
1
Executive Summary
of Colombia's First
National Communication
to the United Nations
Framework Convention
on Climate Change
summary

Abbreviations and conventions

BA	Andean Forest
BEN	Energetic Balance
Bbam	Amazon Basal Forest
Bbo	Orinoco Basal Forest
BBp	Pacific Basal Forest
Bh-PM	Humid Premontane Forest
Bmh-PM	High Humid Premontane Forest
BOE	Barrels of Oil Equivalent
Br	Riverside Forest
CDM	Clean Development Mechanism
CEGA	Agricultural and Livestock Studies Center
CO_2	Carbon dioxide
CPC	Central Product Classification
DANE	Government Statistics Bureau
FAO	UN Food and Agriculture Organization
FCCC	UN Framework Convention on Climate Change
FEDEARROZ	The Rice-Growers Federation
GDP	Gross Domestic Product
Gg	Gigagrams = 10^9 grams
GWh	Gigawatt - hour
GWP	Global Warming Potential
ha	Hectare
IDEAM	Hydrology, Meteorology and Environmental Studies Institute
INVEMAR	Instituto de Investigaciones Marinas y Costeras José Benito Vives de Andreis
IPCC	Intergovernmental Panel on Climate Change
MW	Megawatt
PJ	Petajoule= 10^{15} joules
Sar	Shrub lands
SIN	The National Power Grid
SINA	The National Environmental System
SINCHI	Instituto Amazónico de Investigaciones Científicas
TG	Teragram= 10^{12} grams
TW	Terawatt= 10^{12} watts
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UPME	The Mining and Energy Planning Unit
Xa	Andean Xerofitic vegetation

1. Executive Summary of Colombia's First National Communication to the United Nations Framework Convention on Climate Change

1.1 National circumstances

1.1.1 Geography and climate

Colombia has a total area of 207'040.800 hectares, of which 114'174.800 are continental land mass and 95'866.000 are territorial waters. The island zones consist of a series of islands in the Pacific (Malpelo and Gorgona) and in the Caribbean (archipelago of San Andres and Providencia, and a large number of keys, islets and shallows). Pacific waters cover 33'930.000 hectares and Caribbean waters 48'936.000 hectares. This makes Colombia the fourth largest country in South America and the only one with Caribbean and Pacific coasts. There are five main natural regions on the mainland: Caribbean, Andean, Pacific, Orinoquia and Amazonia (*See map 1.1: Colombia - General location and natural regions*).

The greater part of the country enjoys more or less the same temperature ranges of an annual average of 24-28°C in the eastern zone of the Caribbean plains and a strip of the Pacific coast. Average annual temperatures of over 28°C are to be found in the lower, middle and part of the upper Magdalena valley. In a much smaller area, including Andean and Interandean zones, there is a variety of thermic levels due to the wide variations of air temperature at higher altitudes. The snow line, with temperatures lower than 0°C, is found above 4.600 m above sea level, and is the smallest of the land areas of Colombia.

1.1.2 Vegetation cover, ecosystems and biodiversity

Forests are estimated to account for 63'886.012 hectares, non-forest vegetation for 20'618.423 hectares, continental waters for 238.867 hectares, human settlements for 124.532 hectares and farming and settlement processes for 29'090.731 hectares. These categories of vegetation cover contain a wide diversity of ecosystems which have been attributed to geological and geomorphological factors, water, soil and relief, as well as the location of the country in the tropical zone and the variety of soils and climates. This is reflected in the large number of different geographical areas and areas isolated by the upthrust of mountain ranges (Sierra Nevada de Santa Marta, La Macarena, Chiribiquete, Darien, Baudo, Macuira, and others).

The diversity of Colombia's ecosystems is such that there are very few ecosystems in the world which are not also to be found there. This great diversity of biogeography and ecology, expressed in the variety of species of some biotic communities, give good reason to believe that Colombia has among the highest diversities of species on earth. Thus, with only 0,77% of the world's continental land masses, Colombia has 10%-15% of global biodiversity.

The focal points of biodiversity in Colombia are the Amazon region to the east (Alto Caqueta basin), the humid tropical forests of the Choco in the Pacific region, and the tropical region of the Andes, including the Sierra Nevada de Santa Marta and the San Lucas mountains.

1.1.3 Water resources

Colombia provides runoff for some 2.000 mm/year and an offer of water in excess of 2.000 cu. km/year, or 57.000 cu. m. per capita. This means that Colombia has among the highest levels of offer of water in the world, although the offer is unevenly distributed. More than 95% of water used in production and domestic activities is extracted from the Madgalena-Cauca basins and basins draining into the Caribbean, which between them represent less than 25% of annual water production in the country.

The Pacific region has a great abundance of runoff in the range 4.000-12.000 mm/year, with values higher than 14.000 mm/year in some areas. Other areas of the country suffer from excessive deficits, at levels of 70%-95% below the national average. The latter include the basins or hydrological regions of Alta and Baja Guajira, San Andres and Providencia, Cesar and the Sabana de Bogota. Alta and Baja Guajira have the least favorable situation (200-300 mm/year). But the most critical area is the Sabana de Bogota due to its low natural offer (500 mm/year) and the fact that it carries the greatest population pressure in the country.

1.1.4 Population and development

The population is estimated to be over 42 million, which makes Colombia the third most populous country in Latin America after Mexico and Brazil. The population has grown by more than 10 million since 1985, and may exceed 70 million in 2050.

In 1995 the urban population comprised 69,3% of the total and is expected to rise to 84,5% in 2050, by when the total population is expected to be 71'549.568.

In 1993 the population density was an average of 32,7 per sq. km, which is low compared to Europe or Asia or indeed some Caribbean islands where density exceeds 1.000 per sq. km. In Bogota, density is 3.500/sq. km. and San Andres Island 1.170/sq. km, and in both cases this concentration of the population causes environmental problems. However these two places are not comparable since Bogota is home to 17,4% of the total population, while San Andres Island holds only 0,16%.

The least populous regions are Orinoquia and Amazonia, especially the Departments of Amazonas, Guainia, Vaupes and Vichada, where density is less than 0.4/sq. k. In the Pacific Department of Choco density is 7/sq. km.

Poverty affects 60% of the population, that is 25 million individuals. The overall unemployment rate is estimated at 17,8% and 46% of the unemployed are among the nation's poorest. According to the UNDP Report on Human Development 2000, Colombia is ranked 68th in the world.

1.1.5 Economic background

For almost 70 years (1932-1988) the Colombian economy reported continuous positive growth. Between 1980 and 1999, the average was 3,1%. During the 1980s, when most Latin American economies were in difficulties due to the debt crisis, Colombia's Gross Domestic Product -GDP- grew at an average of 3,7%, more than double the regional average of 1,2%. Real growth slowed down towards the end of the 1990s to an average of 2,6%, which was close to the levels for the rest of Latin America and the Caribbean.

