THE STUDY ON DISASTER PREVENTION IN THE BOGOTÁ METROPOLITAN AREA IN THE REPUBLIC OF COLOMBIA SUMMARY

1. INTRODUCTION

This is a summary of the Final Report (March 2002) for the Study on Disaster Prevention in the Bogotá Metropolitan Area in the Republic of Colombia, which has been conducted in accordance with the Scope of Work and the Minutes of Meetings agreed and signed between the Government of Colombia (Direction of Prevention and Attention of Emergencies of Bogotá D.C.: DPAE, Office for Prevention and Attention of Disaster Cundinamarca: OPAD and Colombian International Cooperation Agency: ACCI) and the Japan International Cooperation Agency (JICA) on November 27, 2000.

The Study Area is the Bogotá Metropolitan Area, which consists of the city of Bogotá and the eight municipalities of the prefecture of Cundinamarca, i.e. La Calera, Chia, Cota, Funza, Madrid, Facatativa, Mosquera and Soacha, and is shown in Figure 1. The Study Area covers 1,949 km² with a population of 6.99 million (in the projection for 2000). The city of Bogotá is the capital district of Santa Fe de Bogotá, which is also the capital of the Republic and of Cundinamarca prefecture. Due to the rapid increase of the urban population, the urban area of the city of Bogotá has been growing and expanding to the surrounding eight municipalities in the prefecture of Cundinamarca.

In the Study Area, various types of disasters such as landslides, floods and earthquakes, and also industrial hazards are actualized due to the rapid urban development. Since the beginning of the 1990s, the national, Bogotá and Cundinamarca governments have prepared their organizations to cope with landslides and floods, but not with the disaster by earthquakes.

In response to the request of the Government of the Republic of Colombia (hereinafter referred to as "GOC"), the Government of Japan (hereinafter referred to as "GOJ") decided to conduct "The Study on Disaster Prevention in the Bogotá Metropolitan Area in the Republic of Colombia" (hereinafter referred to as "the Study") through JICA, the official agency responsible for the technical cooperation program of GOJ, in accordance with relevant laws and regulations in force in Japan. In November 2000, JICA dispatched the Preparatory Study Team headed by Mr. Masayuki Watanabe to Colombia for the preliminary survey for the Study and discussed the Scope of Work with DPAE, OPAD and ACCI.

Under these circumstances the objectives of the Study are:

(1) To formulate the plan for disaster prevention, and

(2) To carry out the technology transfer to Colombian counterpart personnel in the course of the Study.

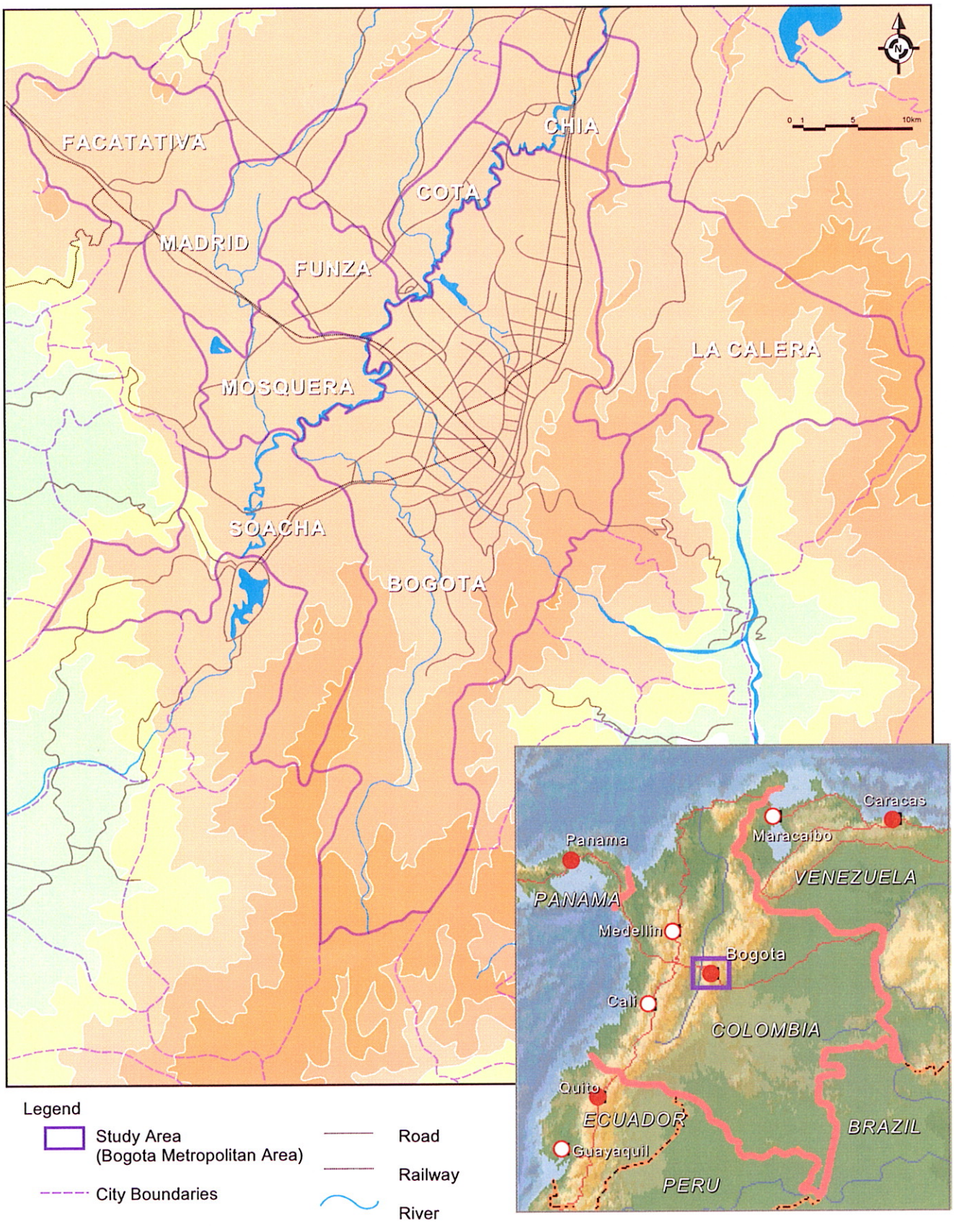


Figure 1 Study Area

The Study was conducted from mid April to mid September 2001 to March 2002.

In the Bogotá Metropolitan Area, the earthquakes over MSK Ⅶ of the past 100 years occurred in 1917, 1923 and 1967, and such magnitude of earthquake might happen again in the near future. In Colombia, a seismic resistant design has been applied for buildings since 1984, when the building regulation was established. However, a large number of buildings and infrastructure and lifeline facilities are still unable to meet the required seismic resistant capability. A large part of the buildings and bridges in the Bogotá Metropolitan Area will be collapsed in a big earthquake and become the most disastrous earthquake on record. However, the awareness for earthquake disaster among the governments, non-government entities and local communities is still very low. In order to cope with this type of disaster, arrangements have to made by the government entities, non-government entities and local communities of the Bogotá Metropolitan Area to enable them to carry out their responsibilities and functions for disaster prevention and also emergency response before, in and after a disaster.

During the Study a database designed for Oracle and Arc/Info operation has been developed as a basic tool for disaster management. It is based on a detailed zoning system as follows:

Area	Rural Area	Urban Area	Number of Zones
Bogotá City	Village Boundary	Cadastral Barrio	950
Eight Municipalities in Cundinamarca	Village Boundary	Urbanized area of Cadastral IGAC divided in DANE Sector	110
			Total:1,060

All basic data and information have been compiled in the database.

The organizations from which basic data and information were collected are shown as follows:

Items	Data Type	Organization
Earthquake	Earthquake data	INGEOMINAS
Population	Bogotá Cundinamarca	DAPD Each municipality and DANE
Building	Bogotá Cundinamarca	Bogotá City Cadastral Department IGAC
Infrastructure	Road network and bridge locations Water pipe distribution Telecommunication network Gas supply network Electronic supply network	IDU EAAB CAPITEL NATURAL GAS CODENSA
Others	Open space Public facilities (Fire fighting station, Civil defense, Red Cross, Police station, Military station, Public and private hospitals, Educational facilities)	IDRD Fire fighting Office, Civil Defense, Red Cross, Police Department, Ministry of Defense, Secretary of Health, Secretary of Education, etc.

