UNITED NATIONS
Office on Drugs and Crime

Government of Colombia

Colombia

Coca Cultivation Survey

June 2007

ABBREVIATIONS

COP	Colombian Pesos
DANE	National Department of Statistics
DEA	US Drugs Enforcement Administration
DIRAN	Colombian Anti-Narcotics Police
DNE	National Narcotics Office
DNP	National Planning Department
GME	Mobile Eradication Groups
ICMP	Illicit Crop Monitoring Programme
INCB	International Narcotics Control Board
IDB	Inter-American Development Bank
NNPS	National Natural Parks System
OAS	Organization of American States
PDA	Alternative Development Programme
PCI	Presidential Programme against Illicit Crops
RSS	Social Solidarity Net
SIMCI	Integrated Illicit Crops Monitoring System
UNODC	United Nations Office on Drugs and Crime.
USAID	United States Agency for International Development
US$	United States Dollars
mt	Metric tons

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PREFACE

In 2006, Colombia intensified its eradication efforts, destroying record amounts of coca. Compared to the year before, spraying increased by 24% from 138,775 to 172,025 hectares, while manual eradication jumped by one third, from 31,285 to 41,346 hectares. This latter figure is impressive: the amount of coca in Colombia that was destroyed by hand in 2006 is almost equal to all the coca grown in Peru last year. As a result of these resolute efforts, the area of land under coca cultivation in Colombia decreased by 9% in 2006 to 78,000 hectares – the lowest level in ten years.

Law enforcement efforts are proving successful – in 2006 more than 127 tonnes of cocaine were seized and more than 2,200 clandestine labs were destroyed in Colombia. The combination of eradication and enforcement seems to be unsettling the market which is now heading towards new trafficking routes and distribution areas.

Yet, Colombia still remains the world's biggest coca grower and is responsible for 62% of the world's supply of cocaine. Furthermore, the decrease of coca cultivation is relatively small in comparison to the significant amount of eradication that is taking place: a reduction in net cultivation of 8,000 hectares compared to 2005 despite over 200,000 hectares of combined aerial spraying and manual eradication.

This suggests that while eradication is having an effect, deeper and more sustainable cuts will depend on providing further incentives to encourage farmers to voluntarily give up their crops. It is also no coincidence that the biggest coca growing regions are under relatively low control of the central government. Therefore, security and development will be essential to win over a critical mass of Colombia's coca farmers who do not yet fully subscribe to the government's drug control strategy.

To reach that tipping point, the Colombian government requires further support particularly in recovering and redistributing the assets (including land) of drug traffickers and in encouraging rural development. Solving Colombia's cocaine problem is a shared responsibility.

Antonio Maria Costa

Executive Director

United Nations Office on Drugs and Crime

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		2005	Variation	2006
Net coca cultivation (rounded total)		**86,000 hectares**	**-9%**	**78,000 hectares**
Of which	Meta-Guaviare region	*25,970 hectares*	*-21%*	*20,540 hectares*
	Pacific region	*17,650 hectares*	*+7%*	*18,810 hectares*
	Putumayo-Caqueta region	*13,950 hectares*	*+23%*	*17,220 hectares*
	Central region	*15,630 hectares*	*-22%*	*12,130 hectares*
	Elsewhere	*12,570 hectares*	*-27%*	*9,170 hectares*
Reported cumulative aerial spraying of coca bush		138,775 hectares	+24%	172,025 hectares
Reported manual eradication of coca bush		31,285 hectares	+32%	41,346 hectares
Average farm-gate price of coca paste		US$ 910/kg	-3%	US$ 879/kg
Total farm-gate value of the production of coca leaf and its derivatives		US$ 843 million	-19%	US$ 683 million
in per cent of GDP[1]		0.7%	-29%	0.5%
in per cent of GDP of agricultural sector		6%	-17%	5%
Number of households involved in coca cultivation		68,600 households	-2%	67,000 households
Annual household gross income from the production of coca leaf and its derivatives		US$ 12,300	-17%	US$ 10,194
Potential production of cocaine		640 mt	-5%	610 mt
in per cent of world cocaine production		65%	-5%	62%
Average wholesale cocaine price		US$ 1,860/kg COP 4,315,000/kg	-5%	US$ 1,762/kg COP
Reported opium poppy cultivation (rounded)		1,950 hectares	-48%	1,023 hectares
Potential opium latex production		59 mt	-47%	31 mt
Potential heroin production		2.5 mt	-48%	1.3 mt
Average farm-gate price of opium latex		US$ 230/kg	+9%	US$ 251/kg
Average heroin price		US$ 9,070/kg	+10%	US$ 9,992/kg
Reported seizure of cocaine		173,265 kg	-27%	127,326 kg
Reported seizure of heroin		745 kg	-41%	442 kg
Reported destruction of clandestine laboratories[2]		1,953	+16%	2,270

[1] GDP of the respective year as reported by the Government.

[2] Includes laboratories processing coca paste/cocaine base, cocaine hydrochloride, heroin, morphine, potassium permanganate, and non-specified.

EXECUTIVE SUMMARY

Through its global Illicit Crop Monitoring Programme, UNODC has been assisting the Colombian Government in the implementation and refinement of a national coca monitoring system since 1999. Annual surveys have been produced since then and the present report provides the findings of the coca survey for 2006.

The results of the survey showed that, at the end of December 2006, 78,000 hectares of coca were cultivated in 23 out of the 32 Colombian departments. This represents a decrease of 8,000 hectares or 9% compared to 2005. The 2006 level of coca cultivation is the lowest (-52%) since the peak level of 163,000 hectares recorded in 2000.

Like in 2005, the most important increase in 2006 took place in the region of Putumayo-Caqueta (+37%). However, most of coca cultivation continued to take place in the region of Meta-Guaviare (26% of the country's cultivation). In fact, 83% of the 2006 cultivation took place in just seven departments, the same seven departments that also accounted for 78% of 2005 total cultivation: Nariño, Putumayo, Meta, Guaviare, Antioquia, Vichada and Caqueta.

It was also noted that the average field size decreased from 1.13 hectares in 2005 to 0.85 hectares in 2006 (25%). This could reflect farmers' attempts to avoid detection and aerial spraying. Between 2005 and 2006, the government reported the manual eradication of 41,346 hectares, a new record compared to previous levels of 4,011 hectares in 2003 and 31,285 hectares in 2005. In addition, aerial spraying continued to be intense and was above 130,000 hectares for the fifth consecutive year. In 2006, a total of 172,025 hectares were sprayed. The total of both types of activities (spraying and manual eradication) amounted to 213,400 hectares in 2006.

In 2006, the potential production of cocaine HCl in Colombia amounted to 610 metric tons, a decrease by 5 per cent or 30 metric tons compared to 2005. As a consequence of this decrease and simultaneous production increases in Bolivia and Peru, Colombia's share of the world cocaine production fell from 65 per cent in 2005 to 62 per cent in 2006.

At the farm-gate level, the gross value of coca leaf and its derivatives amounted to US$ 683 million, equivalent to 0.6% of the Colombian 2006 GDP or 5% of the GDP of the agricultural sector. It should be noted, however, that this value does not take into account production costs like herbicides, pesticides, fertilizers and wages. The coca leaf yield survey also enabled to estimate the total number of households involved in coca farming at about 67,000 households (floating population is not included). The farm gate value thus represents an annual gross income per household of US$ 10,194, equivalent to an annual per capita gross income of US$ 2,020. By comparison, the GDP per capita in Colombia in 2006 was estimated by the National Department of Statistics at US$ 2,900.

1 INTRODUCTION

The objectives of UNODC's Illicit Crop Monitoring Programme (ICMP) are to establish methodologies for data collection and analysis, to increase the governments' capacity to monitor illicit crops on their territories and to assist the international community in monitoring the extent and evolution of illicit crops in the context of the elimination strategy adopted by the Member States at the U.N. General Assembly Special Session on Drugs in June 1998. ICMP presently covers seven countries: Colombia, Bolivia and Peru for coca; Afghanistan, Lao PDR and Myanmar for opium and Morocco for cannabis.

During the 1980's and 1990's, Colombia became the country with the largest illicit coca growing area and cocaine production in the world. Illicit coca cultivation in the country expanded steadily throughout this period, in particular in remote areas of the Amazon basin. Although coca cultivation started to decrease in 2001, Colombia remains the largest coca-growing country in the world.

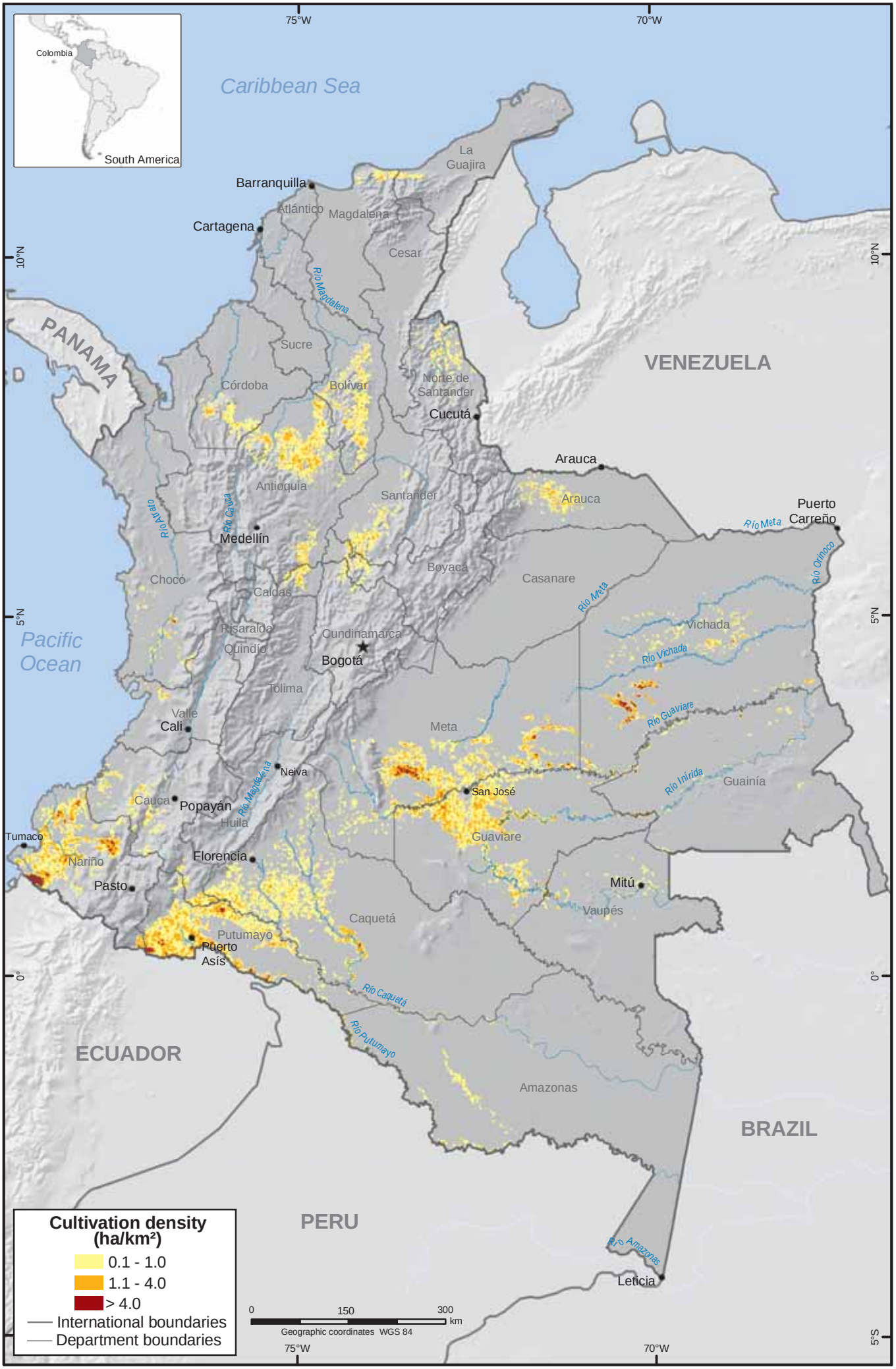
UNODC has supported the monitoring of illicit crops since 1999, and has produced eight annual surveys through a special satellite based analysis programme called SIMCI (from the Spanish initials). In October 2006, UNODC signed a new agreement with the Colombian government to continue and expand monitoring and analysis work. In this context, the SIMCI II project facilitates the implementation of additional tasks in the framework of an integrated approach to analyse the drug problem in Colombia. The project also supports the monitoring of related problems such as fragile ecosystems, natural parks, indigenous territories, the expansion of the agricultural frontier and deforestation. It provides Geographic Information System support to the government's alternative development projects and its Forest Warden Families Programme.

The new project foresees the creation of an Inter-Institutional Committee permanently assigned to govern the project in order to ensure the transfer of know-how to the national beneficiary institutions. SIMCI II is a joint project between UNODC and the Colombian government, represented by the Ministry of Interior and Justice and the International Cooperation Agency. The national counterpart is the Ministry of Interior and Justice.

The project is managed by a technical coordinator and composed of engineers and technicians: four digital image processing specialists, one field engineer, a cartographic technician, a research and analysis specialist, two assistant engineers and an administrative assistant. The team cooperates with technicians from the Police Antinarcotics Division (DIRAN) and National Parks Administration. It supports several studies and investigations for government and private institutions, related to land use, environment, licit crops, etc. SIMCI provides to the above-mentioned institutions experts, access to its Spatial Information Data Bank, transfer of technology and guidance to achieve their goals. Organizations that benefited from SIMCI support include the National Directorate for Statistics (DANE), local governments, the National Federation of Coffee Growers, NGOs as well as other UN agencies and projects.

The project has developed technical agreements with several national and foreign Universities, to interchange and share knowledge, for training activities and joint projects. Among them are BOKU University in Austria, Zaragoza University in Spain, Antonio Nariño and other Universities in Colombia.

Coca cultivation density in Colombia, 2006



Source: Government of Colombia - National monitoring system supported by UNODC

2 FINDINGS

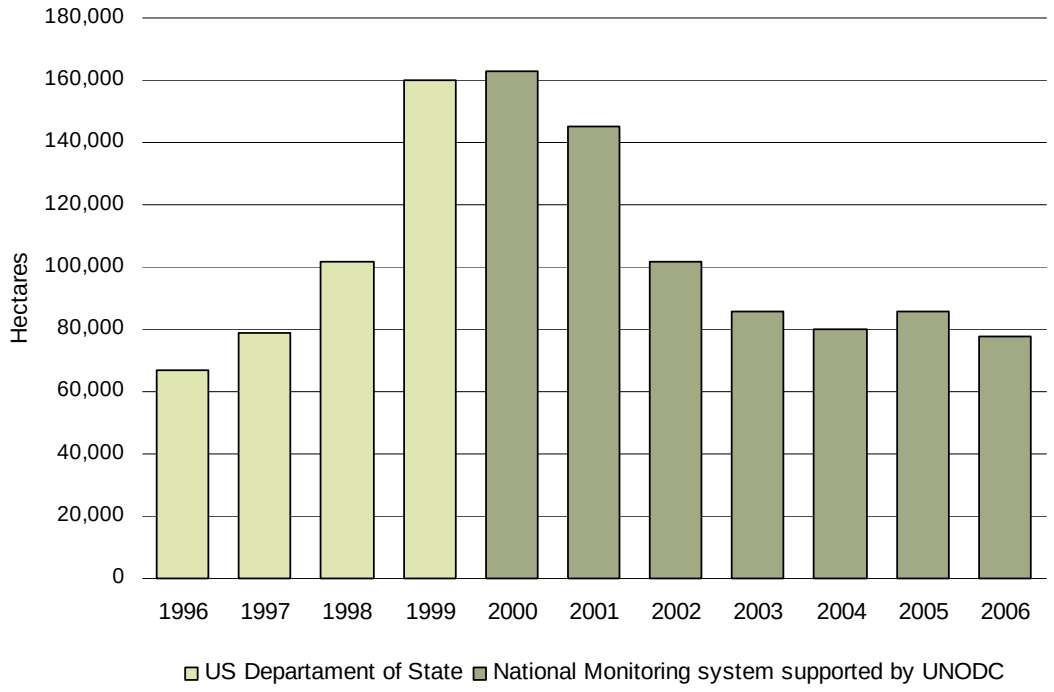
2.1 Coca Cultivation

National Cultivation

In 2006, the total area under coca cultivation in Colombia decreased by 8,000 hectares to 78,000 hectares, a 9% decrease compared to 2005 (86,000 hectares). The area under coca cultivation in 2006 was 52% lower compared to the peak estimate of 163,000 hectares in 2000.

Similarly to the previous four surveys, the 2006 survey represents the situation as of the end of the year, in this case as of December 2006. As was the case last year, the survey covered the whole country and detected coca cultivation in 23 out of 32 departments. In 2006, the area under coca cultivation represents 0.07% of the total national territory.

Figure 1: Coca cultivation in Colombia (hectares), 1996 – 2006



The decrease in coca cultivation between 2005 and 2006 corresponds with a high level of aerial spraying, which reached 172,025 hectares in 2006. In fact, aerial spraying of coca cultivation has remained above 130,000 hectares since 2002. In 2006, the Colombian Government also reported the additional manual eradication of 41,346 hectares of coca cultivation. This level of manual eradication is 10,059 hectares higher than the previous year's record of 31,285 hectares.

Analysis of coca cultivation changes

Coca cultivation is dynamic in Colombia. A range of variables can be associated with increases and decreases of the cultivation area over time. Factors like favourable prices, pressure exerted by armed groups on farmers, the legal economy, and temporary crisis situations can all lead to an increase in the cultivated area. On the other hand, factors such as forced eradication, aerial spraying, improved security

conditions, and plant diseases can contribute to reducing the cultivated area. The coca cultivation survey does not endeavour to assess how or to what extent these factors bring about change in the area under coca cultivation. Rather, it shows the situation on a given date of the year (31st of December).

The multitemporal analysis of coca cultivation is done on imagery of 2005 and 2006 and therefore, concepts like "abandoned" or "new" fields refer exclusively to this period. At the end of the 2005-2006 period, 24% of the fields were the same as identified at the beginning 2006, and can be considered as "stable" as well as 16% of the fields that were identified in previous years and abandoned temporarily. 13% of the fields replaced primary forest vegetation and therefore were newly planted during this period. The remaining 48% of the fields replaced other types of vegetation like pastures or bare soil, but could also have been planted and then abandoned in previous years.

Table 1. Stable and new fields of coca bush in 2006

	Stable area 2005-2006		New area in 2006		Total
	In period 2005-2006	In previous years and 2006	Primary forest 2005	Other vegetation 2005	
Area	18,473	12,151	9,998	37,258	77,870
Percentage	24	15	13	48	100

The multitemporal analysis of the last six years showed that 54% of the coca fields identified in 2006 were cultivated with coca in one or more years in this period.

The analysis of the data also showed that the average coca field size continued to decrease since 2001 from 2.05 hectares, to 1.13 hectares in 2005 and to 0.85 hectares in 2006. A possible explanation could be that farmers reduced the size of their coca fields to avoid detection and aerial spraying.

