

**THE STUDY
ON SUSTAINABLE GROUNDWATER DEVELOPMENT
FOR BOGOTA PLAIN
IN THE REPUBLIC OF COLOMBIA**

**FINAL REPORT
SUPPORTING REPORT**

PART 1

GENERAL CONDITIONS OF THE STUDY AREA

**Final Report
(Supporting Report)**

Part 1 General Conditions of the Study Area

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PART - 1 GENERAL CONDITIONS OF THE STUDY AREA

CHAPTER 1 Socio-economic Conditions

1.1 Administrative Units

The newest Constitution of the Republic of 1991 appoints Departments, Districts, Municipalities and Indigenous (Indian) Territories as territorial units for public administration (Art. 286). Each territorial unit enjoys autonomy for managements of their interests within the limits of the Constitutions and laws, having the right to administer the resources located within the border (Art. 287). The jurisdictions assigned to the various levels will be exercised in accordance with the principles of coordination, competitions and subsidiary relationships (Art. 288). Neighboring departments and municipalities may promote programs for community development, provisions of public services and protections of the environment on a basis of equality, cooperation and integration (Art. 289).

As the basic entity of the political-administrative branch of the state, the municipalities are responsible to provide public services, to build projects required for local progress, to arrange for the development of their territory, to promote community participation, social and cultural development of their inhabitants (Art. 311). The departments exercise administrative functions and coordination with municipalities, and intermediation between the nation and the municipalities. The Constitution has stipulations for the Capital District to give specific political-administrative status and financial resources to guarantee harmonious and integrated development of the city (Art. 322, 324, 325 and 326).

1.2 Study Area

Study Area extends from Tequendama Falls to upstream basin area of Bogotá River. The Study Area is comprised of a part of both Cundinamarca Department (24,210km²) and Bogotá District Capital (Bogotá D.C.; 1,605km²). Cundinamarca Department is divided into 15 provinces (provincia). And these provinces are divided into 116 municipalities (municipios). The Study Area extends to 7 provinces and 31 municipalities of Cundinamarca Department. Out of the 30 municipalities, Soacha, Subachoque and El Rosal were created recently in 1995, 1997 and 1997, respectively. All names of the capital towns of the municipalities are same as names of the municipalities.

Bogotá D.C. is divided into 20 localities. The Study Area includes most of the urban localities of Bogotá D.C.

Study Team overlaid the study area map on the IGAC municipality topographic map of 1:100,000 scales in 1993 and then calculated areas of the Study Area that resulted in 4,268.7 km², equivalent to 69% of the official areas of Bogotá and 31 municipalities of Cundinamarca Department that are 6,159 km². The areas by municipality of the Study Area were shown in Appendix-1.1.

1.3 Population

Although the latest population census was carried out in 1993, DANE estimated the population of the year 2000 as shown in Table-1.1.

According to the estimation, the population of Colombia was 42.3 million. This population increased by 9.2 million compared with the 1993 census. The yearly average growth rate between 1994 and 2000 was 1.88% that slowed down from 2.18% during the census of 1985/1993.

The population of Bogotá D.C. was 6.4 million in 2000 or 15% of the national population. This population increased by 1.5 million from 1993 census, or by 2.60% per annum, a small

slowdown from the previous censuses.

The population of Cundinamarca Department and the Study Area increased more than 2.0% per annum. Population growth of these areas represented less than that of Bogotá D.C.; however the growth in urban area indicated as remarkable as in Bogotá D.C.

The population of whole Study Area including Bogotá D.C. in 2000 totaled to 7.4 million. Population by municipality was shown in Appendix-1.2.

Table-1.1 Actual Population and its Growth of Bogotá and Cundinamarca

Region		Population (1000 persons)				Growth (%)		Family Size ('93)
		Census			Estimation			
		1973	1985	1993	2000	85-93	94-00	
Total	Colombia	20,666.9	27,853.4	33,109.8	42,321.4	2.18	1.88	5.3
	Bogotá D.C.	2,571.5	3,982.9	4,945.4	6,437.8	2.74	2.60	5.7
	Cundinamarca Dept.	1,125.6	1,382.4	1,658.7	2,142.3	2.30	2.09	5.0
	Study Area in Cundinamarca (%)	311.8 (27.7)	500.9 (36.2)	734.2 (44.3)	943.6 (44.0)	3.00	2.11	-
Urban	Bogotá	2,557.4	3,975.0	4,931.9	6,422.2	2.73	2.61	5.7
	Cundinamarca	409.3	641.8	906.9	1,206.2	4.42	2.59	5.4
	Study Area in Cundinamarca (%)	159.4 (40.0)	336.7 (52.5)	561.9 (62.0)	736.6 (61.1)	6.61	2.44	-
Rural	Bogotá	14.1	7.9	13.7	15.6	7.15	0.45	5.3
	Cundinamarca	716.3	740.6	751.8	936.1	0.19	1.46	4.5
	Study Area in Cundinamarca (%)	152.4 (20.6)	164.2 (21.7)	172.3 (22.5)	207.0 (21.9)	0.65	0.96	-

Source: Colombia Estadística 1993-1997, DANE, 1999
Anuario Estadístico 1997-1998, Cundinamarca

The population density (persons/km²) of urban area of Bogotá D.C. and the Study Area of Cundinamarca Department was 8,390 and 220 respectively.