The liberalization process of the 1990s encouraged growth of over 5% between 1993 and 1995, higher than the average for Latin America as a whole. There was an interruption in 1996 due to imbalances in the fiscal and current accounts and the international crisis which began in Asia and spread to other emerging markets such as Russia and Latin America. Growth thus slowed between 1996 and 1998, and contracted -4,3% in 1999. This situation is seen as atypical, given Colombia's strong record in the past. Nonetheless, with public spending cuts and an injection of capital for investment in public and private entities, the reactivation of lending and the reduction in interest rates achieved a recovery of 3% in 2000. Projections for the next few years are positive, but unlikely to match the record of the past. For 2001 GDP is expected to grow 1,7%, and the forecast for 2002 is 2,2%-2,5%.

Available GDP data suggest that the structure of the Colombian economy has not substantially changed in recent years. Commerce and services together are the largest element, accounting for about 59% of real GDP. Next come farming and mining, with about 19%; and manufacturing industry with 15%. The construction sector has been the worst affected by the recent recession.

In 1990 final consumption of energy was 849,6 Petajoules -PJ- of which 11,4% was electricity, 42,6% oil and oil products, 7,6% coal, 5,2% natural gas and 26% biomass. Other products in the energy chain include non-energy products such as

Map 1.1 **Colombia - General location and natural regions**

lubricants, with a 7,3% share. In that year the major consumer was the transport sector with 269,7 PJ (31,7%), followed by residential consumption of 230,1 PJ (27,1%) and industry with 212,9 PJ (25,1%). Other sectors accounted for 136,8 PJ (16,1%), including the farming sector which accounted for 7%; commerce for 3%, construction 4% and others 2,1%.

In 1994, final consumption of energy increased 4,5% annual average, with a total of 1.013,7 PJ. Oil and oil products account for 42,5% of this, 11,9% to electricity, 8,6% to coal, 5,3% to natural gas, 25,8% to biomass and 6,1% to other products in the chain, including non-energy products. The structure of consumption by sectors had changed since 1990. The largest consumer continues to be transport with 27,9% of the total, followed by industry with 27,1% and the residential sector with 23,1%. Other sectors consumed 223 PJ, or 22% of the total, including the farming sector with 7%, commerce with 4% construction 1%, and others 10%.

Energy consumption per capita was 3,93 Barrels of Oil Equivalent -BOE- for 2000, below the Latin American average of 5 BOE.

Final consumption of energy follows the same trend as GDP, and growth was continuous until 1996, when per capita consumption was 6,6 million calories, and fell to below 6 million calories in 1998. In 1996 energy intensity was 2,36 BOE to produce 1.000 dollars of GDP (1990 US dollars). This increased to 2,50 BOE in 1999, thus surpassing the energy intensity of Argentina. Chile, Brazil, Panama, Mexico, Uruguay and Peru.

In 1990 the National Power Grid -SIN- had a generation capacity of 8.350,9 MW, of which 78% was hydraulic, 8% thermic (coal) and 14% natural gas. The INS generated a total of 33,863 GWh, 80% from the hydro-plants and 20% from the steam plants. In 1994 the installed capacity was 10.119 MW, 77,7% hydro-generated, 12,4% natural gas and 8,7% thermic (coal). In that year, 1,2% of generating capacity came from oil products (fuel-oil and diesel). Total generation was 39.490,2 GWh of which 80,6% was hydroelectric and 19,4% steam.

Between 1990 and 1994, 87% of travel was by road, 7,5% by air and 5,4% by river. Train represented 0,1% in 1999. International air travel increased 85,7%.

In 1999 there were 2'616.752 vehicles on the roads, 84,2% being private vehicles, 9,8% public transport and 6% freight vehicles. The liberalization of the economy in the 1990s brought a rapid increase of automobiles. In 1995 alone, 200.871 new vehicles were registered.

Between the 1950s and the early 1990s a large part of the agricultural sector was developed on the basis of import substitution for raw materials. The viability of the crops involved depended on the continued existence of protective barriers against imports, the transfer of income to producers through controlled prices and interest rates and direct subsidies paid from the national budget. Most of the transient tradable crops which formed part of the modern agricultural sector had their origins in this situation: examples are sorghum, cotton, soya, maize, barley and rice. The same conditions also applied to some extent to the development of the intensive farming of poultry and pigs.

The 1990s were difficult years for Colombia's farmers. With the onset of measures designed to liberalize the economy and open it up to competition, the agricultural sector has been subject to a relatively intense process of structural adjustment which is evident in the patterns of production and the use of resources. Transient tradable crops ran into a crisis from foreign competition. Rice and sugar kept their system of protection, but others such as cotton, soya, maize, sorghum and barley had to face an almost total elimination of protection. Other sectors, such as cattle-farming on the range or in intensive production, permanent crops and non-tradable crops have increased their production. Cattle-ranging occupied most of the land which had been abandoned by cereals and oleaginous crops. The growing of coffee suffered a significant reduction in terms of the area under cultivation and production, and the structure of the sector changed to a scheme of small-holdings.

The new market opportunities, encouraged by cost reductions, wider consumption and the modernization of trading structures, have mainly favored fruit, vegetables and tubers. Palm oil and sugar have been helped by high prices or improved technologies or both. Fish and poultry farming brought about new market opportunities by reducing their production costs and improving the commercial infrastructure.

There are also trends towards a greater integration of international and regional markets, and some products are no longer non-tradable.

One market which needs to consolidate itself is that for forestry products. There are some three million hectares available for production. Colombia has the potential to produce timber in cycles of 8-20 years with yields of more than 25 cu. m. /hectare/year. A proper forestry expansion strategy would enable Colombia to enter the market for CO_2 capture. In addition, there is a capacity for expansion in products such as cocoa, exotic oils, flowers, processed food and shrimp-breeding, as well as the exploitation of promising species.

The dynamic growth of exports in the 1990s, compared to that of the 1980s, shows the effects of deregulation and an open economy, as well as the efforts which Colombia made to penetrate new markets and strengthen its position in existing ones. In the last 20 years to 2000, traditional exports (coffee, oil and oil products, coal, etc.) have given way to the non-traditional items (textiles, manufactured goods. etc.). The diversification is mainly due to a strong performance by industry. In the 1980s the traditional exports represented 56% of total exports, and coffee was the largest single item. In the 1990s their share fell to 50%, and coffee exports took second place to oil. By contrast, non-traditional exports increased from 44% of the total in the 1980s to 50% in the 1990s.