The ten municipalities listed below were ranked as the highest municipalities in terms of coca cultivation in Colombia, representing 46% of the national total coca cultivation and 50% of national potential cocaine production. Though the municipality of Tumaco in the Pacific region has the largest coca cultivation area in Colombia (9% of the national total), the municipality of Cumaribo in Orinoco region has the highest potential production of cocaine (11% of the national total) due to the high yield.

Table 2. The ten municipalities with the highest coca cultivation area and cocaine potential production

Municipality	Department	Coca cultivated area (hectares)	% of coca cultivation area in Colombia	Potential pure cocaine production (tm)
Tumaco	Nariño	7,128	9.1	21
Cumaribo	Vichada	5,469	7.0	58
San Jose del Guaviare	Guaviare	3,814	4.9	43
Puerto Rico	Meta	3,521	4.5	40
Mapiripan	Meta	3,311	4.3	37
El Retorno	Guaviare	2,827	3.6	32
Puerto Leguizamo	Putumayo	2,551	3.3	18
Puerto Asis	Putumayo	2,512	3.2	18
Vista Hermosa	Meta	2,289	2.9	26
Puerto Guzman	Putumayo	2,083	2.7	15
Total		**35,505**	**46**	**307**

Coca cultivation density change in Colombia, 2005 - 2006

Source: Government of Colombia - National monitoring system supported by UNODC

In absolute numbers, the most important increases of coca crops between 2005 and 2006 were in the departments of Putumayo (+ 3,300 hectares) in the southern part of the country and Nariño (+1,731 hectares) in the southwest corner of the country. The increase in Putumayo corresponded to 37% of the area under coca cultivation in 2005, from 8,960 hectares to 12,254 hectares. Putumayo used to be the centre of coca cultivation, with 66,000 hectares in 2000. Coca cultivation had strongly declined until 2004 when Putumayo was the sixth largest cultivating area. However, due to increases in 2005 and 2006 this department now has the second largest cultivation level.

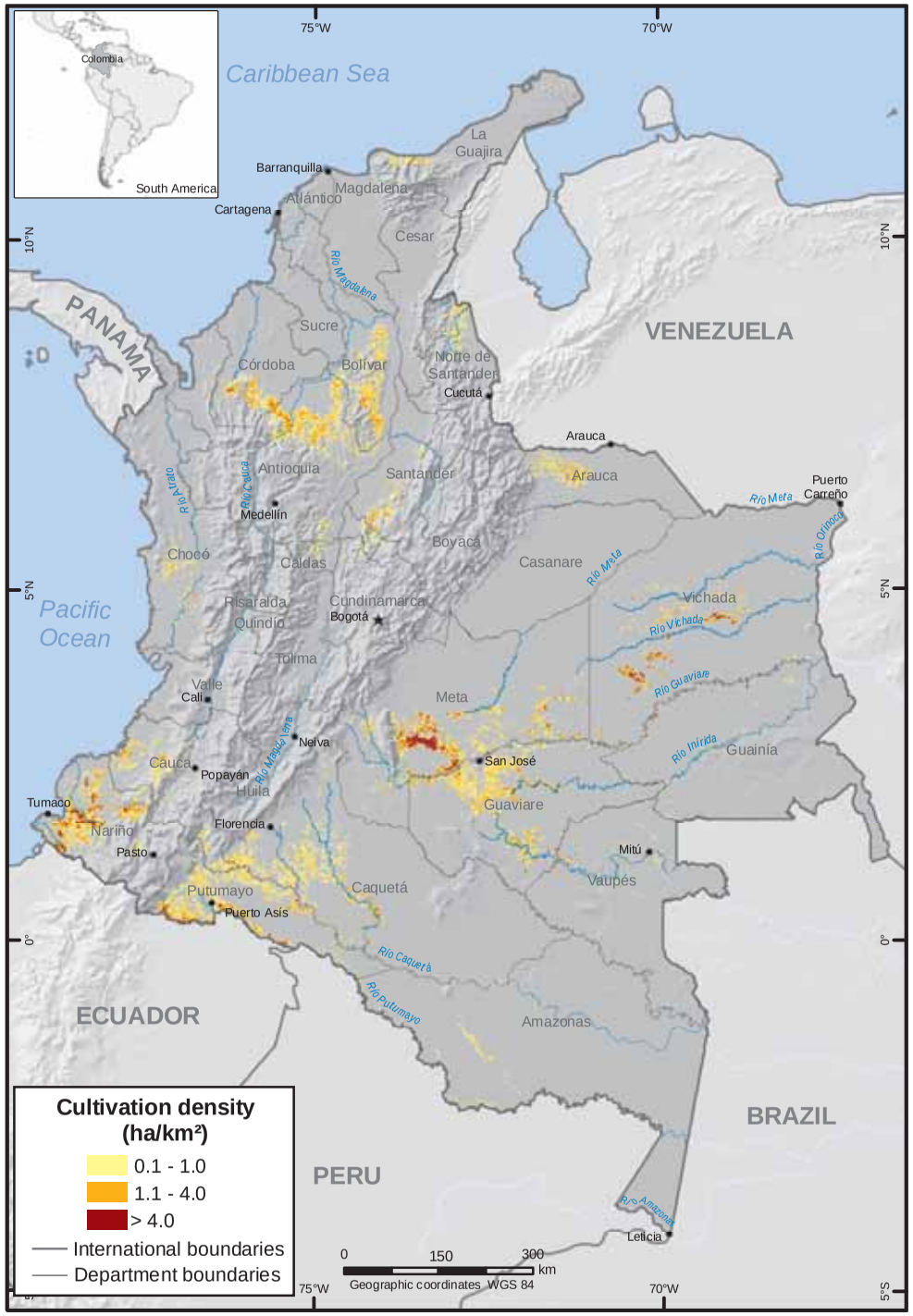
The largest reductions of coca crops took place in the department of Meta (-6,200 hectares). The department of Norte de Santander, at the border with Venezuela, had a small coca cultivation area in 2006, with less than 500 hectares. In 2001 Norte de Santander was among the departments with the highest coca cultivation levels with 9,145 hectares.

Compared to 2005, Nariño and Putumayo – with an combined increase of over 5,000 hectares – became the first two top departments in terms of coca cultivation, together accounting for 36% of the total area under coca cultivation in the country. In fact, 50% of the 2006 cultivation took place in just three departments Nariño, Putumayo and Meta, the same three departments that accounted for 46% of 2005 total cultivation.

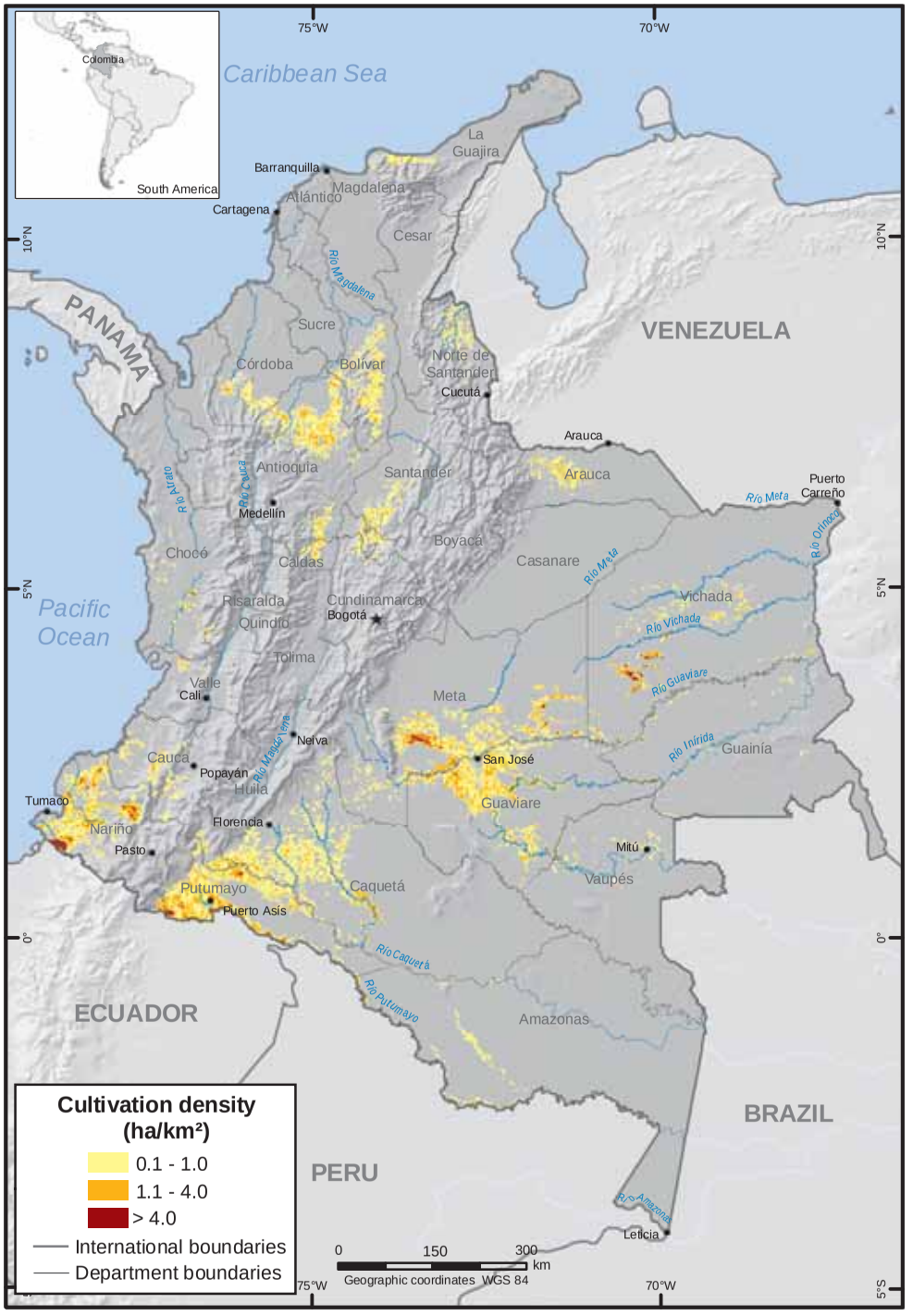
Table 3. Coca cultivation by department, 2001 – 2006 (hectares)

Department	Nov-2001	Dec-2002	Dec-2003	Dec-2004	Dec-2005	Dec-2006	% Change 2005-2006	% of 2006 total
Nariño	7,494	15,131	17,628	14,154	13,875	15,606	12%	20%
Putumayo	47,120	13,725	7,559	4,386	8,963	12,254	37%	16%
Meta	11,425	9,222	12,814	18,740	17,305	11,063	-36%	14%
Guaviare	25,553	27,381	16,163	9,769	8,658	9,477	9%	12%
Antioquia	3,171	3,030	4,273	5,168	6,414	6,157	-4%	8%
Vichada	9,166	4,910	3,818	4,692	7,826	5,523	-29%	7%
Caquetá	14,516	8,412	7,230	6,500	4,988	4,967	0%	6%
Bolívar	4,824	2,735	4,470	3,402	3,670	2,382	-35%	3%
Cauca	3,139	2,120	1,443	1,266	2,705	2,104	-22%	3%
Arauca	2,749	2,214	539	1,552	1,883	1,306	-31%	2%
Córdoba	652	385	838	1,536	3,136	1,216	-61%	2%
Santander	415	463	632	1,124	981	866	-12%	1%
Chocó	354		453	323	1,025	816	-20%	1%
Guainía	1,318	749	726	721	752	753	0%	1%
Amazonas	532	784	625	783	897	692	-23%	0.9%
N. de Santander	9,145	8,041	4,471	3,055	844	488	-42%	0.6%
Caldas			54	358	189	461	144%	0.6%
Vaupés	1,918	1,485	1,157	1,084	671	460	-31%	0.6%
Boyacá	245	118	594	359	342	441	29%	0.6%
Valle del Cauca	184	111	37	45	28	281	904%	0.4%
Magdalena	480	644	484	706	213	271	27%	0.3%
Guajira	385	354	275	556	329	166	-50%	0.2%
Cundinamarca	22	57	57	71	56	120	114%	0.2%
TOTAL	144,807	102,071	86,340	80,350	85,750	77,870	-9.2%	
Rounded Total	**145,000**	**102,000**	**86,000**	**80,000**	**86,000**	**78,000**	**-9%**	
Departments affected	22	21	23	23	23	23		

Coca cultivation density in Colombia, 2005

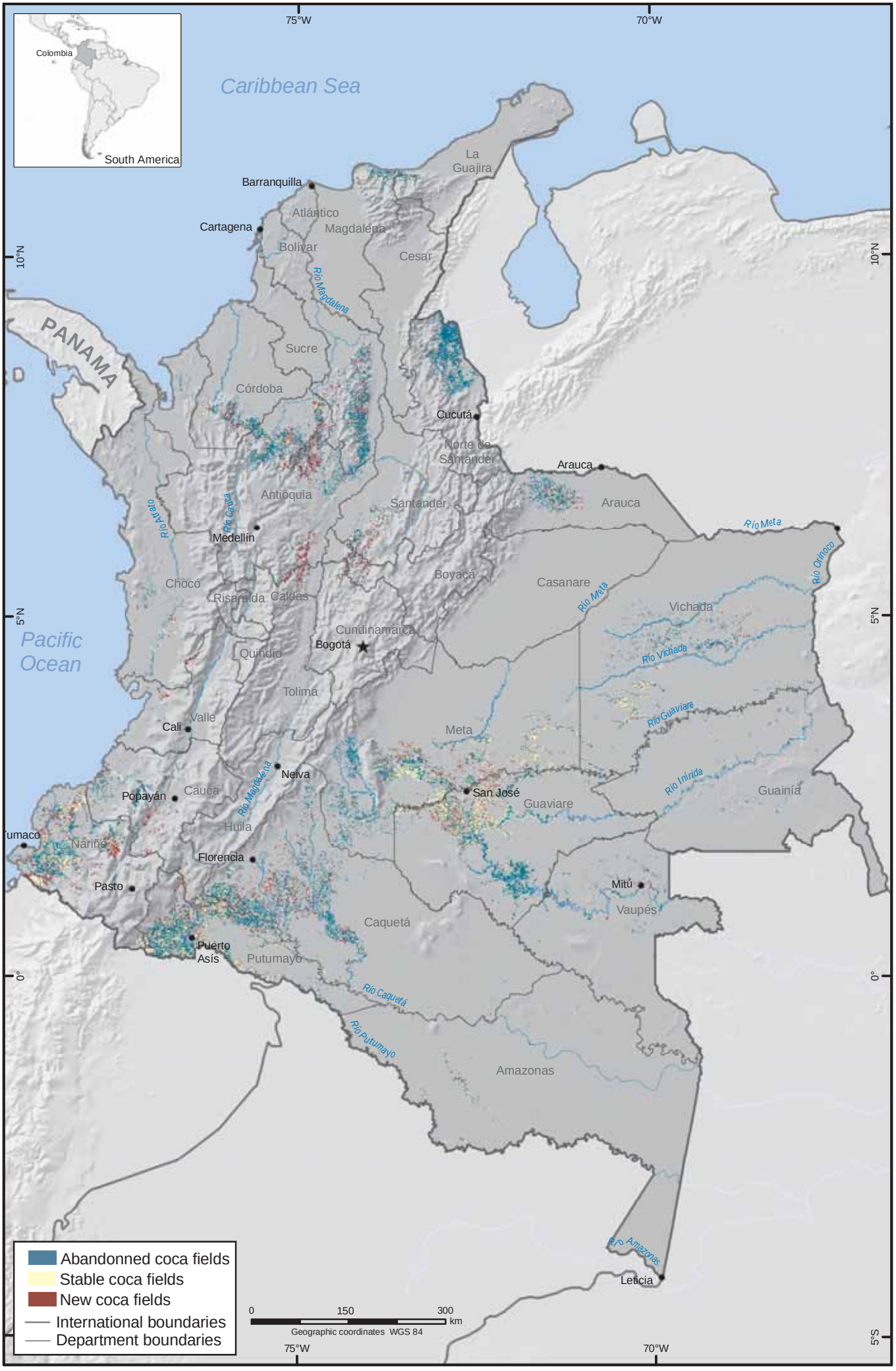


Coca cultivation density in Colombia, 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Changes in coca cultivation in Colombia, 2001 - 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Coca cultivation density in the Andean Region, 2006

Sources: National monitoring systems supported by UNODC - Governments of Bolivia, Colombia and Perú

In 2006, coca cultivation in Colombia represented 50% of the world coca cultivation, while Peru and Bolivia represented respectively 33% and 18%. By and large, the global level of coca cultivation remained stable between 2005 and 2006, as the decrease in Colombia was almost offset by increases in Peru and Bolivia.

