



O-93061 E-93429

Water Resources Management in Guatemala and Nicaragua

Report from a Mission
April/May 1993

NIVA - REPORT

Norwegian Institute for Water Research  NIVA

Report No.: O- 93061/ E-93429	Sub-No.:
Serial No.: 2930	Limited distrib.:

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Report Title: Water Resources Management in Guatemala and Nicaragua. Report From a Mission April/May 1993	Date: August 1993 Printed: NIVA 1993
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	Geographical area: Guatemala/Nicaragua
	Pages: 51 Edition: 50

Contractor: The Norwegian Research Council for Science of the Humanity	Contractors ref. (or NTNF-No.):
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Abstract: Central America is a region where Norwegian development assistance started in the mid 1980s. Few Norwegian scientists have experience from this part of the world. As part of the Norwegian Ministry of Foreign Affairs' scholarship program a mission was undertaken to study water resources management in Guatemala and Nicaragua. The objective of the mission was to assess the water resources problems facing Central America and to assess the administrative and legal framework for water resources management. Both countries face severe water management problems as well as problems related to development; economy, political unrest, etc.. Most water resources are severely polluted and the knowledge about the resource is limited. Solving the water management problems will require substantial technical assistance. Several potential projects are proposed in the report.
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4 keywords, Norwegian

1. Vannressursforvaltning
2. Forurensning
3. Vannforsyning og avløp
4. Guatemala og Nicaragua

4 keywords, English

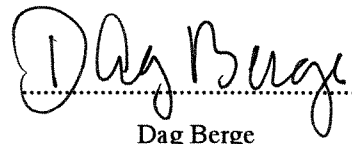
1. Water Resources Management
2. Pollution
3. Water Supply and Sanitation
4. Guatemala and Nicaragua

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For the Administration



Dag Berge

ISBN82-577-2349-5

Norwegian Institute for Water Research (NIVA)

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**WATER RESOURCES MANAGEMENT IN
GUATEMALA AND NICARAGUA
REPORT FROM A MISSION APRIL/MAY 1993**

Oslo, August 1993

Hans Olav Ibrenk
Torbjørn Damhaug

Preface

Central America is a region where Norwegian development assistance started in the mid 1980s. Few Norwegian scientists have experience from this part of the world. As part of the Norwegian Ministry of Foreign Affairs' scholarship program two scientists from the Norwegian Institute of Water Research (NIVA) were given a grant to undertake a mission to the region to study water resources management.

The mission was executed in April - May 1993 and Guatemala and Nicaragua were visited. The main reason for visiting Guatemala was that the secretariat for the Central American Commission for Environment and Development (CCAD) is located in Guatemala City. Besides Guatemala is a country with severe water resources management problems. Nicaragua is one of the countries Norway has a bi-lateral aid program with. Although Norway has not played an active role in any water program in Nicaragua it was decided to visit Nicaragua. The objective of the mission was to study water resources management in the region to gain experience. It should be noted that the mission had no official Norwegian mandate, it was only a study trip.

Central America is a region which has a fair amount of water and extremely high biodiversity. However, the region has faced severe political and economical problems the last decades, as well as civil wars. Still the situation is unclear in many countries. One of the people we met described Central America as a region where "Both nature and society are chaotic". The recent political development in both countries underlines this statement.

We are grateful for all the help we have received from numerous people during our visit. Especially we would like to express thanks to Ms. Marit Brandtzæg, NORAD Managua, Mr. Jorge Cabrera, Central American Commission for Environment and Development (CCAD), Guatemala, and Mr. Estuardo Velasquez, Secretaria de Recursos Hidraulicos de la Presidencia de la Republica, Guatemala, for all the help during the planning and execution of the trip.

This report does not reflect the views and opinions of the Norwegian Government. It is a reflection of the views and experience the authors obtained during the visit to the region. Errors are our sole responsibility.

Oslo, August 1993

*Hans Olav Ibrekk
Research Manager*

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Summary

Central America is a region where environmental and developmental problems are severe. The difficulties are further exacerbated by political unrest, suppression, human right violations, economical problems, heavy reliance on few export products, inefficient public sector, lack of social services, and so forth.

Guatemala

The Republic of Guatemala has a total area of 108,890 km². During the 1980s, the population grew by 2.9 percent annually, reaching about 9.5 million by end 1991. In 1987 36.4% of the population lived in urban areas. Indigenous people constitute about 54% of the population, mestizos (ladinos) 43% and Europeans 4%. The population density is 75 inhabitants/km² (the second highest in Central America).

Guatemala has the largest economy in Central America, with a 1991 GDP of \$9.3 billion, equal to about 30 percent of regional GDP. The economy is predominantly agricultural, with more than half of the country's working population engaged in farming, forestry and fishing.

On a national level Guatemala has an abundance of water resources. This abundance of water combined with a poorly developed society and economy, has lead to a considerable potential of further utilisation of the water resources in the country. At present it is estimated that about 10% of the hydropower potential have been developed, less than 20% of the irrigation potential, etc. However, presently about 60% of the population have insufficient water supply. In the rural areas the coverage, i.e. percentage of population with access to safe and reliable drinking water, is 45%.

Presently about 33 different institutes, authorities and organisations at the government level are responsible for undertaking activities linked to the use of water resources. The organisational structure is based on the traditional sectorial approach, i.e. each entity is responsible for one sector. This complex administrative setting combined with increased political pressure and raising environmental awareness prompted the president of Guatemala in 1992 to establish a new entity which should be responsible for co-ordination of all water management institutions. This entity was named "Secretaria de Recursos Hidraulicos de la Presidencia de la Republica" (SRH).

The challenges facing water managers in Guatemala are daunting. The water quality in most lakes, rivers and marine areas is deteriorating with subsequent loss in productivity and impacts on human health and the use of natural resources. Water is presently a free good in Guatemala and the management system is to a large extent based on a single use approach - i.e. first come, first serve. From a human health and development perspective the low water supply and sanitation coverage is of great importance.

The system for water resources management in Guatemala is comparable to several other countries, including Norway. The system can be categorised as a sector-oriented single-purpose system with lack of co-ordination and subsequent misuse of the water resources. The key problem seems to be lack of a legal framework, a water law.

The system of water resources management in Guatemala is extremely bureaucratic and disorganised. In addition, the problems with corruption hampers the execution of programs and investment projects.

Guatemala is lacking water resources standards and norms as well as a water use strategy or a national water resources management plan. International organisations are pushing Guatemala to prepare such a strategy.

Need for technical assistance

The following areas should be considered as key areas for international aid within the water sector in Guatemala:

- o Pollution abatement strategy for Lake Amatitlan
- o Management plan for "endangered" lakes in Guatemala
- o Environmental impact assessment (EIA)
- o Water resources inventory - monitoring
- o Water pollution control strategy
- o Master plan for water resources
- o Monitoring and assessment of the marine environment
- o Methods for integrated water resources management
- o Technical assistance to the Secretaria de Recursos Hidraulicos de la Presidencia de la Republica

Nicaragua

The Republic of Nicaragua, with an area of 130,000 km², is the largest country in Central America. The annual population growth is 3.4%, and in 1991 the population of Nicaragua was estimated to almost four million.

Nicaragua is the poorest country in Latin America, with a per capita GDP of USD 340 in 1991. The economy is predominantly agricultural, and the industry, which accounts for about 21% of the GDP, has been mainly import substitution.

Nicaragua has an abundance of water resources, however, there is scarcity of good water. It is evident that heavy water pollution and over-exploitation are prevalent, especially in the densely populated Pacific lowlands. Many rivers and lakes are heavily polluted from untreated or insufficiently treated domestic and industrial waste water including agriculture runoff. The water pollution poses severe health hazard for the urban and rural population. Water supply and sanitation systems coverage in urban areas, and in rural areas in particular, is insufficient. In terms of quantities the irrigation requirement is by far the most water consuming activity in the country. In developed areas polluted soil and surface waters prevent the use of ground water reservoirs due to the risk of contamination. There are also indications of over-exploitation of ground water (penetration of saline water) in the Pacific lowlands. Other severe impacts on the watersheds are deforestation and extensive use of pesticides.

The system for water resources management in Nicaragua can be categorised as a sector-oriented single purpose system with lack of co-ordination and subsequent misuse of the water resources. Other problems related to Nicaragua's water resources management are:

- * no coherent government strategy and clearly defined responsibilities on the water sector
- * absence of a proper legal framework, i.e. a water law

- * lack of a Ministry of Environment which has the overall responsibility for comprehensive environmental management including the water resources
- * no agencies for natural resources management and pollution control
- * no inventory of the nation's surface and ground water resources
- * lack of a nation-wide monitoring network and data bank
- * lack of qualified and experienced professionals in water resources management
- * too limited domestic water research capacity

Some of these problems are being approached through various donor assisted projects. A National Environmental Master Plan is in progress and will be submitted for approval by GON (the Government of Nicaragua) and WB (the World Bank) in the near future. A new water law has been drafted and is due for approval by the Congress. The mission was also informed that the Institute of Environment and Natural Resources (IRENA) will most likely be upgraded to a Ministry of Environment. A comprehensive action plan for Lake Managua is in progress and this project will serve as an important demonstration of an integrated water pollution abatement approach. There is, however, a vast need for human resources development and institutional support in the water sector in Nicaragua. On this basis the mission has outlined the following three possible technical assistance projects:

- * Technical Assistance to the Institute of Environment and Natural Resources (IRENA)
- * Technical Assistance to the Water Research Institute (CIRA)
- * Monitoring and Assessment of the Marine Environment

Regional Project

Based on the review of the water resources management sector it can be concluded that most countries in Central America are struggling with the same water resources management problems. All countries seem to lack Water Laws and subsequently complete lack of enforcement. The knowledge about the resource is limited and pollution problems are increasing. Due to lack of resources and comparable setting, regional co-operation seems feasible and efficient. However, a regional strategy must be based on national strategies. A regional strategy must be linked to the various national strategies to facilitate implementation. A regional strategy is especially important in the case of shared water resources (transboundary water courses). The demand for co-ordinated and integrated management of water resources at a regional level will increase with increasing competing demands and lack of resources to serve the needs of the urban population. A regional study to address these problems are proposed to be undertaken by CCAD.

The overall objectives of the study are:

- (i) to identify key issues to be addressed, and actions to be taken, to promote the development of regional environmentally and economically sound strategies for managing the water resources in the future;
- (ii) to promote the awareness of issues relating to water development and management among decision makers and senior water management staff in the region;
- (iii) to ensure that projects and programs are designed and co-ordinated with the regional river systems so that they will contribute to an sustainable distribution and utilisation of the region's water resources, and not reduce the water available for environmental needs

(forestry, instream users, etc.) to unsustainable levels;

- (iv) to develop a project evaluation framework that CCAD member countries and international donors can use for evaluation of proposed projects in the region.

This regional study should be accompanied by preparation of national action plans. The national plans should be based on the regional plan (provides a planning framework) and the national plans will provide input to the regional plan. This implies that the planning efforts in each country have to be co-ordinated with the efforts made by CCAD.

