
Primary Sector	〃	4,092.8	4,203.6	4,060.0
Secondary Sector	〃	4,762.8	4,420.9	4,208.2
Tertiary Sector	〃	9,080.6	8,809.0	8,398.7
Per Capita	〃	4,952.6	4,653.3	4,319.1
Exports	Million US$	235.7	290.1	321.3
Imports	〃	807.1	614.3	664.7
international Reserves	〃	75.0	83.6	102.6

Source:Informe Anual 1990, BCN, Managua, 1991

Table 2.2.2 Population and Employment

Item	Unit	1988	1989	1990
Total Population	1000 Persons	3,621.6	3,746.5	3,858.9
Economically Active Popula.	〃	1,168.0	1,276.9	1,331.2
Employment	〃	864.0	1,169.8	1,171.2
Primary Sector	〃	358.5	387.5	387.5
Secondary Sector	〃	113.8	229.5	229.5
Manufacturing	〃	90.3	188.7	188.7
Construction	〃	20.2	31.2	31.2
Mining	〃	3.3	9.6	9.6
Tertiary Sector	〃	391.7	552.8	554.2
Commerce	〃	99.3	182.3	182.3
Central Government	〃	81.7	71.3	72.7
Transport & Communic.	〃	22.8	42.6	42.6
Finance	〃	16.4	24.7	24.7
Electricity & Water	〃	8.5	10.3	10.3
Service	〃	163.0	221.6	221.6
Open Unemployment	〃	304.0	107.1	160.0
Under-employment	〃	-	509.0	599.6
Rate of Open Unemployment	〃	26.0	8.4	12.0
Rate of Under-employment	〃	-	39.9	45.0

Source: Informe Anual 1990, BCN, Managua, 1991

Table 2.2.3 Agricultural Production

Crop Type	Area(1,000 Mz)			Production(1,000 cwt)		
	1988	1989	1990	1988	1989	1990
Export Mkt.	230.8	275.3	299.2	n.a	n.a	n.a
Coffee	102.1	105.0	106.0	944.5	932.2	837.4
Cotton	57.6	49.0	64.1			
Fiber				567.1	490.0	641.0
Seed				935.7	808.5	899.0
Sesame	13.8	45.0	51.2	71.9	315.0	456.1
Sugar cane	46.4	56.3	65.6			
Cane				38,500.6	47,832.5	65,600.0
Sugar				3,850.0	4,360.6	5,469.3
Banana	3.2	3.2	3.2	4,990.0	5,290.6	5,681.3
Tobacco	1.8	1.7	2.0	35.9	45.1	53.9
Peanuts	2.0	6.5	7.1	76.3	260.0	248.0
Soybeans	3.9	8.6	-	96.5	195.2	-
Domestic Mkt.	627.2	606.8	471.0	n.a	n.a	n.a
Rice	55.3	58.0	53.6	1,402.0	1,493.6	1,579.6
Irrigated	-	22.0	26.9	-	743.8	968.6
Non-irrig	-	36.0	26.7	-	748.8	611.0
Corn	315.7	326.4	223.3	6,471.9	6,364.8	3,629.6
Beans	156.8	150.9	130.0	1,332.8	1,360.2	1,209.0
Sorghum	99.4	71.5	64.1	2,244.9	1,697.1	1,844.0
Total	858.0	882.1	770.2	n.a	n.a	n.a

Source: Informe Anual 1990, BCN, Managua, 1991

Table 2.2.4 Fishery Production

Item	Unit	1988	1989	1990
Shrimp				
Catch volume	1,000 lb	2,137.2	2,100.4	1,349.8
Export volume	1,000 lb	1,621.0	1,769.1	1,438.3
Export value	1,000 US$	5,689.5	5,156.4	4,137.7
Lobster				
Catch volume	1,000 lb	467.4	908.0	562.6
Export volume	1,000 lb	388.3	850.8	483.8
Export value	1,000 US$	3,650.6	6,708.7	4,572.8
Fish				
Catch volume	1,000 lb	735.7	2,520.7	1,176.1
Export volume	1,000 lb	167.9	625.0	192.0
Export value	1,000 US$	177.9	474.6	116.2
Total				
Catch volume	1,000 lb	3,340.3	5,529.1	3,088.5
Export volume	1,000 lb	2,177.2	3,244.9	2,114.1
Export value	1,000 US$	9,518.0	12,339.7	8,826.7