Figure 2: Coca cultivation in the Andean region 1996 - 2006 (in hectares)

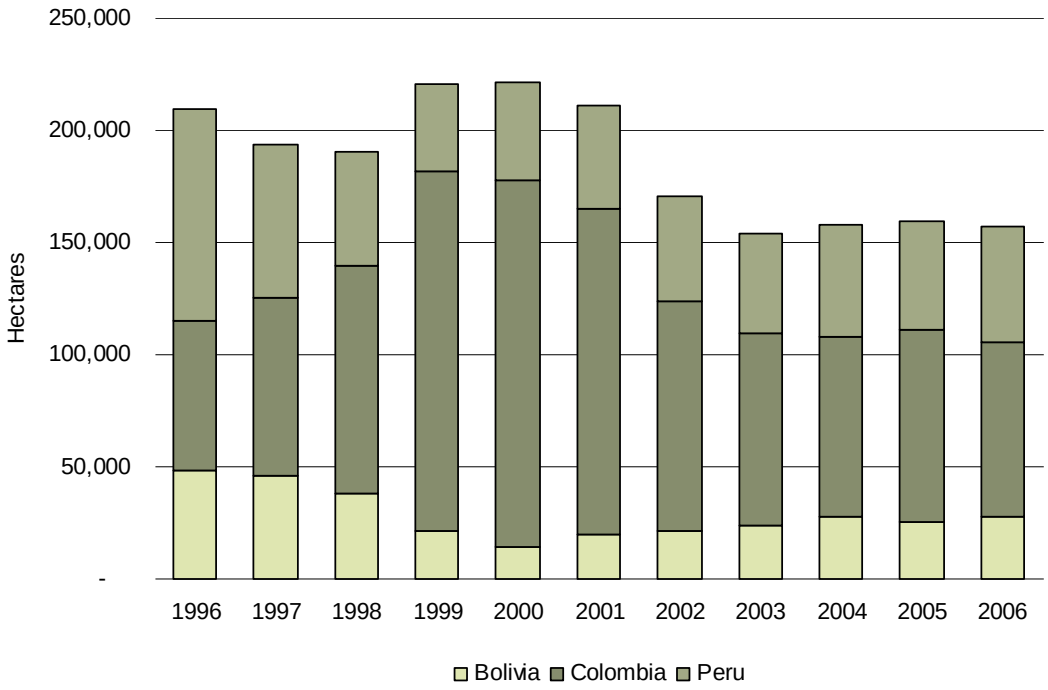
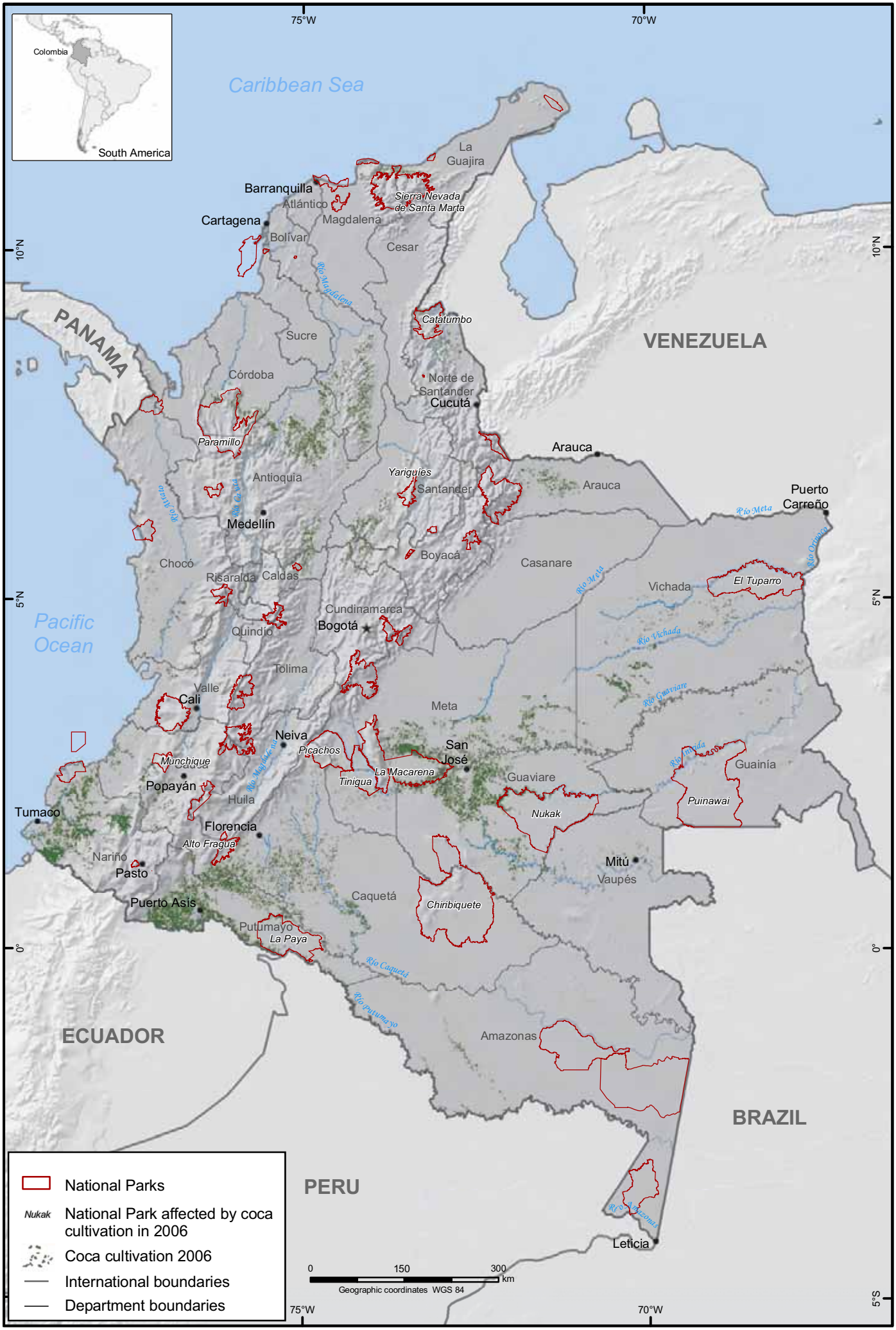


Table 4. Coca cultivation in the Andean region 1996 - 2006 (in hectares)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	% Change 2005-2006
Bolivia	48,100	45,800	38,000	21,800	14,600	19,900	21,600	23,600	27,700	25,400	27,500	**+8%**
Peru	94,400	68,800	51,000	38,700	43,400	46,200	46,700	44,200	50,300	48,200	51,400	**+7%**
Colombia	67,000	79,000	102,000	160,000	163,000	145,000	102,000	86,000	80,000	86,000	78,000	**-9%**
Total	209,500	193,600	191,000	220,500	221,000	211,100	173,100	153,800	158,000	159,600	156,900	**-2%**

Sources United States Department of State National Monitoring System Supported by UNODC

National Parks and coca cultivation in Colombia, 2006



Sources: for coca cultivation Government of Colombia - National monitoring system supported by UNODC; for national parks UAESPNN
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Coca cultivation in national parks

The presence of illicit crops in both Natural Parks and Indigenous Territories has been monitored by SIMCI since the 2001 coca survey, and the data have been delivered to the competent authorities to enable them to identify actions and projects to be applied for the preservation of its social and environmental characteristics with minimum of harm.

The limits of National Parks and Indigenous territories have been provided by the official institutions in charge of their management. In 2005, the limits of National Parks were edited by the monitoring project in cooperation with technicians from the National Parks Administrative Unit. The editing improved the match between SIMCI cartographic material and the official boundaries of the Parks. National Parks boundaries are not always precise and therefore coca cultivation estimated in each of them depends on the accuracy of their delimitation. To enable annual comparison the same boundaries were used for each year.

Coca cultivation in 2006 was found in 14 of the 51 National Parks in Colombia. With 3,556 hectares in 2006, coca cultivation represented 0.02% of the total area covered by National Parks, and coca cultivation in National Parks represented 5% of the total level of coca cultivation in 2006.

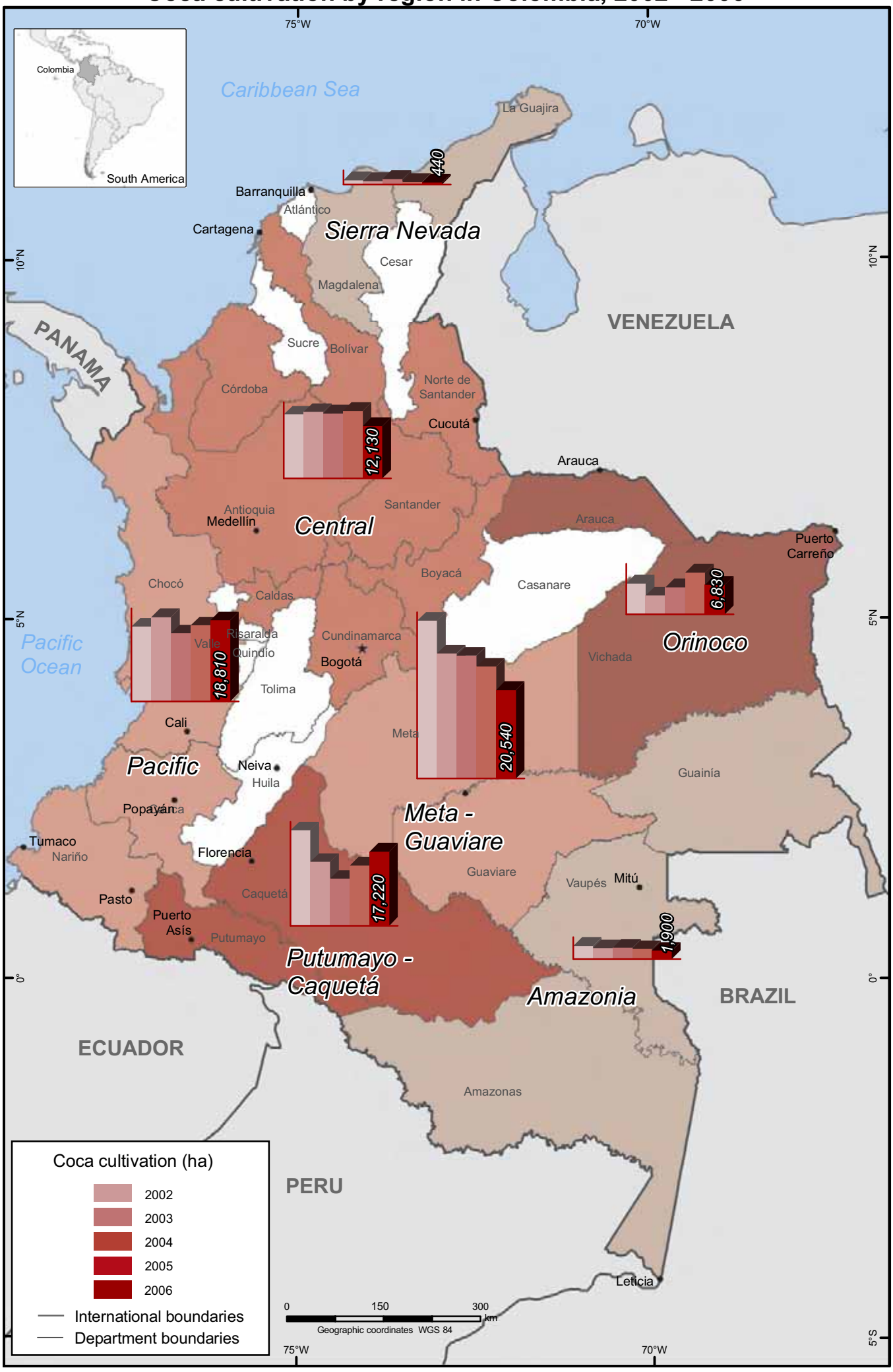
Coca cultivation in National Parks showed a reduction of 41% in the period 2005 and 2006. This decrease was mainly due to a decrease in the National Parks of Sierra La Macarena (-1,665 hectares, or -50%), Paramillo (-450 hectares or -66%) and La Paya (-201 hectares or -28%). In most other National Parks, coca cultivation decreased, and it almost completely disappeared from the National Park of Alto Fragua. However, for the first time, the National Parks of Selva de Florencia and El Cocuy were affected by coca cultivation in 2006.

The detailed results by indigenous territories are presented in the annex.

Table 5. Coca cultivation in National Parks, 2003 – 2006

National Parks	2003	2004	2005	2006	% Change 2005-2006
Sierra La Macarena	1,152	2,707	3,354	1,689	-50%
Nukak	1,469	1,043	930	779	-16%
La Paya	310	230	728	527	-28%
Paramillo	110	461	686	236	-66%
Tinigua	340	387	155	122	-21%
Sierra Nevada	212	241	95	119	+25%
Puinawai	33	139	60	41	-32%
Catatumbo-Bari	129	107	55	22	-60%
Munchique	1	8	13	6	-54%
Los Picachos	13	15	7	6	-14%
Yariguíes	-	-	2	4	+100%
Selva de Florencia	-	-	-	2	-
El Cocuy	-	-	-	2	-
Alto Fragua	8	14	25	1	-96%
Sanquianga	7	-	-	-	-
Farallones	2	-	-	-	-
Tayrona	4	1	-	-	-
Total	3,790	5,353	6,110	3556	
Rounded total	3,800	5,400	6,100	3600	-41%

Coca cultivation by region in Colombia, 2002 - 2006



Source: Government of Colombia - National monitoring system supported by UNODC

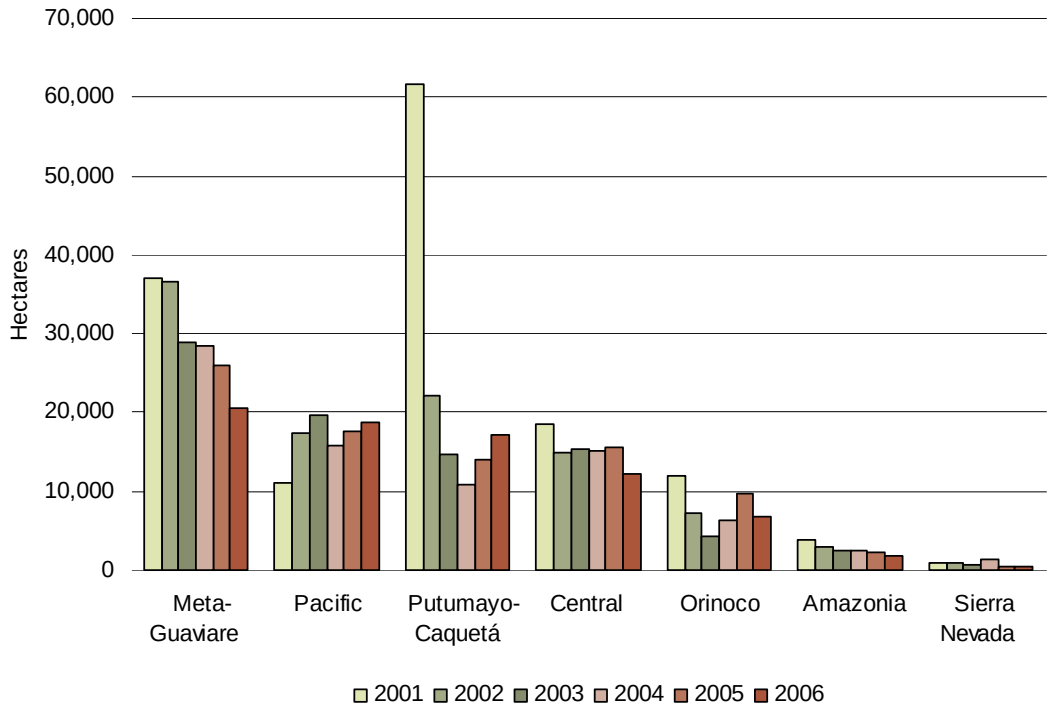
Regional Analysis

In 2006, 48% of coca cultivation in Colombia took place in the coca-growing regions of Meta-Guaviare and Putumayo-Caqueta. The largest increases took place in Putumayo-Caqueta (+ 3,270 hectares) in the southern part of the country bordering Ecuador, and in Pacifico (+ 1,174 hectares), in the corridor between the western range of mountains and the Pacific Ocean coastal region. Important decreases took place in: Orinoco (- 2,880 hectares, -30%), in the northeastern part of the country bordering Venezuela; Meta-Guaviare (-5,423 hectares, -21%) in the southeastern part of Colombia and in the Central region (-3,501 hectares, -22%).

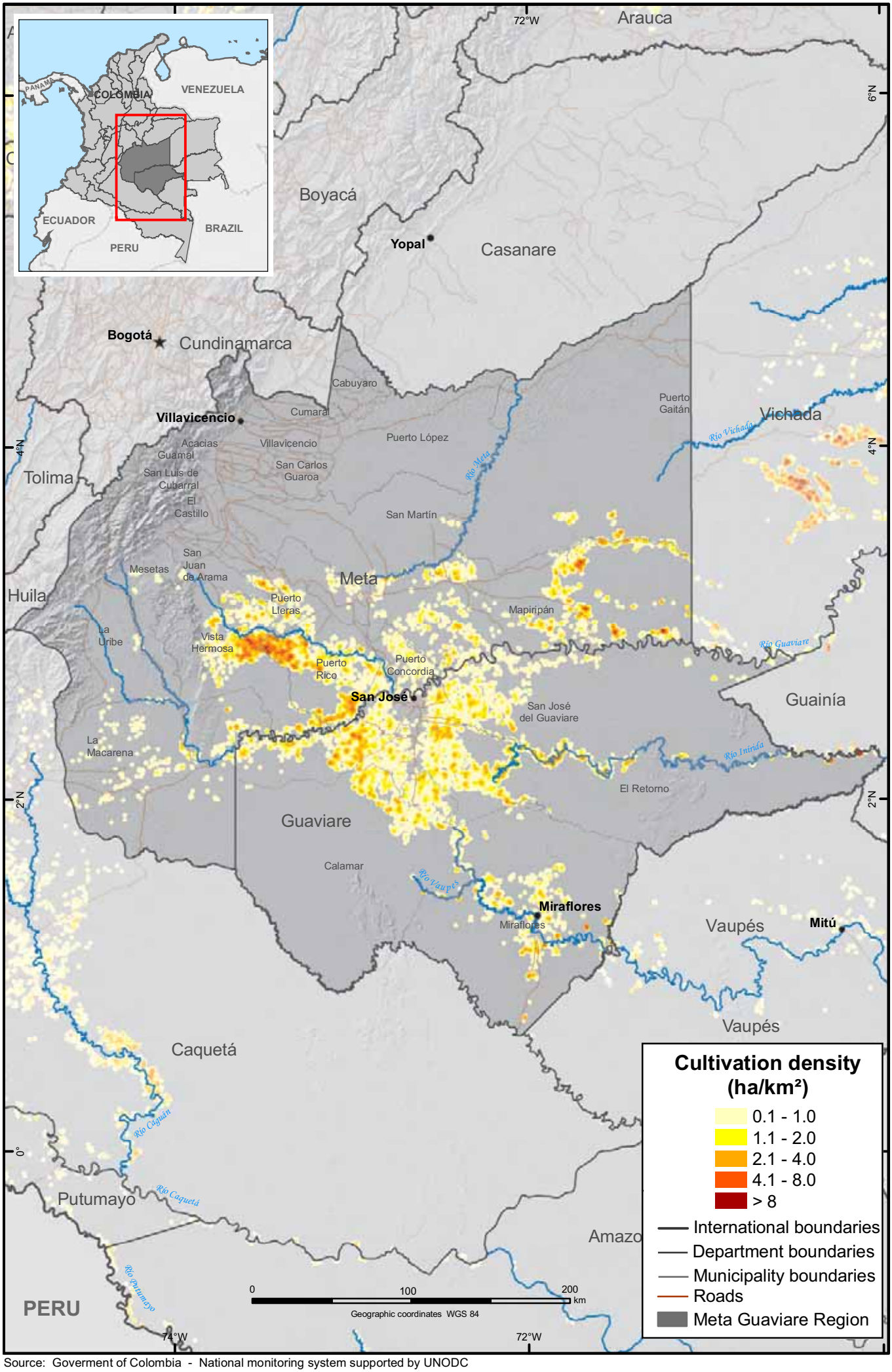
Table 6. Coca cultivation by region 2001 - 2006 (in hectares)

Region	2001	2002	2003	2004	2005	2006	% Change 2005 - 2006	% of 2006 total
Meta-Guaviare	36,978	36,603	28,977	28,507	25,963	20,540	-21%	26%
Pacific	11,171	17,362	19,561	15,789	17,633	18,807	+7%	24%
Putumayo-	61,636	22,137	14,789	10,888	13,951	17,221	+23%	22%
Central	18,474	14,829	15,389	15,081	15,632	12,131	-22%	16%
Orinoco	11,915	7,124	4,357	6,250	9,709	6,829	-30%	9%
Amazonia	3,768	3,018	2,508	2,588	2,320	1,905	-18%	2%
Sierra Nevada	865	998	759	1,262	542	437	-19%	1%
Rounded Total	145,000	102,000	86,000	80,000	86,000	78,000	-9%	100%

Figure 3: Coca cultivation by region, 2001-2006



Coca cultivation density in the Meta-Guaviare region, Colombia 2006



Source: Goverment of Colombia - National monitoring system supported by UNODC

Meta-Guaviare region

Table 7. Coca cultivation in Meta-Guaviare, 2000 – 2006 (hectares)

Department	2000	2001	2002	2003	2004	2005	2006	% Change
Meta	11,123	11,425	9,222	12,814	18,740	17,305	11,063	-36%
Guaviare	17,619	25,553	27,381	16,163	9,769	8,658	9,477	+9%
Total	28,742	36,978	36,603	28,977	28,509	25,970	20,540	-21%
Annual trend	-28%	+29%	-1%	-21%	-2%	-9%	-21%	

The Meta-Guaviare region is traditionally the largest coca-producing region; however, the gap to 2nd largest cultivation area in the Pacific has closed due to a 21% decrease of coca cultivation in 2006.

