Station (Elevation in m)	Annual Rainfall (mm)	Temp.(°C) Av. Max. Min.	Temp.(°C) Max. in month	Temp.(°C) Min. in month
INSIVUMEH, Guatemala (1,502m)	1,200	18.3 24.4 14.0	19.8 (Apr.)	16.5 (Dec.)
Sta. Cruz, Balanyá, Chimaltenango (2,080 m)	970	16.3 22.6 9.5	17.8 (May)	14.4 (Jan.)
Labor Ovalle, Quetzaltenango (2,380 m)	840	13.3 21.7 5.8	14.7 (May)	11.0 (Jan.)
San Jerónimo, Quetzaltenango (1,000 m)	3,842	22.9 27.7 18.0	28.5 (Apr.)	16.5 (Jan.)

2.1.5 Land Use

The present land use conditions were analyzed for development of groundwater in the Central Plateau Area.

A land use map covering the entire Study Area was prepared based on data and maps (1:500,000) provided by IGN (National Geographical Institute), and field surveys carried out by the Study Team.

The total land area (Study Area) is estimated at 8,643 km², and is divided into the Departments of Guatemala (2,126 km²), Chimaltenango (1,979 km²), Sololá (1,092 km²), Totonicapán (1,030 km²), Sacatepéquez (465 km²) and Quetzaltenango (1,951 km²).

Land use is classified into the following five major categories:

* Cultivated lands - consist of cultivated and agricultural land;
* Pasture and shrubs - include pasture, shrub and bush lands;
* Forest land - forests, include dense vegetation and sporadic forests;
* Wetlands - consist of lakes, ponds, swamps, marshes, etc.;
* Others - consist of sandy and rocky areas.

As observed on the present land use map (Fig, 2.1.6), cultivated lands predominate in the Study Area (39.2%), followed by pastures and shrubs (37.9%). The Department of

Guatemala holds 38% of the total percentage of cultivated lands in the Study Area, while Chimaltenango holds 27.9% of the pastures and shrub land.

The major categories of land use in each Department are detailed in Table 2.1.1.

This table shows that 77.1% of the Study Area is made up of pasture and shrub lands, indicating that many of the inhabitants are essentially involved in agricultural activities and, to a lesser extent, livestock.

Due to the unavailability of land use data at municipal level, a detailed classification of land use could not be worked out. The general land use condition was therefore assumed and described below.

The land use pattern in most of the surveyed municipalities (49) are similar, except for those located near Guatemala City, such as Mixco, Villa Nueva, Santa Catarina Pinula (the most urbanized areas of the Study Area, culturally and socioeconomically interwoven with the metropolitan area) and portions of the municipalities of Villa Canales, Fraijanes and Chinautla. Cultivated lands extend widely into other municipalities.

Municipal towns are basically characterized by a "plaza" along with churches and public offices, and are surrounded by commercial stores in low colonial style buildings. Many villages are spread sporadically around the town proper.

Principally, the municipalities are surrounded with agricultural lands (mini-farms) and pasture or shrubs.

As for the land use characteristics around the municipal towns of San Juan Sacatepéquez and San Pedro Sacatepéquez in the Department of Guatemala, agriculture, especially horticulture, is predominant.

The surrounding areas of Almolonga in Quetzaltenango are the most productive vegetable growing areas. The crops are sent to more profitable markets in Guatemala City, or exported.

Coffee, another valuable product, is cultivated in large plantations around the municipalities of Colomba, Flores Costa Cuca and Génova.

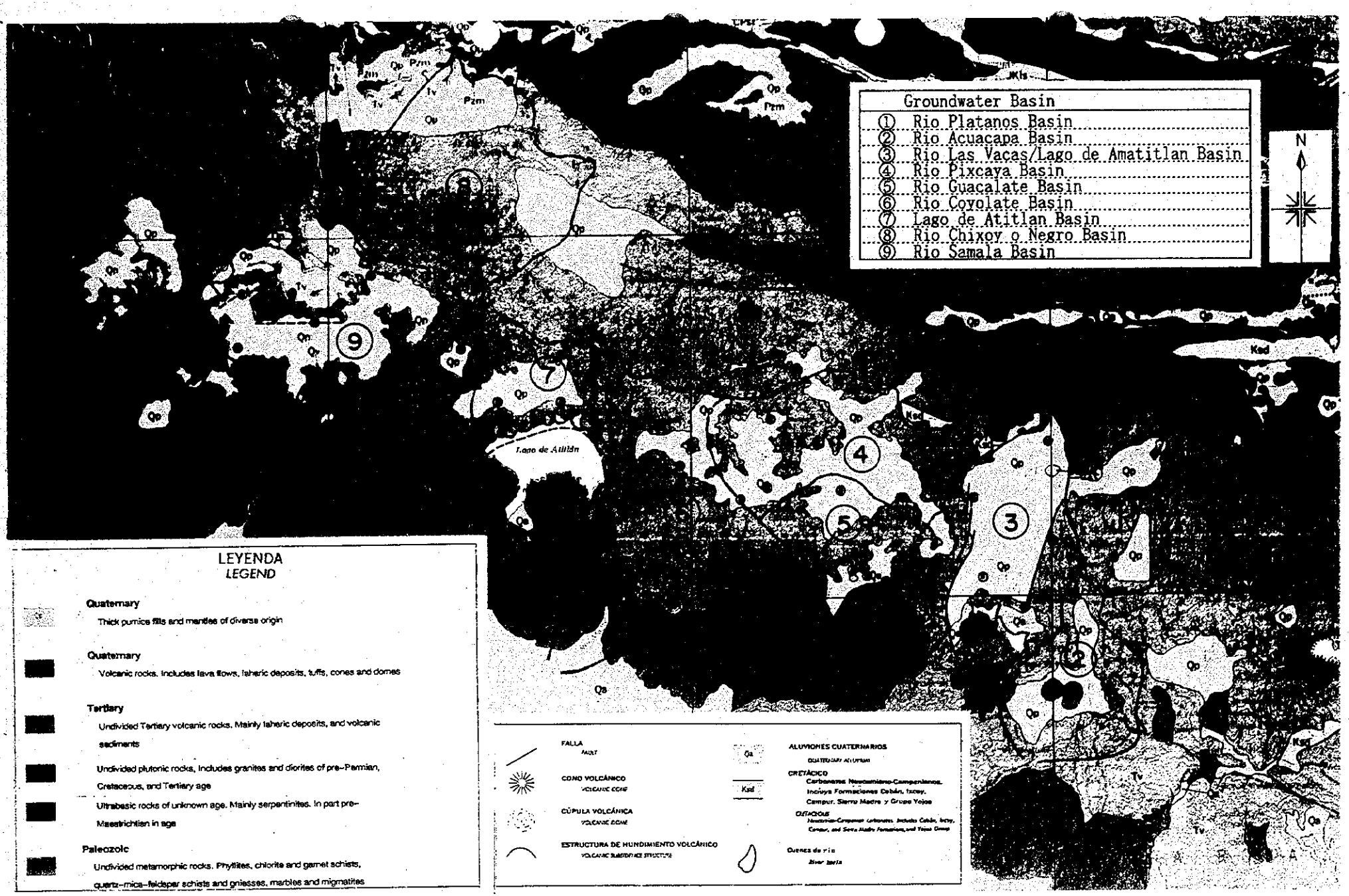
The high and steep slopes constrain the expansion of agriculture in areas like Huitán, Palestina de los Altos, Santa Catarina Ixtahuacán etc., where only small farms exist.

The total urbanization of most of the towns in the Study Area is not possible due to geographic influences; mountain ranges predominate the Study Area topography. However, owing to tradition, the people of the Central Plateau Area

continue to expand their cultivated areas.

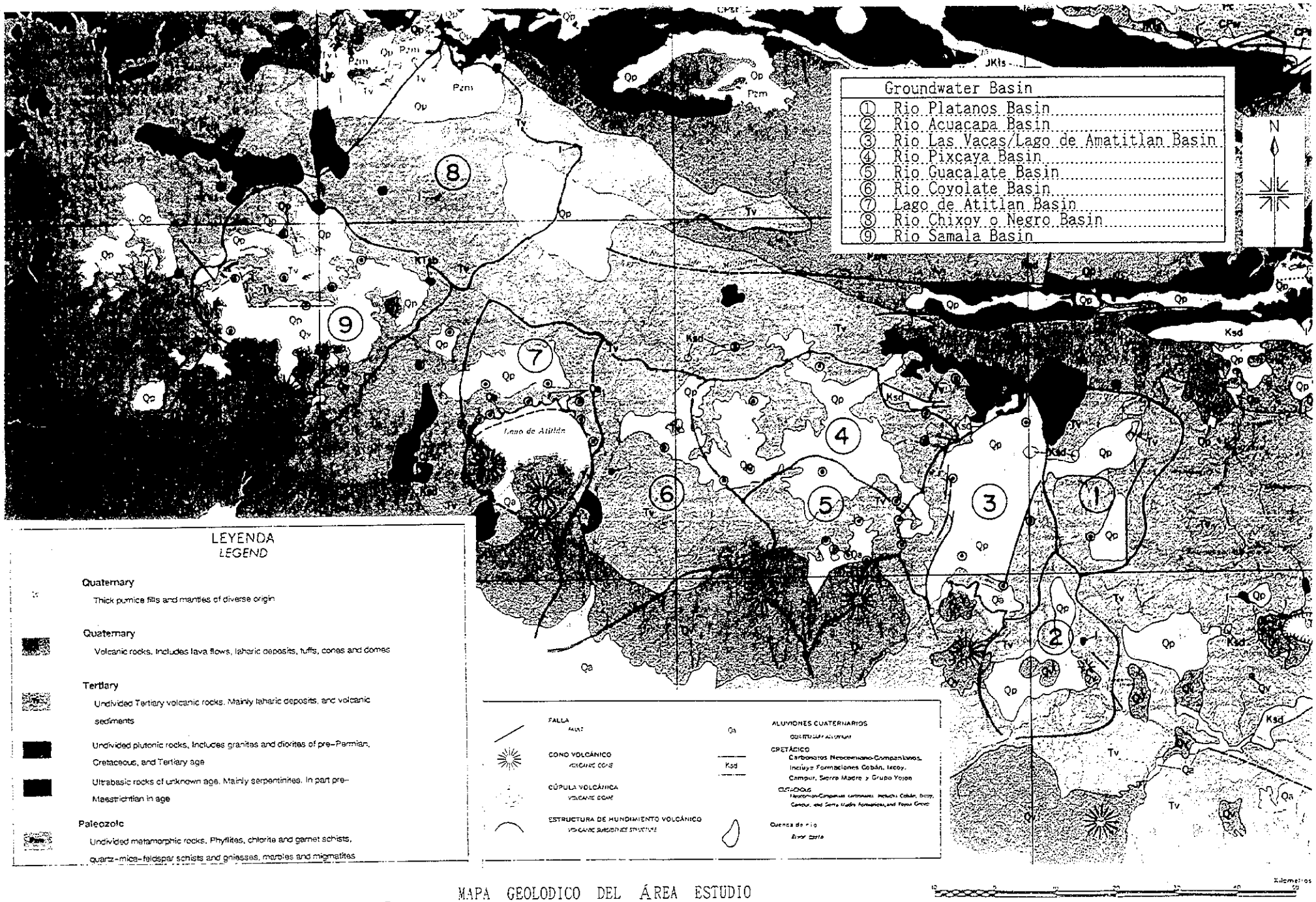
Table 2.1.1 Land use

Department	Cultivated Area		Pasture and Shrub Area		Forest Area		Wetland Area		Others		Total km²
	km²	%	km²	%	km²	%	km²	%	km²	%	
Guatemala	1,285	38.0	707	21.6	19	1.2	115	40.4	–	–	2,126
Sacatepéquez	134	3.9	266	8.1	65	4.0	–	–	–	–	465
Chimaltenango	520	15.4	915	27.9	522	32.4	–	–	22	24.4	1,979
Sololá	481	14.2	135	4.1	276	17.1	167	58.6	33	36.7	1,092
Totonicapán	348	10.3	454	13.9	228	14.2	–	–	–	–	1.030
Quetzaltenango	615	18.2	797	24.4	501	31.1	3	1.0	35	38.9	1.951
Total	3,383	100.0	3,274	100.0	1,611	100.0	285	100.0	90	100.0	8,643
%	39.2		37.9		18.6		3.3		1.0		100.0