It is conceived that preparation of a regional strategy plan should be phased. The proposed phases are:

1. Elaboration of detailed terms of reference (TOR) for the regional study and for the national studies.
2. Preparation of the Regional Strategy Plan and National Action Plans.
3. Implementation of recommended projects.

1. Introduction

During the last decade it has become apparent that environmental issues in general and water issues in particular, can no longer be addressed in a piecemeal manner nor in isolation from other issues. Water resources have to be managed in an integrated manner, considering all the components of the water cycle, and all the uses, agriculture, urban, rural and industrial including the maintenance of the aquatic environment. Fully integrated water resource management can only be accomplished by bringing the land use component in the picture. Sustainable development of our water resources means developing the resource to meet the needs of the present without compromising the ability of future generations to meet their own needs. Integrated water resource management can help meet this difficult goal. However, and this is a much more difficult change, sustainable development can only be achieved if environmental, social, and economic concerns are also factored into water resource decisions.

Water issues are, surprisingly, not given high priority on the international environmental agenda. The phrase "water is life" is not yet a call for action. However, increasing international attention and awareness to water resource issues have been demonstrated through the "International Conference on Water and Environment" held in Dublin, Ireland, January 1992, and the United Nations Conference on Environment and Development's "Agenda 21".

Most developing countries are facing water scarcity, lack of safe drinking water and sanitation, surface and ground water resources are polluted, instream flow requirements are not met due to large uncontrolled abstraction of water, the management system is inadequate, most countries lack effective laws, etc. These problems can be found in most countries.

Norway has a long tradition in water resources management and has supported several water projects in developing countries. Most of these projects have been drinking water supply, sanitation, and hydropower projects. Focus has been on countries in Africa and to a lesser extent Central America.

Central America is a region with relatively good supplies of water, however, the demand is not met in most countries. Few Norwegian scientists have experience with the conditions in Central America.

This mission was undertaken to gain experience with the nature and socio-economic situation in Central America. Guatemala was chosen primarily because the secretariat for the Central American Commission for Environment and Development (CCAD) is situated in Guatemala city. Nicaragua was included because Nicaragua and Norway has a bilateral aid agreement.

Objective:

The objective of the mission was to:

- Assess the water resources problems facing Central America with particular emphasis on the situation in Guatemala and Nicaragua.
- Assess the administrative and legal framework for water resources management and propose how the administrative system can be strengthened.

- Assess the locally available expertise and identify areas where assistance from international expertise seems needed.

2. Water Resources Management in Guatemala

2.1 General Background Information

2.1.1 History

Guatemala is Central America in an exaggerated form. Its volcanoes are the highest and most active, its Mayan ruins the most impressive, its population the largest, its manufacturing base the most developed, its earthquakes the most devastating. Guatemala has the largest indigenous population in Central America.

The country was conquered by Pedro de Alvarado for the king of Spain in the early 1500s. By 1821 Guatemala has proclaimed its independence. As with the American Revolution of 1776, the Latin American movements were conservative in nature, seeking to preserve control of politics, the economy and the military for the upper classes of Spanish extraction. Though independence brought new prosperity to the Creoles (Guatemalans of Spanish extraction), it worsened the lot of the Maya. Mayan claims to ancestral lands were largely ignored and huge plantations were created for the cultivation of tobacco, sugar cane and henequen. The Maya, though legally free, were enslaved by debt peonage to the great landowners.

The history of Guatemala since independence has been one of rivalry and struggle between the forces of left and right. Historically, both movements have benefited the social and economic elites and disenfranchised the people of the countryside, who are mostly Maya.

In the mid 1940s and early 1950s several new initiatives were taken. Among these were the establishment of the nation's social security system, a government bureau to look after Indian concerns, a modern public health system, and liberal labour laws. In addition an agrarian reform law was enacted to break up the larger estates and foster high productivity on small individually owned farms. The expropriation of lands controlled by foreign companies set off alarms in the USA and CIA organised an invasion from Honduras. The president (Arbenz) was forced to step down. After Arbenz, the country had a succession of military presidents. Violence became a staple of political life. Opponents of government power regularly turned up dead.

During the 1960s and 1970s, Guatemalan industry developed at a fast pace, and society felt the effects. Most profits from the boom flowed upwards, labour union organisations put more stresses on the political fabric, and migration from the countryside to the cities, especially the capital, produced urban sprawls and slums. As the pressures in society increased, so did violence of protest and repression, which led to the total politicisation of the society.

In the early 1980s the military suppression of antigovernment elements in the countryside turned a peak. Alarming numbers of people, usually Indian men, were killed in the name of anti-insurgency, stabilisation and anti-communism. The blood bath led to a cut-off of US military assistance to the Guatemalan government, which led in turn to the election in 1985 of a civilian president, Cerezo Arevalo. Before turning the power to the civilians, the military ensured that its earlier activities would not be examined or prosecuted, and it established formal mechanisms for the military control of the countryside.

2.1.2 Geography and Population

The Republic of Guatemala has a total area of 108,890 km². Guatemala borders to Honduras, Belize (Belize declared independence from Guatemala in 1981 but was not recognised by Guatemala before 1991), Mexico, and El Salvador. The country can be categorised as relatively high altitude country with 43% of the total area higher than 1500 m and 20% higher than 3000 m. The climate is tropical, however, in the highland relatively low temperatures have been recorded.

During the 1980s, the population grew by 2.9 percent annually, reaching about 9.5 million by end 1991. In 1987 36.4% of the population lived in urban areas. Indigenous people constitute about 54% of the population, mestizos (ladinos) 43% and Europeans 4%. The population density is 75 inhabitants/km² (the second highest in Central America).

The country is administratively divided into 22 regions (departamentos). The capital of the country is Guatemala City with a population of about 3 million people. Guatemala City is the largest city in Central America.



Figure 1. Map of the Republic of Guatemala

2.1.2 Economy

Guatemala has the largest economy in Central America, with a 1991 GDP of \$9.3 billion, equal to about 30 percent of regional GDP. The economy is predominantly agricultural, with more than half of the country's working population engaged in farming, forestry and fishing. The sector contributed more than one-fourth of the GDP and generated about 75 percent of the country's export revenues during the 1980s. Apart from traditional export crops like coffee, bananas, cardamom, and cotton, non-traditional agricultural exports have become major export earners. The industrialisation efforts of the 1960s and the 1970s have also created an industrial base which accounts for about 21 percent of GDP.

The country is characterised by a very uneven distribution of land and income. The indigenous population - comprising more than half of population - lives in extreme poverty and the margin of the money economy. Social indicators are poor, reflecting, inter alia, persistent under investment in social services and basic rural infrastructure.

Tourism is becoming increasingly important for Guatemala. In 1992 about 0.5 million tourists visited Guatemala.

When President Serrano was inaugurated in January 1992, the country was in a fiscal and balance of payment crisis, reflecting inadequate macroeconomic policies and more fundamental distortions in the economy. The latter include (i) a generally inefficient public sector, with limited resources and capacity to provide social services as indicated by poor health indicators and low literacy levels; (ii) inadequate levels of resource mobilisation reflecting traditionally low savings to GDP ratios; (iii) continued heavy reliance on a few agricultural commodity exports; and (iv) low agricultural productivity (World Bank).

The Administration initiated a program to stabilise the economy and lay the basis for medium term growth. Guatemala has requested an Economic Modernisation loan (EML) from the World Bank to support an adjustment program which includes: (i) implementation of a comprehensive fiscal reform; (ii) strengthening of public sector performance through restructuring and/or privatisation of enterprises; (iii) tariff reform and elimination of most non-tariff barriers; (iv) financial sector reform designed to increase competition, stimulate private savings, and ensure sound banking practices and strengthened supervision; and (v) strengthening the delivery of social services. It is also seeking Bank financial support for the Social Investment Fund (SIF) aimed at addressing the needs of the most vulnerable rural poor (World Bank).

2.2 Water Resources Management in Guatemala - Present Situation

2.2.1 General Characteristics

On a national level Guatemala has an abundance of water resources. The annual precipitation averages close to 2000 mm and several major transboundary water courses originates in Guatemala. The mountain ranges of Guatemala forms two large watersheds; the rivers which flow into the Pacific and those which flow into the Caribbean. The southern watershed has frequent rapids and falls, and eastern watershed has quieter, wider and deeper rivers. On the Pacific side the most important rivers are the Suchiate, Naranjo, Samalá, Michatoya, Paz and Los Esclavos. On the Caribbean side the most important are the Polochic, Rio Dulce, Montagua and Sarstoon.

Guatemala has many lakes, quite a few of them are of volcanic origin. The most outstanding lakes are Atitlan, Amatitlan, Izabal, Petén Itza, Güija and Ayarza.

This abundance of water combined with a poorly developed society and economy, has led to a considerable potential of further utilisation of the water resources in the country. At present it is estimated that about 10% of the hydropower potential have been developed, less than 20% of the irrigation potential, etc. However, presently about 60% of the population have insufficient water supply. In the rural areas the coverage, i.e. percentage of population with access to safe and reliable drinking water, is 45%.

Few studies have been undertaken to assess the quality of the water resources in Guatemala. Some studies on the water quality in lakes have been undertaken mostly by students and private consulting companies. However, even without extensive monitoring it can be concluded that most rivers in Guatemala are polluted by discharges of waste water from municipalities and industries. The most severe problems are associated with discharges of nutrients and organic matter. There are relatively few chemical and metallurgical industries in Guatemala so the problems with heavy metals and micro pollutants should be relatively small. However, the extensive use of pesticides in agriculture indicates the potential of severe contamination.

The same situation can be found regarding ground water and marine waters. Only a few studies especially in the Guatemala City area, have been undertaken to assess the quality of ground water.

The knowledge about the state of the marine waters is very scarce. There is no inventory of sources of marine pollution. On the Pacific "red tides" have been reported since 1985. Fisheries is an important source of revenues for the country and as such the marine waters merit further investigation.

2.2.2 Water Resources Management Organisations

Presently about 33 different institutes, authorities and organisations at the government level are responsible for undertaking activities linked to the use of water resources. The organisational structure is based on the traditional sectorial approach, i.e. each entity is responsible for one sector. At the ministerial level about seven ministries are involved in water management. The ministries have several executing agencies (institutes) which are responsible for the execution of programs etc.

This complex administrative setting combined with increased political pressure and raising environmental awareness prompted the president of Guatemala in 1992 to establish a new entity which should be responsible for co-ordination of all water management institutions. This entity was named "Secretaria de Recursos Hidraulicos de la Presidencia de la Republica" (SRH).

Secretaria de Recursos Hidraulicos de la Presidencia de la Republica (SRH)

The SRH was established in 1992 by the President. SRH will in the future serve as the key water authority in Guatemala responsible for co-ordinating all entities involved in water resources management as an umbrella organisation. Presently SRH reports to the President and operates under his discretion. However, when (if) the new water law is passed in the Congress, SRH will become a government institute with specific responsibilities according to the law and provide the

necessary legal framework for management and enforcement. SRH will have the overall responsibility for water resources management and co-ordinate all the activities undertaken by the different sectors. To facilitate this control and co-ordination, SRH will be given control of the budget allocated to water resources projects. This implies that all activities planned by the different sector have to be approved by SRH before implementation.