In 2004 and 2005, the department of Meta was the department with the highest level of coca cultivation, but dropped to the third place in 2006, because of a decrease of 36%, from 17,305 hectares in 2005 to 11,036 hectares. The department of Meta included 14% of the national coca cultivation area.

Between 2005 and 2006, coca cultivation in the department of Guaviare increased from 8,658 hectares to 9,477 hectares (+9%). At the same time, aerial spraying increased from 11,900 hectares in 2005 to 14,700 hectares in 2006 (+24%) and manual eradication amounted 1,103 hectares.

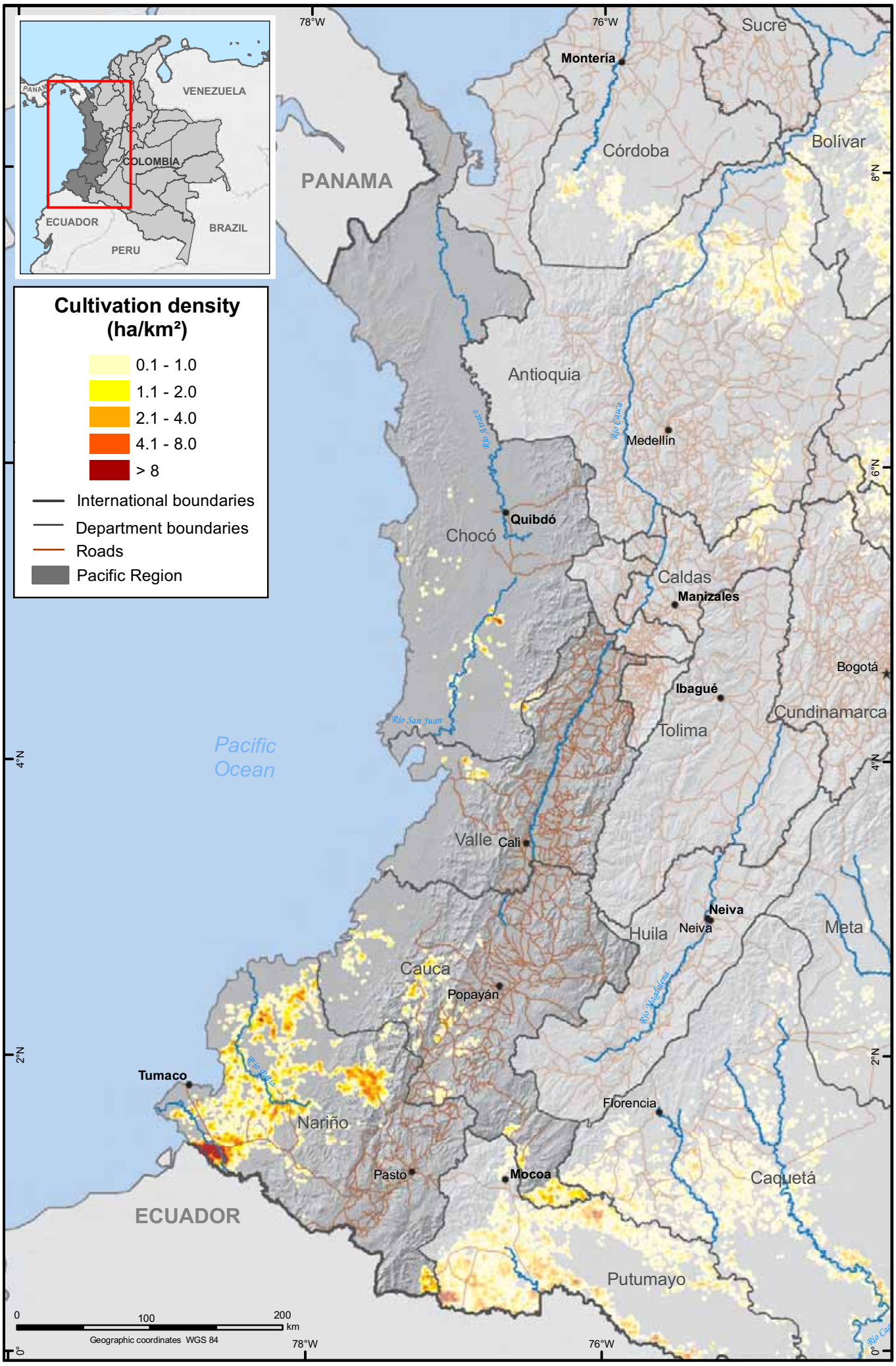
In 2006, a record of 25,900 hectares of coca cultivation was sprayed and 5,176 hectares were eradicated manually in Meta department. This represented 82% of the total eradication and 64% of the total aerial spraying in the region, whereascoca cultivation in Meta was 54% of the region coca is grown with at a high agro-technological level. However, the region has received very little support with alternative development programmes.

Among the fourteen national parks surveyed, the National Park of Sierra de la Macarena, located within Meta department, had the largest level of coca cultivation within a protected area in 2006, with 1,689 hectares. This was a reduction of 1,665 hectares (-50%) from 2005 to 2006, which was mostly due to an intensive campaign of manual eradication (2,893 hectares) and aerial spraying (2,100 hectares) during the first seven months of 2006.

Guaviare was the department where coca cultivation first appeared in Colombia at the end of the seventies. Since then, coca cultivation remained important in the department. Though a significant decrease was noted in the past few years, this trend was reversed in 2006 when 9,477 hectares were detected. Guaviare accounted for 12% of the national total.

Patterns of coca cultivation in Meta Guaviare region: Fragmented and tecnified cultivation

Coca cultivation density in the Pacific region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Pacific region

Table 8. Coca cultivation in the Pacific Region, 2000-2006 (hectares)

Department	2000	2001	2002	2003	2004	2005	2006	% Change
Nariño	9,343	7,494	15,131	17,628	14,154	13,875	15,606	20%
Cauca	4,576	3,139	2,120	1,443	1,266	2,705	2,104	-25%
Chocó	250	354		453	323	1,025	816	-20%
Valle del Cauca	76	184	111	37	45	28	281	+904%
Total	14,245	11,171	17,362	19,561	15,788	17,633	18,807	+7%
Annual trend	-	-22%	+55%	+13%	-19%	+12%	+7%	

Nariño is located in the south-western part of the country, at the border with Ecuador. The geographic features of the region include high altitudes, as well as coastline.This contributed to the spread of cultivation of coca bush and opium poppy, as well as the maritime smuggling of illegal drugs and precursor chemicals through the department.

Coca cultivation in Nariño became significant in 2002, when coca cultivation decreased in the neighbouring departments of Putumayo and Caqueta. Between 2001 and 2002, coca cultivation decreased by 40,000 hectares in Caqueta and Putumayo, while increasing by 7,600 hectares in Nariño. Aerial spraying has been intense in Nariño department since 2000, exceeding 30,000 hectares in 2004 and 2005, and reaching a record 59,900 hectares in 2006. In addition, 7005 hectares of manual eradication were reported in 2006. However, in the period 2005-2006, coca cultivation increased 1,731 hectares.

In 2006, coca cultivation was found in 21 municipalities out of 64. With a total of 15,606 hectares of coca cultivation, Nariño has the highest amount of land under illicit cultivation with 12% of the total coca cultivation in the country. Nariño accounted for 37% of all the fields of less than ¼ hectare found in the country, indicating the small scale of the coca cultivation.

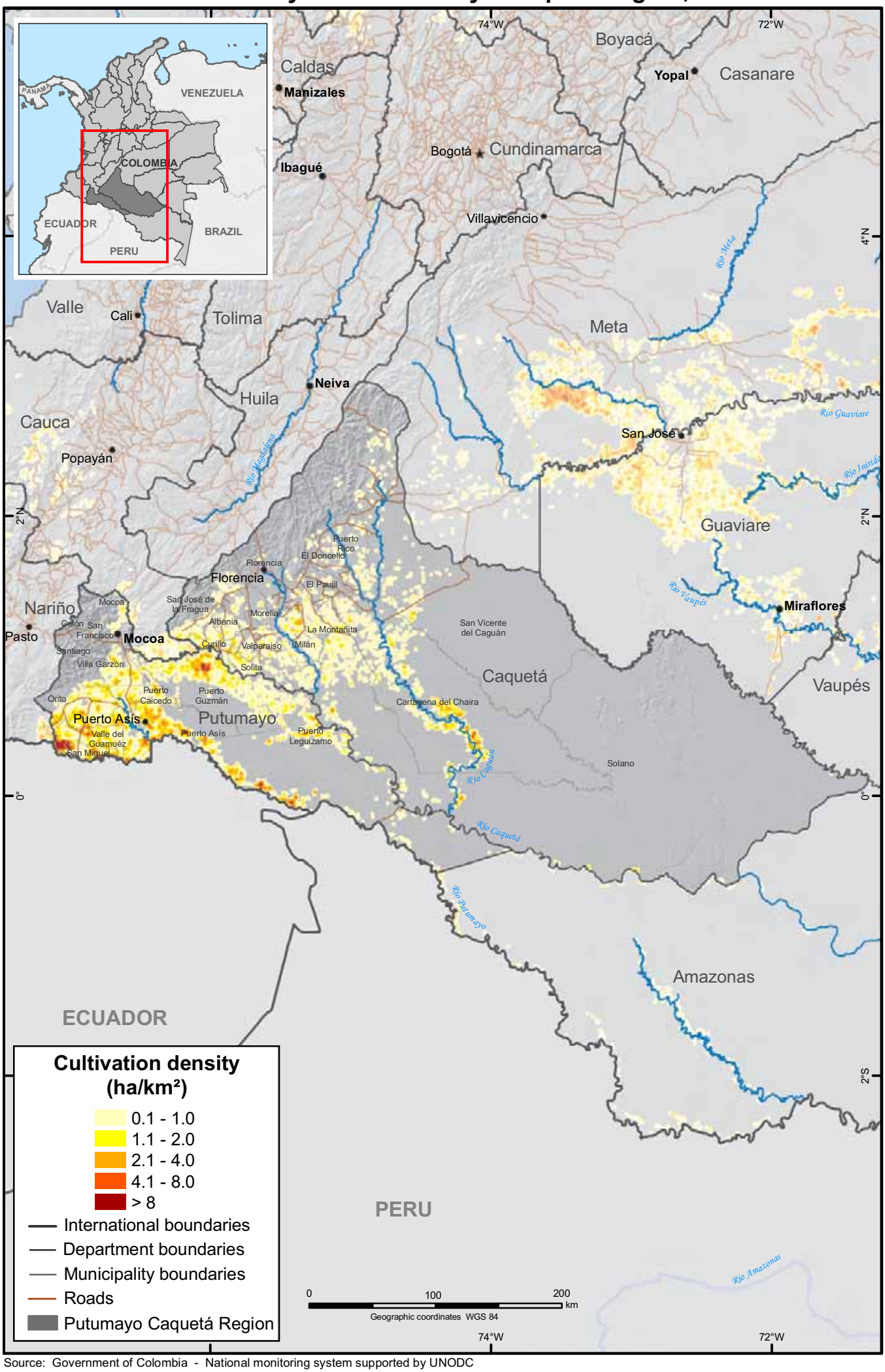
Even though the department of Nariño shows the largest amount of coca cultivation, the investment in alternative development programmes continues at a low level at national level(3.7% in completed programmes and 7.6% in ongoing programmes). In Cauca department, the investment maintained a level of 3.9% of the national total.

Like neighbouring Nariño department, Cauca has a long coastline, high mountain ranges and a mainly rural economy. Coca cultivation remained relatively low in Cauca department, however, following a period of continuous decrease between 1999 and 2004, coca cultivation increased between 2004 and 2005 by 1,420 hectares (+114%) but decreased again in 2006 (- 600 hectares) when 4,174 hectares of coca were manually eradicated.

Although its capital, Cali, was an important centre for narco-trafficking in the nineties, the department of Valle del Cauca always recorded less than 200 hectares under coca cultivation, but it showed a dramatic increase of 253 hectares (900%) in the period 2005-2006, from 28 hectares to 281 hectares, despite the manual eradication of 246 hectares.

Coca cultivation at riverside of Patia River, Nariño Department

Coca cultivation density in the Putumayo-Caqueta region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Putumayo-Caqueta region

Table 9. Coca cultivation in the Putumayo-Caqueta Region, 2000-2006 (hectares)

Department	2000	2001	2002	2003	2004	2005	2006	% Change 2005-2006
Putumayo	66,022	47,120	13,725	7,559	4,386	8,963	12,254	37%
Caquetá	26,603	14,516	8,412	7,230	6,500	4,988	4,967	0%
Total	92,625	61,636	22,137	14,789	10,886	13,951	17,221	+23%
Annual trend	-	-33%	-64%	-33%	-26%	+28%	+23%	

In 2000, coca cultivation peaked in Putumayo department at 66,000 hectares, representing 40% of the national total. Following four years of consecutive decreases, coca cultivation in Putumayo was estimated at only 4,400 hectares or 5% of the national total in 2004, but this trend was later reversed. Between 2004 and 2006, coca cultivation soared by 105% in 2005 and by 37% in 2006, putting this department on the second place of coca cultivation in the country. At the same time, 5,118 hectares were manually eradicated and the aerial spraying increased from 11,800 hectares in 2005 to 26,500 hectares in 2006.

The Government's Plan Colombia to fight against illicit drugs was implemented in 2002 in this department, combining actions of interdiction, aerial spraying, manual eradication and important alternative development projects with good results in the period 2002 to 2004. However, only 0.4% of the 2006 budget of ongoing alternative development projects went to Putumayo, whereas this used to be 35% in the past four years.

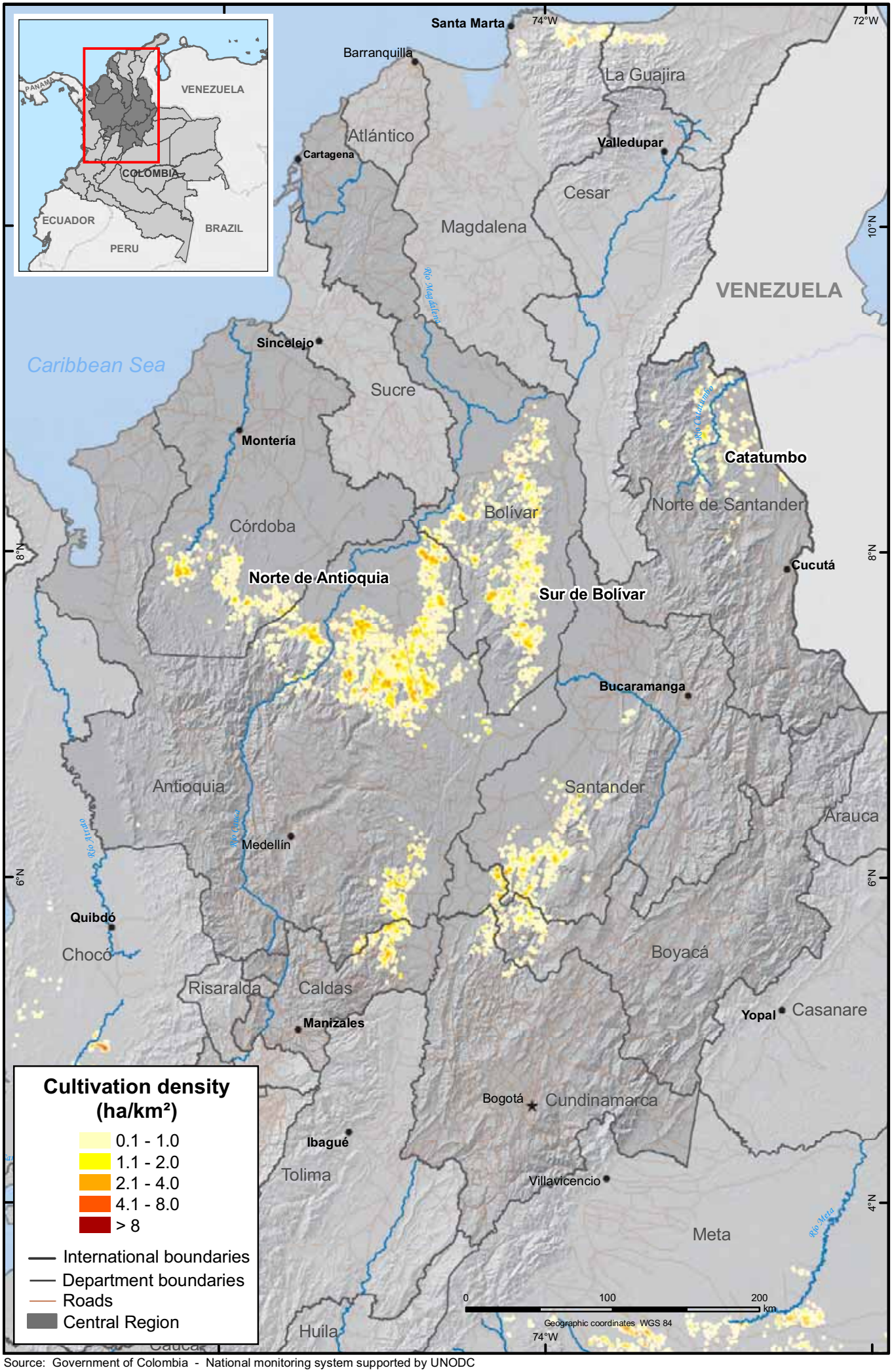
Most of the new coca fields were established on the foothills close to the border with Nariño department and along the riverside of the Putumayo and Caqueta rivers. Spraying is particularly difficult in these mountainous areas, which could be a reason for the shift of coca cultivation to higher regions.

In a belt of about 10 km width along the Ecuadorian border that covers about 550,000 hectares, in the departments of Nariño and Putumayo, 7,000 hectares of coca cultivation were found in 2006. This represented an increase of almost 3,000 hectares (or 72%) compared 2005.

In Caqueta department, coca cultivation peaked at 26,000 hectares in 2000 or 16% of the country total. Following intense aerial spraying that started in 1996 with 537 hectares and peaked in 2002 at 18,600 hectares, coca cultivation decreased. In 2006, coca cultivation was at its lowest level at 4,967 hectares, or 6% of the country total.

Coca fields in Putumayo department.