1.4 Gross Regional Domestic Product

Gross domestic product (GDP) of Colombia was Col\$151.6 trillion in 1999 as shown in Table-1.2.

Gross regional domestic product (GRDP) of Bogotá D.C. in 1999 was Col\$33.0 trillion, accounting for 22% of GDP, while that of Cundinamarca Department in 1999 was Col\$7.5 trillion, 5% of GDP.

GRDP as well as GDP dropped sharply and resulted in negative growth in 1999 due to the consecutive economic stagnancy, in spite of positive growth over the period of last five years.

Table-1.3 shows the distribution of GRDP by economic sector.

Service Sector ranked first both in Bogotá D.C. and Cundinamarca Department. This Sector continued to lift its share in GRDP. The second rank was Industry Sector in Bogotá D.C., while Agriculture Sector in Cundinamarca Department.

**Table-1.2 GDP of Colombia & GRDP of Bogotá and Cundinamarca
(1999 Constant Price)**

Item	Region	1995	1996	1997	1998	1999
GDP & GRDP (Col\$ billion)	Colombia	149,227	152,295	157,519	158,417	151,565
	Bogotá D.C.	35,917	35,426	36,585	37,208	33,020
	Cundinamarca Dept.	7,560	7,883	8,220	7,933	7,544
Share to GDP (%)	Colombia	100.0	100.0	100.0	100.0	100.0
	Bogotá D.C.	24.1	23.3	23.2	23.5	21.8
	Cundinamarca Dept.	5.1	5.2	5.2	5.0	5.0
Annual Growth (%)	Colombia	5.2	2.1	3.4	0.6	-4.3
	Bogotá D.C.	2.7	-1.4	3.3	1.5	-11.3
	Cundinamarca Dept.	6.3	4.3	4.3	-3.5	-4.9

Source: DANE

**Table-1.3 Distribution of GRDP by Economic Sector of Bogotá and Cundinamarca
(1999 Constant Price)**

Item	Sector	1995	1996	1997	1998	1999
Share to GRDP at Factor Cost (%)	Bogotá D.C.	100.0	100.0	100.0	100.0	100.0
	Agriculture	0.0	0.0	0.0	0.0	0.0
	Mining	0.5	0.4	0.4	0.4	0.4
	Industry	35.2	30.6	29.5	29.2	25.7
	Services	64.3	69.0	70.1	70.4	73.9
	Cundinamarca Dept.	100.0	100.0	100.0	100.0	100.0
	Agriculture	32.3	32.5	30.5	29.8	30.1
	Mining	2.7	2.4	1.4	1.3	0.9
	Industry	25.8	24.6	24.5	24.0	22.5
	Services	39.2	40.5	43.6	44.9	46.5
Annual Growth (%)	Bogotá D.C.					
	Agriculture	27.1	-9.3	3.2	-5.7	0.9
	Mining	15.2	-20.9	-3.1	8.2	-13.3
	Industry	1.1	-15.0	-0.7	0.5	-21.4
	Services	2.0	5.2	4.3	2.2	-6.5
	Cundinamarca Dept.					
	Agriculture	7.5	-1.9	2.0	-2.5	-2.9
	Mining	-5.7	-36.6	-8.3	-27.2	2.4
	Industry	2.0	4.2	2.0	-8.8	-5.8
	Services	10.2	12.2	7.9	0.0	-4.3

Source: DANE

Table-1.4 GDP and GRDP per Capita (1999 Constant Price)

Item	Region	1995	1996	1997	1998	1999	(US\$)
Per Capita (Col\$.000)	Colombia	3,872	3,876	3,932	3,880	3,644	2,070
	Bogotá D.C.	6,325	6,092	6,142	6,088	5,261	3,000
	Cundinamarca Dept.	3,927	4,006	4,087	3,860	3,594	2,050
Per Capita Ratio to Colombia	Colombia	1.0	1.0	1.0	1.0	1.0	-
	Bogotá D.C.	1.6	1.6	1.6	1.6	1.4	-
	Cundinamarca Dept.	1.0	1.0	1.0	1.0	1.0	-
Annual Growth (%)	Colombia	3.3	0.1	1.4	-1.3	-6.1	-
	Bogotá D.C.	-0.2	-3.7	0.8	-0.9	-13.6	-
	Cundinamarca Dept.	4.5	2.0	2.0	-5.6	-6.9	-

Note: Average Exchange Rate (Col\$/US\$) in 1999: 1,756.8 (Refer to the Table-1.11)

In 1999, GRDP per capita of Bogotá D.C. and Cundinamarca Department was Col\$ 5,260 thousands on and Col\$ 3,590 thousands respectively as shown in Table-1.4. Per-Capita ratio of Bogotá D.C. was 1.4 to the nation (=1.0), while that of Cundinamarca Department hold almost the same ratio of the nation. Meanwhile, its annual growth continued stagnant and resulted in negative growth in consecutive two years of 1998 and 1999.