Source: Informe Anual 1990, BCN, Managua, 1991

Table 2.2.5 Manufacturing:Value-based Structure

Unit: % of Production Value

Manufacturing Activity	1988	1989	1990
Foodstuff	21.275	19.807	20.245
Beverage	10.440	11.754	13.123
Tobacco	8.314	8.782	8.083
Textiles	6.049	7.182	6.010
Clothing	1.582	0.917	0.385
Leather	0.965	1.616	1.502
Footwear	1.745	1.588	1.099
Furniture	0.715	0.422	0.522
Paper&Paper Products	2.064	2.302	2.183
Printing	2.224	2.168	1.917
Chemicals	13.181	18.417	17.856
Rubber	0.340	0.410	0.517
Non-metallic Minerals	8.153	7.597	7.713
Metal Products	15.988	10.655	10.255
Appliances	1.744	1.126	1.857
Transportation	0.324	0.202	0.120
Miscellaneous	4.898	5.045	6.613
Total	100.000	100.000	100.000

Source:Informe Anual 1990, BCN, Managua, 1991

Table 2.2.6 Main Export Products Unit: 1.000 US$

Export Product	1988	1989	1990
Traditional	201,408	233,338	260,322
Coffee	84,582	89,648	67,607
Cotton	53,067	27,892	36,597
Sugar	5,421	17,190	34,611
Beef	19,320	40,645	64,598
Seafood	8,547	12,009	9,838
Banana	14,681	20,968	23,037
Sesame	2,380	3,189	8,342
Gold	13,271	20,846	14,265
Silver	139	237	202
Non-traditional	34,337	56,783	61,010
Agricultural	3,685	10,783	12,053
Manufacturing	30,652	46,000	48,957
Total	235,746	290,121	321,332

Source: Informe Anual 1990, BCN, Managua, 1991.

Table 2.2.7 Main Imports Products

Unidad : 1,000 US$

Imports Products	1988	1989	1990
Consumption Goods	133,889	107,777	187,488
Non-durables	107,111	90,157	154,508
Durables	26,778	17,620	32,980
Petroleum	121,000	94,285	128,472
Crude Oil	73,540	80,803	109,028
Fuel & Lubricants	47,460	13,482	19,444
Intermediates Goods	284,905	212,763	160,277
Agriculture	100,101	64,915	24,715
Manufacturing	162,063	125,046	108,772
Construction	22,741	22,802	26,790
Capital Goods	259,797	199,870	188,420
Agriculture	34,605	12,132	12,047
Manufacturing	113,692	95,029	79,306
Construction	111,500	92,709	97,067
Miscellaneous	7,547	20	4
Total	807,139	614,716	664,661

Source: Informe Anual 1990, BCN, Managua, 1991.

Table 2.2.8 Foreign Debt Outstanding

Unidad : 1,000 US$

Item	1988	1989	1990
Debt Holder			
A)Medium & Long Term Debt	6,773,124.0	7,543,908.4	8,064,095.0
Central Government	4,879,959.1	5,249,402.4	5,680,143.3
C.Bank of Nic.	1,537,175.5	1,905,268.0	1,970,528.5
Rest of Financial System	143,927.9	143,233.6	147,692.9
Rest of Public Sector	212,061.5	246,004.4	265,730.3
B)Short-term	447,005.9	524,687.5	588,610.2
Total	7,220,129.9	8,068,595.9	8,652,705.2
Credutirs			
A)Medium Long Term Debt	6,773,124.0	7,543,908.4	8,064,095.0
Goverment Organizations	4,489,444.5	5,153,807.1	5,586,871.0
Multilateral Organizations	880,805.1	975,697.3	1,045,044.0
Commercial Banks	1,304,535.1	1,306,392.7	1,306,046.3
Supplies & Others	98,339.3	108,011.3	126,133.7
B)Short-term	447,005.9	524,687.5	588,610.2
Total	7,220,129.9	8,068,595.9	8,652,705.2

Source:Informe Anual 1990, BCN, Managua, 1991.