MAPA GEOLODICO DEL ÁREA ESTUDIO

Fig. 2.1.1 **Geological Map in the Study Area**



MAPA GEOLODICO DEL ÁREA ESTUDIO

Fig. 2.1.1 Geological Map in the Study Area

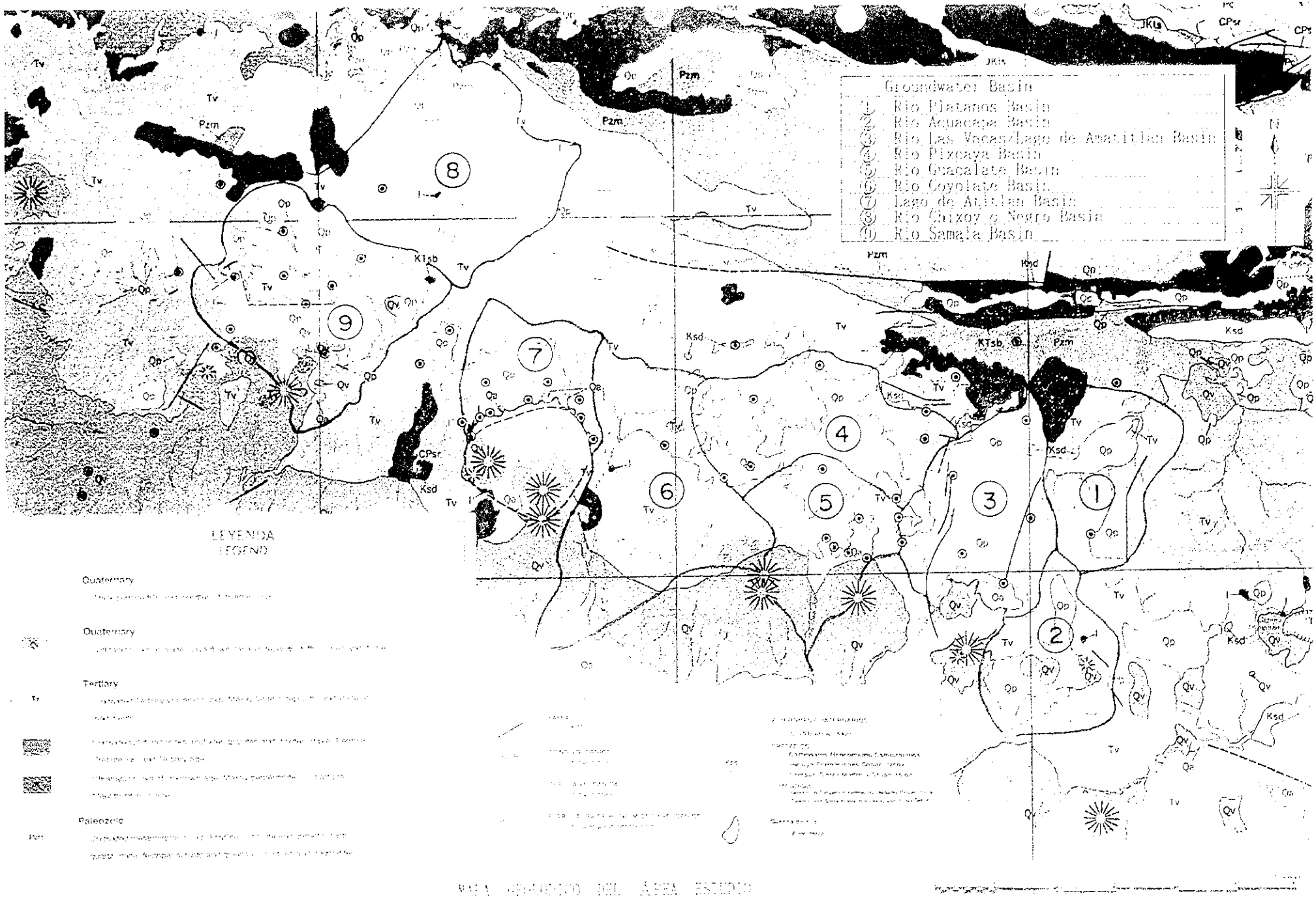


Fig. 2.1.1 Geological Map in the Study Area

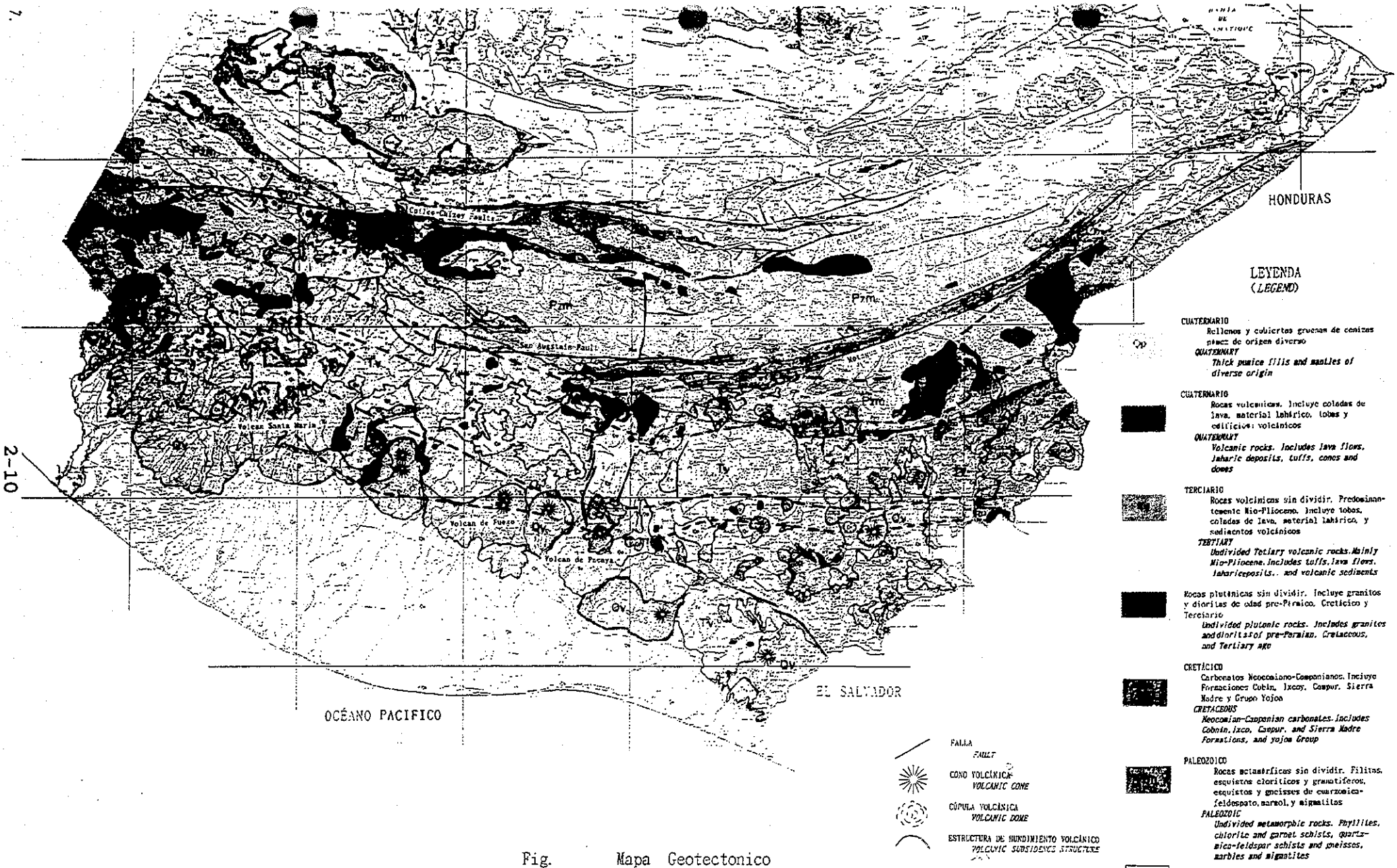


Fig. Mapa Geotectonico

Fig. 2.1.2 **Geotectonic Map**

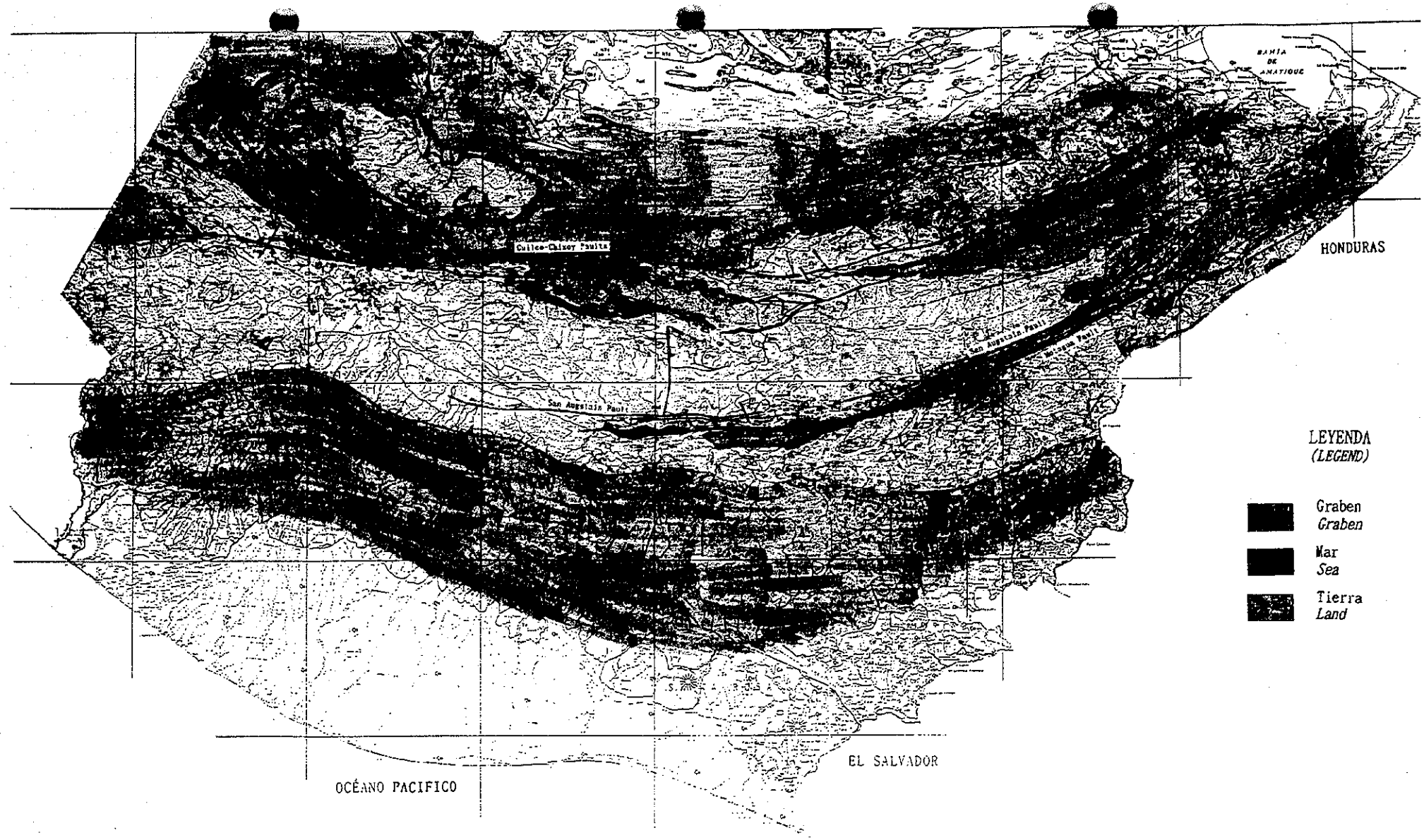


Fig. Mapa Paleogeográfico (Cretáceo Temprano)
Fig. 2.1.3 **Palaeogeographical Map** (Early Cretaceous)

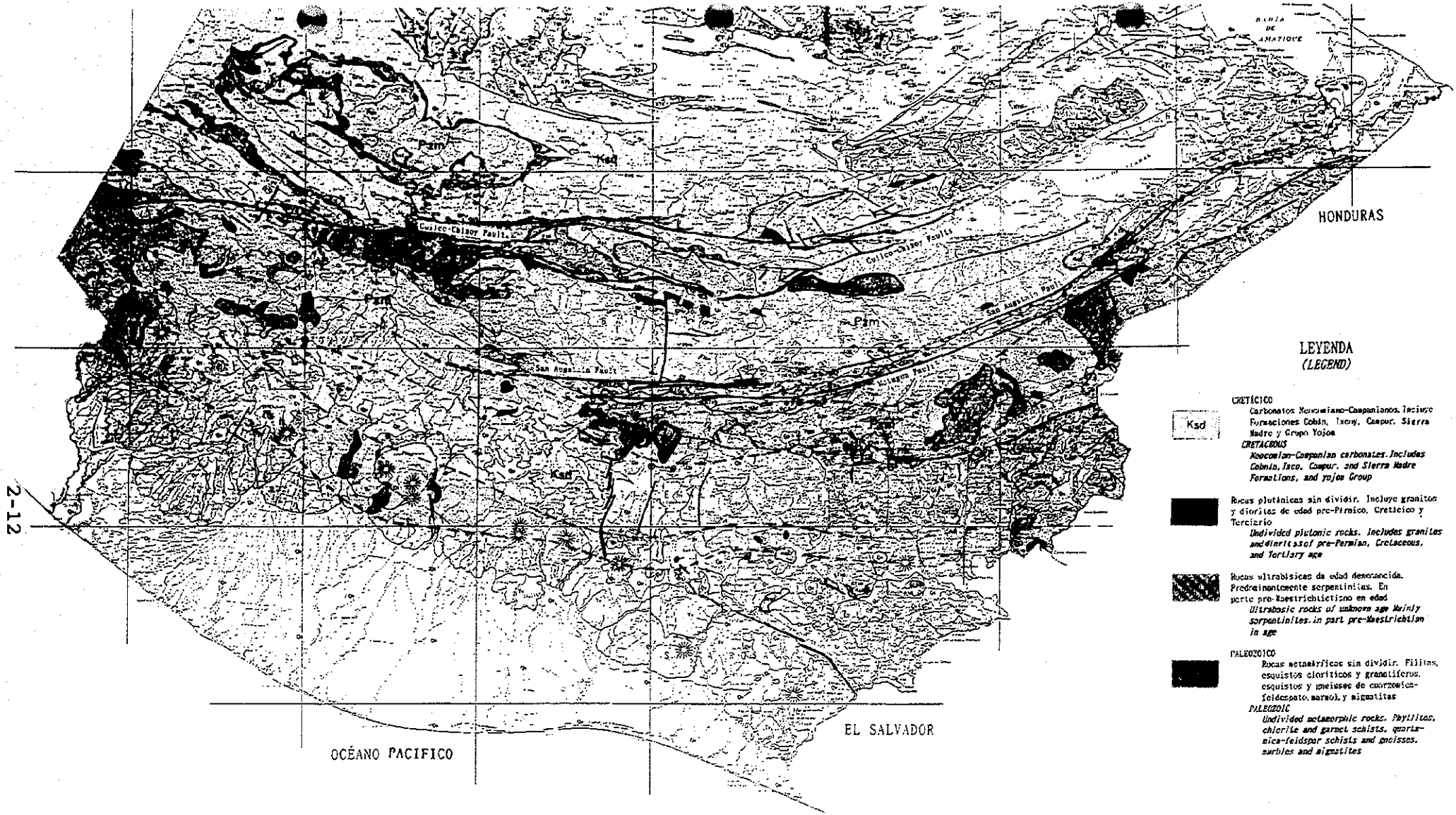


Fig. Mapa Paleogeol ó gico (Cretaceo Tardio-Paleoceno)

Fig. 2.1.4 Palaeogeologic Map (Late Cretaceous-Palaeocene)