1.5 Economic Sector Profile

1.5.1 Agriculture Sector

The value added of agriculture sector in Cundinamarca Department in 1999 was Col\$ 2,270 billion, equivalent to 30% of GRDP as shown in Table-1.3.

<Crops>

Agriculture harvested area was 221,027 hectares at Cundinamarca Department in 1999; transitory cropping area held 56%, permanent cropping area 40% and annual cropping area 4% as shown in Table-1.5.

In the Study Area, transitory cropping is dominant, especially potatoes. Potatoes harvested area has 30,288 hectares, equal to 70% of the areas at the Study Area. Cropping areas by municipality are shown in Appendix-1.3.

Table-1.5 Agriculture Production of the Study Area in 1999

Classification	Distribution of Product Amount		Harvested Area (ha)		
	Total	By Crops	Cundinamarca	Study Area (%)	
Transitory Crops	: 65%	1.Potato : 65%	61,505	30,288	(49)
		2.Pea : 6%	7,330	2,663	(36)
		3.Tomato : 5%	2,925	-	-
		4.Carrot : 5%	2,064	1,587	(77)
		5.Maize : 3%	24,496	1,053	(4)
		6.Onion : 3%	2,283	466	(20)
		7.Others : 13%	20,533	3,352	(16)
		Total : 100%	121,136	39,409	(32)
Permanent Crops	: 35%	1.Sugar Cane : 38%	51,111	-	-
		2.Banana : 16%	13,587	-	-
		3.Citrus : 13%	10,373	-	-
		4.Blackberry : 7%	2,308	-	-
		5.Others : 26%	13,672	558	(4)
		Total : 100%	91,051	558	(1)
Annual Crops	-	-	8,840	315	(4)
Total	100%		221,027	40,282	(18)

Source: Estadísticas Agropecuarias Vol. 16 - 2000, URPA, Gobernación de Cundinamarca

Anuario Estadístico 1997-1998, Cundinamarca

Note: 1) Areas of Transitory and Annual Crops; harvested areas, 2) Areas of Permanent Crops; planted areas

<Livestock>

Pastureland for cattle breeding and cow occupies 176,000 hectares, equal to 42% of the Study Area, of which 39,000 hectares are irrigated according to the source. The heads of cattle in the Study Area are 260,000 equivalent to 22% of Cundinamarca Department. Heads/ha in the Study Area is 1.5 that indicates much higher productivity than 1.0 in Cundinamarca Department. Milk is produced by 1,116,000 liters/day, equivalent to 51% of Cundinamarca Department. Livestock in the Study Area by municipality is shown in Appendix-1.4.

Table-1.6 Livestock of the Study Area

Region	Cattle	Prod. of milk	Pastureland (1000 ha)		Poultry
	1000 Heads	1000 liters/day	Total Area	Irrigated Area	1000 Heads
Cundinamarca Dept.	1,178	2,191	1,174	77	33,677
Study Area	260	1,116	176	39	2,969
(%)	(22)	(51)	(15)	(51)	(9)

Source: Estadísticas Agropecuarias Vol. 16 - 2000, URPA, Gobernación de Cundinamarca

<Flower>

Table-1.7 shows cultivated areas of flowers that are 4,000 hectares in the Study Area (areas by municipality shown in Appendix-1.5. According to the ASOCOLFLORES, these are only registered areas and the cultivated areas may increase to 5,800 hectares if include unregistered areas.

Table-1.7 Cultivated Areas of the Study Area

Region	Total Area (ha)	Carnation (ha)	Rose (ha)	Other Flowers (ha)
Cundinamarca	4,160.8	1,572.85	1,818.91	769.04
Study Area	4,043.4	1,550.55	1,812.44	680.41
(%)	(97)	(99)	(99.6)	(88)

Source: Anuario Estadístico 1997-1998, Cundinamarca

There are 400 flower producers that are mainly companies. On average, the company manages 12 hectares and employs 190 persons that include professionals such as agronomist, civil engineer and marketing.