Table 2.2.9 Central Government Finances

Item	Million Cordobas "Oro"			Percentage Procentaje		
	1988	1989	1990	1988	1989	1990
Total Income	285.10	200.00	236.30	100.00	100.00	100.00
Current Inc.	281.50	199.70	236.30	98.74	99.85	100.00
Tax	266.90	188.70	212.80	93.62	94.35	90.06
Non-tax	10.50	4.10	6.60	3.68	2.05	2.79
1-Current Transfer from S.S	3.00	0.10	2.90	1.05	0.05	1.23
Other Tranfers	1.10	6.80	14.00	0.39	3.40	5.92
From P.Utilit.	0.0	4.5	6.9	0.00	2.25	2.92
From Others	1.1	2.3	7.1	0.39	1.15	3.00
Capital Income	3.60	0.30	0.00	1.26	0.15	0.00
TOTAL EXPENSES	644.80	230.30	552.10	100.00	100.00	100.00
Current Expens	594.50	213.60	526.00	92.20	92.75	95.27
Salaries/Wages	89.60	31.40	115.30	13.90	13.63	20.88
Goods/Servs.	438.50	165.30	340.00	68.01	71.78	61.58
Interests	0.40	0.00	0.00	0.06	0.00	0.00
Current Tranf.	66.00	16.90	70.60	10.24	7.34	12.79
To Govt.	5.2	3.6	20.3	0.81	1.56	3.68
To P.Utilities	4.9	0.1	4.3	0.76	0.04	0.78
To Others	55.9	13.2	46	8.67	5.73	8.33
C.Expenses	30.90	12.00	17.50	4.79	5.21	3.17
C.Transfer	9.30	4.60	8.50	2.99	2.00	1.54
To.Govt	0.00	0.00	0.00	0.00	0.00	0.00
To.P.Utilities	0.50	0.30	6.30	0.08	0.13	1.14
To Others	18.80	4.30	2.20	2.92	1.87	0.40
Loaned out	0.00	0.00	0.00	0.00	0.00	0.00
Current Account Defic.	(313.0)	(14.0)	289.80	na	na	na
Total Deficit W/O Donations	(359.7)	(30.3)	(315.8)	na	na	na
Donations	5.30	22.60	22.60	0.82	9.81	4.09

Source:Informe Anula 1990, BCN, Managua, 1991
(1)SS-Social Security;P-Public.

Table 2.2.10 Central Goverment Income

Item	Million Cordobas Oro			Percentage		
	1988	1989	1990	1988	1989	1990
TOTAL INCOME	285.10	200.00	236.30	100.00	100.00	100.00
CURRENT INCOME	281.50	199.70	236.30	98.74	99.85	100.00
TAX INCOME	266.90	188.70	212.80	93.62	94.35	90.06
Direct Tax	59.20	43.90	57.20	20.76	21.95	24.21
Income Tax	54.80	40.60	45.90	19.22	20.30	19.42
Property Tax	2.70	2.10	8.70	0.95	1.05	3.68
Real Estate Tax	0.80	0.40	1.20	0.28	0.20	0.42
Net Assets Tax	1.00	1.40	7.20	0.35	0.70	3.05
Motor Vehicules Tax	0.80	0.00	0.00	0.28	0.00	0.00
Others	1.80	1.20	2.70	0.63	0.60	1.14
Income & Property Surtax	1.80	1.20	2.70	0.63	0.60	1.14
On Goods & Services	174.60	113.70	115.90	61.24	56.85	49.05
Sales Tax	35.20	21.00	26.90	12.35	10.50	11.38
Consumption Tax	132.10	86.60	80.30	46.33	43.30	33.98
Petroleum	20.60	37.70	29.50	7.23	18.85	12.48
Beer & Alcohol	49.40	20.60	20.10	17.33	10.30	8.51
Tobacco	18.50	7.60	6.00	6.49	3.80	2.54
Others	43.60	20.60	24.70	15.29	10.30	10.45
Stamps	7.20	6.20	8.60	2.53	3.10	3.64
International Trade	22.10	19.50	32.50	7.75	9.75	13.75
Import Tax	22.00	19.40	32.40	7.72	9.70	13.71
Export Tax	0.10	0.10	0.10	0.04	0.05	0.04
Specific Tax	11.00	11.50	7.20	3.86	5.75	3.05
Managua City Govt. Tax	10.30	11.10	7.00	3.61	5.55	2.96
Other Specific Taxes	0.70	0.50	0.20	0.25	0.25	0.08
NON TAX INCOME	14.60	11.00	23.50	5.12	5.50	9.95
(1)Transfer(S.S.,Lothery,Post)	4.1	6.9	16.9	1.44	3.45	7.15
Other-Non-Tax Income	10.5	4.1	6.6	3.68	2.05	2.79
CAPITAL INCOME	3.60	0.30	0.00	1.26	0.15	0.00
TOTAL INCOME PLUS DONATION	290.40	222.50	258.90	101.86	111.25	109.56