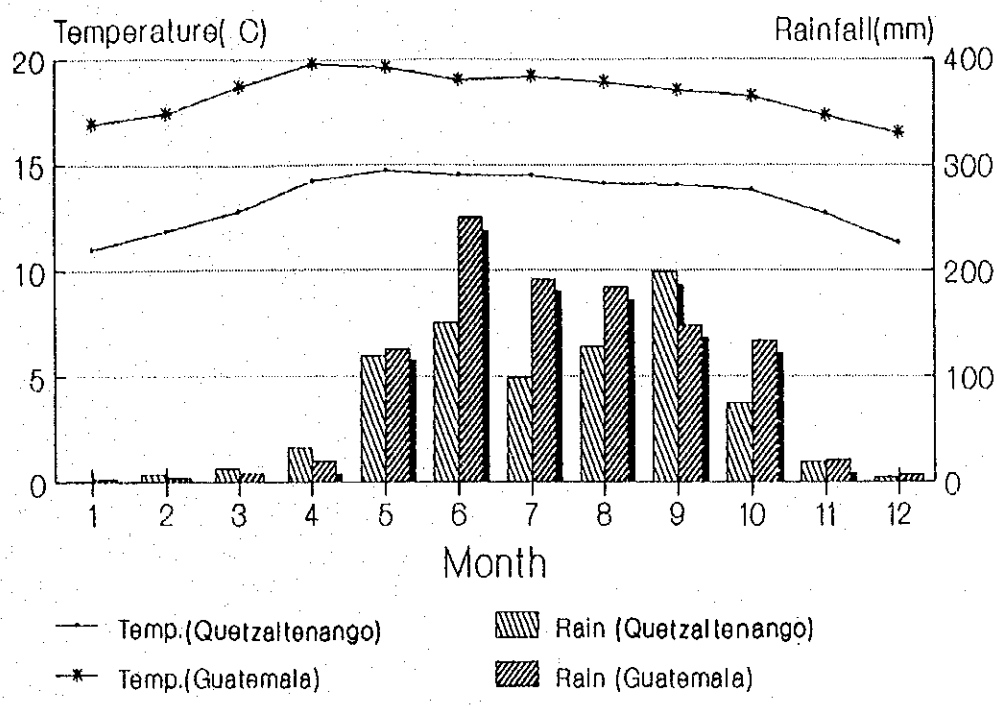


Fig. 2.1.5 Monthly Rainfall

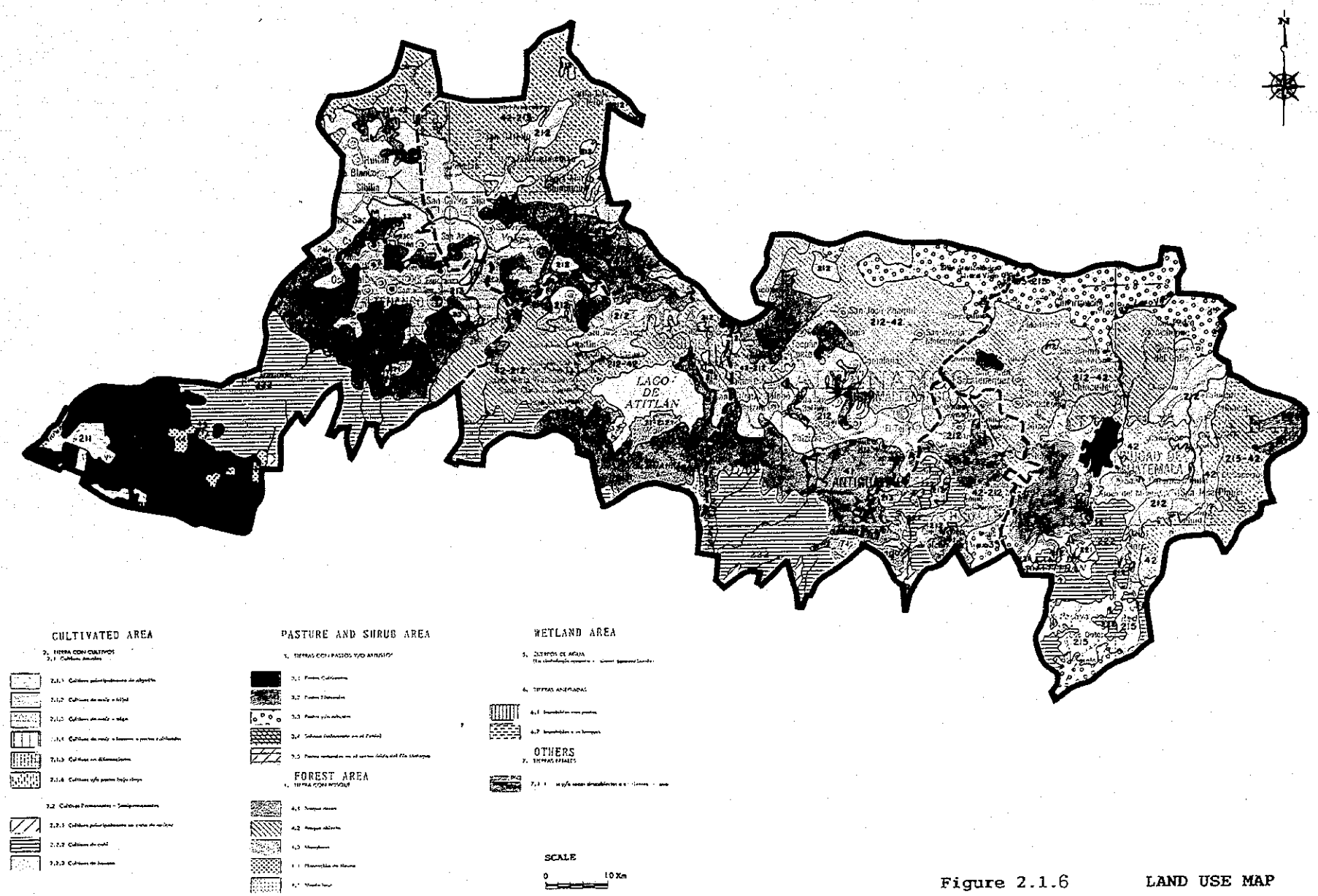


Figure 2.1.6 LAND USE MAP

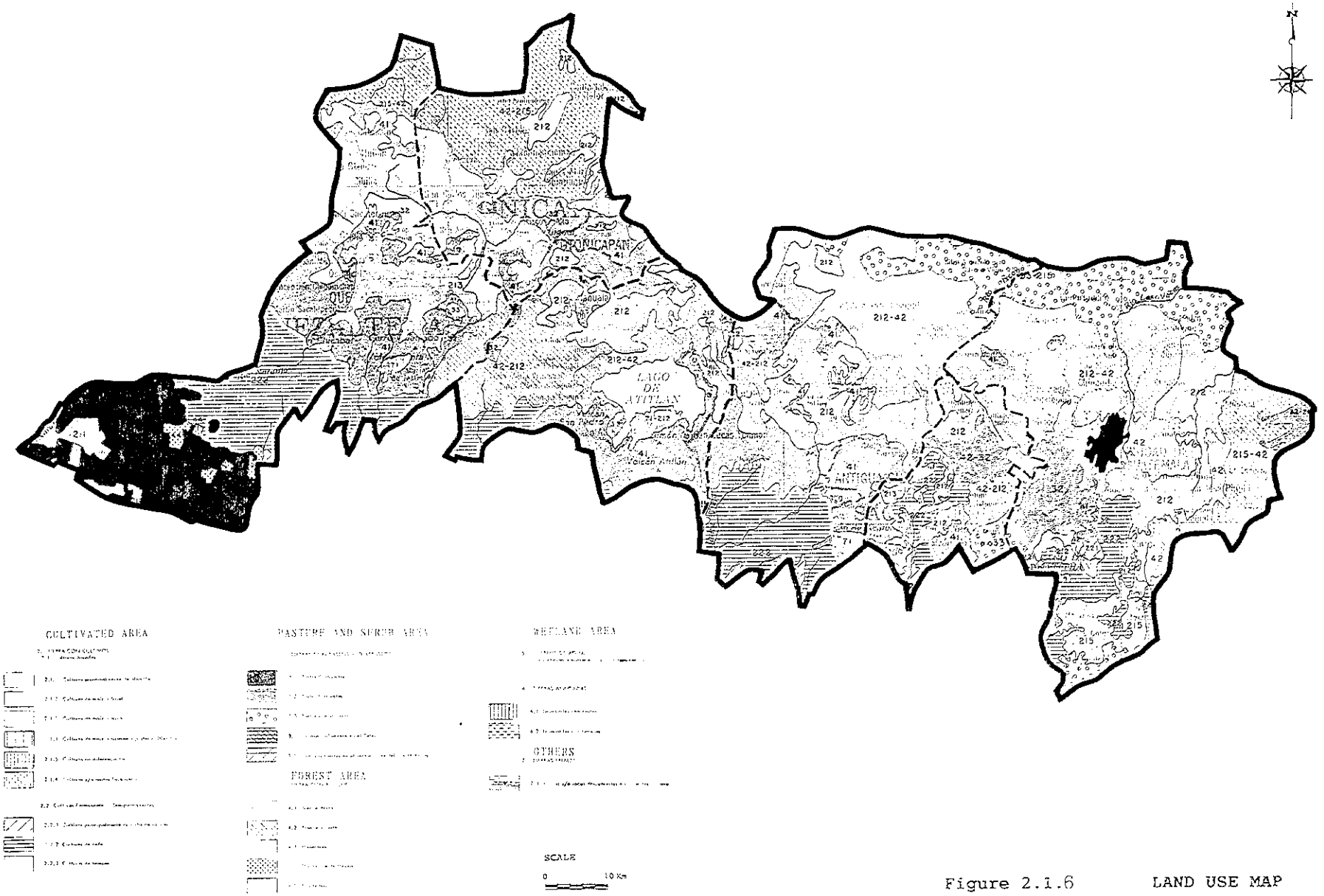


Figure 2.1.6 LAND USE MAP

2.2 Socioeconomic Conditions

2.2.1 Municipal Administrative Unit

The municipalities were established with a view to consolidate a democratic system and decentralize public services. The central government grants them autonomy and, in compliance with the Constitution, contributes 8% (10% since 1995) of the State's general budget.

The municipalities were defined as "A unit of individuals characterized by a permanent relation of vicinity and established on a specific territory, organized by public law, with institutions committed to the common welfare of the residents in the district". The members of the municipal governments are of two types: members elected by the people (mayors, trustees and councilors) and the public officials appointed by the Municipal Council: secretary, treasurer, and civil officials. With the exception of the mayor, the number of members of the municipal administration is determined according to the category of municipality and its total population. The municipalities are headed by the mayor who takes part in the Departmental and Regional Development Councils in order to coordinate the municipal and central government policies.

The duties of the municipalities, by the Municipal Code (Decree 58-88), are based on municipal autonomy and policies, plans and programs of the local government in line with those of the State. The purpose of the municipalities is to provide and administer public services; to establish, maintain, improve, and regulate these services as well as to guarantee fair rates and charges.

The main areas of activity are: sanitation (water supply and sewerage), road infrastructure (road system and transportation), preservation and development of the environment (markets, solid waste collection, green areas, and wholesale meat markets), and urban development (planning of the municipalities and capital city).

The Municipal Code divides the municipalities into four categories: the first category covers the department capitals and towns with a population over 100,000 inhabitants; the second category covers towns over 20,000 and harbors; the third category covers towns with a population between 10,000 and 20,000; and the fourth category covers towns with a population under 10,000. However, this classification was abolished by the Constitutional Amendment of 1994.

The main institutions supporting municipal development are INFOM and the National Association of Municipalities (ANAM).

INFOM was established in 1957 to improve the progress of

municipalities, providing technical and financial assistance to the 329 municipalities which are not located in the metropolitan area.

The main duties of INFOM are:

- Technical assistance, consisting of planning and financing public works and services, organization of municipal finances, advising the preparation of budgets, training of administrative and technical personnel, etc.

- Financial assistance through awarding of credit, and the administration of transfer payments from the government.

- Administrative assistance: collection of funds, organization of water services, development of municipal public services

Since 1982, INFOM has established regional offices for the purpose of providing better services to the municipalities, being more aware of their needs and able to respond in a better way to municipal demands.

ANAM duties are: to protect municipal autonomy, to promote the coordination of municipal programs with national program guidelines, and to provide technical assistance to the municipalities.

2.2.2 Population

(1) Population

The information on population presented in this section was provided by the National Institute of Statistics (INE), INFOM, and the Municipalities.

Based on the National Census taken in 1964, 1973 and 1981, the 1994 population is estimated at 10,322,000, 1.7 times larger than the 1981 population. The population of Guatemala City is estimated at 1,150,000, 11.2% of the national population.

The 6 Departments that make up the Study Area: Guatemala (excluding Guatemala City), Sacatepéquez, Chimaltenango, Sololá, Totonicapán, and Quetzaltenango, account for 27.2% of the national population, as shown in Table 2.2.1.

(2) Current Urban-Rural Population

Guatemala can not be described as a country undergoing urbanization. However, it must be pointed out that the population in areas regarded as "urban" in Guatemala is increasing. The slow growth rate of the urban population in the past, however, leads to the conclusion that Guatemala will remain a predominantly rural country in the foreseeable future.

Internal migration is observed to have a stronger influence at the municipal level rather than the departmental level. The overall effect of migration in each Department is controlled by the different socioeconomic conditions of the municipalities.

Studies on Guatemala indicate urban population increase, but not from urbanization. In Guatemala, urban population growth, in terms of density and volume, is not a result of development. Moreover, the categorization of several areas as urban zones is not a precise description as they are not equipped with the basic infrastructure of an urban environment.

Guatemala is considered monocentric. A large proportion of the urban population and the country's total population is concentrated in the Department of Guatemala (46% of the urban population according to a 1994 estimate), particularly in the municipality of Guatemala and surrounding municipalities that make up the urban area of Guatemala City.

Urban population growth is mainly observed in the areas surrounding Guatemala City and the capital cities of the Departments, but not in the remaining municipalities of the Study Area where only a slight population increase is indicated.

The total population of the Study Area is 2,802,613. More than 37.1% live in the Department of Guatemala, 21.4% in Quetzaltenango, 13.3% in Chimaltenango, 11.6% in Totonicapán, 9.5% in Sololá, and 7.1% in Sacatepéquez (see Table 2.2.2). The average density is 317 persons/km^2. More than 70% of the population in the Study Area live mainly on agriculture: producing corn, beans, coffee, wheat, potatoes, tomatoes, etc.

2.2.3 Economic Characteristics

Agriculture is the most productive sector in Guatemala. It accounts for 25% of the country's GNP. It is also most important to the people living in the Central Plateau area, since it generates jobs and income for approximately 68% of the inhabitants.

Exportable products mainly consist of coffee and cotton, whereas corn, black beans, wheat, and, on a smaller scale, vegetables and fruits, etc., are consumed domestically.

The primary economic activity of the indigenous population, in the majority of the municipalities, is subsistence agriculture. Most of the non-indigenous population is engaged in either subsistence agriculture or industrial activities.

Commercial and agricultural industries, and other industries are owned almost exclusively by a small

percentage of the non-indigenous population. 75% of households live below the poverty line. Extreme poverty is concentrated in rural areas, particularly in the western highlands. These areas are heavily populated, contain most of Guatemala's indigenous communities and have the highest concentration of mini-farms and landless people.

There are no basic data on the economic situation of the municipalities in the Study Area, except for the information received from the visited municipalities, which is summarized in Table 2.2.3.

The smaller municipal cities are usually located far from the large urban areas, and rely economically on agriculture. Most of the industries are located in Guatemala City and, to a smaller extent, in Quetzaltenango City.

Data on the socioeconomic conditions of the municipalities were provided by the public officials of the surveyed municipalities and reviewed by comparing them with the existing data of SEGEPLAN and the housing survey data of INE.

The following general information was obtained from the surveyed municipalities.

- The number of persons per family generally varies from 4 to 9, average of 5.8.

- Most families have more than one source of income.

- The average number of working persons per family is 1.4 (Housing Survey Data).

- Most of the people rely on agricultural activities, and the incomes are classified as follows:

  a) High income (over Q1,000/month) 3%
  b) Medium Income (between Q1,000 and Q500) . 37%
  c) Low Income (under Q500/month) 60%

- The monthly average income in the 54 surveyed municipalities is about Q560, but almost 60% of the families have a lower income.

- Monthly water charge ranges from Q0.25 to Q15.00.

2.2.4 Infrastructure

(a) Roads

Guatemala is highly dependent upon its road system which carries 95% of internal freight plus an even higher percentage of passengers.

More than three quarters of roads serving villages (tertiary roads) are in an inadequate or deteriorating condition. Most are unpaved and are usually passable only in the dry season, which put considerable restrictions on the rural poor who sometimes have to walk an entire day to reach the closest market or health clinic.

The Rural Roads Program Unit, part of the General Road Directorate (Direccion General de Caminos, DGC), has extremely limited financial resources, lacks clear priorities, insufficient equipment, and has a high turnover of personnel who, after training, leave for the more lucrative private sector.

As a result, the DGC does not have the capacity to expand its current program of construction, rehabilitation and maintenance of roads. Thus, there is a considerable need to explore new decentralized methods of financing and implementing road projects through municipalities and local committees, with the help of private contractors and NGOs.

The Study Area is mostly rural, where paved roads are limited to the trunk-roads and to the central parts of the municipal capitals. The inadequate road maintenance is conspicuous along the municipal roads. This is due to limited grants from the central government for the construction and maintenance of infrastructure.

(b) Electricity

Electric power generation and supply services in Guatemala are controlled by the Instituto Nacional de Electrificación (INDE). The service for the metropolitan area (Departments of Guatemala, Sacatepéquez and Escuintla) is provided by the Empresa Electrica de Guatemala S.A. (EEGSA).

The total capacity of electricity generation in Guatemala in 1992 was 976 MW, approximately 50% hydro and 50% thermal power (Table 2.2.4), while the total generated energy in 1992 was 2,427,436 MWh (Table 2.2.5) designating a low operation rate of less than 30% (hydropower: 42%, thermal power: 15%).

About 65% of the generated electricity is supplied to the Departments of Guatemala and Sacatepéquez by EEGSA (Table 2.2.5). While more than 80% of households in these areas receive electricity, the coverage of the electricity service in other Departments is very low (Table 2.2.6).

The percentage of the households with electricity in the Study Area is comparatively higher than in other Departments, although, mostly limited to the urban areas of the municipalities.

The monthly power rates paid by most of the beneficiaries are rather high, ranging from Q15 to Q30, when compared to other public charges such as water rates.

(c) Telecommunications

The telecommunications system in Guatemala has been managed by Empresa Guatemalteca de Telecomunicaciones (GUATEL) since 1966.

International telegrams, telexes, and telephone services are available in almost all of the major cities in the Republic. However, the telecommunication network is still generally poor even though the system has been considerably expanded in the past 5 years (Table 2.2.7).

The total number of telephone subscribers in the Republic as of the end of 1992 was 214,409, of which 80% live in Guatemala City.

The telephone system in the Study Area is generally better developed than in other areas. Whereas the number of the house connections per 1,000 persons in other areas is 4.5, the ratio in the Study Area ranges from 4.8 to 12.1. Exceptions are Totonicapán, which has only 1.2 connections per 1,000 persons, and Guatemala City, which has 159.5 (Table 2.2.6).

(d) Sewer system

About 80% of the municipalities in the Study Area have sewer systems. Sixty to 80% of the households connected to the systems are in the urban areas (see Tables 2.2.9 - 10).

However, many of the systems are often incomplete, e.g., there is a drainage system but there is no sewage treatment plant. Collected sewage and stormwater drain directly into streams, rivers, or lakes and contaminate these waters.

Areas where houses are not connected to the main sewer lines are insanitary and therefore need consideration. The introduction of small scale sewage treatment facilities (individual or community based systems) is a lot better than connecting these houses, particularly those in isolated rural areas, to the main sewer lines.

A sewage treatment plant was constructed and completed at the end of 1994 in the municipality of Sololá, bringing with it a reduction in the levels of pollution in Lake Atitlán. In addition to this type of plant in the urban areas, simple purifiers should be installed in the rural areas.

2.2.5 Position of Women

Throughout Latin America the male has been traditionally considered to be superior. This trait, "machismo", is still strong even in the so called developed areas, and has considerable influence on women's position in society. In addition, the rural areas of the Study Area are densely populated with indigenous people still maintaining traditional life styles. Machismo and the low social status of indigenous people are a burden to the indigenous women.

The women's situation in the Study Area is discussed in the following pages.

(a) Education

In Guatemala, women's development and education is very different from men's. At home, the girl is expected to behave very much differently from the boy. The family assigns girls many tasks and responsibilities, mainly to serve the fathers and brothers. This discriminative formation continues at school, where girls are assigned different tasks and chores from those assigned to boys, reinforcing behavior patterns and attitudes that clearly separate women's role from men's.

Discrimination in terms of access to education and opportunities has often got to do with income disparity, social and ethnic origins, and most of all with sex, producing high rates of illiteracy.

Illiteracy, sex and area (1990)

	Other than 7	Older than 15	Urban	Rural
Female	59.9	63.7	12.4	47.4
Male	40.1	36.3	6.6	33.6

Among indigenous women, the figure reaches 75%, and in some communities it is as high as 90%.

Access to education is very low for women in general. According to figures from the National Institute of Statistics (1987), only 42% of the female population finish elementary school, 9% complete secondary school, and only 1% of Guatemalan women enroll in university studies.