1.1.6 Legislation, institutions and policies

The 1991 Constitution replaced what had governed Colombia since 1886. The new charter contained some sixty provisions related to the environment. Unlike the 1886 document, which had no specific provisions on this subject, the new Constitution brought an environmental dimension into development planning for the first time, and thus environmental policy came to have the same importance as economic or social policy.

Law 99 of 1993 created the Ministry of the Environment as the senior environmental authority, and it organized the environmental system -SINA-, which is composed of ministries, supervisory agencies and state bodies whose actions could have a direct or indirect effect on environmental conservation. It also contains NGOs, community organizations, universities, the private sector and production interest groups.

Law 99 of 1993 also set up five research institutes to provide scientific and technical support for the Ministry and established the basis for a National Environmental Research Information System which was to generate and disseminate information required for decision-taking to government agencies and to the public in general. One of these institutes is the Hydrology, Meteorology and Environmental Studies Agency, -IDEAM-.

The role of IDEAM is to obtain and handle scientific and technical information on strategic ecosystems and to set forth the technical basis for zoning and land-use. It is also responsible for obtaining, analyzing, and publishing basic information on hydrology, hydrogeology, meteorology, biophysical aspects of basic geography, geomorphology, soils and vegetation cover for the management and use of biophysical resources. It sets up and administers meteorological and hydrological resources to obtain and disseminate information, forecasts, announcements and consultancy services for the community. IDEAM also follows up biophysical resources, especially with reference to pollution and degradation, as instrumental support for the environmental authorities in their decision-making processes. IDEAM is the Environmental Information Node for Colombia.

IDEAM supports the Ministry of the Environment in the definition and development of international environmental policy through the regulation of scientific studies and research on global change and its effects on Colombia. IDEAM coordinated the preparation of this First National Communication.

The other institutes are the Jose Benito Vives de Andreis Marine Research Institute -INVEMAR- which contributed with studies and documents to this National Communication; the Alexander von Humboldt Biological Resources Institute; the Amazon Scientific Research Institute -SINCHI-, and the John von Neumann Pacific Research Institute.

1.2 National Inventory of Greenhouse Gases sources and sinks - 1990 and 1994

The National Inventory of Greenhouse-Effect Gases was made for 1990 and 1994, using the guidelines of the Intergovernmental Panel on Climate Change -IPCC-, 1996 version.

1.2.1 CO_2 emission and capture

Activities related to the use of fossil fuels, industrial processes and changes in land-use and forestry emitted 63.510,4 Gigagrams -Gg- of CO_2 in 1990, and 77,103,9 Gg in 1994. Through land-use changes, the capture of 1.010,8 Gg of CO_2 in 1990 rose to 2.014,7 Gg in 1994.

In 1990 emissions due to the use of fossil fuels for energy production produced 73,8% of the gas, followed by land-use changes and forestry, with 18,7% and finally industrial processes with 7,5%. In 1994 fossil fuels generated 71,8% of emissions, land-use changes and forestry 21,5%; and industrial processes 6,8%.

Fossil fuels also contributed significantly to emissions of carbon monoxide (53,9% in 1990 and 56,5% in 1994), nitrogen oxides (84,5% in 1990 and 86,3% in 1994), volatile organic compounds other than methane (94% in 1990 and 93,5% in 1994) and sulfur dioxide (95,6% in 1990 and 95,5% in 1994). Agriculture was particularly important in the emissions of methane (77,3% in 1990 and 77,2% in 1994), nitrous oxide (95,7% in 1990 and 95,8% in 1994) and carbon monoxide (45,3% in 1990 and 42,8% in 1994).

1.2.2 CO_2 equivalent emissions

In order to determine the direct aggregate effect of the various Greenhouse Gases on climate change, emissions are expressed in terms of CO_2 equivalent (*See Tables 1.1 and 1.2*).

Table 1.1 **Carbon dioxide equivalent emissions - 1990 (Gg)**

Sectors	CO_2	CH_4	N_2O	Total
Energy	46.886,1	5.634,3	407,5	52.927,0
Industrial Processes	4.744,5	4,2	62,0	4.810,7
Agriculture		31.862,0	23.557,8	55.419,9
Land - Use Change and Forestry	11.879,8	88,7	9,0	11.977,5
Waste		3,651.9	580,6	4.232,5
Total Country (Gg)	63.510,4	41.241,1	24.617,0	129.368,4

Source: IDEAM.

Table 1.2 **Carbon dioxide equivalent emissions - 1994 (Gg)**

Sectors	CO_2	CH_4	N_2O	Total
Energy	55.351,7	5.972,4	476,6	61.800,7
Industrial Processes	5.212,3	8,2	77,5	5.298,0
Agriculture		34.319,5	27.126,6	61.445,1
Land - Use Change and Forestry	16.540,0	88,7	9,0	16.637,7
Waste		4.061,4	625,0	4.686,4
Total Country (Gg)	77.103,9	44.450,1	28.313,7	149.867,8

Source: IDEAM.

1.2.3 Summary of the National Inventory of Greenhouse Gases, 1990 and 1994 (Gg)

Table 1.3 **Sectorial report for national greenhouse gas inventories - 1990 (Gg)**