For protection and mitigation of the lives and assets of the people in the Bogotá Metropolitan Area from future seismic disasters, it is indispensable for the Bogotá Metropolitan Area to strengthen the urban areas against seismic disasters. The basic measures studied for the Bogotá Metropolitan Area are as follows:

(1) Arrangement of disaster prevention entities;
(2) Strengthening of buildings, infrastructure and lifeline facilities in urban areas;
(3) Arrangement of emergency response;
(4) Enhancement of public awareness.

During the Study, Workshop 1 and 2 and Seminar 1 and 2 were carried out by the Study Team.

2. CONDITIONS OF THE STUDY AREA

2.1 Earthquake

1) Past Earthquakes

The earthquake occurrences in Colombia have been recorded since 1566. The instrumental observation of earthquakes was started in 1922 and the seismic monitoring network became sufficiently dense to calculate focal depth in 1957. The national seismic monitoring network has been in operation since 1993 and now the country has 89 stations, of which 11 stations are in the prefecture of Cundinamarca.

According to a report on the past environmental disasters in Cundinamarca, for the period 1923-1997, 68 earthquakes were recorded in Cundinamarca and 34 in the Study Area.

As for comparatively large earthquakes, according to the other study by INGEOMINAS, the Study Area has experienced seven times of MSK intensity over VII since1600 as follows.

Table 1 List of Major Earthquakes that Affected the Study Area

Year	Month	Date	Latitude	Longitude	Maximum Intensity	Intensity in Bogotá	Epicenter
1616	2	--	5.00	74.00	VII		Cajica
1644	1	16	7.40	72.70	IX	VI	Pamplona
1644	3	16	4.50	74.00	IX		Chipaque
1646	4	3	5.70	73.00	VIII		Sogamoso
1743	10	18	4.40	73.90	VIII	VII	Paramo de Chingaza
1785	7	12	4.70	73.80	IX	VIII	Paramo de Chingaza
1826	6	17	4.80	73.90	VIII	VII	Sopo
1827	11	16	1.90	75.90	X	VIII	Timana
1917	8	31	4.26	74.15	IX	VIII	Paramo de Sumapaz
1923	12	22	4.40	73.20	VIII	VII	Paratebueno
1924	1	7	4.70	73.50	VIII		Gachala
1928	11	1	5.50	71.50	VII		El Milagro
1967	2	9	2.93	74.00	IX	VII	Los Cuachos
1967	7	29	6.84	74.09	VIII	VI	Chucuri

Source: Microzonificación sísmica de Bogotá City, INGEOMINAS, 1997

2) Expected Seismic Level in the Study Area

The Colombian Standard for Earthquake Resistant Construction, prepared by the Colombian Association of Seismological Engineering (AIS) in 1996, served as the basis of the Seismic Hazard Maps. Consequently, the country was classified into nine zones according to the expected maximum acceleration and the Study Area is located in the zone classified as level 5 (maximum base rock acceleration: 0.2g), a medium hazard level zone.

2.2 Landslide

1) Historical Records

Records of environmental disasters in Cundinamarca in the past (1923-1997) showed that there were 121 landslides which claimed 82% of total disaster casualties.

From 1996 to 2000, in the Bogotá Metropolitan Area, 404 events of slope disaster occurred, consisting of landslides (283 events), falls (82 events) and flows (39 events).

2) Landslide Hazard Areas

Most of the landslide hazard slopes are distributed at the steep slopes of the eastern and southern parts of Bogotá, and many of them are located on housing development areas, abandoned quarries and steep slope areas.

A total of 423 landslide hazard slopes were identified in the Study Area based on the information gathered on landslides in the past five years. Prior to the field survey, the interpretation of aerial photographs taken in 1993, 1994, 1996, 1997, and 1998, were conducted, and also the satellite 3D image (March 2001) were used as supplemental information to identify changes in landform, vegetation cover and landslides occurred after 1998.

The 423 potential landslide hazard areas were evaluated based on the diagnostic documents by DPAE and the field survey. The primary factor for evaluation is urgency of the alleviation of human damages by non-structural measures like evacuation or relocation, and the secondary factor is scale of the objects to be protected, of which damage is difficult to be alleviated by non-structural measures. Also, the progress of the countermeasures planned by DPAE has been reviewed and the landslide hazard slopes have been evaluated. The factors for assessment of hazardous slopes and the results are shown in the following tables.

Table 2 Assessment of Hazardous Slope for Risk Classification

Scale of damage (Sub priority factor) / Emergency measures (Priority factors)		Influential to multiple and large facilities	Influential to single and/or minor facilities
		A	b
Urgency (in the same day of the event)	A	Aa: Grade-1	Ab: Grade-1
Dangerous in a few days	B	Ba: Grade-2	Bb: Grade-3

Note:
Grade-1: The area requires structural measures or relocation of inhabitants for protection of inhabitants,
Grade-2: The area requires some structural measures or non-structural measures for protection of inhabitants,
Grade-3: The area requires only non-structural measures for protection of inhabitants.

Table 3 Result of Risk Classification of Slope

City/Municipality	Risk Classification			Total
	Grade 1	Grade 2	Grade 3	
Bogotá	77	50	245	372
Chia	0	1	3	4
Cota	2	2	2	6
Funza	0	0	0	0
Mosquera	2	1	0	3
Madrid	1	0	1	2
Facatativa	2	3	2	7
Soacha	8	9	4	21
La Calera	2	2	4	8
Total	94	68	261	423

2.3 Floods

1) Existing Situation

Majority of the Study Area belongs to the Rio Bogotá basin, of which the main stream flows along the west border of the urban area of Bogotá, and the drainage basin is 4,400 km² at Alicachin gate downstream of Soacha. The riverbed slope of the main stream along the urban area is as gentle as less than 1/5,000.

The area has two rainy seasons from April to June and from September to November. The mean annual precipitation of Bogotá City is 960 mm, but the rainfall depth varies locally from less than 500 mm to over 1,500 mm, less at the southeast region of the lower reach and more at the southeast and northwest of the upper reaches.

Both the flood frequency and the flood damage are low and small, but most of the city or municipalities have drainage problems. The present situations at the city of Bogotá City and the eight municipalities of Cundinamarca are shown in Table 4.

For the management of the Rio Bogotá basin, there are many entities involved in it, but no one entity managing it as a whole. The left bank (the east side or Bogotá City Side) is under the management of the city of Bogotá and EAAB, and the right bank (the west side or Cundinamarca side) is under CAR, the related municipalities and Cundinamarca prefecture. It shall be important to arrange or establish an entity for managing the water environment of the Rio Bogotá basin, considering the existing situation of water resources and water quality.

Table 4 Summary of Floods and Inundation Problems

	Causes of Problem			Remarks
	By Rio Bogotá (or mainstream)	By tributaries	By poor drainage system	
Bogotá	Yes	Yes	Yes	No overflow from Rio Bogotá is reported since 1976.
Chía	Yes	No	Yes	Rio Frio had a problem before improvement.
Cota	No	No	-	
Facatativa	Yes (Rio Botello)	No	Yes	Less capacity of the river and building construction in low-lying area causes inundation problem.
Funza	No	No	Yes	The problem is difficulty of drainage to Rio Bogotá.
La Calera	No	Yes (Qda. Toma)	No	The causes of the inundation by Qda. Toma is inappropriate treatment of stream course.
Madrid	No	No	-	
Mosquera	Yes	Yes	Yes	Illegal housing has been developed in low-lying area along Rio Bogotá.
Soacha	No	Yes	Yes	No overflow from Rio Bogotá is reported, however, dike of the river was damaged and inundated in 1998.