Interviews showed that the ratio of females to males attending secondary school in the Study Area is roughly 2:3. Clear examples of discrimination can be seen in most school texts, especially at elementary level, where men's role seems to be appreciated more than the women's, who are seen as being passive. Contents, language, educational materials and school communication emphasize traditional

roles and stereotypes based on sex.

However, the government decided in May 1994, that all discriminative expressions in textbooks and printed matter should be deleted. The ONAM (Women's National Office) had been lobbying for this action for the past three years.

According to families, especially in the rural area, very small importance is given to girls' school attendance, assigning them to housework and agricultural activities, a pattern that continues from generation to generation (Table 2.2.11).

As mentioned in section 5, Education, a significantly higher percentage of the children in the Study Area, who drop out of schools are girls.

In summary, education emphasizes strong differences according to three main factors; gender, ethnic, and social stratum. Women in the Study Area are bound by these three factors and most of them are left in the educational conditions of the past.

(b) Health

Health conditions nationwide are generally bad, they are particularly a problem for women, considering the importance of their roles as bearers and raisers of children.

Although the data may not accurately show it, women's health conditions, particularly those from indigenous rural communities, have seriously deteriorated due to lack of proper nutrition and education, insanitary housing conditions and deficient health services.

The average number of children per family in Guatemala (5.6 children) is one of the highest in Latin America and is largely influenced by education. Illiterates or those with poor education have around twice as many children as those with secondary education. In the rural area, the average number of children per family is 7.

Thirty years ago, the government promoted family planning nationwide through APROFAM and recommended 4 as the maximum number of children per family. The program is gradually bringing forth good results in the rural sector of the Study Area where the number has decreased to 7 from 10 or 12. The number is slightly lower in the urban areas.

Families in Guatemala usually live together, up to three generations of families, sometimes including relatives. This maybe another reason for the decrease in family size. There are exceptional cases however, such as a woman with 25 children and another who had 16 before she turned 32 years of age. The high numbers are a result of the

established traditional role of women, that is, to give birth to many children, particularly baby boys.

The birth rate is highest among the 15 - 24 age group. Half of the female population of Guatemala have their first child before reaching 20.

In the Study Area, women usually marry at the age of 18, some as early as 13 or 14, having their first child at 15.

The maternal mortality rate is 2.48 per 1,000 live births, mainly influenced by complications during pregnancy, hemorrhages, childbirth and post-natal complications. Childbirth deaths are also influenced by the mothers' past medical history, e.g. abortions. Health services complicate matters also as only 30% of childbirth in Guatemala are assisted by physicians and nurses, while the remaining percentage rely on professional or untrained midwives. Malnutrition and mother-infant relationship are also factors.

Maternal Mortality Rates
(per 100,000 live births)

Guatemala	248
Mexico	87
Costa Rica	26

Maternal Mortality Rates
in the Study Area
(per 100,000 live births), 1991

Guatemala	70
Chimaltenango	200
Sacatepéquez	130
Sololá	210
Totonicapán	120
Quetzaltenango	70

Malnutrition has always affected poor women, particularly so during pregnancy and lactation when additional nutrients are necessary.

Other problems directly affecting women's health are cancer, sexually transmitted diseases, and occupational hazards.

Women are also observed to suffer more mentally due to stress and pressure from their dual role. The women and children are often the victims of family violence, being abused and mistreated physically as well as psychologically.

Women working in the informal sector put themselves under precarious conditions, in terms of safety and hygiene. They are exposed to accidents with no social welfare

coverage.

Health services are deficient, and not easily accessible to the dispersed rural population. Further, there remains strong cultural resistance to use modern medical practices, as well as logistical problems.

(c) **Work**

Underdeveloped countries are usually unable to generate enough jobs for the entire working age population. In addition, males are usually given preference for the positions that are available.

According to a study on population carried out in Guatemala in 1987 by the National Institute of Statistics (INE), the economically active population is 2,740,100, 76% men and 24% women.

The three important elements why women have very low participation in the PEA (economically active population) are: a) discriminatory socio-cultural factors at the time of hiring; b) unreliable data collection system; and c) the low education level and occupations available to women.

In terms of economic activity, women are mostly employed in commercial and service jobs (32% and 31%, respectively) due to low qualification levels. Next is manufacturing and agriculture (19% and 14%), even though the latter is considered as men's work. Although a particular village has started hiring women for some agricultural work usually carried out by men, the women still get paid half of the men's income.

In the analysis of the situation of women in terms of employment, it is important to examine their participation in the Public Sector: 30% of the 110,757 public employees in the Finance section are women. In other sectors, only 6 to 21% are women.

In the Study Area many elementary school teachers and nurses are women. The number of women working in other public sectors, mainly municipal offices, was observed to be increasing recently.

In the informal sector (self-employed work, domestic work, family work), where the working force is mostly made up of women (60%), underemployment (visible and invisible) is prevalent: over 45 hours/week and very low salaries.

Women are well qualified in traditional work such as sewing, weaving, cosmetology, cooking and baking. Like women in the informal sector, these works are basically an extension of household chores, and are very low paying.

In the indigenous societies in the Study Area, almost all women still wear traditional clothes which they usually

make themselves. They also pass their weaving and sewing skills, among others, to their children, as they find it a necessity in their communities.

Because these skills take a long time to master, they are usually taught from a very early age (10 - 14 years). Difficult living conditions force them to work from an early age as well, in many cases, forcing them to drop out of school and end their educations.

Aside from working for a living, women also have to tend to household chores and their children.

In agricultural areas, such as the Study Area, women are required to help the men in farming activities, in addition to housekeeping.

(d) Women's Movements

As mentioned in the previous sections, women's position needs to be improved. Consequently, several women's movements have been set up, such as APROFAM (Asociación Pro-Bienestar de la Familia en Guatemala - Guatemalan Family Welfare Association), ONAM (Oficina Nacional de la Mujer - Women's National Office) and many other private groups. Some of the members belong to indigenous communities, they even head some sections.

APOFAM started out with family assistance programs protecting women's health, especially mothers. It is now in its 30th year after achieving much success in family planning.

ONAM started about 13 years ago as a unit of the Ministry of Labor and Social Welfare mainly organized to uphold women's rights and to fight against discrimination.

In the political field, however, only 6 out of the 116 members of parliament are women, of which three are presently serving as ministers.

2.2.6 Education

The educational system in Guatemala comprises four levels: preparatory, elementary, secondary (middle and diversified) and college.

Preparatory school: from one to three academic years, for ages 4 to 6.

Elementary school: six school years, for ages 7 to 12(14). Elementary education is compulsory.

Secondary school: a) "Ciclo Basico" which is like junior high school, three years, b) diversified, 2 to 3 school years, for ages 13 to 19 years old. Public school education (elementary and secondary) is free.

College (Nivel Superior): 5 to 6 academic years to get a college degree (Licenciatura). Recently there has been an increase in short term courses (3 years).

However, the educational level in Guatemala is among the lowest in Latin America, particularly when compared to other countries with similar income levels. In 1992, 82.5% of children between the ages 7 to 12 were enrolled in elementary schools (boys: 88.0%, and girls: 76.8%).

Number of pupils sharply decreases from the first to the sixth grade. Less than half the children (42.3%) complete sixth grade. Only 27% of children aged 5 and 6 are in school (Table 2.2.12), the worst of all Central American countries.

The problem is particularly acute in rural areas where the population is largely indigenous. Only 49 out of 100 girls are in school, compared to 74 out of 100 in urban areas. In 1992, it was estimated that 30% of the urban population and 70% of the rural population were illiterate. In some poorer rural areas illiteracy reaches 76%.

Improving education is especially challenging given the ethnic complexity of the society, one of the most diverse in Latin America. About half (48%) of the population is indigenous, descendants of the Mayas. There are over 21 separate indigenous groups, each with their own language.

Most of the indigenous people speak one of the three major indigenous languages (Quiché, Kakchiquel and Kekchí), and the majority continues to speak little Spanish which makes it difficult for them to take advantage of educational and health programs.

The demographic structure also offers formidable challenges to education, particularly for women and children. Almost half (46%) of the population is under 15 years of age. Many of these children are located in geographically dispersed and ethnically unique communities.

Preparatory programs are critical to improve school retention because many children of indigenous families reach elementary school age having a considerable disadvantage due to their inability to speak Spanish. Since only 21% of the schools in Guatemala offer bilingual education, many children from indigenous communities either do not attend school or, if they do, they fail and often eventually drop out.

In terms of extra-curricular activities, a clear concept of the personal development and qualification process for work, life and social togetherness does not seem to exist in Guatemala.

A large part of the population is comprised of indigenous

peoples, most of whom inhabit the rural areas of all Departments in the Study Area, except for Guatemala. Almost all results mentioned above, therefore, relate to the educational situation of the Study Area. Additional figures shown below are based on the interviews conducted in the Study Area.

Eighty to 85% of children generally start elementary school at the age of seven, but there are some who do not start until they are ten. Some 20 to 50%, mostly girls, are forced to leave school by the 3rd or 4th grade, mainly because of financial difficulties.

Some children, however, return to school after an interval of several years. Sometimes children aged fifteen, and in a few cases even seventeen, are found in elementary school. Generally, fourteen is the maximum age for elementary education.

All municipalities have at least one elementary school. But the secondary schools are very few and concentrated mainly in the urban areas. The number of children varies extremely by municipality (3 to 90% of girls (average 39%), 5 to 90% of boys (average 53%)). The number of students entering universities is much lower, around 1% for females and about 10% for males. Indigenous people have recently started attending universities, and some of them return to their home town after graduation to become school teachers.

2.2.7 Sanitary Conditions and Health

(a) Environmental sanitation

The UN Economic Commission for Latin America and the Caribbean (ECLAC) estimated that 78% of households in Guatemala have neither potable water nor latrines. However, this figure decreased to 43.5% by 1992-1993.

All of the municipalities in the Study Area are supplied to an extent with potable water through house connections in the urban area, and mostly by communal taps in the rural areas. However, the coverage of water supply still remains low at 62.2% in the Study Area. This figure is a little higher than the national average however.

The main causes of Guatemala's high infant mortality rate are diarrhea and parasitic infections, both of which are related to inadequate water supply and sanitation. Communicable diseases and illnesses associated with poor sanitary conditions are the leading causes of death for adults over 45.

The absence of a national water and sanitation authority in Guatemala has caused fragmentation of the sector. Despite efforts at coordinating water policies, which culminated in the creation of the Permanent Committee for the Coordination of Potable Water and Sewerage (COPECAS), there

is still no clear direction in the water and sanitation sector.

The urban sector has poor policies and lacks the ability to plan and implement programs, and manage day-to-day operations. Water programs in rural areas are characterized by a lack of formal coordination, particularly with respect to strategies, appropriate technologies, tariff policies, and by insufficient emphasis on community participation and hygiene education.

Tables 2.1.13 - 14 show the condition of water supply and sanitary systems in all Departments of Guatemala. The Departments that do not have adequate potable water supplies tend also to have poor sanitation systems (Peten, Jutiapa, Chiquimula, and Jalapa etc.).

However, a high percentage of households in almost all the municipalities of the Study Area, except Génova, have sanitation systems (80.2 - 92.0%); the water supply percentage is not so high, however.

(b) Water quality of the existing water supply systems and shallow wells

Several water quality parameters were checked for spring water, supplied water and water from the shallow wells using simple analytical methods.

Although pH was within the acceptable range, it was generally slightly lower than the standard level.

Coliform and other forms of bacteria, serious impact factors for drinking water, were detected in many places.

The INFOM laboratory periodically checks water quality and bacterial contamination.

Except for only a few municipalities, water is supplied without treatment, resulting in bacterial contamination. Bacteria was detected even in treated water, probably due to insufficient chlorine or hypochlorite.

INFOM advises the operators of the treatment plants on water treatment methods, especially in places where cholera has been found. However, the advice is usually followed once and rarely followed up regardless of the knowledge that diarrhea and other intestinal infections result from poor water treatment measures. The implementation of water treatment measures is usually hampered by financial reasons.

(c) Health and diseases

Although the annual health budget is high (8.5% of the national budget - 1990) and the adult and infant mortality rates have decreased to half what they were 15 years ago (Table 2.2.15), many diseases, especially infant and maternal, still prevail, which is why the mortality rate is still high by international levels (Table 2.2.16).

Health services offered are concentrated exclusively in urban areas. Services from the Ministry of Public Health and Social Welfare cover 25% of the population, IGSS covers 15% and the private sector 14%.

Health institutions	Number
Hospitals	148
Health centers with beds	32
Health centers without beds	188
Consultation offices	35
Clinics and others	3,458
Beds	1.1 per 1000 persons

In the Study Area, government support for health care facilities is very poor. Six (6) public and forty six (46) private hospitals exist in the forty eight (48) municipalities visited. These hospitals were located only in the larger towns. All municipalities had at least one health center or clinic.

In comparison to other Central American countries, Guatemala has the highest number of people not covered by health services.

Comparison with Central American Countries, citizens without health care (millions), 1992 (PNUD)

Guatemala	6.1
El Sal.	2.2
Honduras	1.3
Nicaragua	0.6
Costa Rica	0.6
Panamá	0.5

Diseases that are most common are: acute respiratory infections, severe diarrhea, malaria, and malnutrition. Deaths due to intestinal infections seem also high, although the results were based on insufficient data. In the Departments in the Study Area, the distribution pattern of diseases, except malaria, is similar to the national distribution pattern, but levels are generally higher in the Study Area.

Child mortality in 1989 was 57/1,000, with diarrhea related diseases, severe respiratory infections, and perinatal diseases being the main causes (with 30%, 23%, and 20%, respectively), in addition to malnutrition. In indigenous

groups, child mortality is even higher.

(d) Nutrition

Malnutrition in Guatemala, particularly among children, is very high. In 1990, 4% of children under 5 years old suffered severe malnutrition, and observations indicate that conditions could grow worse. Children, especially in rural areas and the very young in indigenous communities, are underweight. The malnutrition rate among children between 6 - 9, is 37%.

Malnutrition is mainly caused by low consumption of protein, calories, vitamin A and iron deficiency.

Diets vary between urban and rural areas (Table 2.2.17), and between income levels (Table 2.2.18): in rural areas and particularly in the lower income group, a higher dependency on corn and beans is found.

On the other hand, in the urban areas, higher income earners consume more meat, dairy products, eggs and fruit. However, daily energy consumption in the urban and higher income groups is only slightly higher than in others.

The varying regional dietary habits, in general, reflect the socioeconomic conditions of the population, that is, production, availability and access to food, and cultural customs. There are high levels of poverty in rural areas and central highlands. This is manifest in their diet which consists mainly of beans and maize.

People in the highland region, located in the Study Area, consume daily more vegetables and protein than other regions; having a considerably lower energy intake (Table 2.2.19). The dietary habits of the central region, also in the Study Area, are typical of Guatemala.

In both areas, mortalities during pregnancy due to malnutrition and dehydration, and infant and maternal death during childbirth are higher than average. The high mortality rates are considered to be caused by low daily energy intake and the limited variety of foods.