Module/Submodule	Direct Greenhouse Gases			Other Gases			Aerosol precursor
	CO_2	CH_4	N_2O	CO	NOx	COVDM	SO_2
1. Energy*	46.886,1	268,3	1,3	2.602,5	249,9	394,4	135,5
A. Fuel combustion activities							
Energy industries	11.977,9	0,2	0,1	3,4	34,6	0,9	24,9
Thermic plants	5.894,1						15,1
Others plants	6.083,8						9,8
Manufacturing Industries	11.646,9	0,9	0,1	11,5	34,9	1,7	54,5
Commercial / Institutional	788,0	0,1	0,0	0,2	1,1	0,1	1,7
Residential	3.019,4	1,9	0,0	11,2	3,9	1,2	4,0
Agriculture / Forestry / Fishing	869,1	0,1	0,0	0,2	1,2	0,1	1,9
Construction	284,2	0,0	0,0	0,0	0,8		0,7
Others (not specified before)	1.203,3						1,4
Civil aviation transport	976,6	0,0	0,0	1,4	4,1	0,7	1,0
Road transportation (reference approach)	14.777,7	3,8	0,1	1.470,3	134,5	276,1	11,7
Road transportation (source categories)	12.853,6	5,2	0,2	1.129,6	71,9	188,9	
Railways	72,9	0,0	0,0	0,9	1,1	0,2	0,0
Navigation transport	525,4	0,0		7,4	11,0	1,5	0,8
B. Biomass							
Energy industries							
Manufacturing industries		1,2	0,2	163,2	4,1	2,1	6,4
Commercial / Institutional							
Residential		42,8	0,6	722,4	14,3	84,7	20,5
Agriculture / Forestry / Fishing		12,6	0,2	210,3	4,2	25,2	6,0
Others (not specified before)							
C. Fugitive emissions from fuels							
Coal mining		88,4					
Oil		3,3					
Natural Gas		79,6					
Venting and flaring	744,7	33,3					
2. Industrial Processes	4.744,5	0,2	0,2	2,4	0,9	25,3	6,3
A. Mineral products	3.141,5					0,5	1,9
B. Chemical industry	28,5	0,2	0,2	0,2	0,5	2,2	1,4
C. Metal production	1.574,5					0,1	1,3
D. Food and drink production						21,7	
E. Other industries				1,4	0,4	0,9	1,7
3. Agriculture		1.517,2	76,0	2.184,9	44,0		
A. Domestic livestock		1.265,7	0,1				
B. Rice cultivation		168,3					
C. Prescriber burning of savanas		72,9	0,9	1.912,4	32,6		
D. Field burning of agricultural residues		10,4	0,3	272,5	11,4		
E. Agricultural soils			74,7				
4. Land use change and forestry	10.869,1	4,2	0,0	37,0	1,0		
A. Changes in forest and other woody biomass stocks	8.654,0						
B. Forest and grassland convertion	3.225,6	4,2	0,0	37,0	1,0		
C. Abandonment of managed lands	-1.010,8						
D. CO_2 emissions and removals from soils	0,2						
5. Waste		326,6	1.9				
A. Solid Wate disposal on land		311,9					
B. Domestic and commercial wastewater handling		10,6					
C. Industrial wastewater handling		4,0					
D. Human sewage handling			1,9				
Net emissions total - Gg	62.499,7	2.116,6	79,4	4.826,7	295,9	419,7	141,8
Memo items: please do not include in energy totals							
International bunkers	583,6	0,0	0,0	2,6	4,8	0,7	0,9
Aviation	439,4	0,0	0,0	0,6	1,9	0,3	0,5
Marine	144,2	0,0	0,0	1,9	2,9	0,4	0,4
CO_2 Emissions from biomass	16.999,9						

Note: Totals may not coincide with the sum of partials due to approximation by decimals.

* CO_2 emissions from energy only include reference approach values to road transportation.

Source: IDEAM.

Table 1.4 **Sectorial report for national greenhouse gas inventories - 1994 (Gg)**

Module/Submodule	Direct Greenhouse Gases			Other Gases			Aerosol precursor
	CO_2	CH_4	N_2O	CO	NOx	COVDM	SO_2
1. Energy*	55.351,7	284.4	1.5	2.874,5	289,5	436.6	162,5
A. Fuel Combustion Activities							
Energy industries	13.250,3	0.3	0.1	3.7	38.7	1,0	24,9
Thermic plants	6.536,5						17,0
Others plants	6.713,8						7,9
Manufacturing Industries	14.709,6	1,2	0,2	15,0	43,9	2,3	70,5
Commercial / Institutional	1.043,4	0,1	0,0	0,3	1,4	0,1	1,9
Residential	2.952,6	2,3	0,0	14,2	3,7	1,5	4,1
Agriculture / Forestry / Fishing	1.185,1	0,2	0,0	0,3	1,6	0,1	2,6
Construction	234,5	0,0		0,0	0,7		0,6
Others (not specified before)	2.623,8						1,0
Civil aviation transport	1.293,7			1,8	5,5	0,9	1,4
Road transportation (reference approach)	16.620,8	4,1	0,1	1.574,6	152,0	295,7	14,2
Road transportation (source categories)	16.974,1	6,9	0,3	1.472,6	93,6	245,1	
Railways	42,8	0,0	0,0	0,5	0,6	0,1	0,1
Navigation transport	671,0	0,0	0,0	9,3	14,0	1,9	1,1
B. Biomass							
Energy industries							
Manufacturing industries		2,1	0,3	266,9	6,7	3,4	10,2
Commercial / Institutional							
Residential		42,2	0,6	712,6	14,2	83,7	20,3
Agriculture / Forestry / Fishing		16,5	0,2	275,2	5,5	33,0	8,3
Others (not specified before)							1,3
C. Fugitive Emissions from fuels							
Coal mining		94,9					
Oil		3,4					
Natural Gas		82,4					
Venting and flaring	724,1	34,6					
2. Industrial Processes	0.0	0,4	0,4	2,9	1.1	29,8	7,8
A. Mineral products	3.918,4	0,0	0,0	0,0	0.0	0,7	2,5
B. Chemical industry	0,4	0,4	0,3	0,4	0.6	2,2	1,9
C. Metal production	1.293,5	0,0	0,0	0,7	0.0	0,1	1,1
D. Food and drink production	0,0	0,0	0,0	0,0	0.0	25,5	0,0
E. Other industries	0,0	0,0	0,0	1,8	0.5	1,2	2,2
3. Agriculture		1.634,3	87,5	2.178,8	43.8		
A. Domestic livestock		1.403,6	0,1				
B. Rice cultivation		1.450,1					
C. Prescriber burning of savanas		72,9	0,9	1.912,8	32.6		
D. Field burning of agricultural residues		12,6	0,3	265,2	11.2		
E. Agricultural soils			86,2				
4. Land use change and forestry	14.505,3	4,2	0,0	37,0	1,0		
A. Changes in forest and other woody biomass stocks	13.314,0						
B. Forest and grassland convertion	3.225,6	4,2	0,0	37,0	1,0		
C. Abandonment of managed lands	2.034,7						
D. CO_2 emissions and removals from soils	0,4						
5. Waste		374,4	2,0				
A. Solid Wate disposal on land		343,4					
B. Domestic and commercial wastewater handling		21,2					
C. Industrial wastewater handling		9,8					
D. Human sewage handling			2,0				
Net emissions total - Gg	75.069,3	2.297,6	91,3	5.092,3	33,4	453,3	170,2
Memo items: please do not include in Energy Totals							
International bunkers	1,002,7	0.019	0,0247	3,76	7,38	1,1	1,58
Aviation	811,1	0.0058	0,0231	1,16	3,47	0,58	0,88
Marine	191,6	0.0130	0,0016	2,61	3,91	0,52	0,70
CO_2 Emissions from biomass	20.177,6						

Note: Totals may not coincide with the sum of partials due to approximation by decimals.

* CO_2 emissions from energy only include reference approach values to road transportation.

Source: IDEAM.

1.3 Colombia's actions to mitigate Greenhouse Gases emissions

Since 1994 Colombia has taken a number of actions to reduce Greenhouse Gases emissions and to increase capture in sinks. With the exception of the Clean Development Mechanism, most of these actions have been designed and introduced for reasons other than the combat against climate change or the reduction in Greenhouse Gases emissions. The effects are nonetheless related to the provisions of the UN Framework Convention on Climate Change.