Coca cultivation density in the Central region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Central region

Table 10. Coca cultivation in the Central Region, 2000-2006 (hectares)

Department	2000	2001	2002	2003	2004	2005	2006	% Change 2005-2006
Antioquia	2,547	3,171	3,030	4,273	5,168	6,414	6,157	-4%
Bolivar	5,960	4,824	2,735	4,470	3,402	3,670	2,382	-35%
Cordoba	117	652	385	838	1,536	3,136	1,216	-61%
Santander	2,826	415	463	632	1,124	981	866	-12%
Norte Santander	6,280	9,145	8,041	4,471	3,055	844	488	-42%
Boyacá	322	245	118	594	359	342	441	29%
Caldas	-	-	-	54	358	189	461	144%
Cundinamarca	66	22	57	57	71	56	120	114%
Total	18,118	18,474	14,829	15,389	15,073	15,632	12,131	-22%
Annual trend	-32%	+2%	-20%	+4%	-2%	+4%	-22%	

Since 2002, coca cultivation remained stable at around 15,000 hectares in the Central region of Colombia. Between 2005 and 2006, coca cultivation decreased by 22% to 12,131 hectares. At the end of the nineties, Norte de Santander department was one of the most important centres of coca cultivation in the country, accounting for 10% of the country total in 1999. Between 1999 and 2006, the Government has been able to drastically reduce coca cultivation in this department. Between 2002 and 2004, aerial spraying averaged 10,000 hectares per year over this area, but in 2005 and 2006 dropped to less than 2,000 hectares. In 2006, coca cultivation accounted for only 488 hectares, or 3% of the level of coca cultivation in 1999.

In the department of Bolivar, coca cultivation is concentrated in the South, in an area known as Sur de Bolivar. Coca cultivation in the department remained relatively stable, accounting for 4% to 8% of the country total in the period 1999 - 2005. In 2006 coca cultivation decreased by 35% to the amount of 2,382 hectares, the lowest in the last eight years.

In Antioquia, coca cultivation averaged 3,000 hectares between 1999 and 2002. Coca cultivation has been increasing since 2002, from 3,030 hectares to 6,157 hectares in 2006. This increase over the past four years occurred despite the intensification of aerial spraying, from 3,300 hectares in 2002 to 16,800 hectares in 2005 and 18,000 hectares in 2006, plus the manual eradication of 3,146 hectares.

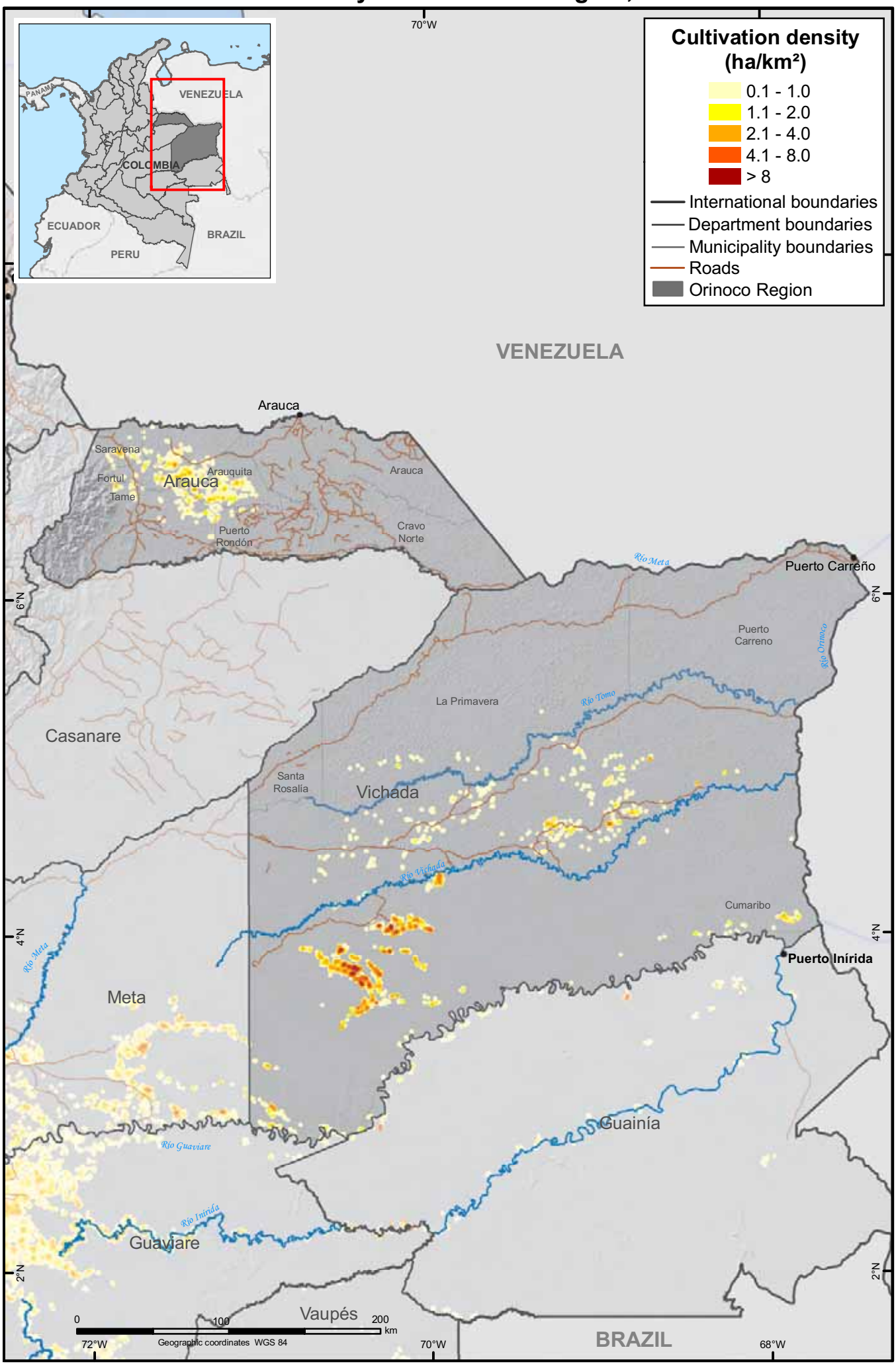
In the department of Caldas, the most important coffee growing area in Colombia, coca cultivation was detected for the first time in 2003 (54 ha). Coca cultivation reached a peak in 2006 with 461 hectares, despite the manual eradication of 552 hectares in 2006.

The department of Cordoba showed a decrease of 1,920 hectares in 2006 (-61%) after an important increase in the period 2004-2005. The manual eradication reported in 2006 amounts to 2,142 hectares and the aerial spraying presented a significant increase from 1,800 hectares in 2005 to 5,600 hectares in 2006.

The departments of Norte de Santander, Antioquia and Santander received the largest support in alternative development in Colombia in 2006 with the 65% of the national total investment, though the coca cultivation amounts only to 9.6% of the national cultivation.

Coca cultivation in Antioquia department

Coca cultivation density in the Orinoco region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Orinoco region

Table 11. Coca cultivation in the Orinoco region, 2000-2006 (hectares)

Department	2000	2001	2002	2003	2004	2005	2006	% Change 2005-2006
Vichada	4,935	9,166	4,910	3,818	4,692	7,826	5,523	-29%
Arauca	978	2,749	2,214	539	1,552	1,883	1,306	-31%
Total	5,913	11,915	7,124	4,357	6,244	9,709	6,829	-30%
Annual trend	-	+102%	-40%	-39%	+43%	+56%	-30%	

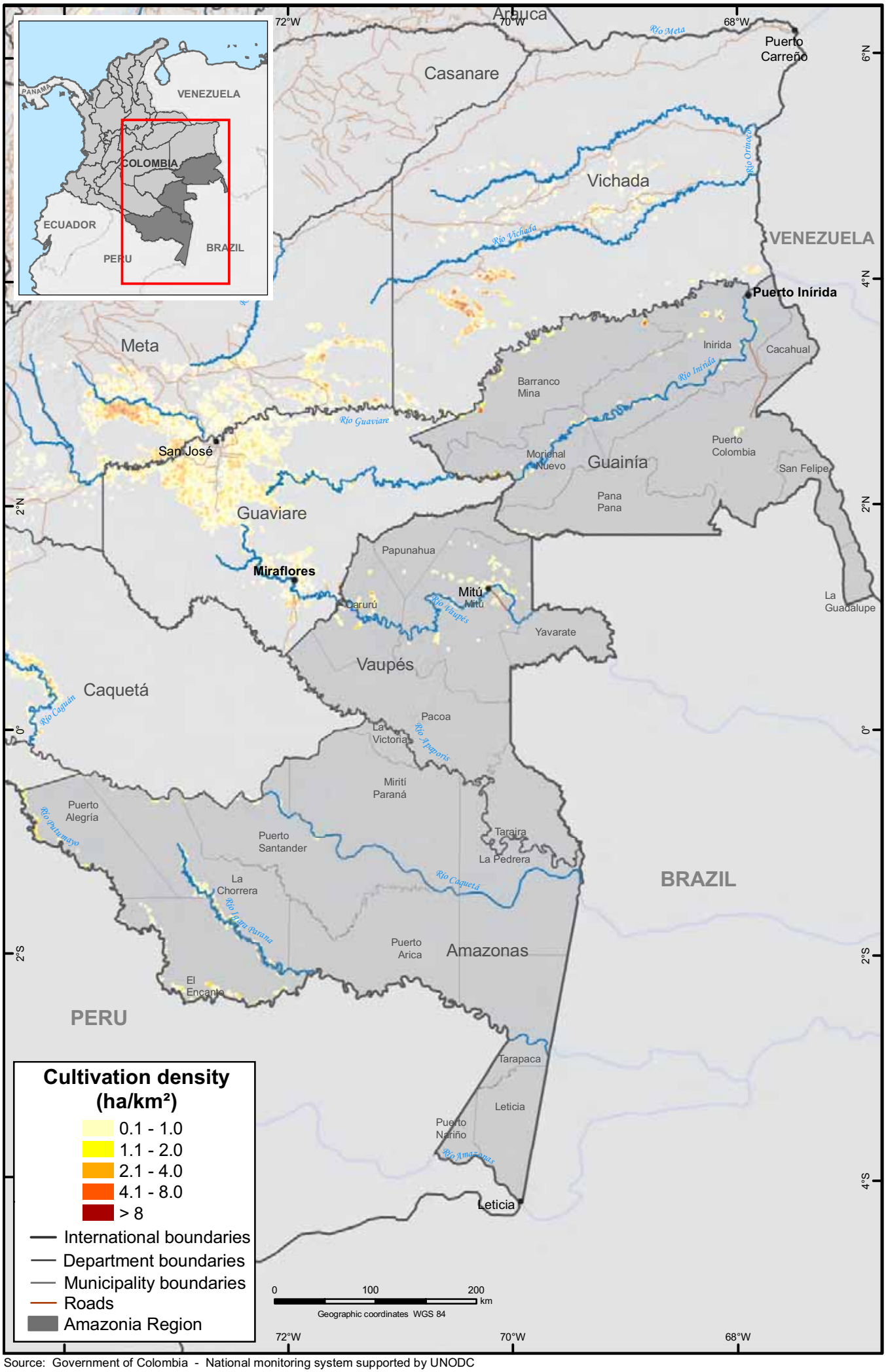
In Vichada department, near the Venezuelan border, coca cultivation peaked at 9,200 hectares in 2001. It remained between 4,000 and 5,000 hectares from 2002 to 2004, but increased by 67% between 2004 and 2005, before decreasing to 5,523 hectares in 2006.

In Vichada, the most important concentration of coca cultivation can be found along the Uva River. However, in the past three years, coca cultivation expanded to the Eastern part of the department, towards the Venezuelan border. The dispersion of coca cultivation in remote parts of the department increases the time flight and cost of aerial spraying. As a result, aerial spraying has been relatively low in this department in the past (below 3,000 hectares). However, in 2006, 5,500 hectares of aerial spraying were reported. Very little manual eradication took place in this department.

Coca cultivation in Arauca was detected for the first time in 2000 with about 1,000 hectares. It went over 2,000 hectares in 2001 and 2002. In 2003, aerial spraying amounted to 12,000 hectares and coca cultivation dropped to 500 hectares in December of that year. However, it increased in 2004 and 2005 and decreased again in 2006 with 1,306 hectares as result of 362 hectares of manual eradication plus 1,400 hectares spraying.

Coca cultivation in savannas of Arauca, and coca fields interspersed with licit crops

Coca cultivation density in the Amazonia region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Amazonia region

Table 12. Coca cultivation in the Amazonia Region, 2000-2006 (hectares)

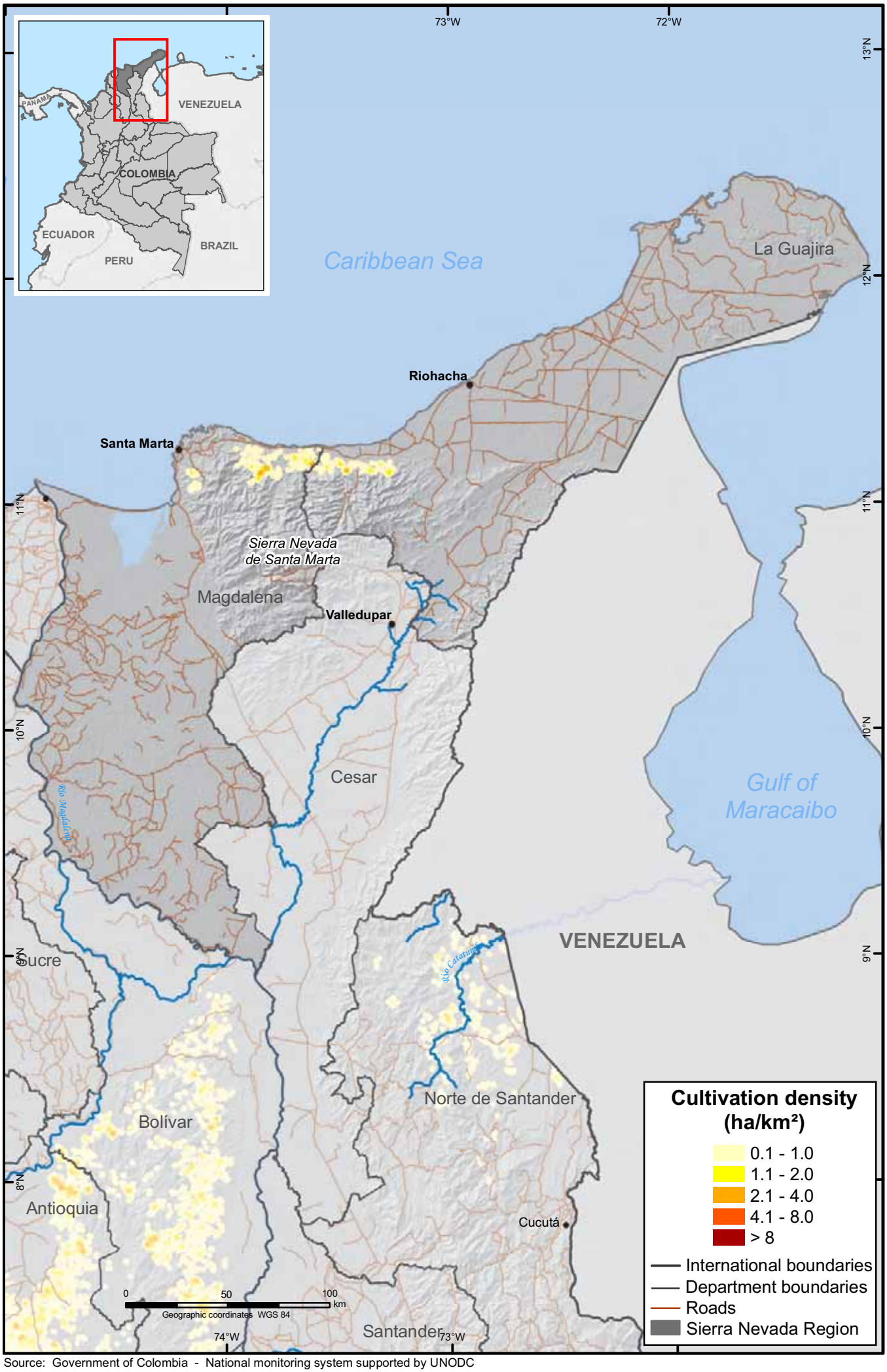
Department	2000	2001	2002	2003	2004	2005	2006	% Change 2004-2005
Guainía	853	1,318	749	726	721	752	753	0%
Amazonas	-	532	784	625	783	897	692	-23%
Vaupés	1,493	1,918	1,485	1,157	1,084	671	460	-31%
Total	2,346	3,768	3,018	2,508	2,588	2,320	1,905	-18%
Annual trend	-	+61%	-20%	-17%	+3%	-10%	-18%	

Like the Putumayo-Caqueta region, the departments of Vaupes, Amazonas and Guainia belong to the Amazon basin. Although sharing important similarity with Putumayo and Caqueta, these three departments, refered to as Amazon region, have never been important centres of coca cultivation. This is due to the remoteness of the area, as well as to the lack of airport and road infrastructure linking this region to the rest of the country. Consequently, aerial spraying of coca cultivation was almost not existent, except in Vaupes.

Coca cultivation continues the trend of slow decrease since coca cultivation was first observed in 2000.

Coca fields surrounded by forest areas in the Amazon region.

Coca cultivation density in the Sierra Nevada region, Colombia 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Sierra Nevada region

Table 13. Coca cultivation in the Sierra Nevada region, 2000-2006

Department	2000	2001	2002	2003	2004	2005	2006	% Change
Magdalena	200	480	644	484	706	213	271	27%
Guajira	321	385	354	275	556	329	166	-50%
Total	521	865	998	759	1,262	542	437	-19%
Annual trend	-	+66%	+15%	-24%	+66%	-57%	-19%	

The Sierra Nevada region, with the departments of Magdalena and Guajira, has never been an important centre of coca cultivation in Colombia. Coca cultivation remained between 500 and 1,300 hectares over the last eight years. Between 2004 and 2006, coca cultivation decreased by an impressive 65%, to reach its lowest level with only 437 hectares. Coca cultivation remained located mainly in the fringe of lowlands between the high mountains of the Sierra Nevada and the seashore.

However, the region is an important area for narco-trafficking activities, in particular for the shipping of drugs to the Caribbean Islands and the United States.

For a few years already, the Sierra Nevada region benefited from important aid for alternative development, mainly due to the Sierra Nevada National Park. Government's data indicated an important increase in alternative development budget for 2005. At the same time, manual eradication activities reached 1,166 hectares in 2006.

The region is also an important tourism centre and hosts the Sierra Nevada National Park. The National Park is one of the most important ecological reserves in Latin America, known for its rich bio-diversity and presence of several ancient indigenous cultures. In 2006, coca cultivation amounted to 119 hectares in the Sierra Nevada National Park, an increase of 25% compared to 2005.

Coca fields in Sierra Nevada Region.

Possible areas of new cultivation

The survey covered and interpreted 100% of the national territory, including areas previously not known as being coca-growing regions. In doing so it serves as an early warning system to detect and prevent the spread of coca into new areas.