Table 2.2.1 Total Population and Growth Rate by Departments

No.	Department	Population (Census)			Population (Estimation)	Annual Growth Rate (%)		
		1964	1973	1981	1994	73/64	81/73	94/81
	Country	4,287,997	5,160,221	6,054,227	10,322,011	2.08	2.02	4.19
	Guatemala City	572,671	700,504	754,243	1,150,452	2.26	0.93	3.30
I	Guatemala (*)	238,187	407,682	556,949	1,039,953	6.15	3.98	4.92
II	Sacatepequez	80,942	99,988	121,127	198,273	2.38	2.43	3.86
III	Chimaltenango	163,153	194,735	230,059	373,258	1.99	2.11	3.79
IV	Solola	107,822	127,268	154,249	266,756	1.86	2.43	4.30
V	Totonicapan	141,772	166,809	204,419	325,940	1.82	2.57	3.65
VI	Quezaltenango	270,916	312,787	366,949	598,433	1.61	2.02	3.83
	Total Municipalities	1,002,792	1,309,269	1,633,752	2,802,613	3.01	2.81	4.24

(*) Excluding Guatemala City

Source: 1964, 1973, 1981, National Institute of Statistics (INE)
1994, estimated by INE and arranged by the Study Team

Table 2.2.2 Urban-Rural Population, Density by Department (1994)

No.	Department	Area (km2)	Population			Density (p/km2)
			Urban	Rural	Total	
	Guatemala City	228	1,150,452	0	1,150,452	5,046
I	Guatemala (*)	2,118	744,947	295,006	1,039,953	491
II	Sacatepequez	465	148,001	50,272	198,273	426
III	Chimaltenango	1,981	149,314	223,944	373,258	188
IV	Solola	1,142	98,820	167,936	266,756	234
V	Totonicapan	1,050	50,756	275,184	325,940	310
VI	Quetzaltenango	2,090	232,325	366,108	598,433	286
	Total	8,846	1,424,163	1,378,450	2,802,613	317

(*) Excluding Guatemala City

Source: National Institute of Statistics (INE)

Table 2.2.3 Economic Conditions by Municipality (1)

GUATEMALA

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >10000 Q	Middl. 1000 Q	Low <500 Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY 8% DISTRIBUTION Received 1992	To receiv. 1994	POPULAT. (1994) Hun.Head	HOUSING Number	P/Hous.	WATER SERV. CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quets/Month) Electr	Others	REMARKS
1	Santa Catarina Pinula *	3	4	24	72	944	1600	Commercial	17	796,843	1,466,044	8,376	1,575	5.5	3.50	1,700		5,100	12.0	13,500	Included in Elec.	Financial capacity
2	San Jose Pinula *	3	25	25	50	800	800	Service / Agricult. / Commercial	28 / 20 / 25	645,453	1,186,879	11,277	1,650	6.1	1.00	1,557	No	1,557	3.0	12,000		Fin. Cap. & w/ to pay O & M
3	San Jose del Golfo *	4				450	450	Agricult.		426,943	786,358	2,070	350	5.9	5.00	330		1,650	12.0	6,000		Economically poor
4	Palencia	2								713,913	1,314,977	5,724	950	6.0								
5	Chinautla *	3								898,158	1,654,342	2,161	400	5.4	7.00							Economically poor
6	San Pedro Ayampuc *	3								497,162	915,237	5,680	950	6.0	3.00	540	No	1,620	1h/e.2day	6,000		Financial invest. W/ to pay
7	Mixco *	2	10	50	30	1200	1200	Service / Others	40 / 50	7,683,682	9,943,150	19,800	3,806	5.2	10.00	2,500	No	25,000	3-4h each 2 days	85,000		Financial capacity
8	San Pedro Sacatepequez *	3						Agricult. / Industry		751,735	1,384,643	7,652	1,320	5.8	1.50			0	20.0	3,000	800	Economically poor W/ to pay
9	San Juan Sacatepequez *	2						Floricult. / Agricult.		865,777	1,594,700	10,041	1,800	5.6	1.00	1,825	No	3,250	6.0	6,960	3,674	W/ to pay
10	San Raymundo *	3		10	30	360	380	Agricult. / Others	85 / 10	505,345	932,652	4,747	850	5.5	6.00	825	825	4,950	1.0			Economically poor
11	Chuarrancho *	3								428,655	749,552	5,601	1,005	5.6	10.00	250	No	7,500				Economically poor
12	Fraijanes	3								487,923	898,720	4,812	819	5.9				0				
13	Amatitlan	2								879,379	1,619,753	38,682	5,500	6.0				0				
14	Villa Nueva *	3	10	26	60	1500	1200	Manufac. / Commercial	60 / 30	328,434	2,446,879	37,423	6,487	5.8	15.00	5,847	Few	84,705	24.0	126,000	32,000	Financial capacity Distr. syst. proj.
15	Villa Canales *	2								826,997	891,855	5,574	1,013	5.5	1.50			0	2(.0	6,000		Financial capacity. No request for well
16	San Miguel Petapa	4								493,582	1,277,527	7,842	1,189	6.5				0				

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

SACATEPEQUEZ

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >10000	Middl. 1000 Q	Low <500 Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY 8% DISTRIBUTION Received 1992	To receiv. 1994	POPULAT. (1994) Hun.Head	HOUSING Number	P/Hous.	WATER SERV. CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quets/Month) Electr	Others	REMARKS
1	Antigua Guatemala	1	15	40	45	3000	2550	Agricult. / Commercial	65 / 33	598,197	2,943,765	21,033	3,946	5.3	12.00	5,800	5,800	69,600				
2	Jocotenango *	4								461,157	849,417	12,731	2,214	5.8	4.50	1,258	1,258	5,661	ow/2;12 h/2 7			?
3	Pastores	4								456,095	840,984	3,837	692	5.8								
4	Sumpango	3								549,048	1,004,978	14,317	2,398	6.3								
5	Sto. Domingo Xenacoj	4								345,133	635,210	5,664	858	6.7								
6	Santiago Sacatepequez	3								483,019	889,687	8,322	1,498	5.2								
7	San Bartolome Milpas Altas *	4	1	9	90	650	600	Agricult. / Commercial	85 / 10	651,885	1,200,728	3,347	598	5.7	7.00	750	Yes	5,250	19:00	3,000	700	W/ to pay O & M
8	San Lucas Sacatepequez	4								622,689	1,146,801	9,767	1,498	7.8								
9	Santa Lucia Milpas Altas *	4	13	65	22	1300	1250	Agricult. / Manuf.	35 / 55	719,368	1,325,025	3,738	700	6.1	6.0 65% 5.0 35%	700	0.30%	3,788	3.50 3 (70%)	4,000	3,710	Economically poor
10	Magdalena Milpas Altas *	4		20	80	600	580	Agricult. / Manuf.	80 / 20	349,509	643,754	4,431	700	6.3	6.00	550	No	3,300	1 (30%)	10,000	2,190	Economically poor
11	Santa Maria de Jesus *	4		20	80	600	400	Agricult. / Commercial	95 / 5	417,563	769,121	11,107	2,000	5.6	10.00	700	Few	7,000	1.50	3,160	2,840	Economically poor W/ to pay
12	Ciudad Vieja *	3						Agricult. / Others	75 / 25	528,600	955,225	14,758	2,400	6.1	5.00	3,300	3,300	16,500	19 (25%) 24 (75%)	24,345	3,000	Financial capacity
13	San Miguel Dueñas	4								527,149	970,954	4,033	758	5.3								
14	San Juan Alotenango	3								494,828	911,438	9,702	1,580	6.1								
15	San Antonio Aguas Calientes *	4		20	70	580	600	Agricult. / Others	80 / 20	431,492	776,385	4,909	869	5.7	1.00	600	Yes	600	24.00		580	Economically poor
16	Santa Catarina Barahona	4								481,341	888,478	7,295	1,158	6.4								

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

Table 2.2.3 Economic Conditions by Municipality (2)

CHIMALTENANGO

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >10000	Middl. 1000 Q	Low <500 Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY 8% DISTRIBUTION Received 1993	To receiv. 1994	POPULAT. (1994) Mun.Head	HOUSING Number	P/Hous.	WATER SERV. CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quetz/Month) Electr.	Others	REMARKS
1	Chimaltenango	1								938,473	726,500	25,667	3,944	6.5								
2	San Jose Poaquil *	3			100	250	250	Agricult.	100	497,093	915,445	3,889	700	5.3	0.40	345	No	338	24.0		1,388	Economically poor W/ to pay
3	San Martin Jilotepeque *	2	5	25	70	300	300	Agricult. Others	75 25	985,387	815,013	5,447	1,300	5.2	7.50	1,300	No	3,250	5.5	3,000	7,100	Economically poor W/ to pay
4	San Juan Comalapa *	2	2	5	93	650	600	Agricult. Commercial	80 10	636,114	171,576	14,710	2,825	5.6	2.45	1,154	1,164	2,328	8h(60%) 5h(40%)	3,000	6,050	Economically poor
5	Santa Apolonia	1								479,583	833,369	4,352										
6	Tecpan Guatemala	2								731,942	348,184	8,461	1,288	6.6								
7	Patzun *	2		30	70	500	500	Agricult. Commercial	90 10	661,465	218,372	13,987	2,293	5.7	4.68	1,134	1,134	4,536	5h/each 7days			Economically poor W/ to pay
8	San Miguel Pochuta	3								466,526	458,845	4,146										
9	Patzicia *	3	10	50	40	700	700	Agricult. Commercial	80 20	693,364	908,277	11,587	1,650	6.9	8.45	687	No	584	7.0		6,000	Economically poor W/ to pay
10	Santa Cruz Balanya	4								362,265	567,265	4,650										
11	Acatenango	3								446,520	822,458	3,807										
12	San Pedro Yepocapa	3								438,462	807,615	8,689										
13	San Andres Itzapa	3								447,883	824,968	15,804										
14	Parramos									385,197	709,431	5,545										
15	Zaragoza *	3	5	20	75	700	650	Agricult. Livestock	75 15	420,758	774,991	7,421	1,500	5.2	3.80	1,500	25%	4,500	2.0	15,000	1,000	W/ to pay
16	El Tejar *	4	2	48	50	800	800	Brick fac. Others	50 50	717,727	1,322,003	7,453	1,200	6.2	10.00 16.00	938 106	1,040	9,380 1,060	10.4	12,000	1,700	Public faucet = 50 Industry = 150 (10%)

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

SOLOLA

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >10000	Middl. 1000 Q	Low <500 Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY 8% DISTRIBUTION Received 1993	To receiv. 1994	POPULAT. (1994) Mun.Head	HOUSING Number	P/Hous.	WATER SERV. CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quetz/Month) Electr.	Others	REMARKS
1	Solola *	1	5	35	60	600	600	Agricult. Commercial	50 30	665,230	1,225,307	15,254	2,800	7.6	3.25	1,449	1,449	4,709	3h(60%) 2(40%)		2,500	W/ to pay
2	San Jose Chacaya	4								388,378	715,365	272										
3	Santa Maria Visitacion	4								321,341	591,703	1,116										
4	Santa Lucia Utatlan *	4			100	500	500	Agricult. Handcrafts	90 10	518,208	954,503	2,176	345	6.3	3.00	149	50%	447	1h/each 7 days		700	Economically poor Public consult.
5	Nahuala *	2		10	90	400	400	Agricult. Manufac.	75 20	744,913	1,372,085	4,223	707	6.0	0.25	550		138	4- 5h			Economically poor
6	Santa Catarina Ixtahuacan *	2			100	300	300	Agricult.	90	698,956	1,288,342	2,289	500	4.6	1.00	450	No	450	24.0		800	Economically poor
7	Santa Clara La Laguna *	4		10	90	300	300	Agricult. Commercial	60 30	359,148	661,625	4,194	600	7.0	0.50	600	No	300				
8	Concepcion	4		18	82	980	825	Agricult.	60	324,756	616,596	1,394	250	5.6	1.00	126	126	126				
9	San Andres Semetabaj *	4	25	35	40	800	600	Agricult. Services	35 65	397,343	731,477	1,769	350	5.0	0.50	350	No	175	6.0		420	Economically poor
10	Panajachel	4								688,768	1,269,583	7,793	1,560	5.0	6.00	1,560	1,560	9,360				
11	Santa Catarina Palopo *	4		5	95	450	400	Agricult. Commercial	40 30	345,278	635,978	1,684	300	5.6	1.00	220	No	220	3.0			Poor economy for operation & mainten.
12	San Antonio Palopo *	4		5	95	450	430	Agricult. Handcrafts	25 75	523,953	965,084	2,470	440	5.6	1.00	369	No	308	4.0			Poor econ.for O & M Tourism dev./infra.
13	San Lucas Toliman	3								549,835	1,012,757	11,023										
14	Santa Cruz La Laguna *	4		10	90	500	500	Agricult. Manufac.	50 40	349,350	643,477	706	125	5.6	1.00	170	No	170				
15	San Pablo La Laguna *	4		10	90	350	350			402,552	741,473	5,918	800	7.4	0.50	500	No	250				
16	San Marcos La Laguna *	4			100	500	300	Agricult. Services	80 10	368,140	678,086	1,375	320	4.3	0.30	315	No	95				
17	San Juan La Laguna *	4		25	75	240	240	Agricult. Manufac.	30 60	351,277	647,027	3,875	650	6.0	0.50	550	Few	275				
18	San Pedro La Laguna			20	80	300	300	Agricult. Commercial	40 50	365,542	674,041	8,624	1,200	6.5	1.00	1,060	Few	1,060				
19	Santiago Atitlan									537,643	989,193	22,858										

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

Table 2.2.3 Economic Conditions by Municipality (3)

TOTONICAPAN

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >1000Q	Middl. 1000Q	Low -500Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY AS DISTRIBUTION Received 1993	To receiv. 1994	POPULAT. (1994) Mun.Head	HOUSING Number	P/Hous.	WATER SERV.' CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quetz/Month) Electr.	Others	REMARKS
1	Totonicapan	1								1,063,356	1,958,626	14,737										
2	San Cristobal Totonicapan									521,669	960,838	7,855										
3	San Francisco El Alto *	2		50	50	600	500	Commercial 60 Agricult. 40		635,754	1,171,873	9,550	1,200	8.0	0.60	600	Y	360	2.0		700	Poor economy Public consult.
4	San Andres Xecul *	3		40	60	500	500	Agricult. 60 Handcraf. 40		610,625	1,124,728	3,748	600	5.2	0.50	600	No	300	1.0		3,500	Poor economy for operat. & maint.
5	Momostenango *			40	60	500	500	Commercial 60 Handcraf. 40		1,153,622	2,493,643	18,338	1,820	5.7	3.00	600	Y	1,800	3.0	1,500	600	W/ to pay the O & M
6	Santa Maria Chiquimula	2								715,559	1,316,889	3,323										
7	Santa Lucia La Reforma	4								467,577	861,744	610										
8	San Bartolo Aguas Calientes	4			100	300		Commercial 90 Agricult. 8		525,151	966,414	1,385			1.00	425		425				

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

QUETZALTENANGO

NO	MUNICIPALITY	CAT.	INCOME BY LEVEL (%) High >1000Q	Middl. 1000Q	Low -500Q	MONTHLY FAMILY INCOME (Q) Income	Expend.	MAIN INCOME BY SECTOR Sector	%	MUNICIPALITY AS DISTRIBUTION Received 1993	To receiv. 1994	POPULAT. (1994) Mun.Head	HOUSING Number	P/Hous.	WATER SERV. CHARGE Q/M	NO. OF CONNEC.	METER	TOTAL WATER CHARGE Q/M	SERV. HOURS (day)	OPERAT. & MAINTEN. COST (Quetz/Month) Electr.	Others	REMARKS
1	Quezaltenango	1								3,155,956	5,829,887	100,593										
2	Salcaja	3	15	50	35	1,200	1,100	Commercial 50 Manufact. 30		591,633	996,114	12,593	2,300	5.5	6.00	1,900	1,800	11,400				
3	Olintepeque *	3	5	35	60	450	450	Agricult. 50 Comercial 50		431,099	794,037	4,958	730	5.6	5.00	360	No	1,800	3.0	1,400	1,000	Economically poor Economically poor
4	San Carlos Sija *	2		60	40	450	450	Agricult. 80 Comercial 20		577,134	863,039	3,264	500	6.5	1.00	450	Y	450	2.0		Y	Can not pay O & M
5	Sibilia	4								418,858	771,507	1,101										
6	Cabrican	4		5	95	550	500	Industry 60 Agricult. 25		468,947	859,767	1,727	200	6.6	5.00	200	No	1,000				
7	Cajola *	4		5	95	300	300	Agricult. 100		381,750	703,157	3,943	560	5.5	0.50	400	No	200	6.0		1,000	Economically poor
8	San Miguel Sigüila	4								374,762	690,265	1,849										
9	San Juan Ostuncalco	2								841,655	104,286	13,518										
10	San Mateo	4				700	500	Commercial 60 Agricult. 40		488,077	899,003	2,004			1.50	595	595	894				
11	Concepcion Chiquirichapa *	4		20	80	350	350	Agricult. 90 Manufact. 10		458,017	828,889	5,076	867	5.3	1.00	850	Not in use	850	3.0		740	Economically poor Y/ to pay ?
12	San Martin Sacatepequez *	3		100	300	300	300	Agricult. 80		462,914	852,655	3,191	615	6.2	0.83	?					800	Economically poor Can not pay O & M
13	Almolonga *	4	15	15	70	500	350	Agricult. 70 Man.& con. 30		658,441	196,865	10,688	2,300	4.7	2.00 6.00	1,400	Yes	4,200 5,100	6.0	20,500	3,500	
14	Cantel	3		10	70	500	400	Commercial 40 Manufact. 30		586,598	980,107	3,351			0.25		No					
15	Huitan *	4		40	60	555	525	Agricult. 90 Others 10		329,596	599,178	1,911	300	6.4	0.50	701	Y	101	6.0		841	Economically poor Can not pay O & M
16	Zunil	4								437,116	805,136	6,663										
17	Colomba *	2								631,289	125,958	5,316	1,119	5.6								
18	San Francisco La Union *	4		10	80	350	300	Commercial 90 Agricult. 10		371,313	683,931	1,797	253	6.7	5.00	199	Y	500	1h/e. 2 days	700	900	Economically poor W/ to pay ?
19	El Palmar	3								476,359	877,418	4,079										
20	Coatepeque	2	3	47	50	800	700	Commercial 45 Agricult. 25		874,447	1,347,440	32,157	5,441	5.9	2.65 7.00	5,441	5,441					
21	Genova *	2		70	30	500	500	Agricult. 60 Service 35		670,203	859,382	3,880	700	5.4	0.50	250	Not in use	215	2.5		2,270	Y/ to pay
22	Flores Costa Cuca *	3			100	300	200	Agricult. 90 Others 10		469,753	865,261	3,971	745	5.0	0.75	300	300	220	15 min. to 4h		640	Economically poor
23	La Esperanza	4								642,572	1,183,672	2,579										
24	Palestina *	4		20	80	300	300	Agricult. 7		429,582	791,269	3,168	585	5.3	10.00	300	300	1,500	24.0	1,000	700	Water sufficiency