1.3.1 Sector policies and strategies

Colombian government policies and strategies which refer directly to environmental considerations and factors which may influence climate change, have been as follows:

- **Energy:** the National Energy Plan was formulated in 1994. There are also policies, which include a reduction in the vulnerability of the system due to hydrological factors; the increase in the number of participants and the encouragement of competition among them; the efficient use of available sources of energy and an increase in the availability of generating plant, especially in the steam generation plants.
- **Transport**: gas-conversion programs; emission controls, restrictions on the use of vehicles and the implementation of mass-transport systems, such as the Metro in Medellin and the Transmilenio in Bogota.
- **Industry**: the national “Cleaner Production” policy, introduced in 1997.
- **Agriculture**: the agricultural sector has been working its way into the ecological products market for the last five years. More than 20 businesses have been certified and 20 more are in transition, covering an area of about 33.000 hectares. They exported some 9 million dollars in 2000.
- **Land-use changes and forestry**: the Forests Policy (1996), the Strategic Plan to Restore and Establish Forests (Plan Verde, 1998) and the National Forests Development Plan (2000).
- **Waste Disposal**: the Integrated Waste Disposal Management Policy, 1997.

1.3.2 Measures to implement the United Nations Framework Convention on Climate Change - The Clean Development Mechanism

In order to prepare a strategy for Colombia's participation in the Clean Development Mechanism, the government has made a National Strategic Study for Climate Change -NSS Colombia- with the support of the Swiss government and the World Bank. The study evaluated national potential in the new market in terms of potential benefits and competitiveness. It also identified the possible limitations in the development of this potential and drew up strategy lines to overcome them and maximize the potential benefits of the Clean Development Mechanism identified. A project portfolio was structured and drawn up.

The NSS Colombia was produced in 1999 when the 6th and 7th sessions of the Conferences of the Parties had yet to be held. These Conferences in the end excluded conservation projects and limited those of afforestation and reforestation in the Clean Development Mechanism. Therefore, the estimated potential and the project portfolio both include conservation, afforestation and reforestation.

1.4 Vulnerability and adaptation

1.4.1 Coastal and island zones

The effects of a potential rise in sea levels were evaluated using geomorphological and morphodynamic indicators and the physical characterization of the shores, their susceptibility and the projection of possible biophysical changes that might occur. With the increase of average sea levels of one meter, there could be a permanent flooding of 4.900 sq. km. of lying coast, with strong formation of pools to total flooding for 5.100 sq.km. of moderately susceptible coastal and the formation of pools in nearby areas and the deepening of bodies of water located in the coastal area and the continental platform. Flooding would also increase erosion in especially sensitive areas where human activities have reduced the buffer capabilities of the coast systems. Natural systems such as beaches and areas of coast swamps by marshers would be the worst affected by erosion and coastal flooding.

In terms of the biophysical changes that might occur by a change of 1 meter in the sea level, much of the population, and their economic activities and vital infrastructure would be threatened by the coastal flooding.

About 1,4 million people live in the area which would be affected by the rise, and 85% of them live in urban areas. In the Caribbean coast only 9% of urban housing would be highly vulnerable to flooding, while 46% of houses in rural areas would be under threat. On the Pacific coast 48% of houses in urban areas and 87% in rural areas would be highly vulnerable.

However, due to cultural traditions a large number of houses are built on wooden piles, and this would make adaptation easier. In terms of social vulnerability of Caribbean coastal homes, in urban areas, 1% would be highly vulnerable, 16% moderately vulnerable, and 83% slightly vulnerable. In the rural areas of this coastal, 28% of homes are highly vulnerable, 11% are moderately vulnerable and 61% are slightly vulnerable. On the pacific coast, 13% of homes would be highly vulnerable; 62% moderately vulnerable and the remaining 25% slightly vulnerable.

On the Caribbean coast the analysis of the agricultural sector concluded that of 7'208.299 hectares of crops and pasture reported, 4,9% would be exposed to different degrees of flooding; 49,5% of this area would be highly vulnerable, represented mainly by crop of banana and african palm plantations. In the industrial sector it was found that 75,3% (475 hectares) of the area used for manufacturing facilities in Barranquilla and 99,7% (877 hectares) in Cartagena are under high-vulnerability. The 44,8% of the roads network would be highly vulnerable, 5,2% would be moderately vulnerable and 22,7% slightly vulnerable.

The proposed adaptation measures are designed to restore and strengthen resilience mechanisms of the coast to facilitate the natural adaptation of coastal areas to rising sea levels. Adaptation options fall within the framework of integrated management of coastal areas that were established by the government for the coast areas, such as the preservation of coastal wetlands, regulation of land-use and activities in threatened zones by flooding, and the protection of zones of vital socio-economic interest.

An analysis was made of the vulnerability of the Caribbean island of San Andres, which is part of a large coral archipelago covering 52,2 sq. km. The island itself has an area of 27 sq. km. of which 17% would be flooded by the projected rise of 1m in sea level, on the northern and eastern shores. The most affected zones by inundation would be those containing the richest of the island´s natural resources as well as where the tourism industry and commerce are established. The high vulnerability of these zones is due to the presence of infills which were built over in the 1950s. In the some way, the public service infrastructure would also be affected, particularly the sewerage system, water supplies and roads. Also, current processes of erosion would increase.

1.4.2 Water resources

According to the evaluation of the effects of climate change on hydrological regime, the possible consequences might be of two kinds:

- An increase in levels of runoff norma, with reductions of seasonal variations and an accentuation of asymmetry;
- A decrease in levels of runoff norma, with an increase in seasonal variability and attenuation of asymmetry.

This means that for the regions in which the current asymmetry coefficient is positive there could be a significant increase in the frequency of maximum flows, which would be slightly attenuated in terms of magnitude.

However, it is also possible to foresee situations in which there would be flows of flood rather higher than at present. Also, minimum flows would be less abundant and their frequency would increase slightly due to an increase in the asymmetry of the runoff norma.

In places now characterized by hydrological regime with a negative asymmetry there could be an opposite but not totally inverse effect. Thus, low flows would increase in magnitude, but with a relevant increase in frequency. Maximum flows would also increase in size but reduce in frequency.

For areas with positive or negative asymmetry there could be a reduction in frequency of modal values for runoff norma, and this would favor seasonal regulation conditions.

For the second type of response, and regardless of differences in asymmetry, the pattern suggests a reduction in the frequency and magnitude of modal values, an increase in the frequency of maximum and minimum flows, which would both become more acute, and finally a deterioration in the conditions of regulation.