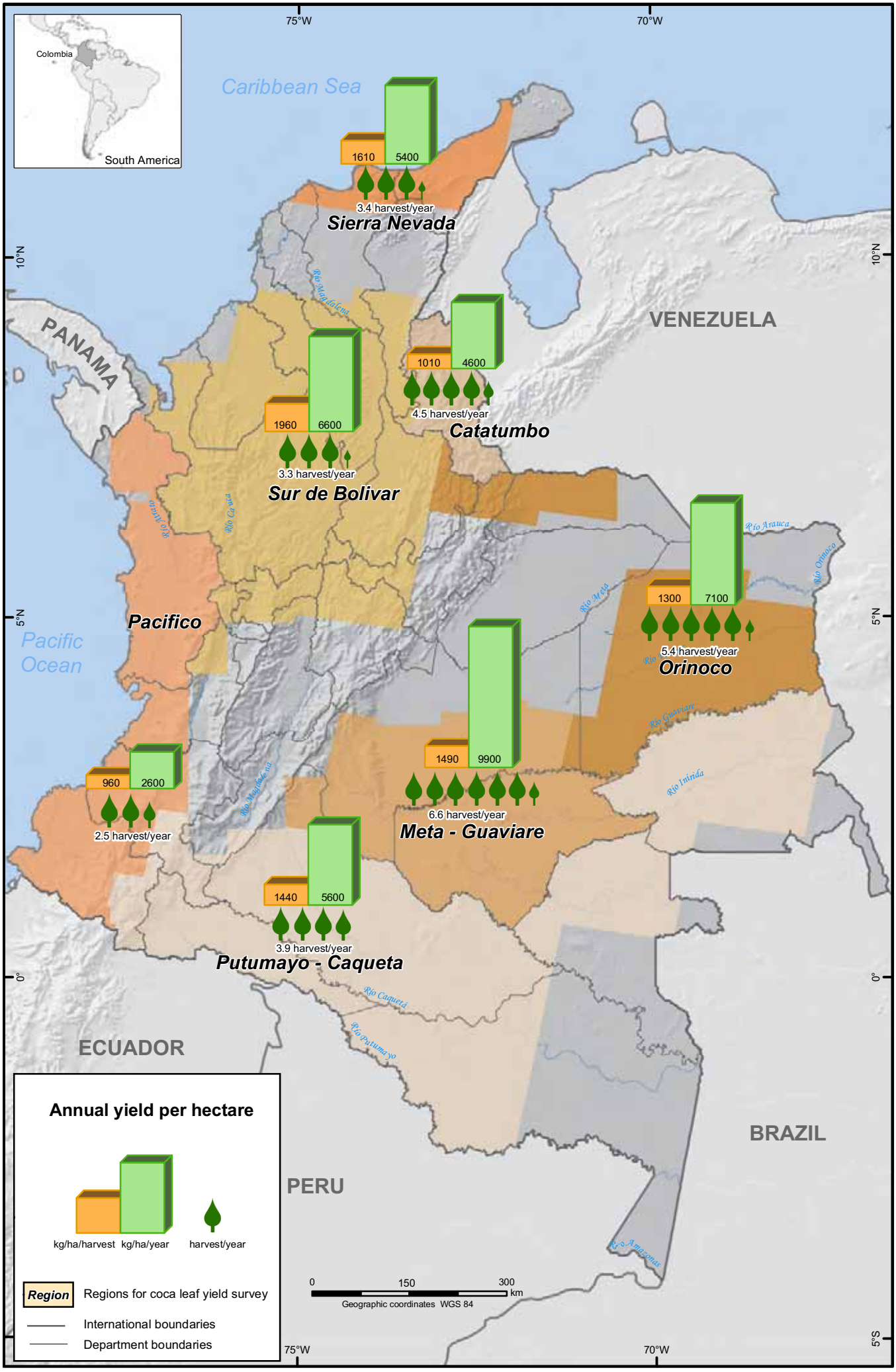
In 2006, potential small coca fields have been detected in remote areas outside the established agricultural areas of the departments of the Orinoco and Amazon River basins. Field verification has not been carried out in these areas because the verification of small and isolated patches of coca cultivation was considered too time consuming and too costly. Therefore, the estimate for coca cultivation in these areas is presented as indicative and was not included in the final estimate. The 2006 survey analysed 19 Landsat images for vegetation having characteristics similar to coca fields. A total of 356 hectares were assessed as possible coca cultivation in new areas.

Table 14. Possible coca cultivation in new area, 2006

Department	Area (ha)
Amazonas	203
Arauca	12
Caqueta	6
Guainia	35
Vaupés	68
Vichada	32
Total	**356**

New coca field in Amazonia region

Coca yield by region in Colombia, 2006



Source: Government of Colombia - National monitoring system supported by UNODC

2.2 Coca leaf, coca paste and base production

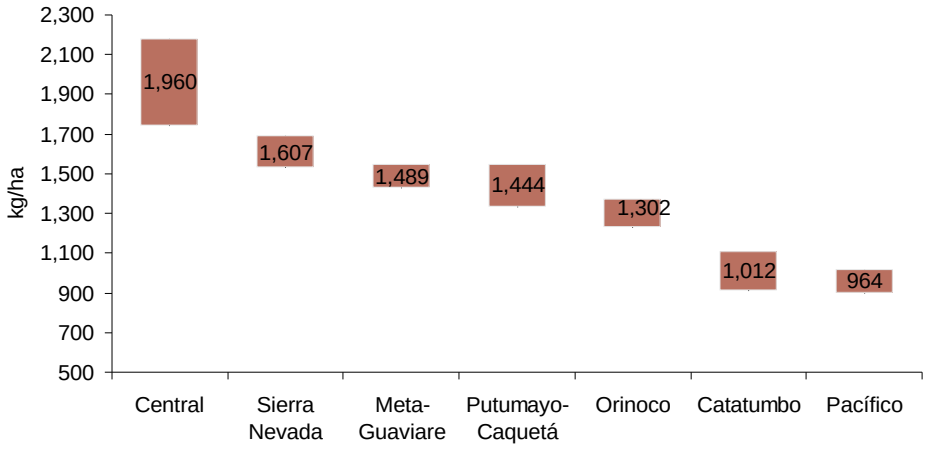
The potential production of fresh coca leaf in Colombia for 2006 was calculated by multiplying the regional average annual yield of fresh coca leaf established by the 2005 yield study by the regional area under coca cultivation[3]. The lower and upper estimates of the potential production of fresh coca leaf were calculated by using the lowest and highest annual regional yields. The potential production of fresh coca leaf was estimated at 489,200 metric tons, within a range of 438,985 and 542,546 metric tons. Assuming 57% moisture content, this was equivalent to a total production of 278,844, metric tons of sun-dried coca leaf.

Table 15. Regional average coca leaf yield per harvest by region

Region	Avg Yield per harvest (kg/hectares)	Lowest limit of confidence interval (kg/hectares)	Highest limit of confidence interval (kg/hectares)	Coefficient of variation (CV in %)
Central region	1,960	1,740	2,180	5.7%
Sierra Nevada	1,607	1,530	1,690	2.6%
Meta-Guaviare	1,489	1,430	1,550	2.1%
Putumayo-Caqueta	1,444	1,330	1,550	3.8%
Orinoco	1,302	1,230	1,370	2.7%
Catatumbo	1,012	910	1,110	5.0%
Pacific	964	900	1,020	2.9%
All regions	1,360	1,340	1,380	1.4%

Catatumbo and Sur de Bolivar make up Central region

Figure 4: Regional average of coca leaf yield per harvest (kg/hectares)



Due to the high annual yield observed in Meta-Guaviare, the region accounted for 42% of the total production, although it represented only 26% of the total coca cultivation.

[3] At the beginning of 2007, a pilot study was conducted in order to update the yield estimates. Preliminary results of this research are within the limits of variation observed during the yield study in 2005. The evaluation of this new study is still ongoing at the time of the printing of this report. In the Annex 4 the methodology and preliminary results are described.

In Colombia, traditional use of the coca leaf can be considered marginal, and virtually the entire coca leaf production is destined for cocaine production. There are various ways to produce cocaine. The overall process is that leaves are processed into coca paste, then into cocaine base, then into cocaine hydrochloride. The farmers can either sell the coca leaves, or process these leaves into coca paste or base. The last step, the processing of the cocaine base into cocaine hydrochloride is not carried out by farmers but in clandestine laboratories.

Coca paste is the first product obtained in the process of alkaloid extraction from coca leaves using sulfuric acid and combustibles. It is then a cocaine sulfate with a high content of organic remnants, pigments, tannin, and other substances. Cocaine base is obtained by dissolving the cocaine sulphate in an acid and adding an oxidant agent (potassium permanganate being the oxidant most often used), then adding a base. The resulting substance is precipitated and filtered.

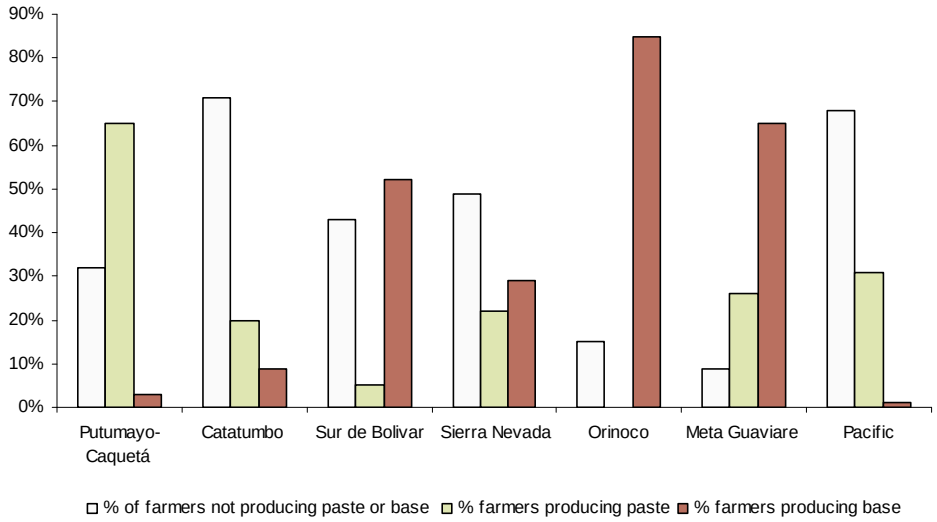
The coca leaf yield survey revealed that 34% of the farmers, representing only 25% of the total coca leaf production, sell directly the coca leaves, without processing them. Another 35% of the farmers, who represent 26% of the total coca leaf production, processed them into coca paste, and the remaining 31% of the farmers, who represent 49% of the total coca leaf production, process their leaves into cocaine base.

Table 16. Division of labour among coca producers

Region	% of farmers not processing coca leaves	% of farmers processing coca leaves into coca paste	% of farmers processing coca leaves into cocaine base
Putumayo-Caquetá	32%	65%	3%
Catatumbo	71%	20%	9%
Central	43%	5%	52%
Sierra Nevada	49%	22%	29%
Orinoco	15%	0%	85%
Meta Guaviare	9%	26%	65%
Pacific	68%	31%	1%
All regions	34%	35%	31%

Catatumbo and Sur de Bolivar make up Central region

Figure 5: Proportion of farmers processing and not processing coca leaves



During the survey, the farmers who processed their coca leaves were asked about the amount of coca leaves and ingredients used, and the amount of final product obtained. The distinction between paste and base is not easy to draw because the terms are often misused by the farmers themselves. In order to distinguish between these two products, it was decided to refer to cocaine base when the farmers reported the use of permanganate potassium or ammonium for processing their leaves, and coca paste when the farmers did not report the use of these products.

Therefore, it was possible to calculate the average conversion rate of one metric ton of coca leaves into coca paste (1.63 kg) and cocaine base (1.52 kg). In other words, coca paste yielded 93% of cocaine base.

Table 17. Average kg of coca paste or base obtained from one metric ton of coca leaf

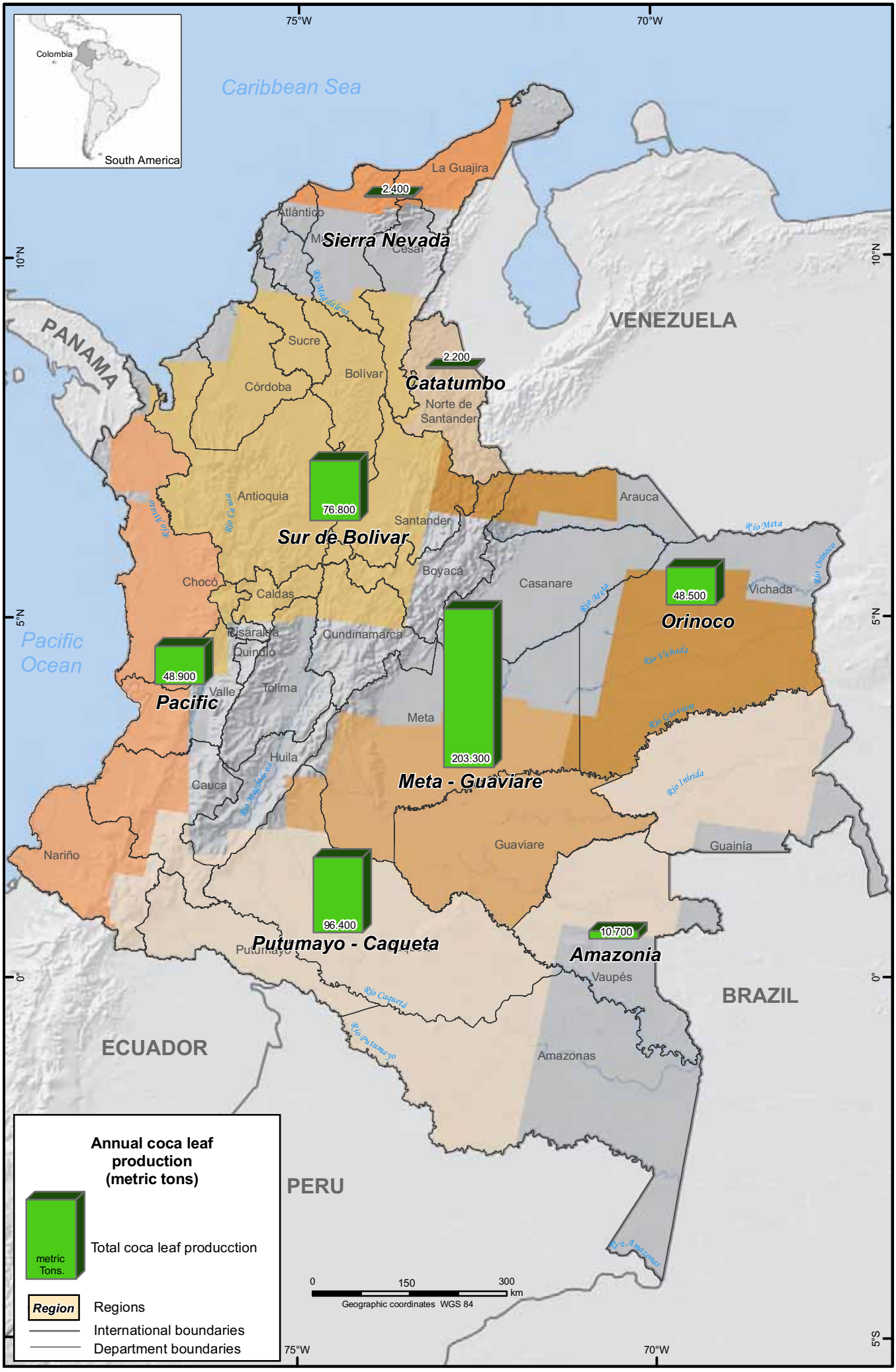
Region	Number of PAU's[4] process coca leaf	Avg kg of coca paste per metric tons of coca leaf	Avg kg of cocaine base per metric tons of coca leaf
Putumayo-Caqueta	152	1.75	1.74
Catatumbo	37	1.39	1.38
Central	107	1.41	1.41
Sierra Nevada	69	1.45	1.45
Orinoco[5]	118	-	1.73
Meta Guaviare	285	1.53	1.52
Pacific	79	1.55	1.46
All regions	847	1.63	1.52

Catatumbo and Sur de Bolivar make up Central region

[4] Agriculture Production Unit: an economical unit dedicated to the production or others licit crops under a unique management of a person or a family

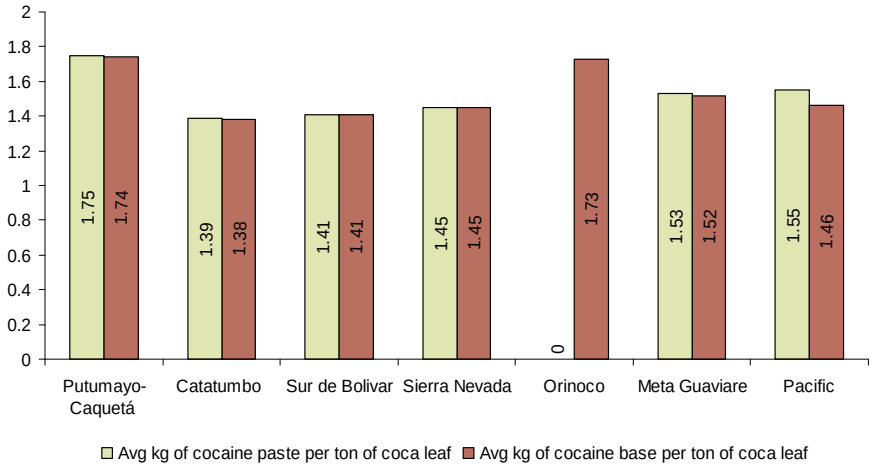
[5] The Orinoco farmers process only cocaine base.

Annual coca leaf production in Colombia, 2006



Source: Government of Colombia - National monitoring system supported by UNODC

Figure 6: Regional average of coca paste and cocaine base obtained from one metric ton of fresh coca leaf



About 30% of the coca leaf production was processed into coca paste. Thus, out of the total production of 489,200 mt of coca leaf, about 142,500 mt tons were processed into coca paste. Using the conversion rate of 1.63 kg of coca paste out of every tons of coca leaf, the total coca paste production from farmers was estimated at 234 mt. This was equivalent to 218 mt of cocaine base, based on a coca paste to base ratio of 93%.

Table 18. Calculation of coca paste production

Region	Total leaf production mt	Proportion of farmers producing coca paste %	Leaf production processed into coca paste mt
Meta-Guaviare	203,300	26%	52,900
Central	76,800	5%	3,800
Putumayo-Caqueta	96,400	65%	62,700
Orinoco	48,500	-	-
Pacific	48,900	31%	15,200
Amazonian	10,700	65%	7,000
Catatumbo	2,200	20%	400
Sierra Nevada	2,400	22%	500
Country level	489,200		142,500

Catatumbo and Sur de Bolivar make up Central region

The rest of the farmers either processed directly into cocaine base, or sell their production as leaf, corresponding to a total of 346,760 mt. Assuming that the production of coca leaf sell directly by the farmers was processed outside the farm into cocaine base at the same rate as within the farm of 1.52 kg per tons of leaf, the total amount of cocaine base was estimated at 536 mt.

Table 19. Calculation of cocaine base production

Region	Total leaf production mt	Proportion of farmers producing cocaine base %	Proportion of farmers selling leaf for base processing %	Total leaf production for base processing mt
Meta-Guaviare	203,300	65%	9%	150,442
Central	76,800	52%	43%	72,960
Putumayo-Caqueta	96,400	3%	32%	33,740
Orinoco	48,500	85%	15%	48,500
Pacific	48,900	1%	68%	33,741
Amazonia	10,700	3%	32%	3,745
Catatumbo	2,200	9%	71%	1,760
Sierra Nevada	2,400	29%	49%	1,872
Country level	489,200			346,760

Catatumbo and Sur de Bolivar make up Central region

Overall, either produced from coca paste or directly from coca leaves, the total production of cocaine base in Colombia in 2006 was estimated at 754 metric tons.