Table 2.3.1 HOUSING & BASIC SERVICES IN 1985

Item	Nicaragua			Region III			Managua Dept.		
	Total	Urbana	Rural	Total	Urbana	Rural	Total	Urbana	Rural
Dwellings (Number)	507,984	270,133	237,851	149,857	127,081	22,775	146,012	126,297	19,715
Households (Number)	533,446	289,253	244,193	159,981	136,462	23,518	155,966	135,558	20,407
Residents									
Per Dwelling	6.5	6.5	6.5	6.3	6.3	6.3	6.3	6.3	6.4
Per Household	6.2	6.0	6.3	5.9	5.8	6.1	5.9	5.8	6.2
Dwelling with Water Supply									
Public System	249,367	212,287	37,080	102,472	94,244	8,229	100,043	93,506	6,537
Standpost	44,299	29,091	15,209	28,811	25,510	3,371	27,976	25,510	2,466
Wells	102,487	13,200	89,287	6,558	1,546	5,012	6,406	1,546	4,860
Others	111,831	15,555	96,276	11,945	5,781	6,164	11,586	5,734	5,852
Dwellings and toilet Facilities									
W.C	264,875	149,656	115,219	69,770	54,555	15,215	66,829	53,937	12,892
Letrine	115,597	109,847	5,750	69,681	68,111	1,570	69,032	67,944	1,087
Nothing	127,512	10,630	116,882	10,405	4,415	5,990	10,151	4,415	5,736
Dwelling with Electricity	319,607	249,325	70,282	131,286	120,387	10,900	128,861	119,602	9,259

Source:ESDENIC 85, Vol. IV, UN/INEC, Managua, 1989

Table 2.5.1 POPULATION WITH WATER SERVICE BY MACRO-REGION IN 1989

Country & Marco-Regions (1)	Region (2)	Population (3)	Population with water service					
			Total (4)	% (4/3)	House Connection (5)	% (5/3)	Public Standpost	% (6/3)
Total								
Nicaragua	I～IX	3,807,925	2,024,111	53	1,503,311	39	520,800	14
Pacific	II, III, IV	2,340,814	1,561,356	67	1,214,406	52	346,950	15
Central	I, V, VI	1,247,898	431,682	35	259,932	21	171,750	14
Atlantic	VII, VIII, IX	219,213	31,073	14	28,973	13	2,100	1
URBAN								
Nicaragua	I～IX	2,217,895	1,730,082	78	1,413,882	14	316,200	14
Pacific	II, III, IV	1,694,323	1,428,258	84	1,164,258	69	264,000	15
Central	I, V, VI	412,357	284,820	69	234,720	57	50,100	12
Atlantic	VII, VIII, IX	111,215	17,004	15	14,904	13	2,100	2
RURAL								
Nicaragua	I～IX	1,590,030	294,029	18	89,429	5	204,600	13
Pacific	II, III, IV	646,491	133,098	21	50,148	8	82,950	13
Central	I, V, VI	835,541	146,862	18	25,212	3	121,650	15
Atlantic	VII, VIII, IX	107,998	14,069	13	14,069	13	-	-

SOURCE: Informe Sectorial Sector de abastecimiento de Agua y Saneamiento, INAA/OPS/OMS, 1990