The water law will regulate the future use of water resources as well as provide mechanisms for pollution control. The bill is pending in the Congress. The question is whether the law, which impose restrictions on the use of water resources by private interest (e.g. irrigation - major landowners), will get enough support in Congress.

SRH's task is to co-ordinate and to a certain extent control the activities of many agencies/institutes. Power struggles will most likely occur and the decisive question is to what extent SRH will be able to influence the activities of the others effectively. It is definitely a difficult task but in order to develop a more efficient system for environmentally sound water resources management in Guatemala the establishment of SRH seems imperative.

Instituto Nacional de Electrificación (INDE)

INDE is a parastatal enterprise responsible for production and distribution of electricity in Guatemala. Currently 65% of the electricity is hydropower. INDE owns and operates most of the existing power plants in Guatemala. In table 1 existing and planned hydropower plants are presented. The planned power plants will be built and operated by private companies and INDE is in the process of being privatised. The demand for electricity is 640 MW. Guatemala is exporting electricity to El Salvador and is planning to export to Honduras in 1994 and Mexico in 1995.

Table 1. Overview of existing and planned hydropower plants in Guatemala.

Power Plant	Installed/planned capacity MW
Existing Power Plants:	
Chixoy	300
Aguacapa	90
Jurun Mannala	60
Eselavos	13
Michatoyas	11
Santa Maria	6
Paryenir	2.8
Chichaic	0.5
Rio Hondo	2.0
Planned Power Plants:	
Chulac	344
Xalala	150
Rio Hondo II	18
Rio Bobos	10
Camalote	8
Santa Maria	60
Palmar	23
Serchil	90
Rio Grande	63

A catalogue of potential hydropower projects has been prepared. A total of 400 projects have been identified. This screening is based on predominantly engineering analysis and to a certain extent economic analysis. However, environmental considerations have not been included.

The potential for hydro power in Guatemala is considerable, however, most projects will be relatively small. The exception is the Mexican project close to the border (Rio Usumacinta, 3000 MW) which will inundate areas in Guatemala.

No master plan for the development of the hydro power sector has been prepared. As part of the decision making process each hydro power project is subject to environmental impact assessment (EIA). No guidelines exist to what the EIA should include and how the EIA should be presented. The need for advice and guidance on preparation of EIAs was expressed strongly.

Instituto Nacional de Sismologia, Vulcanologia, Meteorologia e Hidrologia (INSIVUMEH)

INSIVUMEH has a staff of about 350 and is an institute belonging to the Ministry of Communication, Public Works and Transportation. The institute is responsible for monitoring of seismological and volcanic activities as well as traditional meteorology and hydrology. The institute has a program for investigation of ground water and a small hydrochemistry laboratory.

Data on stream flows are important in all water resources management. INSIVUMEH operates a hydrologic network consisting of about 30 - 40 stations. Due to political unrest, guerrilla activities has stopped the data collection, and lack of resources the network has decreased. In addition to the network of INSIVUMEH other institutions operate their own hydrological network to serve their own purposes (INDE has about 125 stations).

The stream flow records are normally 15 - 20 years, however, the institute lacks resources to maintain the monitoring network. The laboratory could be developed to analyse other water quality parameters and by including water quality sampling at the hydrologic network profiles data on water quality could be collected at a reasonable cost.

Unidad Ejecutora del Programa de Acueductos Rurales (UNEPAR)

UNEPAR is a institute belonging to the Ministry of Public Health. The institute is responsible for providing water supply and sanitation to rural areas. UNEPAR has 5 branch offices covering 8 regions. The activities are primarily funded by international organisations (Germany, CARE, CIDA, UN, etc.).

The drinking water supply coverage in rural areas is 45%. A master plan has been prepared and the objective is to reach 73% coverage within 5 years.

UNEPAR is responsible for planning and execution of the projects. The pipe systems belong to the Ministry of Public Health. The users are not required to pay the construction costs. As part of the projects a local community water committee is established which is responsible for operation and maintenance, setting and collecting water fees.

There are several other institutes responsible for water supply and sanitation in urban and rural areas.

Empresa Municipal de Agua (EMPAGUA)

EMPAGUA is responsible for the service of potable water as well as sewerage to the metropolitan area of Guatemala City. EMPAGUA is part of the municipality of Guatemala city and the operation is controlled by the city council.

EMPAGUA serves approximately 2 million people. The rate of supply coverage is about 75%, however, the supply is not reliable and frequent capacity problems occur. Due to high migration rates into the city, the city is facing a water shortage of about 1.5 m³/s. The water supply is partly ground water, about 60%, and partly surface water. The average water consumption is quite high, 40 m³/apartment per month. The drinking water quality is claimed to be acceptable and comply with the standards set by the American Water Works Association. However, cholera outbreaks have been reported in Guatemala City.

In the city there is no sewage treatment plant. The municipal sewage as well as industrial effluents are discharged directly into the rivers. The receiving waters are heavily polluted. Guatemala city is divided into two major drainage areas, one draining to the Pacific and one draining to the Caribbean. Lake Amatitlan and Rio Michatoya draining into the Pacific are both heavily polluted. Lake Amatitlan can be characterised as a highly eutrophic (high concentrations of nutrients) lake on the verge of "dying". The need for pollution abatement measures is evident, however, due to lack of resources it will be difficult to implement the needed abatement measures in the short run.

In addition to polluting surface water, the uncontrolled discharges of waste water is also polluting the ground water. In addition, the high rate of abstraction and reduced available recharge area has lead to a sinking water level in the aquifer.

The water supply system in Guatemala City has to be expanded to serve the increasing population. However, since the available sources have reached the capacity limit new sources have to be identified. Due to uncontrolled abstraction of water from the aquifer by private interests, the subsequent drop in water level is difficult to control. A system for control and licensing of water abstraction should be established. In addition, measures have to be implemented to reduce the risk of contamination of the ground water resources as well as the surface waters.

La Direccion Tecnica de Riego y Avenamiento (DIRYA)

DIRYA is a agency sub-ordinate to the Ministry of Agriculture primarily responsible for public irrigation systems. DIRYA is also charged with the responsibility of assessing the water and soil resources to determine the potential for irrigation. Currently about 80,000 ha are irrigated, of which 58,500 ha are private. The state operates irrigation plants which irrigate about 17,500 ha. Most of the irrigated land is on the Pacific side.

The irrigation systems developed by DIRYA is financed, operated and maintained by the Government. The farmers receiving water is being charged but on the average only about 25% cost-recovery are accomplished.

Most irrigation projects are initiated by the private sector. Since water abstraction is not controlled in Guatemala, i.e. water is a free and common good, several projects have considerable environmental impacts. All irrigation projects are subject to environmental impact assessment. However, at the moment the Government can not effectively control the irrigation projects

operated by private farmers. It should be noted that the landowner structure of Guatemala is further exacerbating this problem (a few farmers control most of the agricultural land).

2.2.3 Human Resources

Guatemala lacks well qualified and experienced professionals in water resources management at all levels of Government. The expertise available locally is limited due to a low education level and few job opportunities. The total number of professionals working within water management is relatively low when comparing the size of the country, the importance of water issues, and the available water resources. Due to this the recruitment to the water sector is low.

Most professionals working in the sector have a degree in civil engineering (sanitary engineers). The university in Guatemala City has a program in sanitation and hydraulics, however, the number of students entering this program is low. At present there are about 10-15 hydrologists in Guatemala.

Some professionals working in water resources management institutions are trained in other countries, mostly in the USA. However, it seems that there is a need to increase the educational capacity at the universities in Guatemala as well as increasing the number of students studying abroad.

There is no water research institute in Guatemala. Some water research is being done at the universities, mostly as part of thesis work. Students studying abroad often also do their thesis work in Guatemala. Many of the existing investigations of water quality in lakes have been executed by students.

There are some private environmental consulting firms in Guatemala. However, due to the relatively low number of available contracts, the firms are small. Some private companies undertake studies of water resources as part of preparation of EIAs. This has enabled the consulting firms to gather some data on the water quality in selected lakes.

The local expertise should be strengthened to enable Guatemala to become independent of international experts. International experts should be used to initiate and execute training programs, undertake special studies in co-operation with local professionals, the university sector should be strengthened and more job opportunities have to be created within the institutions responsible for water resources management.

2.2.4 Assessment of the water management system in Guatemala

The challenges facing water managers in Guatemala are daunting. The water quality in most lakes, rivers and marine areas is deteriorating with subsequent loss in productivity and impacts on human health and the use of natural resources. Water is presently a free good in Guatemala and the management system is to a large extent based on a single use approach - i.e. first come, first served. From a human health and development perspective the low water supply and sanitation coverage is of great importance.

Guatemala has compared to many other developing countries, an abundance of water and the country has some of the most spectacular freshwater bodies in the world - lakes situated in volcanic areas. These lakes are important ecological elements and attract a lot of tourists every

year. Tourism is becoming increasingly important in Guatemala and the lakes are important as tourist attractions. The need to develop a sound development strategy in the catchment areas of these lakes to balance the environmental and developmental interest, is becoming increasingly important as some the ecosystems of the lakes are on the verge of being affected by discharges of effluent water. To reverse the process integrated, comprehensive management plans are needed urgently.

The water sector in Guatemala is partly public and partly private. The government is in general responsible for providing water supply and sanitation services and irrigation water to marginal areas, while the private sector is developing their own systems for water supply and irrigation. The private sector is the largest water user, i.e. irrigation. Cost recovery is not yet implemented in the public sector. In fact, water delivered to the most well-off residential areas in Guatemala City costs less than water delivered to the urban marginal areas. Privatisation of the water supply and sanitation services is likely in the near future.

Guatemala is lacking water resources standards and norms. National drinking water standards and ambient water quality standards are lacking. Presently international standards are utilised to a certain extent, however, the standards should be revised to reflect the natural characteristics of the nature of Guatemala. Setting of standards and norms are also crucial elements in the future water resources management to provide a tool for enforcement of the water law.

Guatemala is lacking a water use strategy or a national water resources management plan. International organisations (UNICEF) are pushing Guatemala to prepare such a strategy. Important elements in such a strategy should be organisation at all levels, increased decentralisation of water resources management activities (management at the lowest appropriate level), elaboration of water law, defining water rights, pollution control and water use strategies, water resource inventory projects and systems, cost recovery mechanisms, privatisation of water supply and sanitation services, enforcement agencies, allocation of resources to the sector, training, human resources development, institutional building, public participation, etc. The Secretaria (SRH) should be charged with the responsibility of preparing such a strategy. Effective implementation of the strategy requires full political support. Presently, the political climate for increased emphasis on water resources management in Guatemala seems quite good since the President established the Secretaria. This indicates a keen interest in giving priority to the water resources management sector.

The system for water resources management in Guatemala is comparable to several other countries, including Norway. The system can be categorised as a sector-oriented single-purpose system with lack of formal co-ordination and subsequent risk of misuse of the water resources. The system of water resources management in Guatemala is extremely bureaucratic and disorganised. In addition, the problems with corruption hampers the execution of programs and investment projects.