A more detailed sensitivity study needs to be made for certain productive sectors, since 50% of the country might be affected to a high/very high degree by the magnitude of the changes in runoff norma, variation coefficients and asymmetry or by a complete changes in the functioning of the entire hydrological regime.

1.4.3 Vegetation covers

For the evaluation of the possible impact on vegetation, and for identification of its vulnerability, an analysis of the displacement Holdridge's of life-zones was made under the scenario of climate change and it identified vegetation affected by displacement. The country was zoned by degrees of vulnerability of vegetation in the event of climate change. According to this analogy, the following zones might be displaced:

- Glaciar areas (N) would be affected by 92%, with 62% moving to Subalpine Rainy Paramo (pp-SA) and 27% to superparamo or Alpine Rainy Tundra (tp-A)
- Montane, Subalpine and Alpine life zones above 2.500 m, corresponding to sub paramos, paramos and superparamos and snows, could be affected 90%-100% which would be equivalent to a displacement of altitudes not only in the zones indicated in the Holdridge diagram but to higher biogeographical altitudes than those currently occupied by the Andean region.
- Premontane life zones at 1.000-2.000 m above sea level which is in general the altitude of the Coffee Belt and which corresponds to high Humid Premontane forest (Bmh-PM) and Humid Premontane forest (Bh-PM), which cover 7% of Colombia's land area; here, 50%-60% of the land could be affected with a possible upward displacement of altitude.

In addition, a third of the areas which are today farming ecosystems could be affected by climate change, in which case the Andean zone systems would be the most vulnerable with 47% of their area affected.

It is also possible that 14% of the Amazon basal forest (BBam) would be affected, along with 30% of the Orinoco basal forest (BBo) and 7% of Pacific Basal woodland (BBp); 43% of Andean Forest (BA) would be affected.

1.4.4 Approach to the vulnerability of mainland ecosystems

The Holdridge model as used represents a “first approach” to the study of vegetation. It can be generally taken as an interpretation of zonal ecosystems, that is, those whose spatial distribution depends directly on the climatic factors considered. For the main types of natural ecosystem dynamics, factors of natural disturbance, factors of tension were reviewed. The possible effects of climate change were also discussed.

The study was made for zonal and azonal ecosystems, as follows:

- **Zone-bioma of humid tropical woodland**: in Colombia the areas of low forest which are least likely to adapt to climate change due to man-made tension are 1) small and isolated remains of jungle located far from Andean watersheds and foothills, 2) tropical jungle areas close to foothills but highly fragmented and with land-use that has produced erosion and compaction of soils (Caqueta and Putumayo).
- **Pedo-biomas and helo-biomas of the zone-bioma of humid tropical forest**: the project of what could happen to the pedo-biomas is outside the premises of the model used. A future projection could be made through an interpretation of possible changes in the water regimes of river basins. Changes in macro-climate (temperature and rainfall) would have less effect in flood areas of jungle. However, since climate change can also cause changes in the hydrological dynamics or major rivers (flows/seasonal variations) there could be an effect on the morphogenetic dynamics of this type of ecosystem. The indirect effect might also be equally serious. The change in structure and composition of ecosystems as a result of changes in flooding regimes in alluvial plains would have an enormous effect on biodiversity.

  Any model of the future sensitivity and vulnerability of these biomas would have to be constructed on a much more detailed level, and would have to make a simultaneous evaluation of factors such as availability of water in the alluvial plain soils, changes in regional meso-climate and pressures exerted by man. At all events, this is a question of modeling on a more detailed scale than that used for the projection of bio-climatic regions.
- **Zone-bioma of dry tropical forest**: in general, 17,8% of the current areas of dry tropical forests in the Caribbean area would be affected and

would be displaced to warmer and dryer conditions.

Despite the fragility of these forests, the climatic model indicates that in terms of the Holdridge formations, they are among the least affected in relative terms; and knowledge of their dynamics and degrees of tension would allow the assumption that they are among the major types of ecosystem in Colombia which would be most vulnerable to climate change. The capacity of Colombia´s dry tropical woodland to adapt to climate change is minimal.

- **Flatlands** (pedo-biomas or peino-biomas, depending on location): the Holdridge classification system of bioclimates defines most of the flatlands of Colombia as "dry tropical woodland", and allows no distinction between the changes which would occur on the flatlands as such in relation to the "dry tropical forest" as a whole. However, the possibility of changes in biotic structure due to burning, degradation by erosion or significantly increased aridization cannot be ruled out. Climate change would have a destabilizing effect, perhaps as the direct cause of desertification, and changes to, and loss of, biodiversity.
- **Andean mountain jungle biomas**: the changes in Andean life-zones suggested by the Holdridge life-zone displacement model and vegetation coverage affected by climate change to conditions where carbon dioxide doubles show displacement towards drier and warmer conditions. The great fragility of the Andean mountain forests and the very strong human pressure which they face with the reduction in their area, fragmentation, biotic losses and degradation makes them one of the ecosystems most vulnerable to climate change. Adaptation could only be proposed as an immediate measure, with wide-ranging programs for conservation of the residual forests, ecological restoration and the creation of conservation corridors, together with the general ecological improvement of the surrounding agricultural ecosystems.
- **Mainland water ecosystems**: the Holdridge model applied allows for no projection of all the types of ecosystem distributed with some independence from the climatic factors considered. The vulnerability of wetlands to climate change generally depends on the effects on hydrological processes which supports them.
- **Agricultural ecosystems**: it was not possible to establish a general pattern for the behavior of agricultural ecosystems in the face of global changes. This was because in Colombia agricultural ecosystems have been established in almost all kinds of natural ecosystems. Agricultural ecosystems can, at least in the first instance, be seen as a form of transformation or pressure on the natural ecosystem. Thus it can be supposed that the future of the agricultural ecosystems will in general be linked to the scenario of the vulnerability of the natural ecosystems from which they originated.

Guidelines for the adaptation of ecosystems to climate change should develop land-use regulations and include the concept of a Principal Ecological Structure for the country. That is a scenario of national territorial planning which considers the spatial structure of natural and managed ecosystems.

1.4.5 Paramo ecosystems

The particular location of the paramo ecosystems in the high mountain makes them especially vulnerable. If warming occurs, there will be a reduction in their area and a decrease in their biodiversity. Since the advance would be vertical, the ecosystem`s area would shrink and could disappear.

Further, the location on an altitude zone where there is a highly dynamic social and economic processes makes the paramo area considerably more vulnerable. If the current trend of invasion of the high mountain areas continues, crop farming and cattle-raising will increase in the paramo regions where they already have some presence.