Table 2.5.2 POPULATION WITH WATER & SEWER SERVICE BY REGION 1987

Country&Regions (1)	Total (2)	%	URBAN (3)	%	RURAL (4)	%
Total Population						
Nicaragua	3,501,176	100	2,058,223	100	1,442,953	100
I	343,261	100	139,539	100	203,722	100
II	608,543	100	355,402	100	253,141	100
III	949,920	100	835,800	100	114,120	100
IV	624,973	100	397,935	100	227,038	100
V	321,972	100	98,750	100	223,222	100
VI	440,298	100	124,849	100	315,449	100
VII	114,250	100	45,700	100	68,550	100
VIII	58,553	100	46,842	100	11,711	100
IX	39,406	100	13,406	100	26,000	100
With Water Service						
Nicaragua	1,834,720	52	1,581,087	77	253,633	18
I	158,080	46	108,000	77	50,080	25
II	232,553	38	214,302	60	18,251	7
III	836,325	88	819,165	98	17,160	15
IV	361,949	58	273,198	69	88,751	39
V	84,147	26	64,536	65	19,611	9
VI	131,043	30	85,332	68	45,711	14
VII	8,808	8	8,808	19	n.a	n.a
VIII	2,589	4	1,722	4	867	7
IX	19,226	49	6,024	45	13,202	51
With Sewer Service						
Nicaragua	673,624	19	673,624	33	n.a	n.a
I	27,936	8	27,936	20	n.a	n.a
II	84,336	14	84,336	24	n.a	n.a
III	512,302	54	512,302	61	n.a	n.a
IV	48,120	8	48,120	12	n.a	n.a
V	930	-	930	1	n.a	n.a

SOURCE: Informe Sectorial Sector de ABastecimiento de Agua y Saneamiento, INAA/OPS/OMS, 1990

Table 2.5.3 INAA BALANCE SHEET: ASSETS

ASSETS	1991	1990
PROPERTIES & EQUIPMENTS		
Water Supply	71,090,922	1,465,033
Sewerage	1,655,850	393,442
General-Use Property	198,840,833	1,665,747
	271,587,605	3,524,222
Accumulated depreciation	148,120,898	1,171,432
	123,466,707	2,352,790
Construction in Progress	19,556,050	1,883,853
TOTAL PROPERTIES & EQUIPMENTS	143,022,757	4,236,643
CURRENT ASSETS		
Cash & Banks	23,181,873	5,595,097
Accounts Receivable		
Water Supply	42,829,553	6,668,336
Sewerage	2,916,685	1,485,299
Service Receivables	45,746,238	8,153,635
Other Receivables	12,610,023	2,587,292
Total Receivables	58,356,261	10,740,927
Estimated Bad Accounts	2,014,739	278,718
Net Receivables	56,341,522	10,462,209
Inventory		
Materials & Supplies	23,812,016	1,357,741
Materials in Transit	2,384,149	675,259
Total Inventory	26,196,165	2,033,000
Obsolescence Allowance	175,814	-
Net Inventory	26,020,351	2,033,000
TOTAL CURRENT ASSETS	105,543,746	18,090,306
OTHER ASSETS	363,253	2,863,411
TOTAL ASSETS	248,929,756	25,190,360

SOURCE: INAA Annual Financial Reports 1990 & 1991

Table 2.5.4 INAA Balance Sheet : Liabilities

Liabilities	1991	1990
CAPITAL		
Goverment Contribution		
Initial Contribution	10,256,770	2,772,100
Subsidies	136,369,680	2,156,697
Revaluation of Assets	106,014,160	2,666,856
Donations	12,675,280	861,143
Accumulated Loses	(24,170,448)	(7,140,193)
Net Capital	241,145,442	1,316,603
Deposit from Consumers	4,182,688	54,519
Long-Term Debt	-	9,528,795
Current Liabilities		
Current Portion of Long Term Debt	-	8,110,003
Account Payable	3,232,988	1,163,104
Other Liabilities	368,638	565,336
Accumulated Interests	-	4,452,000
Total Current Liabilities	3,601,626	14,290,443
Total Liabilities	248,929,756	25,190,360