2) Flood Hazard Area and Affected Population in the Study Area

(1) Bogotá

The existing flood risk map prepared by DPAE in 2000 is based on "the Flood Risk Zoning Studies on all possible inundation areas in Bogotá," which were conducted from 1999 to 2000, based on the analysis of hazard, vulnerability and prevention. However, the flood risks map in the POT of Bogotá shows only the flood hazard areas of 10-year and 100-year flood return periods under the current land use and river conditions. In future, a more detailed assessment of the flood hazard areas based on land use is necessary.

The major flood hazard areas of the Rio Bogotá are identified at the housing development areas in the low-lying area along the river.

At the east slope of Bogotá City, there are many steep tributaries, which flow into the urban area of Bogotá. Currently, no record of flood or debris flows from those tributaries exists, but they should be watched closely because of the possibility of such occurrences owing to the geomorphologic conditions of the area.

The areas affected by the floods are estimated to be 6,760 ha and the affected households and population are estimated to be 496,800 (households: 83,900) as shown in the following tables:

Table 5 Areas Affected by Floods (Bogotá City)

Affected Zone	Flooding Area (ha)
High Risk Zone	2,300
Medium Risk Zone	3,500
Low Risk Zone	960
Total	6,760

Source: JICA Study
Note: 1. High-risk zone: By floods up to 10-year return period
2. Medium risk zone: By floods from 10-year to 100-year return period
3. Low risk zone: By floods over 100-year return period

Table 6 Affected Households and Population by Inundation (Bogotá City)

Affected Zone	Affected Household	Affected Population
High Risk Zone	16,200	84,400
Medium Risk Zone	46,900	284,100
Low Risk Zone	20,800	128,300
Total	83,900	496,800

Source: JICA Study

(2) Eight municipalities in Cundinamarca

The flood hazard map of the eight municipalities based on the POT of municipalities takes into account their past flood records, and is not based on hydrological/hydraulic analysis. Moreover, it is necessary for the flood hazard areas to be assessed in detail from disaster prevention aspects.

The areas affected by floods are estimated to be 4,050 ha based on the flood hazard map provided by the municipalities of Cundinamarca, but this figure includes an assumed area of the affected area by the failure of Terreros Dam in Soacha. The affected populations and households by inundation in the eight municipalities of Cundinamarca are estimated to be 118,430 and 16,015, respectively. These numbers also include those affected by the failure of Terreros Dam in Soacha. The details are shown in the following tables.

Table 7 Affected Areas by Floods in Eight Municipalities

Municipality	Inundated Area (ha)	Ratio of Affected Area (%)
Chia	520	6.5
Cota	920	17.2
Facatativa	210	1.3
Funza*[1]	80	1.1
La Calera	1,320	4.2
Madrid	-	-
Mosquera*[1]	20	0.2
Soacha	980 *[2]	5.3
Total	4,050	35.8

Source: JICA Study
*1: Municipalities that do not have their own POT data for Flooding. Data was obtained from flood risk of neighboring municipalities.
*2: Includes the affected area by the failure of Terreros dam.

Table 8 Affected Households and Population by Floods in Eight Municipalities

Municipality	Affected Household	Affected Population	Ratio of Affected Population
Chia	860	3,140	4.8
Cota	410	1,610	10.7
Facatativa	2,450	16,520	18.3
Funza	10	40	0.1
La Calera	120	440	1.9
Madrid	-	-	-
Mosquera	5	20	0.0
Soacha	12,160 *	96,660 *	17.6
Total	16,015	118,430	53.4

Source: JICA Study
* Includes the affected area by the failure of Terreros dam.

2.4 Industrial Hazards

The basic data of industrial facilities in Bogotá were collected by DPAE in 1999, and the Study Team has collected those in the eight municipalities in Cundinamarca.

1) Distribution of Potential Industrial Hazards in Bogotá

According to the basic data, the distribution of industries and potential technological threads (Spill, Leak, Fire and Explosion) in Bogotá are summarized as follows:

- About 78% of the industries having potential technological threads are distributed in the eight localities of Puente Aranda, Fontibon, Kennedy, Enqativa, Barrios Unidos, Usaquen, Los Martires and Suba.
- About 80% of the selected industries are micro and small industries based on the size classification criteria which considered the gross assets reported by the Chamber of Commerce.

- Most of the emergencies have occurred within the activities related to the distribution of liquids or gaseous fuel, followed by the distribution of chemical substances in general and then by the waste disposal. However, at the moment there are no regulations in Colombia that control the transportation of hazardous materials.

2) Industrial Accidents in Bogotá from 1979 to 1998

The number of industrial accidents related to spills, leaks, fires and explosions numbered 204, of which 109 were fires. The most dangerous materials by their frequency and impact were gunpowder (including Christmas hot air balloons), propane, gasoline, ammonia, solvents, natural gas, chloride and hydrochloric acid.

3) Industrial Accidents in Eight Municipalities from 1989 to 2001

On the other hand, there were 25 industrial accidents related to the leak of chemical substances in the gaseous state, followed by spills of chemical substances with flammable characteristics. Nevertheless, the explosions and the fires are less frequent. The municipality that has been affected most is Soacha, followed by Funza, Chía, Facatativá and the locality of Fontibón.

2.5 Socio-economy

1) Population Growth in Colombia

The population of Colombia has been increased by an annual growth rate approximately 2% to 3% since 1951. Among the major cities, Bogotá shows the highest growth rates and its population accounted for 15.3% of the national population in 2000.

Table 9 Population Growth in Colombia

	Population				Population Growth		
	1951	1985	1993 Adjusted Pop of 93	2000 Estimate	1951-1985	1985-1993	1993-2000
Colombia	11,454,760	30,062,207	37,145,322	42,209,299	2.88%	2.68%	1.84%
Santafe de Bogota DC	676,099	4,447,601	5,355,979	6,437,842	5.70%	2.35%	2.66%
Barranquilla	302,046	1,156,320	1,090,618	1,276,540	4.03%	-0.73%	2.27%
Cali	304,012	1,674,054	1,847,176	2,087,758	5.15%	1.24%	1.76%
Medellin	413,933	2,050,001	1,834,881	2,043,585	4.82%	-1.38%	1.55%

Source: Projection of Population by the area for Municipalities, Colombia 1995-2000, DANE

2) Population in the Study Area

The population and population density of each locality for 2000 in the city of Bogotá and in the eight municipalities are shown in the following tables. The top three heavily populated localities are Kennedy, Engativa and Suba. Also, the top three localities of high population density are Rafael Uribe, San Cristobal and Ciudad Bolivar, which are located in the southeastern part of Bogotá.

Table 10 Population and Population Density of Bogotá by Locality

	Locality	Population (in 2000)	Urban Area (ha)	Population/ha
1	Usaquen	421,320	4,277.07	98.51
2	Chapinero	122,991	1,349.39	91.15
3	Santa Fe	107,044	662.05	161.69
4	San Cristobal	455,028	1,677.40	271.27
5	Usme	244,270	2,220.35	110.01
6	Tunjuelito	204,367	1,062.33	192.38
7	Bosa	410,099	1,930.11	212.47
8	Kennedy	912,781	3,786.16	241.08
9	Fontibon	278,746	3,323.03	83.88
10	Engativa	749,068	3,612.27	207.37
11	Suba	706,528	9,139.60	77.30
12	Barrios Unidos	176,552	1,190.35	148.32
13	Teusaquillo	126,125	1,419.32	88.86
14	Los Martires	95,541	650.67	146.83
15	Antonio Nariño	98,355	493.74	199.20
16	Puente Aranda	282,491	1,723.13	163.94
17	Candelaria	27,450	164.14	167.24
18	Rafael Uribe	384,623	1,344.71	286.03
19	Ciudad Bolivar	575,549	2,088.78	275.54
	Total	6,378,928	42,114.60	151.47

Source: DAPD Poblacion, estratificacion y aspectos socioeconomicos de Bogotá city