The zone will also start to be used right up to the limits of the very small remaining areas of superparamo. If this happens those ecosystems will disappear and with them their biodiversity and their function as a water-regulator.

If climate change is considered a global process, hard to control on a regional scale, action should be taken to at least permit natural adaptation. There is a priority to control the advance of human activities into the paramo zones, to implement a policy designed gradually to limit social and economic activity in the paramo and to declare these zones to be biodiversity and water natural reserves.

In addition, for those people affected by the above-mentioned measures, there should be alternatives to offer change of paramo land for land at lower altitudes. This will reduce human pressure on the paramo ecosystems.

The adaptation measures will also need to consider specific situations and will require in-depth social and economic studies and surveys of land-ownership in each paramo area.

1.4.6 Glacier zones

The study made shows that the glacier areas of Colombia have lost 80% of their area within the last 150 years since the end of the Small Ice Age (1850). According to measurements taken at the end of the 1990s, Colombian glaciers have reduced in area from 348 sq. km. to 63 sq. km. An analysis of this process, with the current climate trends, suggests that the glaciers of the country will disappear completely within the next 100 years, as happened to other glaciers between 1940 and 1985.

Field measurements in the last decade (1990 - 2000) show a linear withdrawal of the ice of an average of 10-15 m yearly. This can vary due to extreme climate conditions such as El Niño. Contrariwise, there are cold events such as La Niña which can reduce the melting speed process. However this doesn't mean there is a recovery of ice, since the melting process seems to be an almost irreversible natural process. Photogrammetry calculations showed that in the mid-1950s and the end of the1990s the rate of annual loss in existing glaciers was between 0,64% (Huila) and 1,65% (Tolima).

The population which lives around the glaciers benefits from the water generated by melting. The water supplies of Chinchina, Palestina, Manizales, Pereira and Santa Rosa de Cabal in the Nevados National Park depend on the rivers which rise in the high central cordillera, above 3.000 m (Corpocaldas, 2001). Towns such as Guican and El Cocuy take advantage of water from melted glaciers of the Cocuy in the eastern cordillera. The Cocuy is the largest remaining glacier, accounting for 37% of all the country glacier areas.

1.4.7 Agriculture

The analysis of the vulnerability of the agricultural sector, as a consequence of climate change, was carried out by application of the “spatial analogue” method.

From the information on bioclimatic ranges and soil offer it may be concluded that the most vulnerable ranges in the scenario of doubled CO_2 are: cold-humid, cold-rainy and very humid paramo. The area of these bioclimatic ranges, with a high soil offer, would be reduced by about 47,7%.

Based on an evaluation of land suited to intensive agriculture and the susceptibility analysis by desertification processes and irrigation districts, the conclusion was that 7'731.550 hectares, or 7% of Colombia´s land area, are suited to intensive agriculture; and only 12,2% of this area is in dry ecosystems.

The offer of soils for intensive agriculture affected by desertification processes would increase by 1,4% in the area of the dry ecosystems. The areas growing bananas, sugar cane and african palm on soils prone to degradation by desertification, would increase by 3%. Twenty three major user-managed irrigation districts of INAT are in dry zones, of which 15 are affected by degradation by desertification processes (32,2% of the total area of the 15 districts).

With a future scenario of carbon dioxide duplication, the 23 irrigation districts would be affected by degradation by desertification processes (91,3% of the total area of the 23 districts).

Although there is no inventory of areas occupied by agriculture in dry ecosystems, it is estimated that about 10% of this land could be used for intensive farming. If the same type of farming continues to be used in these areas, there would be a high risk of loss of productivity. Therefore, special management plans would be required for agricultural ecosystems in these dry zones.

In order to complement the results obtained in this study, it is recommended that future research should take account of the following factors: 1) Information on water resources should be included, 2) An analysis should be made of the climatic variability and yields for the main intensive crops, using the temporal analogue method, 3) Research should be done on the use of remote-sensing information, identification, geo-referencing and characterization of specific crops, 4) A sustainable agro-technological calendar should be drawn up to contribute to the development of such subjects as: the relationship between physiological requirements and the vegetative phases of crops; the diagnosis of soil and environmental offer for agriculture; the capacity of ecosystems to tolerate agricultural technologies and activities, the susceptibility of the environment to degradation by erosion, compaction, concentration of salt, soda or aluminum, the loss of organic material and the prevention of risks due to climatic conditions, biology, geology and soils, in real time.

1.4.8 Soils and land in a process of desertification

One of the effects of global climate change in Colombia has been the increment of the number of areas in a process of desertification and the droughts, or intensification of processes, of soil degradation within those desertification areas.

The information supplied by the indicators used in the desertification model shows that 4'828.875 hectares have been affected by desertification, representing 4,1% of the country's land area. Of this,

0,6% of the land area of Colombia has reached levels of very serious desertification and non-sustainability; for 1,9% the level of desertification is moderate, and for 1,4% is slight.

If the range of the United Nations (P/ETP) indicator is broadened to 0.75, it is possible to identify areas with a potentially high probability of desertification, adding 3'576.068 hectares to the process (3,1% of the country's land area).

This is feasible, if we consider the future effects of climate changes with an increase in air temperature and human pressure as these soils come to be used for intensive agriculture and the production of oil, gas and minerals with technologies which generate environmental impact on soils, water, fauna, vegetation and the air.

The percentage of land affected by desertification is in fact low, especially in comparison with other Latin American countries, where Colombia is ranked seventh out of nine. But the fact of being located on one of the main poles of its development is still a cause for some alarm.

1.4.9 Human health

Malaria and dengue were the two pathologies selected for a study of the relationship between human health and climate change, given their frequency, which may be associated with such change, and the relevance of these two diseases to morbidity in Colombia and elsewhere in the world.

The zones susceptible to this contagion were defined in terms of climate variables (temperature, rainfall and relative humidity) and the real incidence on the development of malaria and dengue.

The zones most exposed to malaria as a consequence of climate change would include all towns in Choco and Guaviare, some of Putumayo, Caqueta. Amazonas, Meta, Vichada, Vaupes, Guainia and Arauca; the Pacific watersheds of the Departments of Nariño, Cauca and Valle del Cauca; and the watershed of Uraba-Antioquia, southern Guajira, Catatumbo and the Lower Magdalena, Lower Cauca, Nechi, Alto San Jorge and Alto Sinu.

The most vulnerable areas for dengue are Santander, Norte de Santander, Tolima, Huila, Atlantico and Valle del Cauca.

The intention is to strengthen prevention and control of malaria through activities related to the application of chemical insecticides and the treatment of victims with anti-malarial medicaments; measures for environmental management in urban and rural areas; improved early diagnosis; better access to health services and treatment; the promotion of self-care, and community protection.