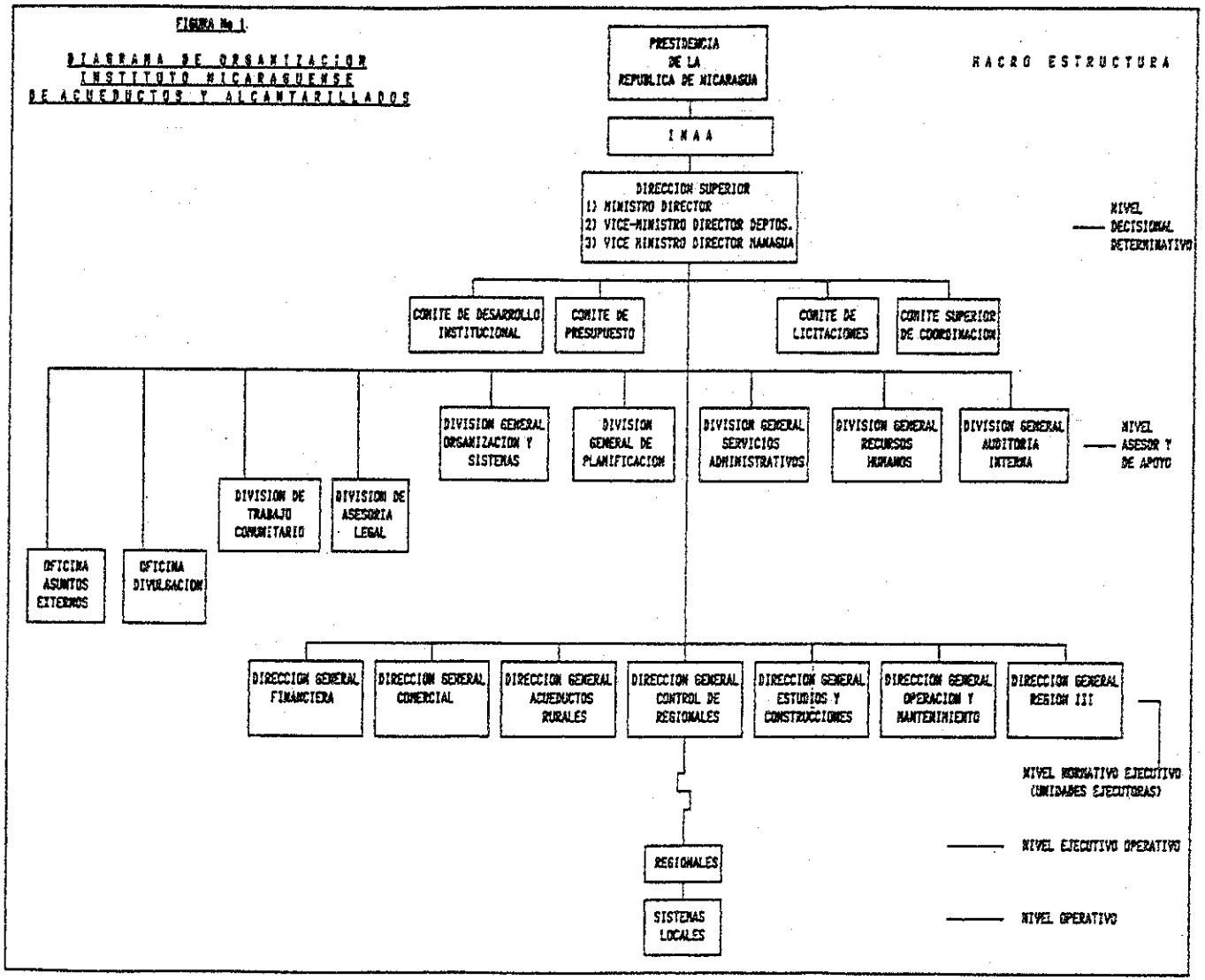
Source: INAA Annual Financial Reports 1990, 1991.

Table 2.5.5 INAA INCOME STATEMENT

REVENUES	1991	1990
Water Supply	107,689,217	23,283,632
Sewerage	26,108,930	4,197,661
Service and Reconnection Fee	11,291,484	233,920
Service Revenues	145,089,631	27,815,213
Discounts	2,825,759	665,449
Net Revenues	142,263,872	27,149,764
Other Revenues	-	-
TOTAL REVENUES	142,263,872	27,549,478
OPERATING & GENERAL EXPENSES		
OPERATION		
O & M	44,653,004	4,985,300
Depreciation	2,874,083	282,181
General		
Registration & Collection	7,188,040	1,032,171
Transport & Workshop	1,298,071	535,952
Administrative	13,550,315	1,460,082
Other Expenses	-	309,207
TOTAL OPERATING & GENERAL EXPENSES	22,036,426	3,337,412
	69,563,513	8,604,893
Earning before interests	72,700,359	18,944,585
INTERESTS ON LONG-TERM DEBT	9,407,841	716,351
Operating Profit	63,292,518	18,228,234
OTHER EXPENSES	898,619	-
Profits before Exchange rate Adjustment	62,393,899	-
EXCHANGE RATE ADJUSTMENT	(60,145,633)	(23,254,873)
Net Profit	2,248,266	(5,026,639)

SOURCE: INAA Annual Financial Reports 1990 & 1991

Fig. 2.5.1 Organization Chart of INAA



CHAPTER 3 WATER SUPPLY

3.1 General Condition of Managua Water Supply

Managua City, an area of 200km^2 with a total population estimated at about 1.2 million, has a total water production of about 268,000m^3 per day (71MGD) as of 1991. The daily average supply quantity per head is about 230 l/c/d (61 g/c/d), and the actual average consumption rate is about 170 l/c/d (44.6 g/c/d).