Source : Arranged by the Study Team from Data provided by the Municipalities and INFOM

Table 2.2.4 Capacity of Electric Power Plants in Guatemala (1992)

Type of Generation	Hydro (MW)	Thermal (MW)				Total
		Geotherm	Gas	Diesel	Bunker C	
SIN						
INDE	486.9	86.0	161.0	9.3		743.2
EEGSA	0.0	33.0	123.0	0.0	55.0	211.0
Total	486.9	119.0	284.0	9.3	55.0	954.2
OPERATION INDIVIDUAL						
INDE	0.0	0.0	0.0	13.3		13.3
Municipality & Private	4.3	0.0	0.0	4.2		8.5
Total	4.3	0.0	0.0	17.5		21.8
Total, Guatemala	491.2	119.0	284.0	26.8	55.0	976.0

Table 2.2.5 Balance between Generated and Consumed Electric Energy - INDE, 1992

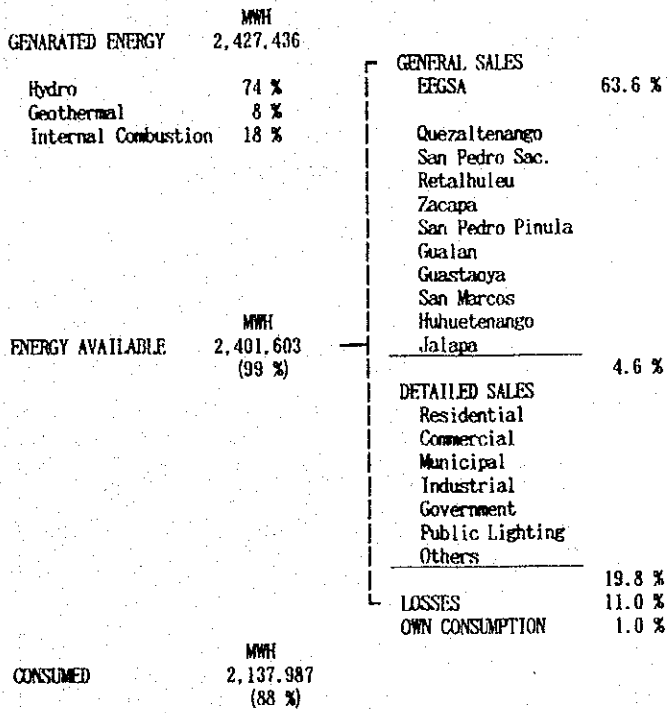


Table 2.2.6 Percentage of the Households with Electric Service in each Department (1992-1993)

Department	%	Department	%	Department	%
National Total	49.1	*Chimaltenango	54.7	Izabal	35.2
		El Progreso	51.3	Quiche	31.8
*Sacatepequez	86.7	Baja Verapaz	49.9	Santa Rosa	29.4
*Guatemala	80.3	*Totonicapan	47.8	Suchitepequez	26.7
Alta Verapaz	59.9	Zacapa	47.0	Peten	20.7
San Marcos	59.8	Escuintla	44.8	Jalapa	20.0
*Quetzaltenango	58.8	Retalhuleu	43.9	Chiquimula	19.9
*Solola	58.8	Huehuetenango	42.4	Jutiapa	14.9

* Department in the study area.

Table 2.2.7 Transition of Guatel

Year	1988	1989	1990	1991	1992
Installed lines	138,222	158,840	190,218	202,209	214,409
Public telephone	1,120	2,062	2,079	2,093	2,251
Community telephone	172	209	258	270	415
Telex subscriber	1,373	1,345	1,257	1,131	1,040
MAYAPAQ subscriber	-	165	199	247	343
Emergency telephone	68	68	16	69	69
	576	640	716	813	926
Service for enterprises(IBS)	-	-	-	-	4
Employees/1000 lines	36	33	26	24	23

Table 2.2.8 Number of Installed Telephone Lines in Departments in the Study Area and Guatemala City (1992)

Department	House lines	No. of lines/ 1000 persons	Emergency telephone	Public telephone	Community telephone
Guatemala*	4,731	4.8	2	68	35
Sacatepeques	1,176	6.3	2	29	17
Chimaltenango	1,828	5.2	1	15	23
Solola	3,026	12.1	2	18	19
Totonicapan	370	1.2	1	16	10
Quaetzaltenango	4,469	7.8	3	74	25
Others	26,724	4.5	50	220	186
Subtotal	42,324	4.9	61	440	315
Guatemala City	172,085	159.5	8	1,811	-
Total	214,409	22.0	69	2,251	315

* Excluding lines in Guatemala City

Table 2.2.9 Sewer System of the Departments in the Study Area

Department	No. of Municipalities			
	Type A	Type B	Type C	Without Sysyem
Guatemala*	8	3	2	3
Sacatepeques	10	3	2	1
Chimaltenango	12	3	1	0
Solola	7	1	0	11
Totonicapan	5	1	2	0
Quetzaltenango	13	5	2	4

* Excluding Guatamala City
Type A: Only human and domestic waste
Type B: Mixed of human waste, domestic waste and rain water
Type C: Separate system

Table 2.2.10 Ratio of Households connected to the Sewer System in the Urban Area and Population without Connection of the Departments in the Study Area

Department	Urban households (%)	Population without connection (%)
Guatemala*	79	34
Sacatepequez	61	54
Chimaltenango	78	69
Solola	70	75
Totonicapan	71	89
Quetzaltenango	80	69

* Excluding Guatamala City

Table 2.2.12 Present Situation of Education in Guatemala (1992)

Elementary schools (Total number of schools: 10.088)

Area	Urban	Rural
Total enrolled students No.	1.340.917	
Area	42.5 %	57.5 %
Boys	54.3 %	
Girls	45.7 %	
First grade	32.6 %	
Sixth grade	8.3 %	
Without desk	16.0 %	
St./Teacher	30.7	40.4
Total students overaged 1st grade	62.4 %	
Ratio of student enrolled at 1st grade to the total population of age 7	56.6 % (girl: 55.1 %, boy: 58.0 %)	
Cost/Student	15.8 Qs	

Secondary school (Total number of schools: 1.529)

Area	Urban	Rural
Total student	218.022	
Total	90.5 %	9.5 %
Girls	28.5 %*	
Boys	33.1 %*	

*: Ratio of enrolled student number to the total population age 13 to 15

Table 2.2.11 Decreasing Ratio of Enrolled Girl Students with Grade (1991) (%)

Year	6	7	8	9	10	11	12	13	14	15	Total
Girl	47.9	47.6	47.3	46.9	46.1	45.4	43.7	40.9	39.0	36.7	45.3
Boy	52.1	52.4	52.7	53.1	53.9	54.8	56.3	59.1	61.0	63.3	54.7

Table 2.2.13 Percentage of the Households with Water Supply Service in each Department

Department	%	Department	%	Department	%
Total Republic	56.5	*Totonicapan	62.2	Retalhuleu	49.2
		El Progreso	61.3	Quiche	47.5
*Guatemala	79.5	Escuintla	53.3	Chiquimula	46.4
*Sacatepequez	74.1	Izabal	53.0	Jutiapa	43.0
*Solola	72.6	Huehuetenango	52.0	Jalapa	39.6
Zacapa	66.4	Suchitepequez	51.4	Santa Rosa	37.7
*Quetzaltenango	62.9	San Marcos	51.3	Alta Verapaz	28.4
*Chimaltenango	62.7	Baja Verapaz	49.7	Peten	27.1

* Departments in the study area.

Table 2.2.14 Percentage of the Households with Toilet in each Department (1992-1993)

Department	%	Department	%	Department	%
Total Republic	74.6	*Chimaltenango	85.0	Izabal	66.4
		El Progreso	80.0	Quiche	59.2
*Sacatepequez	94.4	Baja Verapaz	77.1	Santa Rosa	58.0
*Guatemala	91.2	*Totonicapan	74.2	Suchitepequez	54.4
Alta Verapaz	87.7	Zacapa	74.1	Peten	51.8
San Marcos	86.1	Escuintla	73.1	Jutiapa	47.2
*Quetzaltenango	85.8	Retalhuleu	71.4	Chiquimula	45.2
*Solola	85.3	Huehuetenango	69.8	Jalapa	37.4

* Departments in the study area.

Table 2.2.15 Birth Rate and Mortality

Year	Birth Rate per 1000	Mortality per 1000	Infant Mortality per 1000
1980	44.0	10.3	65.2
1983	40.8	9.9	-
1986	39.0	8.5	-
1989	38.6	7.2	-
1990	38.3	7.9	48.0
1991	37.1	6.8	42.5
1992	35.9	5.8	-
1993	34.8	5.6	33.3

Table 2.2.16 Fertility and Infertility in Guatemala (1991)

Department	Population	Rural Population (%)	Indigenous Population (%)	Birth Rate per 1000	Growing Rate per 1000	Mortality during Pregnancy per 100000 INE 90	Mortality of Infant per 10000 INE 91	Mortality of Mother per 10000 DGSS 89
*Guatemala	2,018,179	14	10.3	34.4	24.5	50	42.5	7
Alta Verapaz	591,911	85	93.7	39.2	32.1	40	39.3	24
Baja Verapaz	184,462	90	60.1	37.5	31.5	43	35.1	13
Izabal	326,402	78	1.3	16.9	13.4	40	33.9	20
Chiquimula	252,052	76	10.9	40.0	33.5	38	36.8	7
Zacapa	161,644	71	17.0	59.1	49.5	38	27.6	9
El Progreso	108,399	72	0.3	35.2	28.2	56	48.3	21
Jutiapa	354,377	79	1.1	41.5	35.2	38	30.6	8
Jalapa	190,847	71	4.5	45.1	38.2	38	34.4	10
Santa Rosa	267,790	76	0.4	36.5	30.1	48	35.3	10
*Chimaltenango	343,818	60	42.1	19.2	15.7	71	45.2	20
*Sacatepequez	180,155	26	71.9	73.9	61.6	70	50.4	13
Escuintla	542,091	63	8.9	27.8	21.1	59	66.9	9
San Marcos	557,831	87	45.3	33.6	27.3	85	51.1	12
*Quetzaltenango	702,288	61	36.3	53.4	45.3	35	34.0	7
*Totonicapan	297,483	85	72.7	44.7	35.7	93	67.1	12
*Solola	242,067	64	70.5	41.2	32.7	85	55.0	21
Retalhuleu	238,857	71	23.3	33.0	26.4	54	44.2	8
Suchitepequez	361,678	67	42.2	38.4	30.3	64	50.7	12
Huehuetenango	716,666	85	74.0	41.7	36.2	33	31.0	20
El Quiche	574,746	88	98.8	37.5	30.4	43	41.2	17
Peten	253,326	66	12.6	42.6	36.2	58	43.4	18
Total Republic	9,467,069	60	41.9	36.0	29.4	51	42.5	13

* Departments in the study area

Table 2.2.17 Daily Consumption of Main Foods in Urban and Rural Areas (1991)

Area / Food	Urban (gs)	Urban % of Total Energy	Rural (gs)	Rural % of Total Energy
Corn	251	24.5	454	45.0
Wheat	107	18.4	51	9.4
Egg	33	2.1	20	1.3
Fruit	96	3.1	58	1.9
Dairy Products	75	6.3	33	2.4
Meat	55	2.9	35	2.0
Beans	51	8.2	62	10.2
Sugar	84	15.2	77	14.2
Others	271	19.8	221	13.6
Total (gs. Kcal)	1.023	2.100.0	1.011	2.061.0

Table 2.2.18 Contribution of Main Proteins and Energy per Capita in the Differet Categories of Monthly Income in Guatemala (1991)

Protein / Category	Corn (gs)	Corn (%)	Beans (gs)	Beans (%)	Meat (gs)	Meat (%)	Dairy Product (gs)	Dairy Product (%)	Total (gs)	Consumed Total Protein (gs)	Consumed Total Energy (Kcal)
< 550 Q	23.2	41.7	13.4	24.1	5.7	10.3	2.8	5.0	76.6	55.6	2.062
550 - 900 Q	17.3	31.5	11.9	21.6	7.6	13.8	4.1	7.5	74.4	55.0	2.071
> 900 Q	13.6	23.7	8.3	19.9	9.8	17.1	5.6	9.8	70.7	57.3	2.113
Republic Guatemala	20.1	36.5	12.7	22.9	6.8	12.3	2.4	4.3	76.0	55.4	2,074

Table 2.2.19 Daily Comsumtion of Main Foods (Corn, Beans, Wheat, Sugar, Fat) and Energy in the Different Regions in Guatemala (1991)

Region	gs	% of Ration	Total Energy (Kcal)
Metropolitan	435	76.0	2,406
Central	544	82.7	2,015
North	597	84.2	2,234
Atlantic Coast	596	78.5	1,973
Oriental	565	83.8	2,131
Pacific Coast	607	80.7	1,979
Highland	620	84.8	1,919
Republic Guatemala	563	81.6	2,074

CHAPTER 3

3. WATER SUPPLY CONDITION IN THE STUDY AREA

3.1 Administrative Organization

The water supply and sanitation sector in Guatemala is not unified under the jurisdiction of a single authority. Rather, it falls under the fragmented responsibility of several government offices and decentralized institutions, serving either urban or rural areas.

The Ministry of Public Health and Social Welfare (MSPAS) is in charge of the rural area through two offices:

- the Environmental and Sanitation Division (DSM) is under the General Bureau of Health Services, and is in charge of planning, design and construction of water systems and sewerage in small towns of less than 500 inhabitants living in dispersed settlements. It also advises the local committees on the operation and maintenance of aqueducts in the rural area. DSM has an executing office named PAYSA (Projects of Potable Water and Sewerage in the Plateau Area); and

- UNEPAR (Executing Unit for Rural Aqueduct Programs) has similar responsibilities. It builds and supervises water and sewerage projects in towns with over 500 inhabitants, financially supported by external resources. Assistance to the communities includes operation and maintenance of water systems and sanitary education.

According to the Municipal Code, the municipalities are responsible for the administration, operation and maintenance of the urban water supply and sewerage systems, and they do it partially with their own finances.

A large proportion of municipal populations of Guatemala and neighboring municipalities, such as Mixco, are supplied with drinking water and sewerage services by EMPAGUA (Municipal Water Supply Corporation of Guatemala City).

In the area surrounding Guatemala City, these services are provided by five (5) municipalities and several private companies, for instance the "Compañia de Agua Mariscal", which controls about 10% of the water connections in the municipality of Guatemala. A very high percentage of the water volume supplied to the metropolitan area of Guatemala is provided by the National Aqueduct Xayá-Pixcayá Project.

Currently, the coordination, planning, management, supervision and administration of national water resources are supervised by the Secretariat of Hydraulic Resources (SRH), organized on April 1992 to formulate water development strategies in the country and to regulate the use, preservation and protection of water. The SRH carries out its activities through national agreements and with aid from international organizations.

A Permanent Committee for the Coordination of Potable Water and Sewerage (COPECAS) was established in 1985, with the participation of INFOM, EMPAGUA, UNEPAR. It coordinates the activities of public institutions concerned with potable water supply and sanitation services.

3.2 Water Quality

3.2.1 Water Quality Standard

Water Quality Standard was established in Guatemala by the Guatemala Committee of Standard -COGUANOR- in 1984, which fixes drinking water quality values (Data book: Chapter 3).

Acceptable Maximum Limits (AML) and Permissible Maximum Limits (PML) are established for each quality characteristics.

AML: The highest acceptable degree of concentration of water properties. When concentration exceeds this level, it does not necessarily harm users, but may be intolerable to some in terms of taste.

PML: The highest degree of concentration of water properties. A degree of concentration higher than this is not acceptable.

In 1983, INFOM has established its own water quality standards.