The key problem seems to be lack of a legal framework, a water law. Before this law is passed in the Congress, the misuse will continue. However, passing of the law will only solve the problems when the necessary enforcement mechanism and the government's willingness to enforce the regulations have been established. The decisive question is whether the government will give priority to enforcement and that the agency charged with the responsibility is given the necessary resources. A step in the right direction is the establishment of the Secretaria de Recursos Hidraulicos de la Presidencia de la Republica.

The division of responsibility between the law making organisations and the organisations responsible for enforcement should be given priority. Policy making and development of the legal framework should be divided from enforcement as far as possible to avoid conflict of interest.

A crucial problem for the future water resources management in Guatemala is the lack of data. The knowledge about the resource is limited. A concentrated effort on establishing data collection programs is needed. This program should include water quantity, water quality and water use. The program should cover surface water, ground water and marine waters.

2.3 Need for Technical Assistance

The following chapters outline the need for technical assistance identified in Guatemala. It should be noted that these proposals are based on the limited information reviewed during the visit and the few meetings held should be considered as key areas where more work seems needed.

Title: Pollution abatement strategy for Lake Amatitlan

Justification: Lake Amatitlan is heavily polluted by discharges of untreated waste water from municipalities (Guatemala City), industries and agriculture. The lake is highly eutrophic and the sediments are contaminated. The ecosystem in the lake is approaching a complete breakdown. Restoration of the water quality will require implementation of costly abatement measures and will take decades to accomplish. To achieve an effective restoration the most cost-effective measures should be implemented first, e.g. the measures which give most environmental benefit should be implemented first.

Objective: Prepare a strategy for cost effective water pollution abatement in Lake Amatitlan

Scope: The project will involve several phases:

- i. Assessment of water quality and inventory of sources.
- ii. Identification of abatement measures; technology and costs
- iii. Development of water quality model.
- iv. Ranking of measures according to cost-effect.
- v. Implementation and planning process.

Title: Management plan for "endangered lakes" in Guatemala

Justification: Guatemala has many crater lakes of great ecological and tourist value, i.e. Atitlan, Amatitlan, Izabal, Petén Itza, Güija and Ayarza. Most of these lakes are important tourist resorts and the associated development is threatening the environment. Most resort areas are developed without considering the environmental impacts, hence waste water is discharged to the lakes without any treatment (during the visit to Lake Atitlan the smell of sewage was profound on the beach of one of the best hotels in Panjachel). This uncontrolled development could severely affect the ecosystems of the lakes and thus the value as a tourist resort. Tourism is becoming Guatemala's main source of revenues and its importance is expected to increase.

Objective: Prepare a development and management plan for specific lakes in Guatemala to promote sustainable use of the water resources. Focus should be on reducing the detrimental environmental effects of tourism.

Scope: Assess the current use of the lake and the watershed and the existing water quality and specific ecological properties. Establish limits for the acceptable loading of pollutants to the lake. Elaborate guidelines and specific requirements new establishment should comply with in order to preserve and maintain the functioning of the ecosystems. Prepare a detailed development plan and set up control mechanisms and enforcement agencies.

Title: **Environmental Impact Assessment (EIA)**

Justification: The application of EIA in Guatemala is promoted by international donors which require that all projects with the potential of environmental impacts should be subject to EIA. Based on impressions, the need for EIA was not felt as strongly in Guatemala by local professionals.

Objective: Elaborate a system for environmental impact assessment (EIA) in Guatemala with focus on preparing detailed guidelines for screening of projects and scope of the EIA, process and specific guidelines related to specific types of activity.

Scope: In co-operation with other Central American countries under the auspices of CCAD develop a framework for EIA which contains legislation, guidelines for the preparation of EIA, and how to undertake the EIA process itself.

Title: **Water resources inventory - monitoring**

Justification: The knowledge about the state of the water resources in Guatemala is very low. Few data collection programs in the water field are running at present. Only the hydrologic network of INSIVUMEH is operational. Water quality data are not collected. Data from only a few selected lakes are available.

Objective: Develop a water quality and quantity monitoring program for freshwater, both surface and ground water, to obtain the necessary data for sound water resources management.

Scope: The monitoring program should be developed in steps. First the most important water courses should be included. Later the program can be expanded to include less important water courses. INSIVUMEH's hydrologic network could form the basis for a water quality monitoring network by including water quality sampling.

The project will require technical assistance and some equipment. Using advanced automatic sampling equipment is not recommended. As part of the program laboratory facilities have to be upgraded and expanded.

- Title:** **Water pollution control strategy**
- Justification:** Guatemala has no strategy for water pollution abatement. The legal framework is lacking as well. The proposed Water Law includes paragraphs on pollution control. Implementation of the water law should be based on an overall strategy for water pollution abatement.
- Objective:** Prepare a water pollution control strategy for Guatemala based on the proposed Water Law.
- Scope:** The strategy should focus on the need for pollution abatement and the objectives for this activity. The strategy has to be based on the relevant paragraphs in the Water Law and will devise a plan for implementation of the required measures. The strategy should focus on using scarce resources in the most optimal way to achieve the greatest environmental benefits, i.e. cost effectiveness. Due to financial and manpower constraints the strategy should focus on attacking the most important water courses in the country. Of particular importance is to develop a system for water rights and water users rights to control the future use of water resources in the country. As part of the strategy water quality criteria should be elaborated.
- Title:** **Master plan for hydro power development.**
- Justification:** Currently about 10 percent of the hydropower potential is utilised in Guatemala. More than 400 potential hydropower projects have been identified. This screening is based on a technical evaluation and to a certain extent economic considerations. There are plans to increase the export of electricity to neighbouring countries subject to increased capacity in the delivery system. No co-ordinated plan for the future development of the hydropower sector has been prepared. The conflicts between development interests and conservation interests are expected to increase in the future. It is therefore essential to consider the exploitation of the remaining water resources in a broader perspective, taking into account the use of water resources for all user interests.
- Objective:** To prepare a co-ordinated plan for the development of hydropower in Guatemala. The plan should present a proposal for priority grouping of hydropower projects for subsequent consideration for licensing. Priority should be given to projects most favourable from both an economical as well as an environmental viewpoint. The plan should also provide a basis for considering which watercourses should be used for other purposes than hydropower.
- The master plans should be described as a national co-ordinated plan for the management of watercourses.
- Scope:** Methods for such a project are available. Norway has prepared such a national plan. The Norwegian methods should be revised and made applicable to the Guatemalan setting. Development of hydropower will directly affect a large number of users. For every project considered, these interests/scientific areas should be evaluated. The consequence of the development on other user

interests and the economy should decide the priority.

Title: Monitoring and assessment of the marine environment

Justification: The fishery sector is important to Guatemala. As part of a regional project in Central America a project aimed at assessing the fish stock, fishing fleet and processing facilities is under way. Subsequently a management plan will be elaborated. The state of the marine environment has not been investigated. Red tides occur annually and due to the low level of treatment, severe local, as well as regional, water quality effects can be expected. To assess the level of contamination of marine waters a comprehensive monitoring program should be developed. A coastal zone management program should be elaborated.

Objective: Develop a comprehensive monitoring program for marine waters to facilitate coastal zone management.

Scope: The monitoring program should include chemical and biological monitoring of the marine waters, studies of effects of contamination on biota, as well as hydrographic studies. In addition to designing the program appropriate institutions should be charged with the responsibility of undertaking the monitoring program.

Title: Methods for integrated water resources management

Justification: Application and use of planning methods for integrated water resources management and planning is lacking in Guatemala. It is of outmost importance to integrate the land use planning and water resources planning. So far few entities exist in the country to facilitate such planning, however, the newly established Secretaria de Recursos Hidraulicos de la Presidencia de la Republica has the responsibility of undertaking co-ordination and planning. To facilitate this planning appropriate planning methods and models should be developed. Appropriate methods and models are developed and can be easily transferred to Guatemala. The transfer should be accompanied by training. Introduction of improved planning systems will improve the future use of water resources and contribute to a more sound water resources management.

Objective: Transfer and adopt methods for integrated water resources planning and management.

Scope: International methods for integrated water resources planning and management should be transferred and adopted to the current administrative and legal system in Guatemala. The transfer process should be organised through seminars, short term technical assistance, international training courses, etc.

Title: Technical assistance to the Secretaria de Recursos Hidraulicos de la Presidencia de la Republica

Justification: The SRH was established in 1992 and its task is to co-ordinate all the entities responsible for sectorial water resources management (more than 30

institutions). Due to vested interests and anticipated problems in co-ordinating intrinsic bureaucratic institutes, the need for strengthening the Secretariat while the political climate is positive, is evident. The decision making structure in Guatemala does not seem to be purely based on objective criteria, personal interests seem to play a certain role. Appointing independent professionals to the secretariat can contribute to enhance the capability and capacity of SRH and to solve some of the co-operation problems that most likely will be encountered.

Objective: Secondment of international scientific officers with extensive experience from water resources management and conflict resolution to the Secretaria.

Scope: Secondment of international professionals to the Secretaria for at least a two years period to assist the Secretaria in the co-ordination of water users in Guatemala.

2.4 International Assistance to Guatemala

Several international donors and organisations are giving aid to Guatemala in the water sector. The most important donors are the Inter-American Development Bank (IDB), the World Bank, UNICEF, UNDP, CARE, GTC (Germany), CIDA, SIDA, FINIDA, Japan, etc. Most of these donors are involved in water supply programs.

Norway does not give bilateral development aid to Guatemala. However, through private organisations (NGOs) and multi-lateral aid the total Norwegian assistance to Guatemala amounts to approximately NOK 100 million annually. The aim of this assistance is to support the peace process and to facilitate the process of repatriation of refugees. Due to the human rights conditions in Guatemala the Norwegian government has not indicated an increase in the support to Guatemala. Norwegian organisations have played a fundamental role in facilitating the on-going peace negotiations and are expected to continue to contribute in this process.

The multi-lateral aid is primarily focusing on projects related to expanding the electricity network in the region (inter-region transfer), fisheries projects, projects related to environment and health, project aimed at establishing regional and national warning system for natural catastrophes (volcano eruptions, earthquakes, etc.).

In addition the Norwegian government is supporting activities of CCAD which is based in Guatemala.

3. Water Resources Management in Nicaragua

3.1 General Background Information

3.1.1 History

Nicaragua has been inhabited for a very long time. Human footprints covered and preserved by volcanic ash are estimated to be at least 10,000 years old.

The first contact with Europeans was in 1502, and in 1524 they were back to colonise the region. Along with the rest of Central America, Nicaragua gained independence from Spain in 1821, was a part of Mexico for a brief time, then part of the Central American Federation, and finally achieved complete independence in 1838.

Somoza, who became president in 1937, created a new constitution to give himself more power, and ruled Nicaragua as a dictator for the next 20 years. He was assassinated in 1957, and he was succeeded by his elder son, and the Somoza family, with the help of Guardia Nacional, continued to rule Nicaragua for many years. In 1972 an earthquake devastated Managua, levelling over 250 city blocks, killing 6000 people and leaving 300,000 homeless. International aid poured into Nicaragua was diverted to Somozas and their associates.