It can be said that the area is entirely dependent on groundwater as its water supply source,because even though about one fourth of the total production originates from the Asososca crater lake, this lake is recharged mostly by groundwater. The remaining three fourths of the production is pumped up from 65 borehole wells located within the city area. (Over 90 wells have been drilled in the city area, of which some are abandoned and some are under rehabilitation.) The quality of water both from the Asososca crater lake and the borehole wells is fairly good, so that the pumped up water is distributed without any treatment other than chlorination. Pumping from Asososca has recently been controlled for fear that the contaminated water of Lake Managua would intrude if the level of Asososca is excessively lowered by overpumping.

As a result of a rapidly increasing population, development of water source has not caught up with the demand. The absolute shortage of the supply resulted in a 2-day-a-week water suspension in every zone. The development of a new source is, therefore, a very urgent matter. Some of the facilities damaged in the 1972 earthquake or the superannuated distribution facilities contribute to a loss amounting to nearly one fourth of the total production. A big portion (53.5% of the total production) of unpaid water in 1991 also a big problem.

3.2 Existing Water Supply Condition

3.2.1 Service area and population served

The water supply system of Managua city covers the entire city area, supplying domestic water to a total population of about 1,164,000. The supply area comprises seven (7) Districts, among which District 1 is the major independent supply area and District 2 to 7 are divided into step-wise zones by elevation.

The situation of the 'Districts' and 'Zones' is shown in Fig. 3.1, and the outline is as follows:

a) Low Zone: The area with the lowest elevation ranging from 35 to 85 meters above sea level along the southern coast line of the Managua Lake, comprising a comparatively old city area, commercial and industrial area, with a population of about 359,000.

b) High Zone: The area with an elevation ranging from 85 to 135 meters and a population of about 363,000, and is regarded as the center of the new city area.

c) Highest Zone: An elevated zone ranging from 135 to 195 meters, which is categorized as a major residential area. The population of this area is about 191,000.

d) High Highest Zone:
An area with the highest elevation ranging from 195 to 350 meters where most of District 7, without coverage of urban water supply services, is located. Population in this zone is about 164,000.

e) Independent Zones:
The area situated in the western end of Managua City, the District 1, is the major area which has an independent water supply system with a population of about 71,000. Other three areas of independent systems are located in High and Highest zones.

The population of every supply district has been estimated from the latest CSE (Supreme Electoral Council of Managua City) data prepared in 1991. The CSE gives the number of over 16 year electorates (16 years old and over) of every electoral sub-district (about 800 sub-districts are involved in every district). They, the population of every sub-district has been calculated by multiplying the number of the electorates the coefficient 3.022. Table 3.1 presents the summed up population by District/Zone.

3.2.2 Water source and pumping amount

The sources of water supply in Managua City in 1992 are Asososca Crater Lake and 65 functioning borehole wells among the so far drilled number of over 90 wells within the City Area. The Asososca Crater Lake is situated in the northwestern part of the City and has a depth of about 75 meters and an area of about 0.7 km^2. Since the Lake has no flow-in nor drainage system, the Lake is regarded as a huge well. Nearly one fourth of the total water production of Managua is pumped up from this Lake. The pumping rate as of 1991 is about 65,700 m^3/day (17.36 MGD) on the average (The pumping rate has been reduced to less than 10 MGD since May of 1992). The quality is fairly good, and, the water from this lake is supplied without any treatment other than chlorination, as is the case with the water from the borehole wells.

The total daily production from the 65 wells in Managua as of 1991 is about 202,800 m^3/day (53.577 MGD) on the average.
The average production of one well is about 3,170 m^3/day (837,000 gl/day), however, the production capacity of every well varies from 570 to nearly 8,500 m^3/day (0.15 - 2.244 MGD) depending on the hydrogeological condition of the well site or the age of the well. Fig.3.2 presents the location of the wells and Fig.3.3 schematically shows the existing water supply system.
The average daily production from all sources in Managua as of 1991 totals 268,525 m^3/day (70,937 MGD), and the production from each source is shown in Table 3.2.