INFOM's standards include Chemical Quality Parameters such as Dissolved Oxygen and Ammonium Nitrogen, as well as Chemical Indicators for Pollution (C.O.D., B.O.D., Total Nitrogen, Ammonia and Grease).

3.2.2 Quality of Water from the Existing Source

Several parameters were used to determine the appropriateness of the water quality of existing sources for drinking and domestic use by using simple methods (Data book: Chapter 3).

General and coliform bacterial numbers indicate how terribly insanitary the water quality of many sources for drinking are.

INFOM occasionally checks the quality of the present water supply and advises on how to treat water, improve sanitary conditions, among others (Data book: Chapter 3).

A lot of children suffer from and die of diarrhea due to poor water quality. Except for a few municipalities in the Study Area, all water are supplied without any treatment, thereby effecting bacterial contamination. Bacteria was also detected even in treated water due to insufficient treatment.

INFOM advises the operators of the treatment plants on the water treatment methods, especially in places plagued with cholera. This advice is only followed up once however regardless of the knowledge that diarrhea and other intestinal infections result from poor water quality. The continuous implementation of water treatment measures is usually hampered by financial reasons.

3.2.3 Drinking Water Quality in Ten Municipalities

Water analysis was conducted in order to determine the potability of the water sources of ten municipalities using the established drinking water quality standards.

Ten samples from each of the existing water supply sources and newly drilled wells were collected and analyzed.

The following physical and chemical parameters were measured and analyzed: Appearance, Taste, Odor, Color, Temperature, pH, EC, Turbidity, Total-Hardness, COD (Mn), Chloride, No_2-N, NO_3-N, NH_4-N, Cr^{6+}, T-Fe, Cu, Pb, Zn, As, Cd, Mn, General bacterial numbers, Total coliform numbers and positive or negative Fecal coliform.

The results are summarized with the comments on the suitability of drinking water supply in accordance with the criteria of COGUANOR (Tables 3.2.1 and 2, Data Book: Chapter 3).

(1) Quality of water collected from the distribution tanks

EC found in water from the tanks was quite low, varying from 55 to 340 µS/cm. These values do not exceed the standard values established.

The water from Santa María de Jesús was not generally hard (30.52 - 63.05 mg/ℓ as $CaCO_3$), although the values were slightly higher (138.30 mg/ℓ) than the AML and much lower than PML.

Almost all of the water samples, except those from Sololá, were colored, ranging from 5 to 10 µ. Especially in San Pedro Sacatepéquez, the value, at 10 µ was higher than AML. The water samples from all tanks, however, showed 0 turbidity. Therefore, these Color occurrences are not caused by organic matter, in particular humus soil. All Color values are lower than PML.

Although lower than AML, the value of total solids found in water samples from tanks was relatively high (92.8 - 250.8 mg/ℓ) as it is composed of organic and inorganic matters. COD (Mn), which is used to indicate organic matter concentration, was not detected in the water from all tanks however.

COD (Mn) does not always represent the weight of actual organic matter because of the presence of $KMnO_4$, which is

usually lower than the actual organic weight. Nevertheless, this does not mean that water samples from all tanks are free of organic matter. A larger part of the total solids seem to be composed of inorganic matters and crystallized and occluded water.

The concentration of other chemical parameters (NO_3-N, T-Fe, Chloride and Zinc) were low.

Chlorine treatment at the reservoir tank is operated in three (S.J. Pinula, S.J. Comalapa and Sololá) out of 10 municipalities, where water, at least from the distribution tanks, is considered to be suitable for drinking.

Although water in Santa Lucía Utatlán does not undergo treatment, it is considered free of bacteria because general bacteria was detected at 10 CFU/mℓ and total coliform was lower than 2 MPN/100 mℓ.

Water samples from other tanks, on the other hand, were measured to have high concentrations of general bacteria (63 - 4,610 CFU/mℓ) and total coliform (23 - 1,100 MPN/100 mℓ). Except for samples from Génova where the water supply system seems to be contaminated with human waste, fecal coliform concentration was not detected.

(2) Water quality of newly drilled wells

Except for samples from Santa María de Jesús (460 CFU/mℓ), water samples from test wells contained considerably high concentrations of bacteria (1,400 - 4,353 CFU/mℓ).

Total coliform concentration was relatively low (3 - 23 MPN/100 mℓ) at all wells, although higher than AML, except in San Pedro Sacatepéquez (1,100 MPN/100 mℓ). Fecal coliform concentration was not detected at all wells.

The presence of bacteria is probably due to the use of surface water for drilling activities. The wells should be thoroughly cleaned before use. Conclusively, the physical and chemical qualities of water is suitable enough for drinking water.

Table 3.2.1 Suitability of the Existing Supplied Water as Drinking Water

Municipality	Characteristics of Quality	Comments for Suitability according to Guatemala Standard
S. J. Pinula	Hardness - soft water (32.54 mg/l) Residual Chlorine - 0 mg/l Color (5 u) - lowest value of MAL Total iron (0.12 mg/l) - slightly higher than MAL	Residual Chlorine was not found, but all bacterial numbers were lower then MAL. Water at the Distribution Tank-1 is acceptable as a drinking water.
S. P. Sacatepéquez	No Cl- treatment Hardness - moderate water (52.88 mg/l) Color (10 u) - higher than MAL General bacteria (1450 CFU/ml) and Total coliforms (93 MPN/100ml) - very much higher than the limit	Although Fecal coliforms were not detected, it is recommended to treat with chlorine, ozon and/or charcoal.
S. M. de Jesús	No Cl- treatment Total Hardness (138.3 mg/l) - slightly higher than MAL General bacteria (4610 CFU/ml) and Total coliforms (110 MPN/100ml) - very much higher than the limit	Same as above
S. M. Jilotepeque	No Cl- treatment Hardness - moderate water (63.05 mg/l) Total iron (0.39 mg/l) - slightly higher than MAL, but lower than MPL General bacteria (1030 CFU/ml) and Total coliforms (1110 MPN/100ml) - much higher, specially coliforms, than the limit	Same as above
S. J. Comalapa	Cl- gas treatment Hardness - soft water (32.54 mg/l) Total iron (0.11 mg/l) - slightly higher than MAL General bacteria (21 CFU/ml) and Total coliforms (<2 MPN/100ml) - lower than the limit	Although Color was detected (5 u), the supplied water at the tank is suitable for drinking water.
Sololá	Cl- gas treatment Residual Chlorine (1.0 mg/l) - the highest value of MPL Hardness - soft water (44.76 mg/l) NO3-N (5 mg/l) - detected General bacteria (4 CFU/ml) and Total coliforms (<2 MPN/100ml) - lower than the limit	The supplied water at the tank is suitable for drinking water. However, it is recommended to make residual chlorine not being higher than 0.5 mg/l.
S. L. Utatlán	No Cl- treatment Hardness - soft water (30.52 mg/l) General bacteria (10 CFU/ml) and Total coliforms (<2 MPN/100ml) - lower than the limit	Although the water is not trated, the supplied water at the tank is suitable for drinking.
Momostenango	No Cl- treatment hardness - soft water (24.41 mg/l) Color (5 u) - detected General bacteria (616 CFU/ml) - slightly higher than the limit Total coliforms (460 MPN/100ml) - much higher than the limit	Although Fecal coliforms were not detected, it is recommended to treat with chlorine, ozon and/or charcoal.
S. F. La Unión	No Cl- treatment Hardness - moderate water (54.97 mg/l) Total iron (0.18 mg/l) and Mn (0.16 mg/l) - higher than MAL, but lower tne MPL General bacteria (1336 CFU/ml) and Total coliforms (290 MPN/100ml) - much higher than the limit	Same as above
Génova	No Cl- treatment hardness - soft water (32.54 mg/l) Mn (0.16 mg/l) - higher than MAL NO3-N (10 mg/l) - detected General bacteria (63 CFU/ml) - much lower than the limit Total coiliforms (29 MPN/100ml) - higher than the limit Fecal coliforms - positive	Fecal coliforms were positive. It is strongly recommended to cut-off the effect of human waste on the supplied water and to treat it with chlorine, ozon and/or charcoal.

Table 3.2.2 Suitability of Water from the Newlly Drilled Well as Drinking Water

Municipality	Characteristics of Quality	Comments for Suitability according to Guatemala Standard
S. J. Pinula	Water is quite hard (152.54 mg/l), which is higher than MAL. Total residue at 104°C - although lower than MAL, quite high (309.2 mg/l) General bacteria (2200 CFU/ml) - extremely high	General and coliform bacterial numbers were very high, however, it is due to the effect of polluted river water used when the new well was drilled. Physical and chemical qualities indicate this water is suitable for drinking water.
S. P. Sacatepéquez	EC (380 uS/cm) - quite high Color (5 u) - detected General bacteria (2300 CUF/ml) and Total coliforms (1100 MPN/100ml) - much higher, especially coliforms, than the limit	Same as above
S. M. de Jesús	Total Hardness (128.1 mg/l) - slightly higher than MAL Total residue at 104°C (230.4 mg/l) - quite high, although lower than MAL General bacteria (460 CFU/ml) - lower than the limit Total coliforms (3 MPN/100ml) - slightly higher than the limit	Suitable for drinking water
S. M. Jilotepeque	Color (5 u) - detected Total residue at 104°C (223.6 mg/l) - quite high, although lower than MAL General bacteria (2250/ml) - much higher than the limit Total coliforms (23 MPN/100ml) - slightly higher than the limit	General and coliform bacterial numbers were very high, however, it is due to the effect of polluted river water used when the new well was drilled. Physical and chemical qualities indicate this water is suitable for drinking water.
S. J. Comalapa	General bacteria (1400 CFU/ml) and Total coliforms (39 MPN/ml) - much hgiher than the limit	Same as above
Sololá	EC (710 uS/cm) - higher than MAP, although lower than MPL General bacteria (4353 CFU/ml) - much higher than the limit Total coliforms (14 MPN/ml) - higher than the limit	Same as above
S. L. Utatlán	Hardness - moderate water (54.19 mg/l) Color (5 U) - detected General bacteria (1680 CFU/ml) - much higher than the limit Total coliforms (9.1 MPN/100ml) - slightly higher than the limit	
Momostenango	Hardness - soft water (22.39 mg/l) General bacteria (2130 CFU/ml) - much higher than the limit Total coliforms (11 MPN/100ml) - slightly higher than the limit	Same as above
Génova	Hardness - moderate water (22.39 mg/l) T-Fe (0.09 mg/l) - deetected General bacteria (2500 CFU/ml) - much higher than the limit Total coliforms (3 MPN/100ml) - barely higher than the limit	General bacterial number was very high, however, it seems the effect of polluted river water used when the new well was drilled. Physical and chemical qualities indicate this water is suitable for drinking water.

3.3 Water Supply System

3.3.1 Water Source

Due to the limited capacity of existing water supply sources, most of the municipalities, except the following, use the majority of these sources for drinking water supply:

a) Domestic and agricultural use

- Villa Canales (Gu) . . . . . (Spring)
- San Pedro Sacatepéquez . . . . . (Spring)
- Santa Catarina Barahona (Sa) . . . . . (Spring)
- San José Poaquil (Sa) . . . . . (Spring)
- Sololá (So) . . . . . (Spring)
- Santa Catarina Ixtahuacán (So) . . . . . (River)
- Nahualá (So) . . . . . (River)
- San Carlos Sija (Qu) . . . . . (River)
- Cajolá (Qu) . . . . . (River)
- Almolonga (Qu) . . . . . (Spring)

b) Domestic, Industrial and Commercial use

- Villa Nueva (Gu) . . . . . (Well)
- Mixco (Gu) . . . . . (Well/Spring)
- El Tejar(CH) . . . . . (Well)

The sources for domestic water use are classified into: spring, tube well, and river water. The percentage of each source is:

Spring:	67.78 %
Tube well:	31.11 %
River water:	1.11 %

(a) Spring Water

A total of 44 municipalities are using spring water as water source. Average spring production is 2.5 ℓ/sec. Water is generally collected in a concrete chamber and conveyed by natural flow to the distribution tank located at an elevation higher than the serviced area. Since such convenient spring sources have been fully exploited, pumping from lower places should be taken into consideration for additional spring source development.

(b) Groundwater

Twenty-six municipalities pump up groundwater from tube wells, which yield an average of 9.8 ℓ/sec. Since the electricity rate was doubled in 1994, most of the well pumps are operated for a very short time, 2-3 hours a day.

The Study Area may have potential for groundwater development, but the extraction of water from deep aquifers requires high energy cost. This is one of the major

problems, particularly in the Central Plateau Area where groundwater level is generally very deep.

(c) River water

Two municipalities (San Jose Poaquil and Chuarrancho) use river water because of the unavailability of other sources. The use of river water as a source, however, entails the following problems:

- unstable year-round supply
- deterioration of quality by contamination

3.3.2 Water Supply Facilities

All of the 96 municipalities have water supply facilities, although the type and scale are different by place, as shown in Table 3.3.1.

The water supply system consists basically of intake, transmission, and distribution facilities. Only a few municipalities have water treatment facilities.

(a) Intake Facilities

Intake facilities differ according to water source.

Spring and River Water :	Water is collected in a concrete chamber and piped to distribution tanks by natural flow or by pump pressure
Groundwater :	Water is extracted by motorized pumping, and directly transmitted to the distribution tank

In most municipalities, distribution tanks are installed in places higher than the residential area in order to lower distribution costs. If the production well is drilled at a lower elevation, a pump of greater capacity is required.

(b) Distribution System

Distribution facilities are composed of a tank and pipe network connected to individual houses or to communal faucets.

The distribution network of most municipalities have serious leakage problems due mainly to dilapidated pipes, especially of the asbestos-cement, and high internal pressure brought about by the large head of natural flow system.

The replacement of these dilapidated pipes or the installation of pressure reduction valves would be a more effective solution for some of the municipalities, rather than the development of new water sources.

The majority of the municipalities utilize spring water and groundwater, sources with generally good water quality. However, water quality analysis have indicated the existence of bacteria-related problems which may be attributed to the poor sanitary environment around the intake, storage, and distribution facilities. Only 16 of the 96 municipalities are equipped with disinfection systems, of which the majority are not functioning.

Table 3.3.1 Result of Survey on Existing Water Supply Systems (1)

GUATEMALA

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time	Operation Cost		W/Charge	M/Income
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S	(hs)	(Q/Month)	(Q/Month)	(Q/C/M)	(Q/Month)
1	Santa Catarina Pinula	2	2	-	2.521	1.635.12	-	-	1	610	CL	1.700		A	B	B	12.0	13.500	800	3.00	5.100
2	San Jose Pinula	-	4	-	1.536	768.10	-	-	2	750	CL	1.557		B	A	B	4.0	12.800	800	1.00	1.557
3	San Jose del Golfo	1	2	-	499	262.66	-	-	2	570	CL	330		A	A	B	6.5~12.0	6.000	800	5.00	1.650
4	Palencia																				
5	Chinautla	2	1	-	153	78.62	-	-	1	130	-			A	B	B	12.0	0	1.600	2.00	
6	San Pedro Ayampuc	2	2	-	623	399.17	-	-	2	240	-	540		B	B	B	5days 3.0h	6.000	800	3.00	1.620
7	Mixco	9	4	-	3.157	2.658.91	-	-	3	1.500	CL	2.500	10	B	A	B	2days 4.0h	85.000	2.000	10.00	25.000
8	San Pedro Sacatepequez	3 *	1	-	660	330.05	-	-	2	580	CL			B	A	B	8.0~16.0	3.000	800	1.50	
9	San Juan Sacatepequez	3	5	-	1.901	1.382.40	-	-	2	780	CL	1.625		B	B	B	12.0	6.940	3.674	2.00	3.250
10	San Raymundo	-	2	-	1.908	953.86	-	-	1	250	CL	825		B	A	B	3.0	6.000	800	6.00	4.950
11	Chuarrancho	1	-	1	961	480.82			1	320	-	250		A	A	B	24.0		800	10.00	2.500
12	Fraijanes																				
13	Amatitlan																				
14	Villa Nueva	1	5	-	5.745	4.858.99			2	2.100	CL	5.647	53	B	A	B	20.0	128.000	32.000	15.00	84.705
15	Villa Canales	1	3	-	15.008	9.447.84			2	150	-			B	A	B	4.0	6.000	800	1.50	
16	San Miguel Petapa																				