Decades of right-wing dictatorship followed by an unstable socialist revolution during the 1980s have left the country in a serious economic situation. At present, democracy seems to have secured a stronger position.

3.1.2 Geography and population

Nicaragua, with 130,000 km², is the largest country in Central America. It is bordered on the north by Honduras, on the south by Costa Rica, on the east by the Caribbean Sea, and on the West by the Pacific Ocean. The country has three distinct geographical regions: the Pacific lowlands, the north central mountains, and the Caribbean lowlands.

The Pacific coastal region is a broad, hot, fertile lowland, broken by about 40 volcanoes.

The north- central region, with its high mountains and valleys, is cooler than the Pacific lowlands and also very fertile. About 25% of the country's agriculture takes place here. The highest point in the country, Pico Mogoton (2103 meters) is near the Honduran border.

The Caribbean region occupies about half of Nicaragua's area. It is the widest lowland plain in Central America, averaging around 100 km in width. The 541 km coastline is broken by many large lagoons, river mouths and deltas. The Caribbean region is hot, though not quite as hot as the Pacific side, and it gets an immense rainfall.

There are a number of small islands off the Caribbean coast, surrounded by coral reefs. The largest island, though even they are small, are the Islas del Maiz (Corn Islands)

Government statistics estimate that, in 1991, the population of Nicaragua was almost four million. *Mestizos*, of mixed Spanish and Indian ancestry, form the majority with 77% of the population. Other groups include Spanish and Europeans, 10%; blacks 9% and Indians 4%. The great majority

of the population, around 90%, live in the Pacific lowland belt. The Caribbean region is very sparsely populated; it makes up half the country's land area, but has only 6% of its population.

Even though the country has high population growth, 3.4%, it still has significant agricultural potential. The fertile volcanic soil, and the hot climate with its distinct rainy and dry seasons, make the Pacific lowlands the most productive agricultural area in the country. Coffee, cotton, beef and bananas account for more than 50% of exports.

3.1.3 Economy

Nicaragua is rich in natural resources, but still one of Latin America's poorest countries. Economic deterioration has been dramatic the last 15 years, and its per capita GDP was USD 340 in 1991. The industry in Nicaragua has been mainly import substitution oriented and accounts for 21% of GDP.

Upon launching the economic reform program in early 1992, the Government reached broad consensus on the necessity of structural adjustment to move Nicaragua toward a competitive market economy. The International Development Association (IDA) helped the Government to prepare the structural adjustment program, and in the future the foreign aid programs will play a more active role in restructuring the economy. The period 1993 - 95 is expected to be one of transition from stabilisation to sustainable economic growth for the Nicaraguan economy.

The situation in Nicaragua is, however, still characterised by a permanent political and economical crisis. Donors are now putting heavy pressure on the Nicaraguan government to put an end to political quarrelling and instead enter into a constructive dialogue with the opposition. Concern for human rights, as well as the muddled situation respecting land ownership, has made several countries reluctant to continue providing aid. It seems to some extent at least, that things have changed in Nicaragua, where people now talk of a new political climate. But the question is whether this is enough. 75 percent of Nicaragua's GDP is financed by donors, making Nicaragua one of the most assistant dependent countries in per capita terms. In comparison with its export capacity, Nicaragua is probably the world's most debt ridden country today.



Figure. Map of Nicaragua.

3.2 Water Resources Management in Nicaragua - Present Situation

3.2.1 General Characteristics

Water resources

Nicaragua has an abundance of water resources, however, there is scarcity of good water. The Pacific lowlands is notable for their lakes. Lago de Nicaragua, with a surface of 8200 km², is the largest lake in Central America, and the 10th largest freshwater lake in the world. Its elevation is approximately 32 meters above sea level. Forty-five rivers flow into Lago de Nicaragua. The Rio San Juan, flows from Lago de Nicaragua to the Caribbean, and defines much of the border between Nicaragua and Costa Rica.

Lago de Managua, 640 km² and 37 meters above sea level, is also a large lake with eight rivers flowing into it and one, the Rio Tipitapa, flows from it into Lago de Nicaragua. There are many smaller lakes in volcanic craters.

The Caribbean coastline is broken by many large lagoons, river mouths and deltas. Twenty-three rivers, some of them very big, flow from the central mountains into the Caribbean. One of them is the Rio Coco, 685 km long, Nicaragua's longest river, which forms most of the border between Nicaragua and Honduras. The Rio Grande de Matagalpa, 430 km long, is the second-longest river, with its source near Matagalpa.

Precipitation, the primary source of freshwater, varies a lot between the regions. The Caribbean coastal lowlands have an annual rainfall anywhere between 3300 mm and 6350 mm, whereas the average annual rainfall of the country is in the order of 1000 mm.

There is generally a lack of inventories and long term monitoring programs on Nicaragua's groundwater and surface water resources. Many studies and investigations have been carried out in the major rivers and lakes, however, in the context of water resources management there is a need for long term and reliable hydrologic, hydrogeologic, water quality, and environmental data. This would require a nation-wide monitoring network and long term monitoring programs.

Water pollution

It is evident that heavy water pollution and over-exploitation is prevalent, especially in the densely populated Pacific lowlands. The main sources of pollution in the densely populated areas are:

- untreated sewage
- agriculture runoff
- pesticides
- food processing plants
- industrial waste waters
- heavy metals from different industrial plants (Zn, Pb, Hg)
- solid wastes
- thermal power plants (salts in cooling water)
- cyanide from the mining industry (North coast of the Caribbean Sea)

Many rivers and lakes are heavily polluted from discharge of untreated or insufficiently treated domestic and industrial waste water including agriculture runoff. The water pollution poses severe health hazard for the urban and rural population. The proximity of polluting activities to the drinking water sources and the poor quality of water and sanitation services, are causing a high incidence of water-borne diseases.



Figure. Map of Nicaragua showing the main rivers and lakes.

The water of Lake Managua is of the sodium bicarbonate type, also found in underground and surface runoff. During the last 50 years the lake has received pollution and it is now heavily polluted from agricultural runoff, municipal sewage, industrial discharges, solid waste and

landfills. Seepage from the Volcano Momotombo is also a suspected source of pollution of the lake. The salinity of the water is constantly increasing due to the discharges combined with a high degree of evaporation. The volcanic influence have contributed to enhance salinity and to eutrophication of Lake Managua.

One example of *industrial pollution* is discharge of mercury from a chlor-alkali factory. After the first methyl mercury poisoning events the industrialised countries imposed strict controls for environmental protection. Many industries were moved from industrialised to developing countries, and a chlor-alkali industry was built in Managua. A recent investigation concluded that total mercury levels in the ecosystems related to the lake are very high, and mercury contamination in the lake may be considered as dangerous for human health. The factory is now closed.

So far there has been no systematic monitoring of the pollution loads and the water quality of lakes rivers and groundwater sources in Nicaragua. Such data will serve as important input to Nicaragua's national water strategy and environmental action plans.

Water needs

According to the water sector paper under the new National Environmental Master Plan for Nicaragua, which is under preparation, the overall water requirement for different user categories are as follows:

-	Water supply	5%
-	Industrial demand	2%
-	Irrigation	64%
-	Hydroelectric	19%
-	Total	100%

Although *water supply and sanitation* only accounts for 5% of the water demand, this component has considerable social and economic significance, and health and nutrition indicators reflect the acute problems facing the Nicaraguan poor due to i.a. lack of potable water and sanitation. Infant mortality is 72 per 1,000 live births due largely to diarrhoea and other water borne diseases.

Water supply and sanitation systems coverage in urban areas, and in rural areas in particular, is insufficient. While from 1980 to 1989 coverage in urban areas increased from 67% to 78 %, coverage in rural areas over the same period increased only from 6% to 18%. In the non-covered areas people drink water from the same sources that often are being used as recipient for human wastes. Urban sewerage coverage ranges from 65% in Managua to only 6% in Boaco. In the rural areas only between 9% to 16% of the population have latrines.

Poor piped water quality is also a major health risk, and only a low percentage of the "covered" population consumes chlorinated water.

In terms of quantities the *irrigation* requirement is by far the most water consuming activity in the country. The concentration of salts in Lake Managua limits the possibility of using the water for irrigation. Nicaragua's groundwater resources, especially in the Pacific lowlands, are becoming increasingly important for irrigation and water supply purposes. As surface waters become more polluted the water users turn to groundwater as a source of a cheaper and more appropriate supply.

In developed areas the proximity of the ground water resources to the polluted soil and surface waters prevents the best exploitation of such reservoirs due to the risk of contamination. There are indications of over-exploitation of ground water in the vicinity of San Antonio, and it was claimed that saline water is penetrating into the ground water over a distance of approximately 15 km from the coast.

Other severe agro-impacts on the watersheds are extensive use of pesticides. Pesticides that are banned in developed countries are being used in Nicaragua. In certain areas with ground water supply there are conflicts between drinking water and irrigation interests. For instance consumers contacted by the study team in the San Rafael del Sur area claimed that the ground water table, i.e. the water level in their wells, was constantly decreasing.

The Central American Power Stations, 200 MW and 18 MW respectively, are the two main existing *hydropower* stations in Nicaragua. Both of the stations draw water from the Lago de Apanas, an artificial lake in the Jinotenga Region. This lake is also serving as a source for drinking water schemes in the region.

Viejo hydropower schemes (40 MW and 5 MW) are SIDA funded projects for two new power stations near Sebaca township. A new dam will be constructed in an inter-mountainal valley. This will be an integrated hydropower, irrigation and water supply project.

3.2.2 Water Resources Management Organisations

Presently several ministries, authorities and institutions are responsible for management of water resources. The institutional framework is characterised by a typical sector approach.

There are about 12 - 14 *ministries* involved in water management issues and the most important are:

El Ministerio de Salud (Ministry of Health) (MINSA)

MINSA's role in the water and sanitation sector is to establish, in conjunction with the Nicaraguan Institute for Water and Sewage (INAA), health standards for water quality and preventative interventions such as hygiene education. The ministry is also representing the Nicaraguan office concerning a regional water quality monitoring program.

The Social Investment Fund (FISE) is expected to help to improve the provision of water and sanitation services, particularly in the rural and urban marginal areas. The Pan American Health Organisation (OPS) is also assisting MINSA in implementing water and sanitation programs. At the present there is one integrated health program in Jinotenga region in the border areas to Honduras. The purpose of this project is i.a. to increase coverage of water and sanitation in five communities.

Another example is the Rosita water supply which is an integrated component of the Regional Health Program in the Region Autonoma del Atlantico Norte funded by NORAD.

El Ministerio de Economico y Desarrollo (Ministry of Economics and Development) (MEDE)

MEDE is the ministry responsible for the new Environmental Master Plan which is now under

completion by ECOTRAS, an autonomous body under MEDE. The Environmental Commission of Nicaragua (CONAMOR) is also under MEDE.