Carnation and rose are main products; 84% (year of 2000) of the products were exported to USA that amounted to US\$580 million. At Cundinamarca Department, the floriculture production value held approximately 70% of agriculture production value in 1998 as shown in the Table-1.8. Nevertheless, the production growth rate has been declining mainly due to increasing keen competition in the US market. According to ASOCOLFLORES, such high growth of production as before cannot be expected in the future caused by high competency of such countries as China, India, Peru and Ecuador.

Table-1.8 Share of Floriculture and its Production Value Growth

Item	1990	1995	1996	1997	1998
Share (%) in Agriculture Production Value	42.3	60.9	64.7	66.8	68.0
Production Value Growth (%)	10.3	4.6	7.6	1.4	1.3

Source: Anuario Estadístico 1997-1998, Cundinamarca

1.5.2 Industry Sector

The number of establishment and employee, and value added of the industries at Bogotá and Cundinamarca in 1997 was shown in Table-1.9. Although these data are extracted from main big manufacturing companies only, these value-added figures represent approximately 85% among all in Bogotá D.C. (Col\$8,268 billion) and 90% among all in Cundinamarca Department (Col\$1,964 billion).

The largest five industries were shown in bold letter. It is noted that remarkable industries in Bogotá D.C. are 1) Textile and garment, 2) Food and Beverage, and 3) Petroleum & Chemical. Also remarkable industries in Cundinamarca Department are 1) Food and Beverage, 2) Ceramic & Glass, and 3) Cement.

Comparing with the data of year 1993, the industries such as food and beverage, and plastics increased in terms of establishment, employee and value added in both regions. Also ceramic and glass industries in Cundinamarca Department raised these figures. On the other hand, textile and garment industries sharply declined in both regions.

1.5.3 Services Sector

The services sector has been the largest contributor to GRDP in both regions. Among all classification, the public services showed the sharpest increase, while the commerce shrunk largely as shown in the Table-1.10.

Table-1.9 Size of Industry Sector of Bogotá and Cundinamarca in 1997

Classification of Industries	Establishments		Employees		Value Added (Col\$ billion)	
	Bogotá	C/namarca	Bogotá	C/namarca	Bogotá	C/namarca
1.Food & Beverage	372	80	32,363	13,787	1,649	679
2.Textile & Garment	536	15	46,486	1,205	839	20
3.Wood & Furniture	149	12	6,090	873	98	20
4.Paper	72	5	3,467	554	84	52
5.Printing	179	-	14,249	-	472	-
6.Petroleum & Chemical	216	43	20,518	2,800	1,434	214
7.Rubber & Tire	41	7	1,931	1,130	42	52
8.Plastics	162	15	14,020	2,412	460	103
9.Ceramic & Glass	27	10	1,181	4,868	27	312
10.Cement	59	33	4,139	2,614	152	174
11.Iron and Metal	296	22	13,461	1,561	333	59
12.Machinery	177	11	9,620	1,559	189	35
13.Electric Appliance	95	3	10,667	1,598	273	29
14.Transport Equip.	112	9	10,363	548	728	8
15.Precision	30	-	1,355	-	34	-
16.Miscellaneous	86	11	4,525	1,385	135	31
Total	2,609	276	194,435	36,894	6,948	1,789

Source: Anuario de Industria Manufacturera 1997, DANE, 1999

Note: (1) Bold figures indicate the five largest industries among all. (2) Value added is adjusted to 1999 price.

Table-1.10 GRDP Distribution of Services Sector by Category (%)

Region	Classification	1995	1999
Bogotá D.C.	1. Immobile	22.4	21.6
	2. Financial	17.5	15.5
	3. Public	9.5	13.3
	4. Commerce	14.4	11.0
	5. Transport	7.8	7.1
	6. Others	28.4	31.5
	Total	100.0	100.0
Cundinamarca Dept	1. Public	20.5	29.9
	2. Transport	11.6	9.6
	3. Commerce	12.1	7.3
	4. Others	55.8	53.2
	Total	100.0	100.0

Source: DANE

1.5.4 Inflation

The consumer price index of Colombia during nine years was shown in the Table-1.11. The index of the first five years of 1990's recorded more than 20% per year. From 1999 to date, it has fallen sharply to less than 10%. On the other hand, it should be noted that the exchange rate of Colombian Peso has been stabilized against US Dollars from 2001 until first half of 2002, but sharply devaluated since the beginning of second half of year 2002. It declined to 2,850 Col\$/US\$ at the end of October, reportedly triggered off South American financial crisis.

Table-1.11 Consumer Price Index

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002
Consumer Price Index in Colombia									
(%)	22.6	19.5	21.6	17.7	15.7	9.2	8.8	7.7	5.3
Exchange Rate (Average Rate of the Year)									
(Col\$/US\$)	826.5	912.9	1,036.6	1,141.1	1,426.4	1,756.8	2,087.6	2,305.1	2,847.4

Source: DANE

Note: 1) Consumer Price Index of 2002: From January to September, 2) Exchange Rate of 2002: as of October end