The recommended adaptation measures for dengue are the ones most commonly used to combat it: stronger action such as chemical control to eliminate adult mosquitoes, environmental measures to prevent them from breeding; and clean-up campaigns organized with the aid of community organizations and health workers.

1.5 Limitations, recommendations and needs

In general, the analysis of the components of this First Communication applied the methods recommended by IPCC 1996 for the preparation of the inventory of greenhouse effect gases, the construction of scenarios for climate change to evaluate potential impact and to identify vulnerability. During the process of application of the IPCC guidelines and supporting documents, we encountered difficulties which limited the scope of results presented here. We therefore make some recommendations to guide and improve information for future reports.

1.5.1 Problems with the IPCC 1996 method for inventories

- **Industrial processes**: there were problems with the method since there are ambiguities in the options for data to be used in order to calculate emissions, such as in the information on the production of clinker and cement. This leads to the risk of under or over-estimation of emissions and a distortion in the results of the inventory.

There are also problems of harmonization of categories of IPCC product classes with those used locally. The options in the IPCC guidelines with regard to available data are sometimes too generic and sometimes too specific. This creates confusion in the guidelines, especially when national official figures do not match those provided by industry associations or research groups. The default emission factors proposed by IPCC are not clear with regard to the way in which they were obtained. In this context, IPCC does not provide information regarding technology, degrees of production and the aggregation of information for the construction of results, its representative value and statistical significance.

- **Land-use change and forestry**: the guidelines are not clear enough with regard to the calculation of biomass stocks. The terms used are ambiguous: account is taken only of planted forests or those which are the result of mass felling production and does not explain the category to be used for selectively intervened forests, such as is found in Colombia. Also, the default values proposed do not consider the most appropriate values for tropical forests in Latin America since each country has a specific regime for the use, management and exploitation of this element and each should make its own inventories in these terms. The calculation procedures of CO_2 capture could lead to mistaken values in the national GHG inventories.
- **Chapter for waste**: the terms used in the guidelines correspond to countries with advanced techniques for waste treatment.

1.5.2 Problems with the IPCC 1996 vulnerability and adaptation method

- In the evaluation of vulnerability, the IPCC method was not followed since the information contained limitations of availability, homogeneity and geo-referencing. It also had the problems mentioned with regard to the guidelines as to how to project and construct future scenarios with and without climate change.
- In general, the definition of vulnerability and risk is open to several interpretations. For international comparability it would be necessary to define the quantity of the aggregation of reference information for exposure units.
- The method requires the incorporation of other important criteria and concepts which should apply to an evaluation of vulnerability, such as the consideration that a threat has a different impact on different social groups and between them, due to socioeconomic and cultural characteristics. This means that only a part of the exposed elements recommended by the IPCC could be analyzed.

1.5.3 Recommendations for the improvement of IPCC 1996 guidelines for inventories

- The industrial process model should require the emission factors to have a minimal consistency with the emission studies sponsored by the World Bank and other international organizations.
- The module for land-use change and forestry allow for different interpretations. Although they all may be valid, there should be a review to clarify whether biomass stocks in natural woodland should be included or not in the dynamic balance and advanced state of succession caused by natural phenomena which allow their renewal.

  Some interpretations would say that this type of stocks implies processes of natural regeneration of cleared surfaces and thus to removal of CO_2 from the atmosphere.

  If all forests are included in all states of succession and dynamic balance, the result is a substantial increase in the figures for carbon dioxide capture in the greenhouse gas inventory.

  It would also be important that the method should take into account the classification which each country has used for its types of forest cover. Also, the inclusion of carbon dioxide capture by oceans could lead to more realistic values in the GHG inventories.

- We would recommend that a method be developed to account for the biomass of natural grass flatlands and other ecosystems already considered, since they are taken into account in the agriculture module only for accounting for burning off and not as important sumps for carbon.
- For the waste module, we suggest that the guidelines should use the Central Product Classification System -CPC- to facilitate the identification of each product included in estimates for greenhouse gases. The default values proposed are not reliable. The factor for burning or recovery of methane in developing countries does not allow appreciation of the fraction of the gas which escapes into the atmosphere during the generation of the gas.
- We recommend that an inter-institutional agreement be drawn up and formalized with the participation of national experts, to make adjustments to the IPCC methods in terms of criteria, definitions, variables and parameters to be applied in subsequent Colombian National Communications.
- One valid recommendation for all modules of the inventory is that the reference manual and other texts of UNFCCC and subsidiary bodies should be available in the UN official languages. We would also recommend that once the translations have been made they should be reviewed to ensure that they are faithful to the original text, in order to avoid problems of interpretation.

1.5.4 Recommendations for the improvement of IPCC 1996 guidelines for vulnerability and adaptation

As a general comment on IPCC methods, it would be recommendable that minimum requirements of content and scope should be set for National Communications, such that an in-depth evaluation of vulnerability would be required, but that also comparisons could be made between the information and results presented by each country.

1.5.5 Recommendations for obtaining information and for research in the context of future country reports

- It would be important to request analyses of changes of vegetation cover for woodland areas on a scale of 1:100.000, in order to obtain an appropriate degree of resolution.
- In order to determine information related to the abandonment of land over 20-100 years, satellite images with spatial and spectral high resolution would be needed for the years 1970-2000.
- The level of confidence in information will increase as and when more regular inventories are made of representative regional ecosystems.
- Greater detail is required of the composition and structure of different types of vegetation cover identified at national level since this would allow a more accurate appreciation of their natural dynamics.
- As a complement to the structural study of ecosystems, more in-depth work needs to be done on forestry variables which can provide a description of content in the basal level, volumes, wealth and diversity of flora, intraspecific competition and amount of sunlight received by lower layers of vegetation, as a means of forming other possible sumps which have not yet been studied in depth.
- The IPCC could arrange for Latin American regional workshops to discuss and establish technical criteria and methods for making the inventories, especially in relation to the module for land-use change and forestry so that the module can be adjusted to national particularities. We would also propose the arrangement of technical workshops to help countries to define measures for adaptation and mitigation.

1.5.6 Costs borne by IDEAM in the preparation of the First National Communication

IDEAM acted as coordinator of the First Country Report for Colombia to the UNFCCC. In doing so, it received financial support of 345.000 dollars from GEF/UNDP. In addition, and as established in the GEF/UNDP project, Colombia made in-kind contributions to the project through IDEAM. IDEAM conducted an analysis to establish the dollar value of the Colombian contribution in order to allow the evaluators and those responsible for UNFCCC decision-making to gain an idea of the real costs and needs which Colombia has for such funding, and to identify funding requirements for subsequent reports. The costs borne by IDEAM as the in-kind contribution totaled about 900.000 dollars for this First National Communication.


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