Environmental Impact Assessment (EIA) has now become a mandatory exercise prior to all new development projects in Nicaragua. This is regulated by the new "Investment Law" as a result of pressure from the World Bank (WB), the Inter American Development Bank (IDB) and other donors. Along with applications for new loans the banks will check that the environmental issue (EIA) has been properly examined before a new loan agreement can be signed.

Although IRENA would be the natural agency responsible for EIA in connection with new loan applications, it appears that the EIA element of the new investment law is considered to be transferred to the Ministry of Economics and Development (MEDE), as IRENA is not regarded as "powerful enough".

El Ministerio de Agricultura (Ministry of Agriculture) (MAG)

MAG is involved in water management aspects related to agriculture, irrigation and drainage. The ministry is also responsible for the aquaculture sector, both fresh water and marine aquaculture (fish, lobster, shrimps). Management of land is another high priority area of MAG.

At present there is no updated national inventory of agriculture properties which is urgently needed.

MAG has prepared a list of prohibited toxic chemicals (pesticides), however, so far there are no efficient regulations and measures to control the use of such products.

Other ministries responsible for various aspect of water resources management are Ministry of Finance (MOF), Ministry of External Co-operation (MEC), and El Ministerio de Construcción y Transporte (Ministry of Transport and Construction) (MCT).

Executing agencies with water management responsibilities are:

Instituto Nicaraguense de Recursos Naturales y del Ambiente (Institute of Environment and Natural Resources) (IRENA)

The institute is responsible for planning, control, investigations, management and utilisation of natural resources. IRENA has more than 1000 employees, and its network is formed by 26 offices in 16 departments of Nicaragua. However, until recently IRENA has mainly been dealing with forestry aspects mainly due to influence by the SIDA financed forestry programs. The institute also includes a planning group, PAF. IRENA is dependant on international support as approximately 85% of the annual budget is funded by donors.

IRENA shall keep a register of environmental, administrative and legal experts who can support their own staff in resolving issues concerning policy matters and natural resources management.

On the water and environmental sector IRENA has played quite a humble role, and the institute has for example only 2 water pollution experts. There has also been very limited co-operation between IRENA and the Water Research Institute (CIRA), which under normal circumstances would have been a natural partner for IRENA concerning water resources investigations and

monitoring etc.

On the water resources sector IRENA is co-ordinating an action plan for Lake Managua through "Comision Cuenca Del Lago De Managua". This is meant to serve as a demonstration project involving policy matters and strategies for integrated abatement and multipurpose use of the watershed system.

IRENA is also to a limited extent involved on the marine sector and is financing a marine research station.

IRENA has not obtained a ministry status, but upgrading of IRENA to a Ministry of Environment is claimed to be in progress. Nevertheless, there is lack of specific laws and regulations related to use and protection of water resources, and IRENA has not actually been given the administrative, human resources, and legal power to really act as an agency responsible for management of the country's natural resources.

It was explained that as a model for restructuring of IRENA the agency (or ministry) shall be responsible for environmental co-ordination between the ministries. According to this model IRENA shall second environmental officers to work within the different ministries (transport and communication, municipal, agriculture, irrigation, drainage etc.). These officers shall be responsible for the environmental aspects within each ministry, and report to IRENA.

El Instituto Nicaraguense de Aqueductos y Alcantarillados (Nicaraguan Institute for Water and Sewage) (INAA)

INAA is responsible for control and use of water for drinking water purposes including projects to improve the water and sanitation systems in urban, rural and the marginal urban areas. It shall also ensure operation and maintenance management of the systems, including sustainability of investments through cost-recovery.

Although INAA has the mandate to cover water and sanitation development in the entire country it operates principally in the cities. INAA is for instance fully occupied with an IDB-financed project to improve the water systems in 15 cities. The agency has a *Directorate for Rural Water* (DAR) to increase the coverage in the rural areas.

INAA has not been provided with enough resources and formal power to issue and enforce permissions and licenses on the water and sanitation sector.

El Instituto Nicaraguense de Energia (INE)

INE is responsible for regulations in connection with electricity supply, dams and flow control. The institute has its own water laboratory. The Inter American Development Bank (IDB) has requested INE to establish an Environmental Impact Assessment (EIA) section for energy development projects.

El Instituto Nicaraguense de la Pesca (Fisheries Department) (INP)

INP is i.a. responsible for issuing of licenses to fishermen. On the environmental sector INP is involved in the "red tide" (red flagellates) problems in terms of toxicity to clams and filter feeders.

La Comision del Ambiente y Ordenamiento Territorial (CONAMOR)

CONAMOR is an environmental commission under Ministry of Economics and Development (MEDE). The Nicaraguan representative in the Central American Commission for the Environment and Development (CCAD) comes from CONAMOR.

ECOTRAS

ECOTRAS is a autonomous body under MEDE with 7 regular employees and 2 expatriate experts, one of them is a Dane. ECOTRAS is responsible for preparing the water section of the new National Environmental Master Plan which is supported by DANIDA and the World Bank (WB). The report will be submitted 1 July 1993. The master plan will be approved first by the Government of Nicaragua (GON) and then by the World bank (WB). It has not yet been decided which institution/agency shall be responsible for implementation of the National Environmental Master Plan.

Research institutions and universities involved in water related activities are:

Centro para la Investigacion en Recursos Aquaticos de Nicaragua (Water Research Institute) (CIRA)

CIRA is a research unit under the Universidad Autonomada de Nicaragua (UNAN). In the early 1980s the GON decided to establish a basic national facility on water quality. The institute is undertaking water research activities as part of the university system. CIRA has no official commitment towards the government to assist the authorities in monitoring of water resources and water management issues, but the institute offers its services to agencies, organisations, municipalities and industrial clients on paid or free of charge basis. Another task of CIRA is training of experts from Ministry of Health.

In general CIRA's management is cautious about taking on too many contract research or consultancy projects due to the fact that the basic research activities could possibly be given lower priority among the research scientists. On the other hand it is claimed that contract research would bring CIRA closer to executing agencies and the institute would be more involved in the real environmental problems Nicaragua facing.

CIRA is financed over the university budget and the annual personnel budget is approximately USD 500,000. The institute has about 70 employees, 25 administrative and 45 scientists of whom 41 are holding B.Sc. degrees and only 4 are holding M.Sc. degrees. At the present the director is completing his Ph.D. The long term objective is to increase the academic level of CIRA's research staff.

CIRA mainly covers the fields of water chemistry, microbiology, zoology, algae, and isotopic hydrology. The chemical and biological laboratory facilities seemed to be well equipped and operated by a keenly interested staff. There are also activities within the field of environmental technology carried out by teachers and engineering students from the Universidad Nacional de Ingenierra (UNI).

CIRA's analytical laboratory is serving as a reference laboratory for the 5-6 laboratories in

Nicaragua. Inter calibration was initiated for the first time during the preparation of the earlier mentioned new National Environmental Master Plan where the water resources contribution is being prepared by ECOTRAS.

CIRA is receiving assistance from abroad through co-operation agreements with other universities and donations of instruments and equipment from various development co-operation agencies. The most active countries in providing assistance to CIRA are Sweden, Denmark, Holland and USA. CIRA is also co-operating with the International Atomic Energy Agency.

El Instituto Nicaraguense de Estudios Territoriales (INETER)

INETER is dealing with geology, meteorology, but not hydrology. The institute is furnished with a laboratory. The director of INETER is working in the Environmental Master Plan team and make sure that the plan will be an "economic" environmental master plan.

El Instituto Nicaraguense de la Minería (Institute of mining) (INIENE)

Has got a water laboratory

La Universidad Autonomada de Nicaragua (UNAN)

La Universidad Nacional de Ingenieria (UNI)

La Universidad Nacional Agreria

La Universidad Centroamericana

Non-government organisations (NGO):

Organizacion Panamericana del Salud (Pan American Health Organisation) (OPS)

OPS is an international public health agency with more than 85 years experience. The headquarters of OPS is situated in Washington D.C. and the agency has 38 member countries in Central and South America. On the water and sanitation sector the strategy of OPS is to improve coverage and service quality to the poor communities in order to reduce water-borne diseases.

The OPS office in Nicaragua is co-located with the Ministry of Health, MINSA, in Managua.

3.2.3 Human resources

Nicaragua lacks well qualified and experienced professionals in water resources management at all levels. The expertise available locally is limited due to the emigration of professionals in the 1980s to neighbouring countries, as well as low education capacity and few job opportunities. Skill-upgrading will therefore be needed for country policy analysts, planners, scientists, engineers, managers, technicians, economists, lawyers etc.. This enhancement of human resources will be needed to meet the demand for dealing with cross-sectorial analysis, with legal, regulatory, and privatisation issues, and with river basin management, environmental protection, and participatory water resources management in Nicaragua.

The prospective Ministry of Environment, now IRENA, and the co-operating ministries and institutions are suffering from lack of staff capacity within most of the above mentioned categories. Nicaragua will need substantial support from other countries and development agencies to upgrade its own water resources management and implementation capacity within a reasonable period of time.

The same will be the case for CIRA if the institute shall be able to carry out research programs, provide educational assistance, and undertake national water quality monitoring programs.

3.2.4 Assessment of the Water Resources Management System in Nicaragua

General

Water is increasingly a scarce resource in Nicaragua requiring careful economic and environmental management. The situation is made more critical by rapid growth and urbanisation in the country. The demand for water for human and industrial use has escalated, leading to competition for water used by irrigated agriculture in some areas. Inadequate and/or lack of water services results in consumption of poor quality water and causes the high incidence of water-borne infectious diseases.

Public and private investments in Nicaragua seem to have neglected water quality and environmental concerns. In the past the government has misallocated and wasted water, as well as permitted damage to the environment. The main reasons for this mismanagement are to institutional weaknesses, lack of role definition, lack of environmental policies and misguided investments. Water has become one of the most critical factors for social and economic development.

It is important to realise that the environmental aspects of development is primarily determined by a country's own development policy and international conditions. Development aid can never replace national policies, but has an important role to play in conjunction with partner countries' efforts to achieve social and economic development based upon sustainable utilisation of their resources. It is important that Nicaragua itself recognise its responsibility for the environmental problems that are widespread in the country.

A statement made by one of the contact persons is that Nicaragua is a quite chaotic society when it comes to responsibility distribution and decision making in the public administration.

Legislation

The most critical issue for the water sector is the absence of a coherent government strategy, reflecting a lack of strategic objectives, sectorial priorities, institutional capacity, and resource planning.

It is established in Nicaragua's constitution that the State is responsible for protection, conservation, and restoration of the environment and the natural resources. In addition the State is responsible for promoting a harmonic and integrated development within the different regions of the country.

In 1979 a comprehensive law on environment and natural resources was established, however, the law was never properly enforced. Hence, since 1979 there has been a mixed and partly overlapping legal system in Nicaragua concerning rights to utilise the water resources. This system states that

certain water resources is being considered as public property whereas others are being regarded as private property. This phenomena is typical for all Latin American countries as a result of the French legislation in the 19th century dominated by privatisation tendencies. The legislation has been more concerned about protecting the private rights rather than protection and promoting the balanced use of water resources. This has to do with the problems surrounding ownership of land and the traditional rights to exploit natural resources including water.