Table 11 Population and Population Density of the Eight Municipalities

	Municipality	Urban Population 2000	Urban Area (ha)	Density
1	Chia	56,522	722	78.29
2	Cota	6,665	138	48.30
3	Facatativa	82,409	698	118.06
4	Funza	47,670	542	87.95
5	La Calera	15,637	94	166.35
6	Madrid	44,485	593	75.02
7	Mosquera	24,227	1,074	22.56
8	Soacha	278,665	2,163	128.83

Source: Population by the DANE Projection for Municipalities 1996-2005

3) Economic Conditions

(1) National trends

The 1999 Gross Domestic Product (GDP) and GDP per capita were Columbian Pesos (COP) 72,357,004 and COP. 1,739,810, respectively. The GDP and per capita GDP for the term of 30 years are as follows:

Table 12 Changes of GDP in Colombia

(Constant Price in 1994)

	Total GDP		GDP per Capita	
Year	Mil COP in 1994	Growth Rate	Mil COP in 1994	Growth Rate
1970	23,864,764	-	1,115,401	-
1973	29,057,029	6.78%	1,231,057	3.34%
1975	31,440,432	4.02%	1,254,283	0.94%
1978	37,201,189	5.77%	1,367,332	2.92%
1980	40,804,622	4.73%	1,427,609	2.18%
1983	42,792,602	1.60%	1,400,749	-0.63%
1985	45,600,609	3.23%	1,433,534	1.16%
1988	52,913,800	5.08%	1,571,152	3.10%
1990	57,063,451	3.85%	1,634,273	1.99%
1993	63,821,419	3.80%	1,734,761	2.01%
1995	71,046,217	5.51%	1,843,363	3.08%
1998	75,412,448	2.01%	1,847,130	0.07%
1999	72,357,004	1.84%	1,739,810	-5.62%

Source: Colombia Statistics 1993-1999 DANE and DANE website

(2) Regional trends in Bogotá

The regional GDP in the city of Bogotá shows that Bogotá had an average annual GDP growth of approximately 7% from 1970s to 1980s, slowing down in the mid 1980s and then picking up again to register a growth of more than 5%. In 1995, the regional GDP of the city of Bogotá reached approximately COP. 16,665,172. In the same year, the national GDP was COP. 71,046,217, meaning that the GDP of the city comprised approximately 25% of the national GDP.

Table 13 Growth of GDP in Bogotá

Unit: Million Pesos as of 1994 fixed rate

Year	Total GDP	Avg Annual Growth Rate
1970	4,492,097	-
1975	6,349,231	7.17%
1980	8,445,638	5.87%
1985	9,496,560	2.37%
1990	11,971,082	4.74%
1995	16,665,172	6.84%

Source: Historic Statistics Bogotá city 1950-1999, Department of Planning

4) Socio-economic Indicator (Estrato)

(1) General idea of estrato

The Estrato is the index of the urban residential variables that are classified into six, from Estrato-1 (Lowest) to Estrato-6 (Highest). This classification was first done in 1995 through the "Stratification Program," planned and guided by the National Department of Planning (DNP), directly executed by the District Planning of Administrative Department of Bogotá (DAPD) and other related municipalities. After 1996, each municipality has been obligated to keep updating the data of the stratification project, and some revision has been made in the city of Bogotá.

The Estrato is applied to all the urban areas throughout Colombia, through the manzana census and its evaluation, based on the stratification model published by the DNP. It is classified into four, as shown below.

1) Type Bogotá: Applied only to Bogotá City
2) Type 1: Applied to the city with population more than 200,000
3) Type 2: Applied to the city with population up to 200,000
4) Type 3: Applied to the city with population up to 5,000

The estrato classification is essentially based on the criteria for present condition of the Manzana and land use classification by DNP, which considered the following variables: 1) land use, 2) planning of the settling, 3) materials of the construction, 4) density pertaining to real estate, 5) quality of the public space, and 6) degree of deterioration of the housing.

(2) Distribution of the Estrato

The highest estrato in the Study Area is set in the north-central part of Bogotá City. Surrounding the area of Estrato 6 is the area classified as Estrato 5, including Barrios Unidos. Forming a semi-circle in the north-central part adjacent to Estrato 5 is the area of Estrato 4, and the rest of the area in the northern part of Bogotá is mainly Estrato 3. Central Bogotá to southern part is mainly composed of Estrato 3 and 2, while the lower estrato is found as far as to the southern expansion. The eight municipalities in Cundinamarca belong mainly to Estrato 2 according to the classification set by the DNP.

(3) Basic service charges and estrato

The following committees shall establish the charges to the residential area:

- Regulation committee for energy and gas: CREG: Ministry of Mining
- Regulation committee for water: CRA: Ministry of Development
- Regulation committee for telecommunication: CRT: Ministry of Communication

In these committees, the Estrato is taken into consideration for setting the amount of service charges, under the District Decree 347 of May 10, 1997. The main idea for these charges is to cover the consumption of residents of Estrato 1 and 2 by the collection from the residents of Estrato 5 and 6. However, the duties finally imposed to the residents are a combination of the Estrato and the monthly household consumption.

The established amount of charge is imposed directly by the public facility companies, of the energy (CODENSA), telecommunications (ETB), and aqueduct and sewerage (EAAB).

On the other hand, charges which are not correlated to the estrato are the commercial charge, industrial charge, and business charge.

2.6 Buildings, Infrastructure and Lifelines

1) Buildings

(1) Characteristics of building types

The building data in the Bogotá Metropolitan Area are based on the Cadastral data.

The total number of buildings is approximately 956 thousand (Bogotá: 828 thousand, 8 Municipalities: 127 thousand), of which the building types of 76 thousand are classified as unknown, mainly because of lower quality than the criteria for the classification. The building types and their numbers are shown in the following table:

Table 14 Building Types and Numbers

Building types	Number	%
Madera and prefabricated	49,088	5.6
Masonry	777,347	88.4
Reinforced	53,189	6.0
Sub total	879,624	100
Unknown	76,367	
Total	955,991	

Masonry structures are mainly used for residential buildings such as independent house buildings as well as apartment buildings and also for other public buildings such as hospitals, schools, hotels, offices and other many varied facilities. Among these masonry buildings, there are a large number of the non-reinforced masonry types. Also, there are many non-engineered buildings, especially in the lower Estrato 1 and 2; the non-engineered buildings are estimated to be very large in number. In the Quindio earthquake of 1999, a large number of masonry buildings like non-reinforced or non-engineering buildings were collapsed. It will be the most important and urgent measures for the Bogotá Metropolitan Area to reinforce the weak buildings in order to decrease the seismic damage.

(2) Building regulation in Colombia

A. Law 11 of 1983 and Decree 1400 of 1984

The building regulation in Colombia was established in 1984 after the 1983 Popayán Earthquake (Magnitude: 5.5, causing 241 deaths and 1,500 injured). Before 1984, all the buildings in Colombia were designed and constructed under no legal regulation with respect to seismic resistant capability. Only experienced structural engineers used the United States' building code (UBC: Uniform Building Code) as a general guide for design and construction and the SEAOC code (SEAOC: Structural Engineers Association of California) as a guide for earthquake resistant design.

In the end of 1983, Law for Earthquake Resistant Construction (Ley 11 de 1983) was announced and Decreto 1400 de 1984: *Codigo Colombiano de Construcciones Sismo-Resistentes*) was issued. After 1984, related building regulations such as construction enforcement law were issued accordingly.

B. NSR 98

In 1997, the national law for earthquake resistant design and construction of buildings was issued, which was followed by several decrees issued in 1998, 1999 and 2000. These sequential law and decrees have been compiled as NSR-98 (*Normas Colombianas de Diseño y Construccion Sismo Resistente*: Colombian Regulations for Earthquake Resistant Design and Construction) by the Colombian Earthquake Engineering Association (AIS). NSR-98 is composed of Ley (Law) 400 de 1997, and this was followed by Decreto (Decree) 33 de 1998, Decreto 34 de 1999 and Decreto 2809 de 2000.

Under the framework of these national laws and decrees, it is recommended that the big cities with populations over 100,000 issues their own decree for the design and construction practices based on microzoning studies. The city of Bogotá conducted a microzoning study from 1994 to 1997.