SACATEPEQUEZ

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time	Operation Cost		W/Charge	M/Income
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S	(hs)	Q/Month	Q/Month	Q/C/M	Q/Month
1	Antigua Guatemala																				
2	Jocotenango	1	3	-	3.404	1.702.08	-	-	1	450		1.258		A	A	B	12.0		800	4.50	5.661
3	Pastores																				
4	Sumpango																				
5	Sto. Domingo Xenacoj																				
6	Santiago Sacatepequez																				
7	San Bartolome M. Altas	2	2	-	1.158	596.16	-	-	1	140	-	750		B	B	B	20.0	3.000	700	7.00	5.250
8	San Lucas Sacatepequez																				
9	Santa Lucia M. Altas	-	2	-	691	345.60	-	-	2	300	-	700	-				4.0	4.000	3.710	4.00	3.780
10	Magdalena Milpas Altas	4	1	-	882	476.06	-	-	3	370	-	550		B	B	B	6.0	10.000	3.190	6.00	3.300
11	Santa Maria de Jesus	2	1	-	648	388.80	1	20	1	240	-	780	5	A	A	B	5days 1.5h	3.160	2.840	10.00	7.800
12	Ciudad Vieja	1	3	-	3.514	1.780.70	-	-	3	1.050	CL	3.300		A	A	B	24.0	24.345	3.000	5.00	16.500
13	San Miguel Duenas																				
14	San Juan Alotenango																				
15	San Antonio Aguas Cal.	3	1	-	877	803.52	-	-	1	200	-	600		B	B	C	24.0	0	580	1.00	600
16	Santa Catarina Barahona	4	-	-	1.519	759.63					-			A	A	B		0	800		

Probable Capacity
- Water source of gravity type 24hr/day operation
- Water source of pumping type 12hr/day operation

Water Sources
- N:Spring
- *:Pumping type
- P:Well
- R:River

Water supply Facilities
- C/Tank:Collection Tank
- D/Tank:Distribution Tank

Functioning
- C/F:Collection Facility
- T/S:Transmission System
- D/S:Distribution System

Functioning
- A:Good
- B:Fair
- C:Poor

Table 3.3.1 Result of Survey on Existing Water Supply Systems (2)

CHIMALTENANGO

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time (hs)	Operation Cost		W/Charge Q/C/M	M/Income Q/Month
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S		Q/Month	Q/Month	Q/C/M	Q/Month
1	Chimaltenango																				
2	San Jose Poaquil	2	-	1	266	266.11	-	-	2	220	CL	845		B	B	B	24.0	0	1,300	0.40	338
3	San Martin Jilotepeque	3	1	-	1,633	816.48	-	-	1	600	CL	1,300		B	B	B	5.5	3,000	2,100	2.50	3,250
4	San Juan Comalapa	2 *	1	-	3,439	1,719.36	-	-	3	750	-	1,164	71	C	B	C	4.0	3,000+ 2,500(G)	6,060	2.00	2,328
5	Santa Apolonia																				
6	Tecpan Guatemala																				
7	Patzun	3 *	-	-	1,460	730.08	2	85	2	720	CL	1,150		B	B	B	2days 4.0h	7,500(G)	4,000	4.00	4,600
8	San Miguel Pochuta																				
9	Patzicia	3 *	-	-	1,605	802.66	-	-	2	460	-	687		C	C	C	2days 2.0h	5,400(G)	600	0.85	584
10	Santa Cruz Balanya																				
11	Acatenango																				
12	San Pedro Yepocapa																				
13	San Andres Itzapa																				
14	Parramos																				
15	Zaragoza	5	1	-	1,172	1,036.37	-	-	3	580	CL	1,500		A	A	A	6.0	15,000	1,000	3.00	4,500
16	El Tejar	-	3	-	2,652	1,326.24	-	-	2	500	-	104		B	B	B	19.0	12,000	1,700	15.00	1,560

(G):Gasoline

SOLOLA

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time (hs)	Operation Cost		W/Charge Q/C/M	M/Income Q/Month
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S		Q/Month	Q/Month	Q/C/M	Q/Month
1	Solola	2	-	-	2,627	2,626.56	-	-	2	590	-	1,449	-	B	B	B	12.0	0	2,500	3.25	4,709
2	San Jose Chacaya																				
3	Santa Maria Visitacion																				
4	Santa Lucia Utatlan	4	-	-	162	162.43	-	-	3	90	-	149		B	B	B	2days 1.0h	0	700	3.00	447
5	Nahuala	3	-	-	300	299.81	-	-	3		-	550		B	B	B	5.0	0	800	0.25	138
6	Sta. Catarina Ixtahuacan	3	-	-	630	629.86	-	-	1	125	-	450		B	A	B	24.0	0	800	1.00	450
7	Santa Clara la Laguna						-	-	1	200		600	-								
8	Concepcion						-	-	1	50		128	5								
9	San Andres Semetabaj	8	-	-	82	82.08	-	-	1	140	-	350	-	B	B	B	6.0	0	420	0.50	175
10	Panajachel						-	-	1	633		1,560	8								
11	Sta. Catarina Palopo	2	-	-	270	269.57	-	-	2	160	-	220	9	B	B	B	3.0	0	500	1.00	220
12	San Antonio Palopo	1	-	-	36	36.29	-	-	1	122	-	300	18	B	B	B	6.0	0	500	1.00	300
13	San Lucas Toliman																				
14	Santa Cruz la Laguna						-	-	1	100		170	1								
15	San Pablo la Laguna						-	-	1	50		500	-								
16	San Marcos la Laguna						-	-	3	54		316	10								
17	San Juan la Laguna						-	-	1	200		550	-								
18	San Pedro la Laguna																				
19	Santiago Atitlan																				

Probable Capacity
- Water source of gravity type 24hr/day operation
- Water source of pumping type 12hr/day operation

Water Sources
- N:Spring
- *:Pumping type
- P:Well
- R:River

Water supply Facilities
- C/Tank:Collection Tank
- D/Tank:Distribution Tank

Functioning
- C/F:Collection Facility
- T/S:Transmission System
- D/S:Distribution System

Functioning
- A:Good
- B:Fair
- C:Poor

Table 3.3.1 Result of Survey on Existing Water Supply Systems (3)

TOTONICAPAN

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time (hs)	Operation Cost		W/Charge Q/C/M	M/Income Q/Month
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S		Q/Month	Q/Month		
1	Totonicapan																				
2	San Cristobal Totonic.																				
3	San Francisco el Alto	8	-	-	579	578.88	-	-	3	564	-	600		B	B	B	2.0	0	700	0.60	360
4	San Andres Xecul	1	1	-	199	198.72	-	-	2	300	-	608		B	B	B	1.0	0	3,500	0.50	304
5	Momostenango	2 *	-	-	1,227	786.24	-	-	2	700	-	600		B	B	B	3.0~12.0	1,500	600	3.00	1,800
6	Santa Maria Chiquimula																				
7	Santa Lucia la Reforma																				
8	San Bartolo Aguas Cal.																				

QUETZALTENANGO

No.	Municipality	Water Sources					Water supply Facilities and Functioning										Supply Time (hs)	Operation Cost		W/Charge Q/C/M	M/Income Q/Month
					Capacity (m3/day)		C/Tank		D/Tank		Disinf-	House	Pub. Con. &	Functioning				Electr. C.	Man. C.		
		N	P	R	MAX	Probable	Num.	Vol. (m3)	Num.	Vol. (m3)	ection	Connect.	Cistern	C/F	T/S	D/S		Q/Month	Q/Month		
1	Quetzaltenango											1,900								6.00	11,400
2	Salcaja																				
3	Olintepeque	1	1	-	1,043	562.03	-	-	2	400	-	360		B	B	B	2.0~4.0	1,400	1,000	5.00	1,800
4	San Carlos Sija	3	-	-	242	241.92	-	-	1	110	-	450		B	B	B	2.0	0	800	1.00	450
5	Sibilia																				
6	Cabrican											200								5.00	1,000
7	Cajola	6	-	-	159	158.98	-	-	1	250	-	400	-	B	B	B	5.0	0	1,000	0.50	200
8	San Miguel Siguila																				
9	San Juan Ostuncalco											596								1.50	894
10	San Mateo																				
11	Cpcion. Chiquirichapa	2	-	-	1,000	999.65	-	-	2	360	CL	890	-	B	B	B	3.0	0	740	1.00	890
12	San M. Sacatepequez	2	-	-	272	272.16	-	-	2	120	-	?		B	B	B		0	600	0.83	
13	Almolonga	1	3	-	5,251	3,656.45	-	-	3	1,200	CL	865		A	A	B	8.0~10.0	20,500	3,550	6.00	5,190
14	Cantel																			0.25	
15	Huitan	2	-	-	79	78.62	-	-	1	50	-	85		B	B	B	6.0	0	542	0.50	43
16	Zunil													B	B	B					
17	Colomba	2	-	-	1,501	1,500.77															
18	San Francisco la Union	1 *	-	-	51	25.49	1	60	1	55	-	100		B	B	B	2days 1.0h	700	960	5.00	500
19	El Palmar																				
20	Coatepeque											5,441								7.00	
21	Genova	7		-	262	261.79	-	-	1	140	CL	358	8	B	B	B	2.0	0	2,270	0.60	215
22	Flores Costa Cuca	1	(1)	-	675	354.59	-	-	2	250	-	300		C	B	B	0.25~4.0	0	840	0.75	225
23	La Esperanza																				
24	Palestina	-	1	-	1,200	600.05	-	-	1	100	-	300	-	A	A	B	24.0	1,000	700	10.00	3,000

Probable Capacity
Water source of gravity type 24hr/day operation
Water source of pumping type 12hr/day operation

Water Sources
N:Spring
*:Pumping type
P:Well
R:River

Water supply Facilities
C/Tank:Collection Tank
D/Tank:Distribution Tank

Functioning
C/F:Collection Facility
T/S:Transmission System
D/S:Distribution System

Functioning
A:Good
B:Fair
C:Poor

3.4 Operation and Maintenance of facilities

Operation and maintenance of the water supply facilities are undertaken by the municipal governments. Most of the municipalities assign persons to take charge of facility maintenance and such daily operation as valve control, chlorination, pumping rate control, etc.

However, this maintenance work is conducted without a permanent support from INFOM or any other organization. Moreover, information concerning the water supply system, for example, distribution network and construction drawings, are not kept in the municipal offices, thereby making systematic operation and maintenance difficult. Further, the technical level and basic knowledge of the operators in many of the municipalities, particularly in terms of sanitation, is not satisfactory.

Daily supply service time is generally limited to less than 8 hours in 50 of the 54 surveyed municipalities mainly due to two reasons: the shortage of water source, and the shortage of funds. In 7 of the municipalities, even with pumping restriction, the cost of electricity is higher than the total water charges collected (Table 3.3.1).

3.5 Water Charge Collection

The method used for water charge collection is unique in the Study Area. The water charge must be paid at the Municipal Treasury Office, in accordance with an INFOM regulation approved by the Municipal Corporation. However, the municipalities are partly autonomous and can revise their own water service rates. Either before or after the resolution, representatives of the beneficiaries are called to approve the new water tariffs. If they disagree, a new tariff will be fixed by mutual agreement. Finally, the agreed upon water rates are approved by the Ministry of Government and published in the Official Gazette.

Currently, the monthly water tariff in the Study Area ranges from Q0.25 (Nahualá, the lowest) to Q15.00 (Villa Nueva, the highest).

The level of tariff imposed depends mostly on the type of water transmission system, namely, low cost for the natural flow system, and high cost for the motorized pump system.

Table 3.5.1 shows the water service rates, the daily water service and the supply source of the concerned municipalities.

Table 3.5.1 Water Service Rate by Municipality

GUATEMALA

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Santa Catarina Pinula	3.00	5,100	12.0	2	2	-
2	San Jose Pinula	1.00	1,557	3.0	-	4	-
3	San Jose del Golfo	5.00	1,650	12.0	1	2	-
4	Palencia						
5	Chinautla	2.00			2	1	-
6	San Pedro Ayampuc	3.00	1,620	2h/e.3d	2	2	-
7	Mixco	10.00	25,000	4h/e.2d	9	4	-
8	San Pedro Sacatepequez	1.50		20.0	3	1	-
9	San Juan Sacatepequez	2.00	3,250	6.0	3	5	-
10	San Raymundo	6.00	4,950	3.0	-	2	-
11	Chuarrancho	10.00	2,500		1	-	1
12	Fraijanes						
13	Amatitlan						
14	Villa Nueva	15.00	84,705	20.0	1	5	-
15	Villa Canales	1.50		24.0	1	3	-
16	San Miguel Petapa						

SACATEPEQUEZ

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Antigua Guatemala	12.00	69,600				
2	Jocotenango	4.50	5,661	7.0-12.0	1	3	-
3	Pastores						
4	Sumpango						
5	Sto. Domingo Xenacoj						
6	Santiago Sacatepequez						
7	San Bartolome M. Altas	7.00	5,250	19.0	2	2	-
8	San Lucas Sacatepequez						
9	Santa Lucia M. Altas	4.00	3,780	3.5	-	2	-
10	Magdalena Milpas Altas	6.00	3,300	3.0-6.0	4	1	-
11	Santa Maria de Jesus	10.00	7,800	1.5	2	1	-
12	Ciudad Vieja	5.00	16,500	19.0-24.0	1	3	-
13	San Miguel Duenas						
14	San Juan Alotenango						
15	San Antonio Aguas Cal.	1.00	600	24.0	3	1	-
16	Santa Catarina Barahona				4	-	-

CHIMALTENANGO

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Chimaltenango						
2	San Jose Poaquil	0.40	338	24.0	2	-	1
3	San Martin Jilotepeque	2.50	3,250	5.5	3	1	-
4	San Juan Comalapa	2.00	2,328	1.0-4.0	2	1	-
5	Santa Apolonia						
6	Tecpan Guatemala						
7	Patzun	4.00	4,600	5h/e.2d	3	-	-
8	San Miguel Pochuta						
9	Patzicia	0.85	584	2.0	3	-	-
10	Santa Cruz Balanya						
11	Acatenango						
12	San Pedro Yepocapa						
13	San Andres Itzapa						
14	Parramos						
15	Zaragoza	3.00	4,500	2.0	5	1	-
16	El Tejar	15.00	1,560	19.0	-	3	-

SOLOLA

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Solola	3.25	4,709	3.0-13.0	2	-	-
2	San Jose Chacaya						
3	Santa Maria Visitacion						
4	Santa Lucia Utatlan	3.00	447	1h/e.2d	4	-	-
5	Nahuala	0.25	138	4.0-5.0	3	-	-
6	Sta.Catarina Ixtahuacan	1.00	450	24.0	3	-	-
7	Santa Clara la Laguna	0.50	300				
8	Concepcion	1.00	128				
9	San Andres Semetabaj	0.50	175	6.0	8	-	-
10	Panajachel	6.00	9,360				
11	Sta. Catarina Palopo	1.00	220	3.0	2	-	-
12	San Antonio Palopo	1.00	300	4.0	7	-	-
13	San Lucas Toliman						
14	Santa Cruz la Laguna	1.00	170				
15	San Pablo la Laguna	0.50	250				
16	San Marcos la Laguna	0.30	94.8				
17	San Juan la Laguna	0.50	275				
18	San Pedro la Laguna	1.00	1,060				
19	Santiago Atitlan						

TOTONICAPAN

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Totonicapan						
2	San Cristobal Totonic.						
3	San Francisco el Alto	0.60	360	2.0	8	-	-
4	San Andres Xecul	0.50	304	1.0	1	1	-
5	Momostenango	3.00	1,800	3.0	2	-	-
6	Santa Maria Chiquimula						
7	Santa Lucia la Reforma						
8	San Bartolo Aguas Cal.	1.00	425				

QUETZALTENANGO

No.	Municipality	Watre Charge W/Charge Q/C/M	Watre Charge Total Q/Month	Service Hours h/day	Water Sources N	P	R
1	Quetzaltenango						
2	Salcaja	6.00	11,400				
3	Olintepeque	5.00	1,800	3.0	1	1	-
4	San Carlos Sija	1.00	450	2.0	3	-	-
5	Sibilia						
6	Cabrican	5.00	1,000				
7	Cajola	0.50	200	5.0	6	-	-
8	San Miguel Siguila						
9	San Juan Ostuncalco						
10	San Mateo	1.50	894				
11	Cpcion. Chiquirichapa	1.00	890	3.0	2	-	-
12	San M. Sacatepequez	0.83			2	-	-
13	Almolonga	6.00	5,190	8.0	1	3	-
14	Cantel	0.25					
15	Huitan	0.50	101	6.0	2	-	-
16	Zunil						
17	Colomba				2	-	-
18	San Francisco la Union	5.00	500	1h/e.2d	1	-	-
19	El Palmar						
20	Coatepeque	7.00					
21	Genova	0.60	215	2.0	7		-
22	Flores Costa Cuca	0.75	225	15min-4h	1	1	-
23	La Esperanza						
24	Palestina	10.00	3,000	24.0	-	1	-