UNODC/SIMCI /DNE field work to estimate the potential production of coca leaf in Colombia.

Potential cocaine production

The coca yield survey implemented by UNODC and DNE in 2005 focused on obtaining data on the yield of coca leaf and on the processing by farmers of coca leaf into coca paste or cocaine base. The data on annual coca leaf yield and the conversion rates of coca leaves into coca paste and cocaine base were combined with the 2006 census estimating coca cultivation to estimate the total productions of coca leaf, coca paste and cocaine base.

To estimate cocaine production, UNODC relied on external sources. Indeed, investigating clandestine laboratories was not possible because these laboratories are directly in the hands of narco-traffickers. So far, UNODC did not collect any data to estimate the efficiency of these clandestine laboratories nor on the quantity of cocaine hydrochloride that can be produced from coca paste/base. In addition to the technical difficulties to obtain these data, this kind of survey is also complicated by the existence of several techniques to produce cocaine hydrochloride, and various purity level of the end-product.

The UNODC calculation for cocaine production in 2006 relied on its own estimate of cocaine base and on data obtained by the US Operation Breakthrough regarding the conversion rate from cocaine base to cocaine hydrochloride and the purity level of cocaine hydrochloride for conversion into equivalent of pure cocaine production.

US Operation Breakthrough mentioned a 1:1 conversion rate from cocaine base to cocaine hydrochloride. However, this was obtained from laboratories especially set up for this kind of survey, and thus this conversion rate is likely to correspond to ideal circumstances not always obtained in reality, especially by farmers. The same source also communicated to UNODC that cocaine base contained about 75% of pure cocaine alkaloid and the cocaine hydrochloride contained about 85% of pure cocaine alkaloid. From this data, UNODC derived a 1:0.9 ratio from cocaine base to cocaine hydrochloride. This ratio of 1:0.9 was deemed to apply better to the cocaine base production which corresponded to cocaine base obtained from farmers not working in ideal conditions. DEA and Operation Breakthrough insist that the ratio is 1:1

Based on this data, the 754 metric tons of cocaine base were equivalent to 678 metric tons of cocaine hydrochloride or 577 metric tons of pure cocaine. This represented an average pure cocaine yield per hectare of 7.4 kg/hectares.

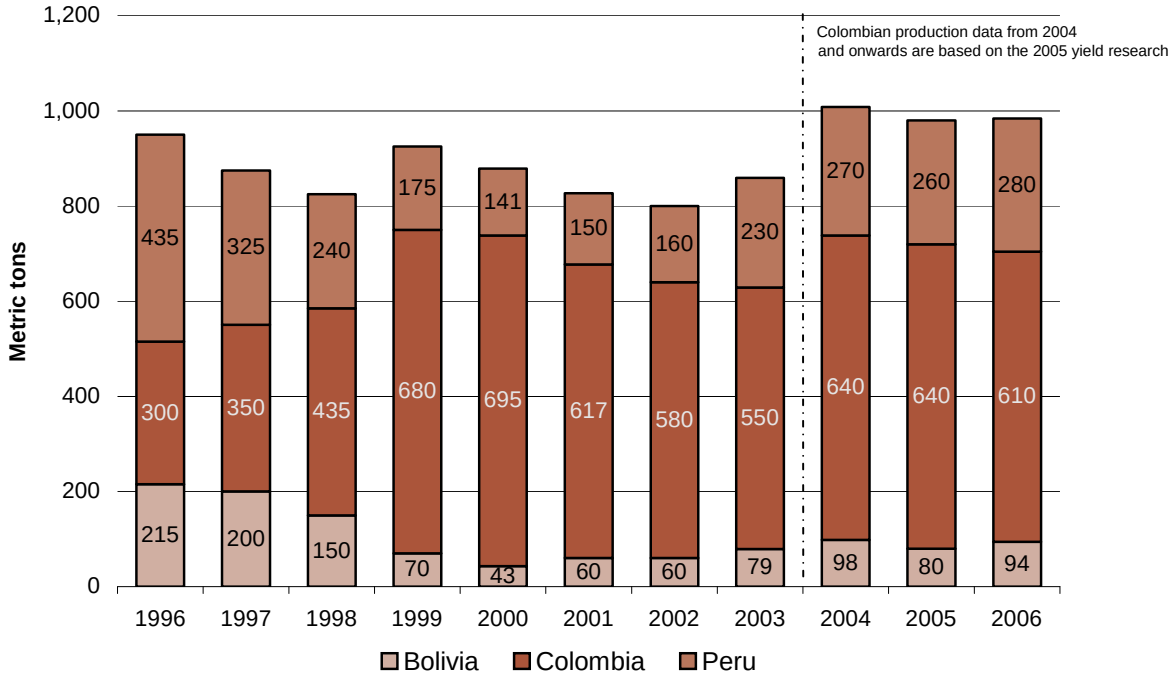
Since 2002, UNODC estimated the cocaine production in Colombia based on the average of the two cultivation figures recorded as of December of the previous year and December of the current year. This average was then multiplied by the estimated yield per hectare. This method enables to take into account that coca fields are harvested more than once in a given year and eradication activities are spread over several months. Therefore, based on an average coca cultivation level of 82,000 hectares, the pure cocaine production in Colombia for 2006 amounted to 610 metric tons.

Processing of coca leaves to coca paste.

Coca leaves mixed with gasoline

Coca paste obtained.

Figure 7: Global Cocaine production 1996 - 2006 (in metric tons)



Note: Production estimates for Bolivia in 2004 and 2005 and for Peru from 2003 to 2005 were revised based on updated information available.

In 2006, at the global level, the potential cocaine production in Colombia represented 62% of the global potential cocaine production of 984 metric tons.

Table 20. Global potential cocaine production, 1996 – 2006 in metric tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	% Change 2005-2006	% of 2006 total
Bolivia	215	200	150	70	43	60	60	79	98	80	94	+18%	10%
Peru	435	325	240	175	141	150	160	230	270	260	280	+8%	28%
Colombia	300	350	435	680	695	617	580	550	640	640	610	-5%	62%
Total	950	875	825	925	879	827	800	859	1,008	980	984	+0.4%	100%

Source: World Drug Report 2007.

Note: Production estimates for Bolivia in 2004 and 2005 and for Peru from 2003 to 2005 were revised based on updated information available.

2.3 COCA PRICES

Coca leaf, cocaine base and cocaine prices

Between 2005 and 2006, coca leaf prices decreased by 9% in US$ terms and stayed stable in the local currency, Colombian Pesos (COP). The cocaine base, coca paste and cocaine prices also showed a decrease of 2 to 5%.

The changes in prices and purity of drugs are important indicators for the availability of drugs on the market. In 2005, UNODC-SIMCI started the periodic and systematic collection of price data in the first production stage (coca leaf, coca paste and cocaine base). This information is completed with data from the Presidential Programme against Illicit Crops (PCI). The prices of cocaine, cocaine base, morphine and heroin were provided by DIRAN and were collected by intelligence services in different cities in the country.

More and more, peasants take part in the transformation process and produce cocaine paste, and sometimes up to cocaine base themselves. Coca paste is the most traded product by farmers, whereas cocaine base would be produced mainly in clandestine laboratories as an intermediary product to cocaine hydrochloride. A 2005 study on the Agricultural characteristics of coca cultivation in Colombia[6] showed that 34% of the peasants sell coca leaves without processing. Another 35% sell coca paste and the remaining 31% sell cocaine base.

Most peasants sell coca paste that they themselves produce in small "kitchen" located on the farm. The processing does not require much know-how and technology and therefore, in 85% of the cases the peasant does the processing himself, and only in 15% a "cook" or "chemist" is hired to do the processing. The technical know-how was brought to the farmers during the 90's by drug-traffickers to facilitate and to increase the commercialisation of cocaine.

The prices of coca in different processing stages (coca leaves and coca paste) are influenced by the aerial spraying and manual eradication, interdiction and the intervention of illegal armed groups, who often impose their prices and conditions on the farmers. In general, it was observed that repressive interventions of the national army have a decreasing impact on the prices due to the unavailability of sellers and resellers, although it does not necessarily affect production. On the other hand, extensive aerial spraying or problems due to adverse climate, pests and diseases could have an increasing impact on the prices.

Table 21. Average prices of coca leaf and its derivates, 2004-2006

Derivates	2004		2005		2006		% Change 2005-2006	
	US$/ kg	´000 COP/kg	US$/kg	´000 COP/kg	US$/kg	´000 COP/kg	US$/kg	´000 COP/kg
Cocaine hydrochloride	1,710	4,600	1,860	4,315	1,762	4,155	-5.3	-3.7
Cocaine base			1,090	2,532	1,038	2,447	-4.8	-3.3
Coca paste	810	2,119	910	2,109	879	2,070	-3.4	-1.8
Coca leaf	1.2	3.3	1.1	2.4	1.0	2.4	-9.1	0

Source: UNODC/SIMCI

[6] A study performed in 2005 by UNODC/SIMCI and DNE

Coca leaf prices

In Colombia, coca leaf is traded as fresh, whereas in Peru and Bolivia, coca leaf is traded as sun dried.

Converted in equivalent sun-dried coca leaf (assuming a moisture loss of 57% between fresh and sun-dried coca leaf), coca leaf price in Colombia in 2006 established at US$ 2.6/kg, which is similar to prices of sundry coca leaf in Peru (US$ 2.5/kg) but a bit lower than in Bolivia (US$ 3.2/kg).

Average national coca leaf prices have shown little fluctuations in the last two years. At the regional level in Colombia, the highest coca leaf price was registered in Putumayo-Caqueta region and the lowest in Sierra Nevada region.

Coca paste prices

Prices of coca paste decreased from an average of US$ 910 in 2005 to US$ 879/kg in 2006 (-3%). However, the prices in local currency remained virtually unchanged in the last three years (around COP 2.1 million) and did not show large changes in the period 2000-2006; the lowest level in this period was registered in 2000 (COP 1.7 million) and the highest was in 2003 (COP 2.2 million). Nevertheless, the fluctuations within a year are much more significant as can be seen in Figure 12, where the final price of 2006 is 28% higher than the price at the beginning of the year and is at its highest point in two years.

At the regional level, the highest coca paste prices were observed in Sierra Nevada, which is an important distribution point and where the prices are 30% higher than the national average price. At the beginning of 2006, it showed its lowest price of the year, which can be attributed to the demobilization of the AUC armed group; however, the prices recovered during the year and ended with COP 2.8 million.

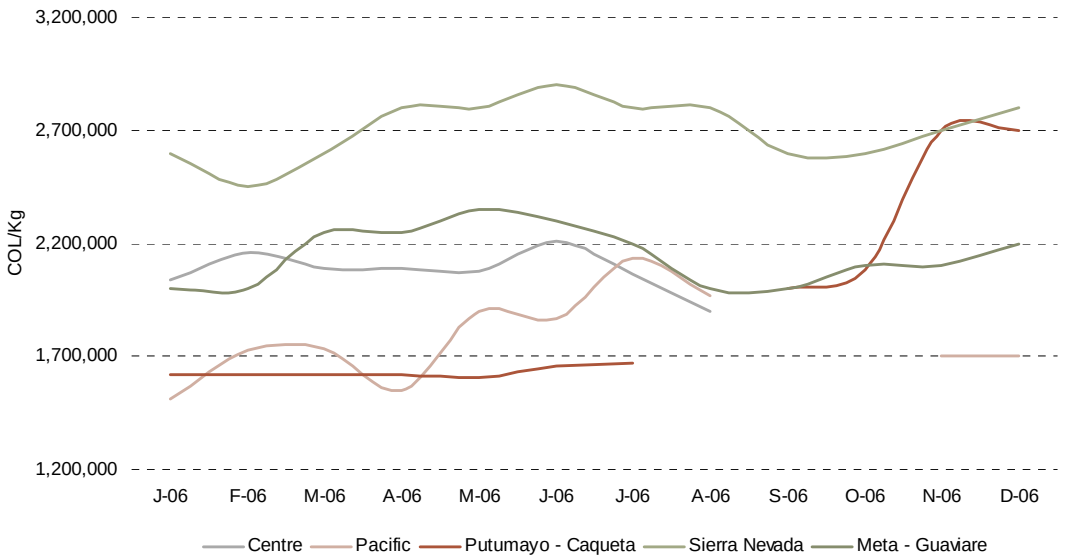
The lowest prices were paid in the Pacific region (COP1.8 million or US$ 755), followed by Putumayo-Caquetá (COP1.9 million or US$ 891); nevertheless, there was an increasing trend in the 2nd semester, which can be attributed to the high levels of aerial spraying in 2006.

Table 22. Monthly coca paste price, 2006 (in '000 COP/kg)

Months	Weighted national average	Central	Pacific	Putumayo-Caqueta	Sierra Nevada	Meta-Guaviare
January	1,846	2,037	1,512	1,621	2,600	2,000
February	1,939	2,159	1,729	1,621	2,450	2,000
March	1,932	2,089	1,733	1,621	2,600	2,250
April	1,918	2,087	1,550	1,617	2,800	2,250
May	2,002	2,075	1,900	1,608	2,800	2,350
June	2,061	2,212	1,866	1,658	2,900	2,300
July	2,040	2,062	2,133	1,670	2,800	2,200
August	2,150	1,900	1,967		2,800	2,000
September	2,100			2,000	2,600	2,000
October	2,150			2,083	2,600	2,100
November	2,340		1,700	2,700	2,700	2,100
December	2,360		1,700	2,700	2,800	2,200
Average COP	2,070	2,078	1,779	1,900	2,704	2,146
Average US$	879	779	755	891	1,147	911

Source: UNODC/SIMCI

Figure 8: Monthly coca paste price in Colombia, 2006 (in '000 COP/kg)



*Orinoco does not have information on coca paste because the coca is immediately processed into cocaine base, which can be explained by the region's easy access to the necessary chemicals.

Cocaine base prices

The collection of prices data and their analysis is complicated by the absence of standard in naming the products, and in the absence of indications on the quality of the products. This is the case for cocaine base and coca paste, which can easily be confused. However, the data on cocaine base, albeit less frequently reported than the data on coca paste, confirmed that cocaine base is a more refined product than coca paste, and that both products can be traded. On average, for 2006, prices of cocaine base were 19% higher than the prices of coca paste and the highest prices for cocaine base were obtained in Orinoco and Meta-Guaviare.

Cocaine prices

In 2006, the decreasing trend in cocaine prices has continued. The decrease started in 2004 after 7 years of increase in cocaine prices. The annual average in 2006 was US$ 1,762/kg, which was a 6% decrease compared to the average of 2005. The highest prices were paid in Meta Guaviare, followed by the Central region and Sierra Nevada; the lowest prices were paid in the Pacific region and Orinoco.

Because of the clandestine nature of the trade, cocaine prices are less easily collected than prices of coca paste or coca leaf. This explains that fewer data are available for cocaine prices compared to other products. In Colombia, prices of cocaine hydrochloride are collected by DIRAN (the Anti-Narcotics Police), and refer to wholesale prices in the main cities. The purity level was not investigated in this study.

The table below presents the annual averages of cocaine prices since 1991. The prices are presented both in Colombian Pesos (COP) and US$ as constant price of 1991 to correct for the inflation.

Table 23. Cocaine HCl price in Colombia 1991-2006

Year	'000 COP/kg	US$/kg
1991	950	1,500
1992	1,020	1,500
1993	1,377	1,750
1994	1,488	1,800
1995	1,232	1,350
1996	1,762	1,700
1997	1,769	1,550
1998	2,101	1,472
1999	2,800	1,592
2000	3,100	1,485
2001	3,599	1,571
2002	4,389	1,532
2003	4,500	1,565
2004	4,600	1,713
2005	4,315	1,860
2006	4,155	1,762

Source: DIRAN

When an analysis is made of the trend of annual prices of cocaine in Colombian pesos and the trend of the annual total areas of aerial spraying, a positive correlation is found (ρ= 0.92 for constant prices between 1994 and 2006), meaning that in general an increase in area sprayed corresponds to an increase in cocaine prices in Colombian Pesos. However, that relationship cannot be so strongly established for prices of cocaine in US$ (ρ= 0.19 for constant prices between 1994 and 2006).

Income per hectare

The data from the monthly survey on prices of the Andean coca market combined with the data from the coca leaf yield survey, enabled to calculate a theoretical income from the sale of coca leaf, coca paste and cocaine base. The differences between these incomes give an indication of the value-added if farmers produce coca paste and cocaine base. The table below shows a definite increase in the value added at each step of the processing. The value-added of cocaine base (60%), the final product that can be produced by the farmers, also explained why 49% of the coca leaf production was transformed into cocaine base by the farmers.

Table 24. Potential annual gross income per hectare of coca cultivation for different derivatives of coca leaf

Derivatives	Annual yield kg/ha	Average annual price US$/kg	Annual income in US$/hectares	Value-added from coca leaf %
Coca leaf	6,300	1.0	6,300	---
Coca paste	10.2	879	8,966	44%
Cocaine base	9.5	1,038	9,861	57%
Cocaine hydrochloride	7.4	1,762	13,039	107%

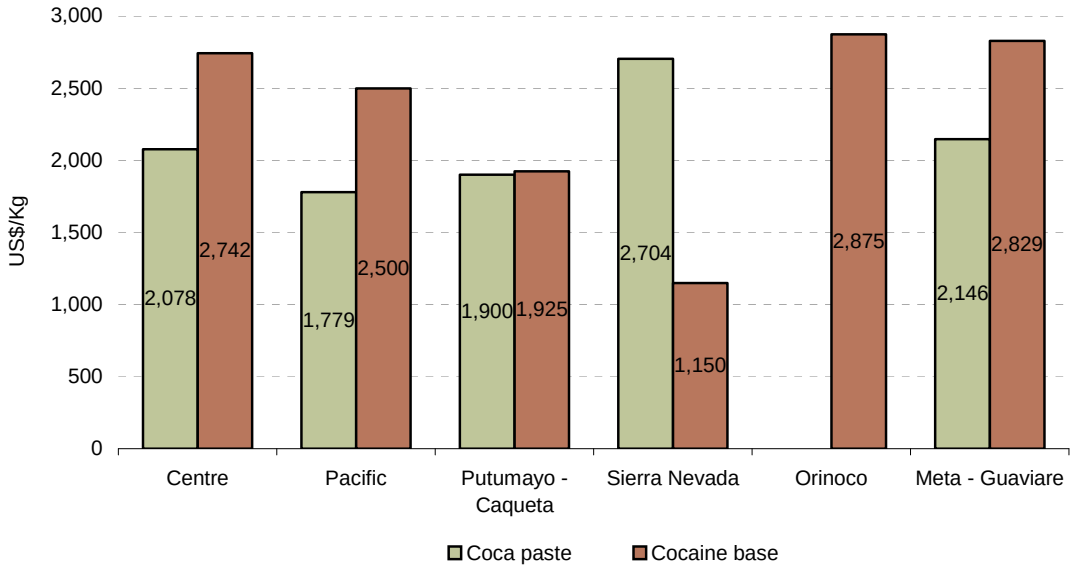
Based on the total production of each product sold by the farmers and the respective prices in 2006, the total farm-gate income value resulting from coca cultivation was estimated at about US$ 683 million. This value does not take into account the farmers' production costs, like cost of herbicides, pesticides, fertilizers and labour wages. It should also be noted that 47% of this value is made in the region of Meta-Guaviare, because of its very high annual yield (9,900 kg/hectares) and high proportion of farmers processing cocaine base.