A recent mayoral decree issued on January 30, 2001 was Decree 74 (Decreto 074) by which the Construction Code for the city of Bogotá was partly modified based on the results of the microzoning study.

C. Status of present regulations

The regulatory guidelines for the earthquake resistant design and construction in Colombia and in the city of Bogotá are, to some extent, satisfactorily prepared, and the items and contents of the present regulations cover almost all the factors that are now taken into consideration in the USA as well as in Japan. However, it is necessary for the present Building Regulations to be reviewed and updated on the following points:

a) Masonry structure to meet the local conditions

The description for the masonry structure should be reviewed and reconsidered with much more careful attention paid on the existing local conditions. For example, the minimum thickness of masonry wall (approx.100mm), defined in the decree, should be reconsidered, because, with the thickness of 100 mm of brick, seismic resistance of masonry structures is not guaranteed due to the rather rigid stiffness and consequent bigger earthquake forces. In Japan, non-reinforced masonry is prohibited and minimum thickness of masonry wall is 15 cm for a one-story house unit.

b) Construction approval and inspection process

Regarding the inspection during and after the construction work, there is no legislated and/or authorized process. Although before the construction of buildings, the designers/engineers in Colombia have to submit all the building documents to the CURADURIA URBANA (approval office of the local government) in order to get the construction approval, the consequent inspection by authorized institutions during and after construction is not mandatory. In the USA as well as Japan, the inspection of the construction site by the authorized institution is mandatory in order to guarantee the quality of the building constructed. Therefore, establishment of the inspection process as well as the full enforcement of the decree should be of the most urgent matter.

Also, it is necessary for the CURADURIA URBANA in Bogotá to increase its capacity enough to meet the demand of new building constructions, although there are five offices of CURADURIA URBANA in Bogotá, giving construction approvals for about 5,000 building constructions annually.

c) Control of informal buildings in the urban areas

In the Bogotá Metropolitan Area, a large number of informal buildings, those constructed by unskilled laborers over a long period of time, even after 1984, are existing buildings and their number is still increasing, because of the lack of related regulations and enforcement of law and so forth. The informal buildings are mostly lacking resistance to earthquake forces and tremendous damages of both life and property are expected in the event of an earthquake.

d) Provision for retrofitting of the existing buildings

Seismic retrofitting of the existing buildings is of an urgent matter. From a practical viewpoint, although necessary items for the retrofitting design are described in the regulations mentioned above, no practical methods to be applied to the retrofitting works for the existing buildings are given.

(3) Public buildings

The public facilities data items collected in this study are those of strategic buildings and facilities like government buildings, disaster prevention related buildings, transportation facilities, storage buildings and shelter/evacuation related buildings in the Study Area. They are shown in the following table:

Table 15 List of Public Facilities and Buildings

Locality	Government		Disaster Organization						Transportation		Storage Places		Evacuation Facilities		
	Locality Offices	Minintries	Police	Civil Defense	Fire Fighting	Red Cross	Hospitals & Clinics	Army	Airport	Bus Terminal	Goods Storage	Food Storage	Public Schools (Primary/Secondary)	Kindergartens	Parks & Open Sapces
WITHIN BOGOTA CITY :															
1 - Usaquén	1		1		1		9	2					32	7	246
2 - Chapinero	1		2	1	1		9						11	3	133
3 - Santa Fé	1	5	4	1			2						18		71
4 - San Cristóbal	1		1	1	1		7	1					64	3	194
5 - Usme	1		1		1								64	11	154
6 - Tunjuelito	1		1		1		2	1					24	5	58
7 - Bosa	1		1		1		1						34	12	187
8 - Kennedy	1		1		1		3					1	70	8	494
9 - Fontibón	1	1	2	1	1		1		1	1			19	1	132
10 - Engativá	1		2	6	2	2	3						61	3	508
11 - Suba	1		1	1	2		1						42	10	319
12 - Barrios Unidos	1		1										26	4	109
13 - Teusaquillo	1	4	3	3			9	1			1		4		119
14 - Los Mártires	1		1	2	1		4						15	1	47
15 - Antonio Nariño	1	3	1		1		1						12		54
16 - Puente Aranda	1		2	2	1	1		2					33	3	284
17 - La Candelaria	2	7	1	1	1								7		15
18 - Rafael Uribe	1		1	1			2						53	5	212
19 - Ciudad Bolívar	1*		1				1						69	10	263
SUBTOTALS	***20***	***20***	***28***	***20***	***16***	***3***	***55***	***7***	***1***	***1***	***1***	***1***	***658***	***86***	***3,599***
WITHIN EIGHT MUNICIPALITIES :															
Chía	1		1		1	2	7						29		17
Cota	1		1				1						9		
La Calera	1		1	1			1						9		
Facatativá	1		1	1	1	2	7						17		18
Funza	2		1	1	1		3						15		20
Madrid	1		2				4	1					25		29
Mosquera	1		1		1		3						19		26
Soacha	2		6	1	1	1	13						32		12
SUBTOTALS	***10***		***14***	***4***	***5***	***5***	***39***	***1***					***155***		***122***
TOTALS STUDY AREA	***30***	***20***	***42***	***24***	***21***	***8***	***94***	***8***	***1***	***1***	***1***	***1***	***813***	***86***	***3,721***

Source: JICA Study Team

2) Infrastructure

(1) General

The infrastructure is classified into roads, bridges, airports and railways.

(2) Administrative institutions for roads and bridges

The national roads outside the city of Bogotá are under the jurisdiction of the Ministry of Transport and the Instituto Nacional de Vias (INVIAS) under the Ministry is responsible for the construction and maintenance of these national roads. All the roads in the city of Bogotá are under the jurisdiction of Bogotá City and the Urban Development Institute (IDU) under the city of Bogotá is responsible for the construction and maintenance of the roads. The eight municipalities are responsible for the roads within their boundaries. The Prefecture of Cundinamarca is responsible for the roads connecting to the national roads and municipality roads. The administrative institution of roads and bridges is summarized as follows:

Table 16 Administrative Institution of Road and Bridges

Road Classification	Administrative Institution		
	Bogotá	Cundinamarca	
		Urban Area of Eight Municipalities	Rural Area in Eight Municipalities
National Road	IDU		INVIAS
Municipal Road	IDU	Each Municipality	
Prefectural Road	-	-	Cundinamarca

(3) Road network in the Study Area

Four trunk roads that connect with Bogotá D.C. form the radial road network of Bogotá D.C. The four national roads connecting Bogotá D.C. and other cities are as follows:

- National Road No. 55 (Bogotá D.C. to Tunja/Cucuta/Venezuela)
- National Road No. 45A (Bogotá D.C. to Tunja/Cucuta/Venezuela)
- National Road No.50 (Bogotá D.C. to Manizales/Medellin/Cali)
- National Road No.40 (Bogotá D.C. to Villavicencio)

They are major supply routes between the Study Area and other municipalities. Especially, the gateways from Medellin and Cali in Western Colombia are important for transporting food supplies.

Three ring roads and seven radial roads form the principal road network in Bogotá D.C. The seven roads radiate outwards from city center and serve as distributor roads to each Barrio, and the three ring roads act as connector roads to each radial road. The ring roads and radial roads are as follows:

- Ring Roads:
  1. Avenida Ciudad de Quito
  2. Avenida del Coggreso
  3. Avenida Boyaca
- Radial Roads:
  1. Autopista del Norte
  2. Autopista del Sur
  3. Avenida Villavicencio
  4. Avenida del Americas
  5. Autopista El Dorqado
  6. Autopista Medellin
  7. Avenida Suba

The secondary roads have been developing in accordance with the progress of housing and industrial developments.

(4) Distribution of bridge structure

The existing bridges are composed of pedestrian bridges, vehicular fly-over bridges and river bridges. Vehicular fly-over bridges are constructed in various types such as diamond, semi-cloverleaf and full cloverleaf types as interchanges. Among them, the diamond-type interchange is the most popular.