The laws have not to date included specific clauses that open for legal actions to enforce water resources management measures. It has been announced that a new water law similar to the ones in Costa Rica and Guatemala, is coming up and is planned to be passed in the Congress.

Institutional framework

The present administrative structure is typically a centralised system i.e. management from ministry level, as the regional structure is not existing any more. Furthermore the lack of a water law and operational regulations leave the environmental authorities with too limited power to execute sound planning and real control of the water resources.

Strengthening and upgrading of IRENA to a Ministry of Environment is another action to be taken to achieve more efficient management of water resources.

In the longer term, a decentralisation of management responsibilities to department level and municipality level needs to be defined. At the moment the environmental offices of the municipalities have the power to deal with local environmental issues, and even the possibility to establish own guidelines on these matters. Another aspect that should be dealt with through the municipality network is information and campaigns and school teaching to improve public awareness related to environmental issues.

The sustainability of water and sanitation services in urban areas is hampered by major water losses and consequently reduced revenues, which are crucial for operation and maintenance. The system for meter reading, billing, and collection of water and sewage revenues is inadequate and according to figures prepared for the new National Environmental Master Plan the present tariff structure is inadequate to meet the running costs. Hence, the construction and operation of water and sewage facilities will have to rely on external donors.

Main issues in water supply include the need to improve coverage and service quality, particularly in rural areas, the poor sustainability of investments due to inadequate cost-recovery, and the lack of definitions of roles of the Nicaraguan Institute for Water and Sewage (INAA), Ministry of Health (MOH), municipalities, and communities for the provision of water and sanitation services.

The master plan shall be approved by the Government of Nicaragua (GON) prior to the approval by the World Bank (WB). It has not yet been decided which institution/agency shall be responsible for implementation of the National Environmental Master Plan.

One of the main constraints in establishing a national water management system is the lack of an inventory of the nation's surface and ground water resources and an operational monitoring network. Furthermore the domestic research and development capacity needs to be upgraded. One option would be that CIRA was given a stronger commitment towards the government regarding applied research on water management issues and being upgraded accordingly. CIRA should also be given the task of building up a network of laboratories and execution of a nation-wide monitoring program and data base on water quality.

3.3 Need for Technical Assistance

Nicaragua is probably the country in Central America that will need longest time to develop, hence all co-operation must have long term perspective.

The proposed "needs" for technical assistance given in this chapter should be considered as immediate outline ideas from the mission.

Title: **Technical Assistance to the Institute of Environment and Natural Resources (IRENA)**

Justification: IRENA needs to upgrade its professional staff and increase its capacity to meet the requirements as a possible new Ministry of Environment.

Objective: During a transition period IRENA will be dependent on international support in order to restructure and strengthen the organisation.

Scope: Secondment of expatriate expertise on water resources management to assist IRENA by on-the-job training of key personnel under technical assistance programs for periods of 0.5 to 2 years.

Title: **Technical Assistance to the Institute for Water Research (CIRA)**

Justification: CIRA needs skill-upgrading if the institute shall be able to carry out research programs, provide educational assistance, and undertake national water quality monitoring programs.

Objective: Provide skill-upgrading to CIRA and strengthening of the institute's capabilities.

Scope: Research co-operation, scholarship programs, provision of instruments and technical equipment, and exchange of scientists with similar expatriate institutions. To be co-ordinated with CIRA's other co-operation agreements.

Title: **Monitoring and Assessment of the Marine Environment**

Justification: There is a need to strengthen the management of the fishery and marine aquaculture sector in Nicaragua. The state of the marine environment has not been investigated. Red tides occur periodically and due to the low level of treatment, severe local, as well as regional water quality effects can be expected. A baseline study followed by a systematic and comprehensive monitoring program for marine water quality, hydrography, and biology should be established.

Objective: Develop a comprehensive monitoring program for marine waters to facilitate coastal zone management.

Scope: The baseline study and monitoring program should include chemical and biological components, studies on effects of contamination on biota, as well as hydrographic studies. In addition to designing the program appropriate institutions

should be given the responsibility of implementing the program and introducing the management system to the institution responsible for its future management.

3.4 International Assistance to Nicaragua

Norwegian co-operation

The overarching objective of the *bi-lateral* Norwegian assistance to Nicaragua is to contribute to sustainable economical growth and development by supporting country efforts to reduce poverty and consolidate the democracy. Norway's policy is also to support Nicaragua in implementation of the structural adjustment program. In general Norway has based the co-operation on use of consultants and volunteers, and not on NORAD experts as in other countries. At present the main sectors of the Norwegian bi-lateral co-operation are:

- Agriculture
- Commodity assistance
- Import support
- Fisheries including stock assessment, fish processing and freezing plants, harbours
- Oil exploitation

Among projects related to the water and sanitation sector can be mentioned:

- Water supply and sanitation at Corn Island. Big Corn Island (with an area of 10 km² and a population of about 6000) discharges sewage and other wastes into the soil and the surrounding seawater. A NORAD funded survey of the huge aquifer on Big Corn Island revealed that groundwater resources are contaminated by nutrients originating from human wastes and two seafood plants. In response to the findings from this survey IRENA proposed a project entitled "Development Strategy for Protecting the Corn Island Reef Systems and the Islands Drinking Water Supplies". Realising the importance of establishing a protection strategy NORAD agreed to finance the project. The proposed management strategy has a two-fold purpose:
 - protection of the island's vulnerable water supply sources
 - safeguard the reefs on Big Corn Island and Little Corn Island

The plan suggests various physical measures and behaviour restrictions being implemented and enforced on the islands. However, the responsibilities for enforcement and execution of the plan and the financial aspects still remains to be settled.

- Rosita water supply is an integrated component of the Regional Health Program in the Region Autonoma del Atlantico Norte. The project is financed by NORAD and executed by MINSA (Ministry of Health) assisted by OPS (Pan American Health Organisation)

An example of EIA of Norwegian projects before implementation is a proposed slaughterhouse project that was supposed to be financed by NORAD. An initial EIA carried out by a Norwegian consultancy company concluded that the project could be implemented with acceptable environmental impacts. However, a second EIA, which was undertaken by a local consultancy company stated, that the environmental effects were too serious to recommend the project, and the project was stopped.

Norway's bi-lateral support to Nicaragua in 1993 is totalling approximately NOK 70 million.

A new strategy for NORADs co-operation with Nicaragua is now under preparation, and adjustments in priority sectors can be expected. The water sector is not on the proposed priority list.

The total Norwegian *regional assistance* to Nicaragua outside the country program, is around NOK 200 million in 1993, which is actually more than what is being allocated under the country agreement. The regional support has to a large extent become co-ordinated donor efforts between the Nordic countries. The main areas for the regional support to Central America are environment, energy, research, health, agriculture, and refugees.

Co-operation with other donors on the water sector

Among other co-operation programs on the water sector can be mentioned an urban water and sewer system rehabilitation program. The program is funded by IDB loans of 47 mill USD with co-financing of 6.4 mill USD from the Nordic Development Fund (NDF), and 5 mill USD from the Association of Oil Producing Countries (OPEC). The executing agency is INAA.

The loans will improve the quality of water and sewage services in the city of Managua and in 27 localities in the interior and will strengthen the INAA's efforts to achieve financial self-sufficiency. They will also make possible the preparation of designs of future investments in the urban sector and the expansion of the Managua sewerage system. The operation will provide financing for the rehabilitation of water services in the Managua area, which encompasses 50 percent of Nicaragua's urban population and 30 percent of the country's inhabitants overall. The current water supply systems in Managua, as well as in the interior cities, have deteriorated quickly and the water treatment plants are sporadically maintained. Studies financed through the program will update Managua's comprehensive plan for sewerage including collection, treatment, and proper disposal of the effluent and will be used to establish a priority ranking methodology for the national water and sewerage systems in urban areas.

The first symposium concerning protection of water resources was held in Managua in September 1992. The initiative was taken by Center for International Technological and Educational Co-operation Unit (CITEC) at the Royal Institute of Technology (KTH), Sweden. CITEC's involvement in "Sustainable Use of Water Resources" (SuWaR) comprises programs in various countries. The symposium, which was sponsored by SIDA, was arranged in co-operation with several Nicaraguan institutions.

DANIDA is an important agency on the water sector and there is presently a fact finding mission at IRENA looking for project possibilities within the water sector. DANIDA is also sponsoring the National Environmental Master Plan regarding preparation of input on the fresh water and marine side. SIDA is contributing on the forestry issue in the same plan.

The Japanese are conducting a two-year hydrological mapping program including a baseline study in the south western part of the country. The assistance also includes ground water protection measures, for instance the influence of pesticides.

The mission was also told that IDB and WB are also looking for projects on the water sector and it seemed to be a certain competition between the international agencies on this sector.

4. Water Resources Management in Central-America

4.1 Introduction

The region of Central-America has high annual precipitation and as such the amount of water available for human consumption and use is generally great. However, due to changes in the natural runoff cycle, deforestation and other environmental changes some parts of the region are facing water scarcity.

In the region 12 million people are deprived without access to safe water supply and sanitation. During the international water supply and sanitation decade the level of coverage increased somewhat, however, the statistics are highly unreliable in the region. 70% of the population live in urban areas.

The region has been notorious for political unrest, human rights violations, civil wars etc. the last decades. The processes of peace and democracy are beginning to consolidate themselves currently. At the same time, Central America is confronting an economic and environmental crisis that, if not reverted, may endanger not only these processes but also the opportunities for the future generations of Central Americans to attain sustainable development. In the past decade, there was a negative transfer of capital, as the region received US\$ 13 billion in loan disbursements and paid US\$ 17 billion in debt services.

The system for water resources management in the Central American countries is inappropriate and all countries lack efficient environmental legislation. Environmental legislation is needed to provide the framework for effective environmental management. However, effective laws are not enough. The crucial part is strengthening of institutions responsible for enforcement.

4.2 Regional Co-operation in the Field of Environment

In 1989, the Presidents of the Republics of Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua met to discuss the need to establish regional mechanisms for co-operation to promote the wise use of natural resources, the control of pollution and the recovery of the ecological balance. As a result of this summit the Presidents agreed on a Central American agreement for the protection of the environment which called for the establishment of the **Central American Commission for the Environment and Development (CCAD)**.

The agreement states several objectives related to the protection of the environment. The responsibility of the Commission (CCAD) is stated in the agreement as follows:

- a. To formulate strategies to promote the environmentally sustainable development of the countries of the region;
- b. To prepare an action plan for the implementation of these strategies;
- c. The approval of internal, financial and administrative regulations necessary for its operations;
- d. Organising and directing a Secretariat and the oversight of the Fund established by the Agreement; and

- e. To designate the President of the Commission, who will be its legal representative.

The secretariat is located in Guatemala. The establishment of the secretariat was made able by financial grants from the USA (AID/ROCAP). International donors, mostly the USA, Canada and the Nordic countries, have provided the financial means to the secretariat. So far the member countries have not put up any major funds for CCAD, however, Guatemala has pledged a support of US\$ 50,000 for 1993.