3.2.3 Water supply quantity by zone

The raw water pumped up from the Asososca Lake and the borehole wells is transmitted to the reservoir tanks and distributed to the houses directly after chlorination.
Of the total production of 268,500 m^3/day (70.,37 MGD), the amount supplied to every zone is shown in Table 3.2, and summarized below.

To Low Zone:	103,095 m^3/day	(27.235 MGD)	287 l/c/d
To High Zone:	84,668 m^3/day	(22.367 MGD)	233 l/c/d
To Highest Zone:	65,306 m^3/day	(17.252 MGD)	184 l/c/d
To Independent Zone:	15,456 m^3/day	(4.083 MGD)	178 l/c/d

The amount to every zone is also shown in Fig. 3.3 which schematically represents the water flow of the Managua water supply system. The average supply quantity per head for the

whole of Managua is about 230 l/c/d (60.7 g/c/d), varying by zone from 287 l/c/d (largest) in the low zone to about 180 l/c/d (smallest) in the Highest zone and Independent zones, as shown above. As described later, the actual domestic water consumption rate is less than 70% of the supplied amount. As a result of the rapid increase in the population of Managua in the recent several years, the total supply has not caught up with the demand. The balance is being managed by a 2-day-a-week water supply suspension in every zone.

3.2.4 Actual water consumption and leakage

1) Estimation

The supplied amount comprises the water effectively used and the leakage (uneffective water). The effective consumption is, from the viewpoint of water supply operation/management, divided into paid for water and unpaid for water such as leakage, and meter missed water. Therefore, the actual consumption amount can be calculated by two methods, if the ratio of leakage is given and if the ratio of the unpaid for portion among the effective consumption is negligible. However, in the case of Managua water supply, the leakage amount has not been examined so far, and since the non-charged portion is too big, probably caused by considerable illegal connections, the actual water consumption should be estimated by counting back from the existing water charge collection data, somehow including a not so reasonable assumption. The actual water consumption is obtained by multiplying the ratio of effectiveness by the supply amount. The ratio of effectiveness was estimated by use of the water charge collection data as follows.

a: Number of houses (places) from which water charge is collected in 1991 ..... 99,843 houses

b: Average number of persons per house ..... 7.386 persons

c: Total population charged
99,843 x 7.386 = 737,440 (persons)

d: Total amount of daily charged water consumption: 32.961 MGD
Not only for domestic use but including other categories of water use such as government, commercial and industrial

use (Table 3.3)

e: Daily charged water consumption per head is 32.961 MGD / 737,440 = 44.69 g/c/d

f: Since the daily water production (supply amount) per head is 60.94 g/c/d as shown in Tables 3.1 and 3.9, the ratio of effectiveness is: 44.69 / 60.94 = 73.3 (%)

Thus, actual water consumption (effective water) is estimated at 51.8 MGD (70.937 MGD x 0.733).
Consequently, the water leakage (uneffective water) is estimated at 19.14 MGD (70.937 MGD - 51.8 MGD), which is 27.0 % of the total supply amount.

2) Measurement of actual water consumption

In order to investigate the actual water consumption rate, a sample survey of water consumption was conducted at the beginning of Phase 2 of the Study. Four types of houses were sampled from each of 7 Districts in 3 zones, and the meter was read every hour for 3 days. The measured data is presented in the data report, and the summary is presented in Table 3.4 and Fig 3.4.
In this sample survey, various types (small, middle, big and biggest) of houses were selected, and the average water consumption per head by house type was as follows:

Household type	Average daily consumption per head
Small	63 l/c/d (16.8 g/c/d)
Middle	174 l/c/d (45.9 g/c/d)
Big	321 l/c/d (85.0 g/c/d)
Biggest	596 l/c/d (157.5 g/c/d)

Since the "middle" is the most popular household type among the above 4 types, the value of 174 l/c/d (45.9 g/c/d) is considered to represent the average daily consumption per head in Managua, and this value is similar to the consumption rate "170 l/c/d (44.72 g/c/d)" obtained from the charge collection data mentioned in the above clause.