During the Study, a bridge site survey has been carried out in Bogotá D.C. and in the eight municipalities based on the IDU bridge inventory. The result showed that 13 of 134 pedestrian bridges and one of 103 vehicular fly-over bridges in the IDU inventory do not exist, but 26 pedestrian bridges, 8 vehicular fly-over bridges and 68 river bridges are newly found in the site survey and added to the IDU inventory. The number of bridges by type is shown as follows:

Table 17 Number of Bridges by Type

	Pedestrian bridges	Vehicular bridges			Total
		Flyover	River	Sub-Total	
Bogotá	146	108	69	177	323
Eight Municipalities	19	6	11	17	36
Total	**165**	**114**	**80**	**194**	**359**

(5) Bridge design code

The Colombian bridge design code (CCP-200) was stipulated in 1995 and a seismic coefficient of 0.2 is adopted in Bogotá. Before 1995 the bridges were designed based on the AASHTO standard (USA design code) with modification from time to time. After 1997 the seismic coefficient was taken according to the response spectrum in accordance with the results of the previous

microzoning study. However, liquefaction is generally not considered in the design but only specific to a requirement.

3) Lifeline Structures

The lifeline structures include water supply facility, electricity supply facility, gas supply facility and telecommunication facility.

(1) Administrative institution of water supply and sewerage

EAAB-ESP (*Empresa de Acueducto y Alcantarillado de Bogotá*) is responsible for water supply, sewage and drainage services of the city of Bogotá. EAAB is an Industrial and Commercial Company of the Capital District, rendering domiciliary public services, equipped with legal identity, administrative autonomy and independent patrimony, according to Agreement 6 of 1993.

With regard to the eight municipalities, a public company in each municipality supplies water from wells and rivers, and manages their resources and supply facilities. However, EAAB supplies water to them to cover the shortage of water supply in each municipality. The amount supplied by EAAB to each municipality ranges widely between 10% and 100% of their water demand.

(2) Water supply system

The distribution system is divided into matrix networks of tunnels or of big iron pipelines with diameter between 60 and 78 inches, which conducts the water from the sources to the purifying plants, and then to the main distribution networks with diameters between 12 and 36 inches. Detailed distribution network is composed of pipelines less than 12" in diameter. According to the brief description provided by EAAB, water for distribution is supplied through a 6,500-km-long pipeline utilizing 65 operation stations composed of 31 pumping stations, 25 storage tanks and 9 control stations.

A special pumping station that receives water from Chingaza and Tibito system is the one called *Planta de Rebombeo de Usaquen*. The plant water is pumped and distributed to approximately 70% of the city, and to the municipalities of Funza, Madrid and Mosquera, located on the west of Bogotá City. The purification plants and their 11 service zones and water sources are as follows:

Table 18 Zone System by Main Purifying Plant/Water

Zone	Laguna	Vitelma	Control Santafe	San Diego Sur	San Diego Norte	Paraiso	Chico	Zona Inter-media	Zona Baja Sur	Zona Baja Norte	Soacha
Main Source	Laguna Purifying Plant	Vitelma or San Diego Purifying Plant	Usaquen pumping station	San Diego Purifying Plant	San Diego Purifying Plant	Wiesner Purifying Plant	Wiesner Purifying Plant	Usaquen pumping station	Usaquen pumping station	Usaquen pumping station	Usaquen pumping station
Aprox. Area Served in Bogotá (%)	8.3	10.0	4.0	3.0	1.5	2.0	3.0	1.5	15.0	45.0	7.0

Source: JICA Study Team, 2001

Table 19 EAAB Systems of Water Supply

System	Dam Composition	Storage Capacity (Million $m^{3)}$	Max. Supply Capacity (m^3/seg)	Tunnel Conduction (Km)	Pipeline Conduction (Km) / Diameter	Delivers water to
Chingaza	Chuza San Rafael	332	34	32	4.5 Km (60")	Wiesner Purifying Plant
Vitelma	La Regadera Chisaca Los Tunjos	11	1.35	No	(34") to Vitelma (20") to La Laguna	La Laguna or Vitelma Purifying plant
Tibitoc	Sisga Tominé Neusa Aposentos	894	-	No	(60")	Tibitoc Purifying plant and then to Usaquen pumping station
San Diego	San Francisco River	No	0.14	No	(14")	San Diego Purifying plant

Source: JICA Study Team, EAAB, 2001.

2.7 Emergency Health and Medical Service System

1) Health and Medical Response Plan

A Health and Medical Response Plan should be prepared at national level, regional (Cundinamarca) level, district (Bogotá D.C) level and local municipality levels. However, Bogotá D.C. is the only city in Colombia where a plan for medical response in case of a disaster has already been settled.

The plan divides the causes of disasters into two categories: natural threats and man-made threats.

Table 20 Disaster Threats in Bogotá

Type of Threats	Threats
Natural Threats	Earthquake, Landslide, Flood and Gale
Man-made Threats	Technological, Epidemiological, Organizational and Chemical

The plan takes up the disasters, which are expected to occur more frequently, for example, riots or social unrest as threats by human activity and the 'El Niño' phenomenon or flooding as natural threats. Therefore, a response plan against a potential massive earthquake is not contained in the plan. It is possible, however, to develop the target plan from the existing plans.

There is a clear relationship between the type of disaster and its effect on health. Assessment of health needs in these disasters is to make clear what, where and how extensively health needs may be expected within a disaster-affected area.

In addition, some effects, such as burns or poisoning after an earthquake and epidemics after a flood, are considered potential rather than inevitable conclusions; especially epidemics are preventable by taking appropriate measures.

Damages by any disaster can be categorized into two: damages to people itself and to social structures. Although the effects of landslides, floods and industries are restricted to some areas, an earthquake affects almost all areas in the health sector as follows:

Table 21 Expected Damages by Type of Disaster

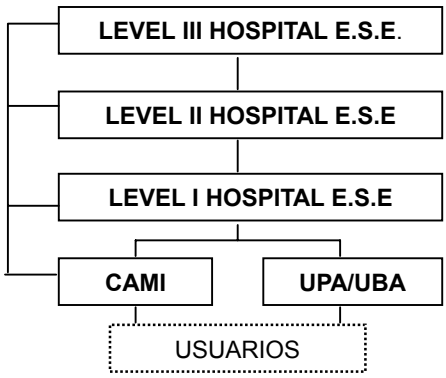
Kind of Damage			Extent of Damage by Hazard			
			Ert	Fld	Lsd	Ind
Human Damages	1. Death		○		○	○
	2. Injury	2.1 Severe & Intermediate	○		○	○
		2.2 Slight	○	○		○
	3. Burns		△			○
	4. Chemical poisoning		△			○
	5. Outbreak of communicable diseases		△	△		
	6. Mental disorder		○			
	7. Interruption of normal health delivery		○	○		
Structural Damages	1. Destruction of health facilities		○			
	2. Destruction of dwellings		○	○	○	
	3. Infrastructure: Water supply		○	○		
	4. Infrastructure: Sewage system		○	○		
	5. Waste disposal system		○			
	6. Interruption of logistics: Medical supplies		○			
	7. Interruption of transportation: Ambulances		○	○		

Note: ○ mark indicates health and medical needs
△ mark indicates potential but preventable by taking effective measures.
Ert: Earthquake, Fld: Slow-onset Flood, Lsd: Landslide, Ind: Industrial Hazard

2) Medical and Health Service System

(1) Public health service system

The public health institutions are categorized into the following three levels:



- **LEVEL III:** furnish several subspecialties and an Intensive Care Unit (ICU), other than Internal Medicine, Surgery, Ob/Gyn, and Pediatrics.
- **LEVEL II:** furnish inpatient wards for Internal Medicine, Surgery, Ob/Gyn, and Pediatrics.
- **LEVEL I:** Small hospitals and affiliated health centers, CAMI, with basic treatment, dental care, disease prevention activity and observation beds.

E.S.E.: Empresa Social del Estado
CAMI: Centro de Atención Medica Inmediata
UPA: Unidad Primaria de Atención
UBA: Unidad Básica de Atención

Figure 2 Health Service System

(2) Net of services

The Health Department divides the city of Bogotá into four health service zones, and arranges one level Ⅲ hospital in each zone. And in each locality one level I hospital is allocated, at least.