CCAD has encouraged the creation and strengthening of national environmental and developmental agencies (CONAMAs) in each member country. The agencies differ in size and their influence on the country's environmental policy differs. Of other achievements of relevance can be mentioned, inter alia:

- o CCAD participated and endorsed the Tropical Forest Action Plan for Central America.
- o A "Debt-for-Nature-Swap" project has been prepared.
- o The presidents of the region have signed the Central American Convention on Biodiversity and the Central American Convention on Toxic Wastes, which are now in progress of ratification.
- o CCAD prepared the "Central American Agenda for Development and Environment" which was approved in 1992. The agenda was submitted to UNCED.

4.3 Central American Agenda for Development and Environment

The Agenda was approved by the Commission at its eight meeting in Belize in February 1992. The priorities highlighted in the document are:

- i. To promote environmental legislation, to strengthen the National Commissions on the Environment and Development (CONAMAs), to ensure future financing of their activities through the creation of a Regional Fund for the Environment and Development;
- ii. To strengthen regional co-operation in relation to environment and development;
- iii. To protect natural resources and to foster education and training at all levels. As short term activities to be undertaken, two priority subjects were identified in the document: the preservation and rational management of forests and of water resources.

The Agenda contains few proposed actions in the field of water, however, several of the proposed actions involve actions within the water sector. The key actions related to water are:

A5. Health:

- o Conserve, improve and control water resources, with emphasis on water quality, adopting standards of residual water discharge and water quality indicators, standardising and legalising their application throughout the region.

B1. Environmental Management:

- o Promote the analysis and restructuring of institutions in charge of development planning so they can effectively include environmental management in the planning processes.
- o Plan and control environmental quality in urban centres of the region.
- o Promote programs for the management and development of border watersheds between countries of the region, that include reforestation, protection and natural resource conservation programs.
- o Promote programs for the management of coastal and ocean resources.
- o Propitiate the establishment of monitoring and control systems for urban environmental conditions and for environmental contingencies/emergencies.
- o Establish an integrated technical team that will analyse the environmental pollution problem of the region and propose prevention and mitigation measures.
- o Formulate a financial strategy to support the development of pollution prevention, mitigation and control programs.

B2. Environmental Law and Legislation:

- o Legislate to prevent the destruction of the region's cultural and natural patrimony.
- o Promulgate laws that make environmental impact assessments obligatory, according to the needs of each country.
- o Propitiate training and education in environmental law and assistance.

In addition several other proposed actions deals indirectly with water.

4.4 CCADs Proposal to the Nordic Countries

CCAD was requested to make a proposal for future support from the Nordic countries along the lines of the results of "Ecology for Growth" which is a report experts of the International Aid Agencies of the Nordic Countries prepared in 1991. The proposal consists of six programs:

- a. Environmental education
 - Formal environmental education
 - Informal environmental education
- b. Environmental information
- c. Inclusion of environmental costs in the National Accounts
- d. Strengthening environmental management in the region
- e. Creation of an Endowment Fund
- f. Creation of a Contingency fund to finance consultancy studies.

The total amount requested is US \$3.5 million over five years. The Nordic Aid Agencies has undertaken a joint appraisal of the proposal. The appraisal report requests more information and further elaboration of several of the proposed programs, however, most of the programs will most likely be given support. The Nordic Agencies are in principle positive to increase their support to

CCAD as from 1993.

The Nordic Agencies consider it important to strengthen the different CONAMAs. A clear strategy for strengthening the CONAMAs as well as a proposal to support environmental legislation and enforcement is welcomed and should be elaborated by CCAD.

4.5 Regional Water Resources Management Program

CCAD has given priority to biodiversity and freshwater issues in the Environmental Agenda. The Norwegian Government sponsored a regional seminar on the UNCED process with special emphasis on freshwater resources and biodiversity issues in Guatemala City in January 1992. The report of the seminar is included in Annex II. As a follow-up to this seminar CCAD has proposed to launch a regional water resources management program. This program calls for elaboration of a regional strategy plan and national action plans.

Based on the review of the water resources management sector it can be concluded that most countries in the region are struggling with the same water resources management problems. All countries seem to lack Water Laws and subsequently complete lack of enforcement. The knowledge about the resource is limited and pollution problems are increasing. Due to lack of resources and comparable setting, regional co-operation seems feasible and efficient. However, a regional strategy must be based on national strategies. A regional strategy must be linked to the various national strategy to facilitate implementation. A regional strategy is especially important in the case of shared water resources (transboundary water courses). The demand for co-ordinated and integrated management of water resources at a regional level will increase with increasing competing demands and lack of resources to serve the needs of the urban population.

The problems of freshwater availability and quality are intimately linked to broader environmental concerns and that they should not be viewed independently. Combining then requires a conceptual framework which facilitates and inter-disciplinary and inter-sectoral approach.

Water resources management comprises the totality of tasks required to produce water and water related goods and services. Such tasks include planning and analysis, research, monitoring, direct production of water, provision of information, issuing regulations and standards and assessment of available resources. The ultimate objective of water resources management is optimal socio-economic development and maximisation of societal well-being. Water resources management aims to develop and utilise water resources in an efficient, environmentally sound, economically sustainable and equitable manner to satisfy the demand of society for water and water-related goods and services.

In the long term interests of the region, aquatic systems must be environmentally sustainable. This would include, inter alia;

- (i) ensuring continued water availability for environmental needs, i.e. for nature conservation in parks, for instream flows to preserve fish habitat, for maintaining good water quality and shoreline stability in estuaries and lakes, and for forestry and other long-term crops that support wildlife. Water demands for such needs must be included in the overall projections of future water demand;

- (ii) including environmental assessments in planning procedures for water resource investments, for changes in the operation of existing facilities, and for implementing environmental protection measures. Projects must seek to consider the environment as a potential benefit or cost.

Economic development is being driven by the need to catch up with the past and to prepare for the future. Issues in water planning for the future are the anticipated population growth rate, the changing demographic distribution of the human populations of Central America, and the changes in land use that some areas are experiencing.

Realising doubling times of less than twenty years in some areas, population pressures on water resources are bound to increase in intensity. The impact of population growth on water systems is aggravated by increased intensity of urban/industrial and irrigation water use and the associated deterioration of water quality.

In preparation for Central America's era of water scarcity, two important factors must be taken into account. First, there is merit in attempting to adapt water project thinking to the specific climatological, hydrological and water demand/supply circumstances in the region, rather than mechanically using methodologies from temperate zones.

As there are limits to how much water supplies can be increased in Central America or how practical or economically justifiable it would be to do so, it is at least as important to devise ways for the societies of the future to live within their means, i.e. within the sustainable bounds of resource availability. This implies that attention should be paid to the management of demand for water, as to enhancements of supplies themselves.

This requires a shift from planning to meet unconstrained demands to planning to constrain demands when resources are scarce. Constraints can be economic, through pricing or penalties for excess use during drought, or they may be environmental, through crop management and land use.

The second important factor in future water planning will be the need for comprehensive strategies on a trans-national integrated basis, including all major river basins and countries in the region. Present water developments show that the future of water in the region lies in the direction of interdependency. This means that no part of Central America should be left out; all the players and geographical areas that are relevant politically, economically, or hydrologically, should be included in the analytical framework for regional initiatives affecting water resources.

Objectives of the study

The overall objectives of the study are:

- (i) to identify key issues to be addressed, and actions to be taken, to promote the development of regional environmentally and economically sound strategies for managing the water resources in the future;
- (ii) to promote the awareness of issues relating to water development and management among decision makers and senior water management staff in the region;
- (iii) to ensure that projects and programs are designed and co-ordinated with the regional river

systems so that they will contribute to an sustainable distribution of the region's water resources, and not reduce the water available for environmental needs to unsustainable levels;

- (iv) to develop a project evaluation framework that CCAD member countries and international donors can use for evaluation of proposed projects in the region.

To reach the objectives of the study quite extensive data are needed. However, the study will be based on an analysis and evaluation of existing data - new base data are not expected to be collected during this study. The study will identify gaps in existing data and propose collection of data as follow-up projects.

The study, together with subsequent studies and actions, would constitute steps towards identifying possible multilateral and/or bilateral agreements that will contribute towards sound long-term water management in the Central America region.

Key Questions the Study Should Address

Based on a structural and comprehensive review of the features of the water resources in the region, the study shall identify key issues and actions to be taken to answer the following key questions (data from existing projects/programs shall be used to the largest extent possible):

Water Consumption and Managing the Demands

- What factors determine the actual consumption of water, such as biomass production, population growth, pricing, environmental preservation, hydrologic variability, economic development policies, sector policies that will affect future demands, etc., under current and possible future land use practices?
- What is the present and future consumptive and non-consumptive sectoral water demand per hydrologic unit and per country? What water quality is required for these uses?
- What type of planning framework is needed to steer water demands, and related demands on the environment, towards long-term goals?

Water Sources

- What is the current availability of water from different sources in each hydrologic unit and in total for the region? How can the availability be increased?
- What effects will changing land use patterns in the region have on water availability?
- What type of planning framework is needed to steer water projects, and related projects, towards long-term goals?

Reconciling Water Demand and Supply

- What are the environmental and social consequences of exploiting various sources of

supply to meet various demands?

- What are the barriers to moving water into the most productive sectors of the economy and between basins - physical, financial, institutional?
- How can integrated land and water management serve future water needs and maintain or enhance water quality at environmentally sound levels?
- How could the existing environmental institutions in the region contribute more to the economically and environmentally sound reconciliation of water demand and supply? What resources would be needed to enhance their role in future water management?
- How can appropriate mechanisms be developed to facilitate regionally responsible development of river basin resources?
- Are the current pricing and tariff policies optimal? How can pricing of water lead to conservation and recycling of water?
- How can new economic instruments be used to facilitate environmentally sound management of water resources?
- How can the capabilities of scientific resources in the region be focused and strengthened for water management?

This regional study should be accompanied by preparation of national action plans. The national plans should be based on the regional plan (provides a planning framework) and the national plans will provide input to the regional plan. This implies that the planning efforts in each country have to co-ordinated with the efforts made by CCAD.

It is conceived that preparation of a regional strategy plan should be phased. The proposed phases are:

1. Elaboration of detailed terms of reference (TOR) for the regional study and for the national studies.
2. Preparation of the Regional Strategy Plan and National Action Plans.
3. Implementation of recommended projects.

Phase 1 will involve the following tasks:

1. Solicit support from the member countries' National Commissions for Environment (CONAMOs).
2. Identify the key water resources management and development problems facing each member country.
3. Undertake an initial assessment of the administrative and legal framework for water resources management.
4. Assess the capacity and capability of local and regional scientific institutions, NGO's and consultants.

5. Prepare TOR for the regional study.
6. Prepare TOR for the national studies.
7. Propose a work schedule and budget for the studies.

The study should be executed by CCAD. CCAD has few resources. International funding is a prerequisite for implementation of the study. To the extent possible local expertise should be utilised, however, international experts should be contracted to develop terms of reference.

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ISBN-82-577-2349-5