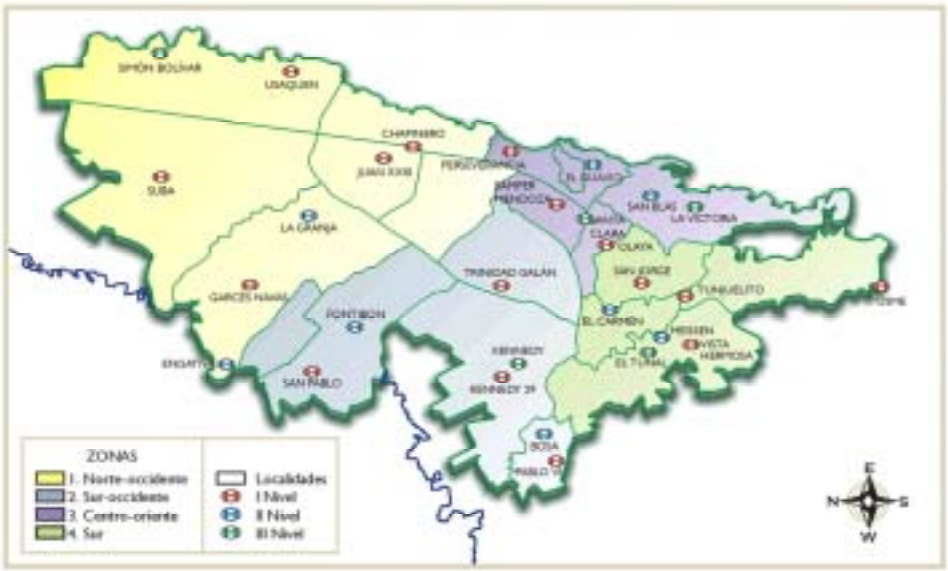


Figure 3 Four Zones and Hospital Allocations in the Health System

Such a network of zones has just been adopted from 2001 by the change of health administration system.

(3) Public hospitals by level

The number of public hospitals E.S.E in the Bogotá Metropolitan Area is 39, and the number of beds is 2,189 excluding emergency beds. There are 13 hospitals of level Ⅱ and level Ⅱ furnished with 921 beds in total. These 13 hospitals are expected to become the bases to provide in-hospital care in times of disaster. The hospitals of level III in Bogotá are functioning as Top Referral Hospitals not only for Bogotá City but also for Cundinamarca. The current usage of beds in the public hospitals is very high at 80-85% BOR, compared with 60% of private clinics.

And "Fusion" of the hospital name shows that it is a complex of a hospital and CAMI and/or UPA/UBA affiliated to it. This is also a newly established system by the reform in 2001.

Table 22 Number of Public Hospitals E.S.E and their Beds by Level and Area (Year: 2001)

Area		Level III		Level II		Level I*	
		No.	Beds	No.	Beds	No.	Beds
Bogotá	North	1	328	3	160	6	116
	South-West	1	245	3	141	5	82
	Center-East	2	339	3	323	4	13
	South	1	165	3	157	7	120
Bogotá Total (a)		5	1,077	12	781	22	331
Eight municipalities in Cundinamarca (b)				1	140	7	190
Bogotá Metropolitan Area (a) + (b)		5	1,077	13	921	29	521
Cundinamarca Total (d)		1	258	9	1,530	67	1,271

Name of Public Hospitals E.S.E

Area		Level III	Level II
Bogotá	North	Simon Bolivar: 328 (ICU: 24 beds)	Engativa: 17 Granja: 51 Fusión Engativá: 92
	South-West	Kennedy III: 245 (ICU: 23 beds)	Fontibon: 36 Fusión Fontibón: 46 Bosa: 59
	Center-East	La Victoria: 161 Santa Clara: 178 (ICU: 15 beds)	Guavio: 52 Fusión Centro Oriente: 59 San Blás: 212
	South	Tunal: 165 (ICU: 18 beds)	Carmen: 20 Fusión Tunjuelito: 44 Meissen: 93

Note: *mark shows that Health Centers are included in both numbers.

(4) Private clinics and other public hospitals

All private clinics in Bogotá are classified as Level II and/or Level III; they number 37 and have 6,521 beds in total. This capacity is equivalent to 2 times in number of facilities and 3.5 times in beds in comparison with those of public hospitals at the same levels. Moreover, there are many comparatively bigger hospitals in terms of admission capacity. In addition to clinics, number of private practitioners comes up to 12,565.

It is clear from these figures that the role of the private sector in health and medical activities in case of a disaster is not to be ignored.

Table 23 Number of Private Clinics, Other Public Hospitals and their Beds by Level

Area	Level III		Level II	
	No.	Beds	No.	Beds
Bogotá	31	6,153	6	368
Eight municipalities in Cundinamarca (b)	-	-	3	364
Bogotá Metropolitan Area (a) + (b)	31	6,153	9	732

Note: * Not including beds for emergency purpose.

3) Emergency Medical Service Network

The information and communication center for emergency medical service is CRU in Bogotá and CRU Cundinamarca (CRUC). With regard to their information centers, both are located in the center of Bogotá independently, with a staff of 23 for CRU and 12 for CRUC working 24 hours by 3-shift system.

It should be noted that there is no direct radio contact between CRU and CRUC. But rather the radio system of SAMU is connected with all the organizations directly. It means that SAMU occupies the important position in terms of covering the metropolitan area as a whole.

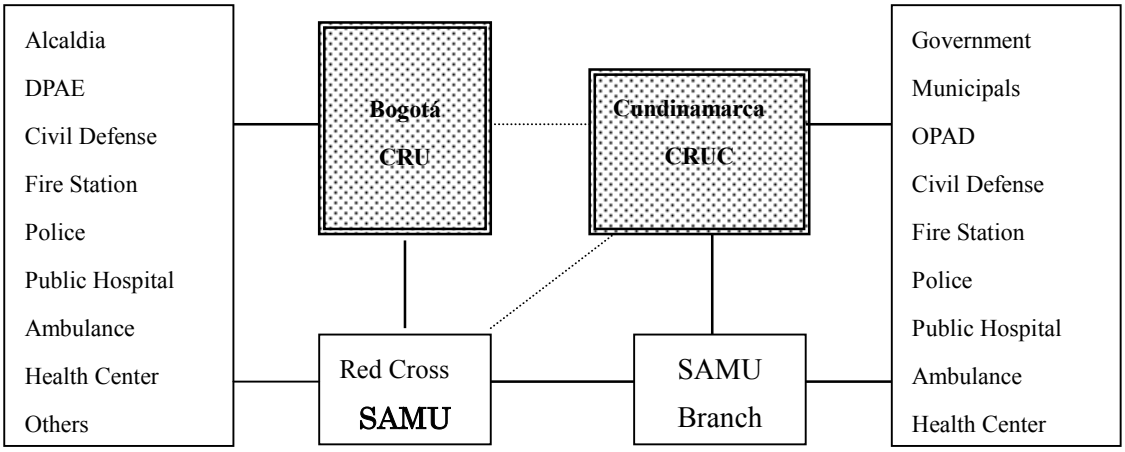


Figure 4 Radio Communication Network in Bogotá Metropolitan Area

4) Preparedness

(1) Progress situation of preparing a plan for disasters

The city of Bogotá has already prepared an essential plan, but does not have a plan for a big earthquake completed yet. Furthermore, the eight municipalities have not prepared a fundamental one yet.

(2) Education on disaster medicine

A. Ministry of health

A study is made of 35 medical doctors in charge of emergency services on Disaster Administration in 8 courses (2 years) in Valle University and Antioquia University respectively. Another 2 courses will be added in 2001.

B. Bogotá City

Apart from the academic and comprehensive education mentioned above, several health entities like Secretaria de Salud in Bogotá are providing health personnel with educational courses. Targets of these educational courses and the executing agencies, shown in the table below, are characterized as follows:

- There is no subject on disaster medicine in the undergraduate and postgraduate courses.
- Training courses by health authorities are carried out actively, but they are very low-key in Cundinamarca.

Table 24 Agencies In-Charge of Training and Enlightenment Activity on Disaster Health Care

Executing Agencies \ Education Targets	1.Undergraduate: Medical Students	2.Postgraduate Education	3.Professional Health Personnel	4.Community Health Volunteers	5.Community People	6.School Students
1. Ministerio de Salud			○			
2. Secretaria de Salud, Bogotá			○	○	○	○
3. Alcaldia Localidades, Bogotá			○	○	○	○
4. Secretaria de Salud, Cundinamarca			○	○		
5. Alcaldia Municipios, Cundinamarca						
6. Cruz Roja			○	○	○	○
7. University or other agencies	○	○	○			

Frequency of holding training courses is about once a year. Consequently, the number of participants is quite large.

2.8 Communication System

1) DPAE System

The communication system of DPAE is the vertebral column type, which has been chosen for its functionality. It connects all the personnel in DPAE as well as 15 different entities subscribed in the *Red Distrital de Emergencia* (District Emergency Network), which are Secretary of Health (District), Secretary of Traffic, Water Supply and Sewerage, Energy, Natural Gas, Telephone Service, CISPROQUIM, Fire Fighting Office, Red Cross, Civil Defense, Police, 13th Army Brigade, DNPAD (National Directorate of Emergency Attention), Transmilenio (Public Transport System) and DPAE.

2) SIRE (*Sistema de Informacion para la gestion de Riesgos y Atencion de Emergencia de Bogotá*)

SIRE was created by the inter-administrative agreement between FOPAE and INGEOMINAS and to facilitate the risk management by capturing, organizing, processing, and supplying available information rapidly.

The objectives of SIRE are summarized as follows:

- Store, integrate, and maintain adequately the information related with the risk management;
- Facilitate the access or the query of existing and future information in the most rapid way;
- Help in the promotion of the disaster prevention culture; and
- Guarantee the security, integrity, recuperation and privacy of the information for all types of events.

SIRE contains basically two types of information system, namely, generated information or product information and locally structured information.

- Product Information: The product information is information generated by a third party (studies, maps, reports and others) that cannot be modified by the users in any of the risk management stage. This type of data will be entered in the system with meta-data and geographic coverage.
- Locally structured Information: This information is generated during the risk management stages and organized with relational tables.

General Restrictions are:

- SIRE in itself does not do the risk management and it is just a tool to facilitate the risk management.
- SIRE is not the best system for simulation modeling for risk management.

DPAE and INGEOMINAS are the institutions that can update the SIRE to a newer version.

3) Other Related Agencies

Since 1995, all the agencies of Cundinamarca in charge of emergency attention and relief-provision are concentrated in Cra. 58 with calle 10 in Puente Aranda.

The communication system of Cundinamarca government serves to establish a link with all the 116 municipalities of prefecture. It connects all the municipalities through a network of 16 repeaters.

This communication system actually falls under the “Secretary of Government.” It consists of one independent analog system. Adjacent to this communication unit is a smaller unit handled by one person from the national army.

The objective of the unit is to coordinate and administrate the communication network installed in the base unit and the other 116 municipalities

2.9 Public Education

1) Existing Situation

Many government and non-governmental organizations are participating in public education related disaster prevention, and major organizations that plan and implement education and training on prevention and attention of disaster are summarized below with their responsibilities. The organizations are categorized as shown in the following table:

Table 25 Organizations Related to Education and Training for Prevention and Attention of Disaster

Level	Educational Organization	Special Organization for Disaster Management	Coordinator	Cooperating Institution	Private Sector
National	Ministry of Education	- National Committee - National Advisory Commissions - SNPAD	DNPAD	- Ministry of Health - National System of Fire Fighters - National Police - Colombian Civil Defense	Red Cross Colombia
Regional (Cundina-marca)	-Secretariat of Education -Board of Education	- CREPAD - CLOPAD	OPAD	- Secretary of Health - Corps of Fire Services - Metropolitan Police - CAR - Civil Defense	Red Cross
District (Bogotá City)	Secretariat of Education	- SDPAE - District Committee	DPAE	- Secretary of Health - Firemen Official Body - Metropolitan Police - Civil Defense	Red Cross

There are some potential capacities that can be utilized for education and training on disaster prevention and attention, because there are many organizations already established for these topics, and various training and workshops have been organized by different agencies to various target groups using many materials. There are some agencies that have been working with communities, the private sector and NGOs.

2) Issues, Constraints, Potential and Measures

Based on the viewpoints of education and training, the most important issues related to the public education for disaster prevention are considered as follows:

- Coordination among concerned entities is not enough for planning and implementation of the educational activities.

- Distribution of the related information is not well organized, not shared among the entities and distributed to the appropriate persons.
- Training and workshop are not organized continuously nor controlled. There is no systematic planning about training policy and no analysis of the training necessities from different target groups and demands. None of the organizations has done their evaluation and follow-up activities. Topics of the training are almost the same in the different agencies. The target number of participants covered by each organization is still limited because of insufficient financial and human resources. Topics are sometimes very thematic and some of them are not specialty of the organizations.
- Educational and training materials for disaster have not been produced taking into consideration the target groups, objectives and the present situation. The evaluation of the materials has never been implemented and most of them have different terminology, generating conceptual confusion in the people who use the materials.
- Awareness of prevention and attention of disaster in the community is generally low. The efforts to increase their awareness have not been done enough.
- In spite of many regulations on education instructing the incorporation of prevention and attention of disaster into school education, the way of implementation and operation have not been clarified at national level and not achieved at the field level.
- The opinions and ideas of the local people, especially inhabitants with high possibility of disaster, have not been collected and analyzed for the planning.

2.10 Institutional Arrangement for Disaster Management

1) Regulation for Disaster Prevention

The government of Colombia started the disaster management project by the cooperation of UNDP in the 1980s, which has proposed to establish disaster management systems for national and local levels.

In accordance with Law 46, November 1988, the government of Colombia established a national system for prevention and attention of disaster. Decree No.919 of 1989 regulated the national disaster management system to define the responsibilities for the public sector, private sector and community organizations in disaster situations. The government of Colombia enacted several disaster related laws and regulations. Since 1989 the government of Colombia has applied the disaster management system from the central to the local government.

In accordance with Article 3 of Decree No. 919, 1989, the government of Colombia established the national office for the Attention of Disaster within the Ministry of Interior. The National Office for Attention of Disaster prepared a National Plan for Prevention and Attention of Disaster, which was approved by the National Committee for Prevention and Attention. The plan became

Decree No.93 of 1998, now called National Disaster Management Plan, which includes and determines all policies, actions and programs in the disaster management in Colombia.

Article 52 of Decree No. 919, 1989 mandated that local governments prepare their own disaster management systems on the basis of their situations.

The government of Bogotá City established a Fund and Coordination Office for Emergency, Prevention and Attention as mandated by Decree No. 919, 1989 as well as Agreement 11, 1987, issued by the Bogotá Council, and also the government of Cundinamarca created a prefecture management system by Decree No. 3019 of 1998, as laid out in Decree No. 919, 1989.

In May 1999, the governments of Bogotá and Cundinamarca developed a cooperation agreement for the disaster management. The agreement has been limited to infrastructure and lifeline areas, but it is a big step toward the regional cooperation between Bogotá D.C. and Cundinamarca.

2) Organization for disaster management

(1) National

In accordance with Decree No. 919, 1989, the national government established a National Committee and a National Office for Prevention and Attention of Disasters. The National Committee consists of National Technical Committee, National Operation Committee and Regional/Local Committees.

(2) Bogotá City

The government of Bogotá established a District Committee for Emergency, Prevention and Attention of Disaster and DPAE, and the District Committee consists of operation, technical, educational inter-institutions committees and Emergency Local Committees.

(3) Cundinamarca Prefecture

The government of Cundinamarca established a Regional Committee for Prevention and Attention of Disaster of Cundinamarca (CREPAD), OPAD, Municipal Committees (CAM) and Local Committees (CLOPAD).