The total farm-gate value of production of coca leaf and its derivatives corresponded to 0.5% the 2006's GDP. In 2006, the total farm-gate value of coca cultivation represented 5% of the agricultural GDP.

Table 25. Value of the production of coca leaf and its derivative at farm-gate level

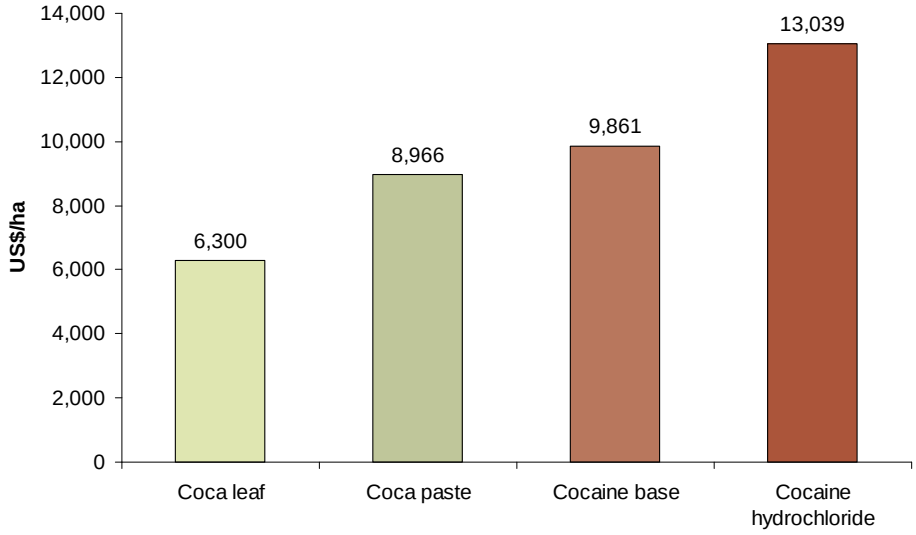
Product	Kg	US$/kg	US$ value
Coca leaf	128,858,000	1.0	128,858,000
Coca paste	234,000	879	205,686,000
Cocaine base	336,000	1,038	348,768,000
Rounded total farm-gate value			683,312,000

Figure 9: Comparison of the prices of coca paste and cocaine base in 2006 in US$/kg



*Orinoco does not have information on coca paste because the coca is immediately processed into cocaine base, which can be explained by the region's easy access to the necessary chemicals.

Figure 10: Potential annual income per hectare of coca leaf, coca paste, cocaine base and cocaine hydrochloride



2.4 OPIUM POPPY CULTIVATION

Reported Opium Poppy Cultivation

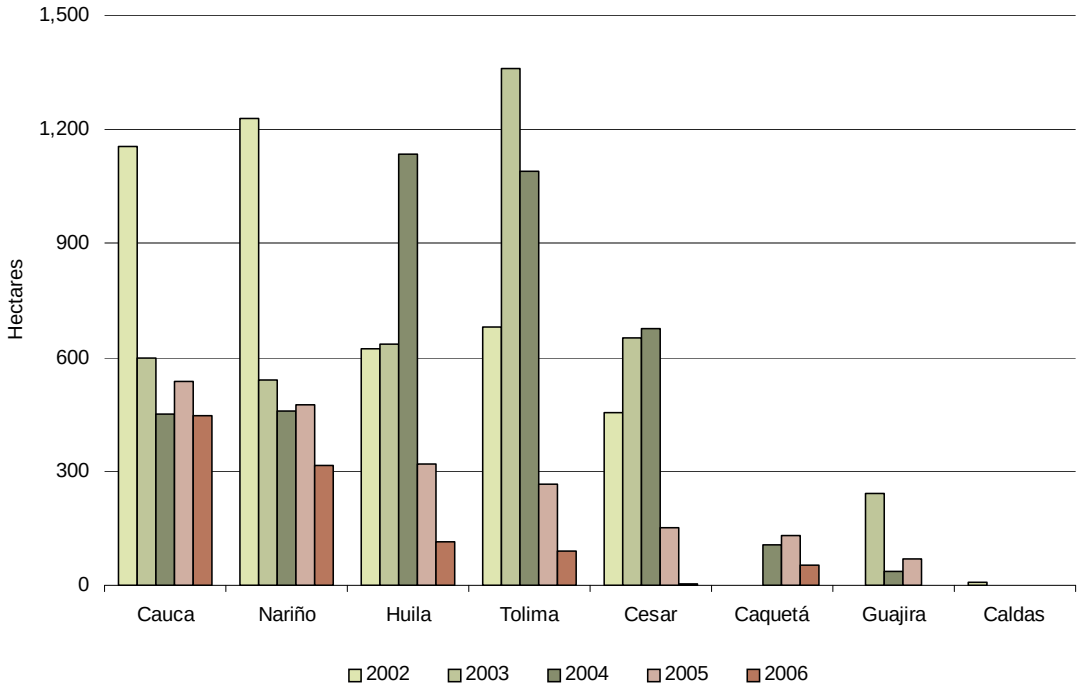
Opium poppy in Colombia is mainly being cultivated on mountain sides in the south-west, especially in the departments of Cauca, Nariño, Huila and Tolima and in minor extensions in Cesar, Caqueta and Guajira. Farmers cultivate opium poppy at an altitude ranging between 1,700 to 3,000 meters, in small fields, interspersed with licit crops.

Table 26. Opium poppy cultivation by department in Colombia, 2002 – 2006 (hectares)

Department	2002	2003	2004	2005	2006	% Change 2005-2006	% 2006 total
Cauca	1,155	600	450	538	448	-17%	44%
Nariño	1,230	540	460	475	316	-33%	31%
Huila	624	636	1,135	320	114	-64%	11%
Tolima	682	1,359	1,090	265	90	-66%	9%
Cesar	454	651	675	152	3	-98%	0,3%
Caquetá	-	-	105	132	52	-61%	5%
Guajira	-	240	35	68	-	-	-
Caldas	8	-	-	-	-	-	-
Total	**4,153**	**4,026**	**3,950**	**1,950**	**1,023**	**-48%**	
Rounded total	**4,200**	**4,000**	**4,000**	**2,000**	**1,000**		**100%**

Source: DIRAN (by aerial reconnaissance)

Figure 11: Opium poppy cultivation by department in Colombia, 2002 – 2006 (hectares)



UNODC does not monitor opium poppy cultivation in Colombia, but uses the figures based on over flights by the Colombian Anti-Narcotics Police (DIRAN).

Table 27. Global opium poppy cultivation, 1996 – 2006 (hectares)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Afghanistan	56,800	58,400	63,700	90,600	82,200	7,600	74,100	80,000	131,000	104,000	165,000
Myanmar	163,000	155,200	130,300	89,500	108,700	105,000	81,400	62,200	44,200	32,800	21,500
Colombia	5,000	6,600	7,400	6,500	6,500	4,300	4,100	4,100	4,000	1,950	1,023
Others	32,800	31,800	36,600	29,600	24,600	25,200	20,600	22,300	16,800	12,750	12,477
Total	257,600	252,000	238,000	216,200	222,000	142,100	180,200	168,600	196,000	151,500	200,000

Source: UNDOC

According to the DIRAN, the extent of opium poppy cultivation as of February 2007 (there are no data for December 2006) was 1,023 hectares representing a decrease of 49% compared to 2,000 hectares in December 2005. Opium poppy cultivation in Colombia represents only 0.5% of the world opium poppy cultivation in 2006. The principal production country is Afghanistan, which cultivates 83% of the opium poppy in the world.

Opium Latex and Heroin Production

Studies on heroin production performed by the US government found that Colombian opium poppy farmers cultivate two crops per year in all growing regions except in Nariño department, where there is one crop per year.

In Colombia, opium is harvested in the form of latex. In Asia instead opium is harvested as a denser gum. In Colombia, opium poppy cultivation is confined to the mountainous areas because it requires low temperatures at some stages in the growth cycle. Opium poppy is therefore not found in association with coca cultivation, which is located in low lands.

According to the US studies, opium poppy fields yield between 13 and 17 kilograms of latex per hectare and per harvest, depending on the growing region. Assuming an average yield of 15 kilograms per hectare, and 2 harvests per year, the total potential opium latex production would be around 30 metric tons. Based on a conversion rate of 24 kg of opium latex for one kilo of pure heroin (US-DEA study, 'Operation Breakthrough' conducted in 2001), the total potential heroin production in Colombia would amount to about 1.3 metric tons of heroin in 2006, representing 0.2% of the global heroin production of 606 metric tons[7]. Afghanistan produces 92% of the global opium, followed by Myanmar with 5%.

[7] UNODC World Drug Report 2006

Opium Latex and Heroin Prices

Table 28. Monthly opium latex, morphine and heroin prices, 2004-2006 ('000 COP/kg)

Month	2004			2005			2006		
	Opium latex	Heroin	Morphine	Opium latex	Heroin	Morphine	Opium latex	Heroin	Morphine
January	450	21,000	18,000	560	20,100	14,700	531	24,521	17,133
February	400	18,000	16,000	560	20,100	14,700	560	22,506	16,083
March	400	18,000	16,000	512	-	-	500	22,633	16,933
April	400	18,000	16,000	516	-	-	500	21,000	16,933
May	450	21,000	18,000	400	23,000	15,500	450	28,000	19,000
June	450	21,000	18,000	450	20,500	13,400	583	26,917	22,333
July	400	18,000	16,000	480	-	-	550	25,500	22,125
August	400	18,000	16,000	525	-	-	*550*	21,083	17,168
September	450	20,800	18,800	546	19,146	12,833	*550*	21,000	17,166
October	450	22,000	19,600	614	21,250	16,500	*550*	22,500	22,000
November	500	23,000	20,000	576	19,500	15,000	900	26,083	20,750
December	450	22,000	19,000	666	19,389	12,571	900	21,000	20,000
Annual Average	**433**	**20,067**	**17,617**	**534**	**20,373**	**14,401**	**593**	**23,562**	**18,969**
Annual Average US$	**165**	**7,642**	**6,709**	**230**	**8,778**	**6,204**	**251**	**9,992**	**8,045**

The decline in opium poppy cultivation is reflected in the increase of prices in opium latex and derivatives. Between 2005 and 2006, average opium latex prices went up from US$ 230/kg to US$ 251/kg, equivalent to an increase of 9%. A similar trend can be noted in the annual average prices of heroin: between 2005 and 2006, heroin prices went up from US$ 9,070/kg to US$ 9,992/kg, equivalent to an increase of 12%.

Figure 12: Opium latex prices in Colombia, 2001-2006 by month ('000 COP/kg and US$/kg)

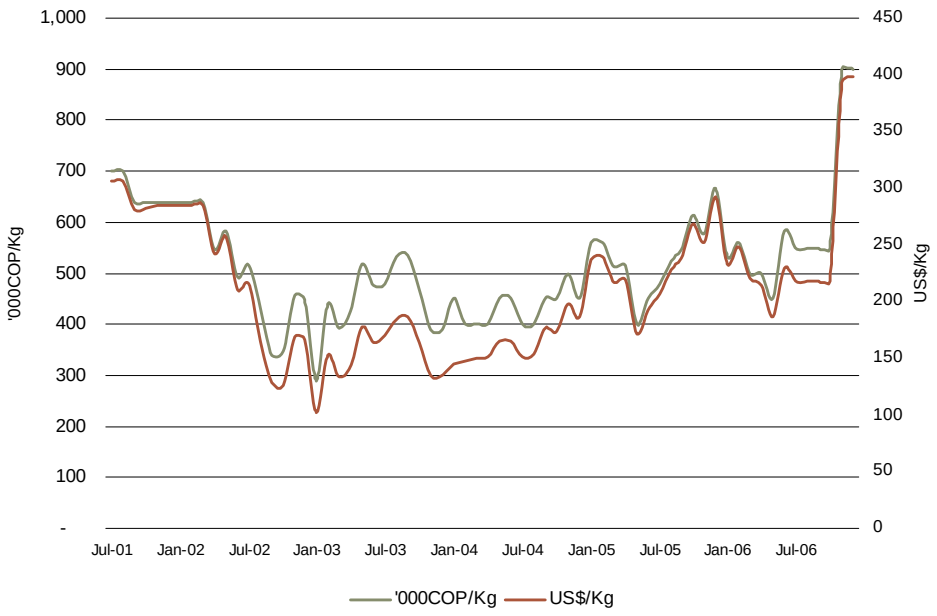


Table 29. Annual average prices of opium latex, morphine and heroin 2004-2006

Product	2004		2005		2006		% Change 2005-2006	
	US$/kg	´000 COP/kg	US$/kg	´000 COP/kg	US$/kg	´000 COP/kg	US$/kg	´000 COP/kg
Opium latex	165	433	230	534	251	593	9.1	11
Morphine	6,709	17,617	6,204	14,401	8,045	18,969	29.6	31.7
Heroin	7,642	20,067	9,070	21,051	9,992	23,562	10.1	11.9

Source: DIRAN

Poppy cultivation. Source : DIRAN

Flowers and capsules in a poppy field. Source UNODC Forrest Warden Monitoring.

2.5 RELATED STUDIES AND RESEARCH

The project has submitted several studies and investigations that have considerable relevance for the development of programmes or projects, which need high quality data concerning land use in areas affected by coca cultivation.

1) A study that determines the structure of costs and incomes as much for the agricultural process as for the transformation of coca leaf into coca paste or cocaine base, including a comparative analysis with licit forms of agriculture.

2) An assessment of the impact on the environment caused by deforestation in a test area affected by illicit crops located in the Antioquia– Sur de Bolivar area, and also the environmental contamination caused by chemical and agrochemicals in the production of illicit crops. The methodology can then be applied to obtain data at the national level by analyzing six other regions of the country.

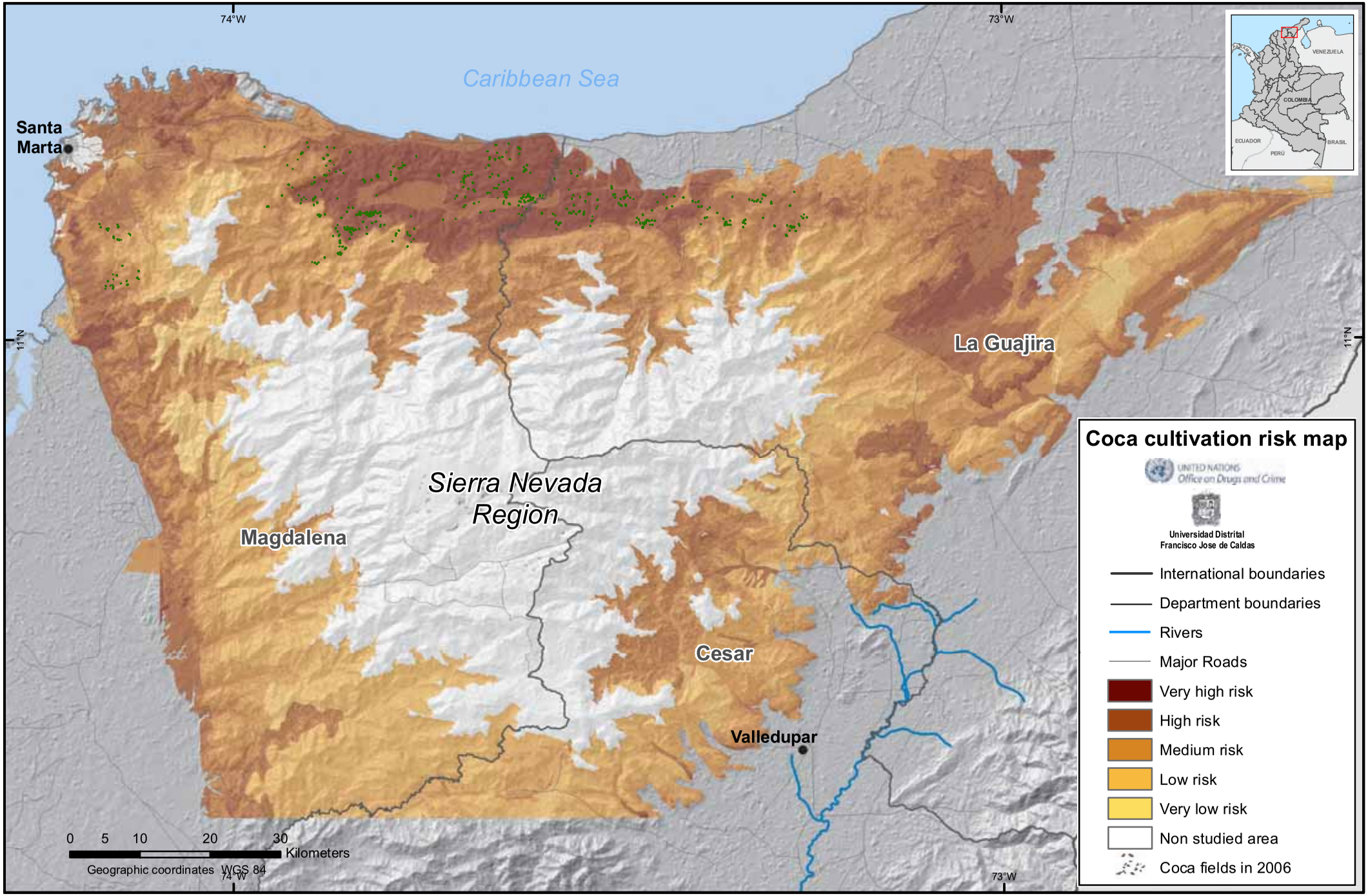
3) A study to identify areas at high risk of deforestation in the National Parks by retrieving satellite images of the parks affected and their 25 km buffer zones and to produce statistically valid data on soil use, vegetation coverage and the expansion of human settlements. Satellite image interpretation will be used to measure annual changes and developments in the NNPS during the period 2006-2009. The same study might also develop a monitoring system used to identify suitable areas in the protective buffer zones for Clean Development Mechanisms-CDM- projects.

4) A study to determine the structure of costs and proceeds for the process of transforming cocaine base and paste to cocaine hydrochloride. The study will also aim to identify the type of connection at this stage of development to coca leaf production and the wholesale commercialisation of cocaine.

5) With the cooperation of the Universidad Distrital of Bogota, Colombia, the first phase of a methodology named *"Guide for the assessment of biophysical aspects in a region vulnerable to coca cultivation as support for planning – Sierra Nevada Pilot Project-"* was developed. The study consists in a statistical analysis of biophysical variables to build a context guide, which will identify the geographical risks of the area to become cultivated with coca and the land use limitations. The second phase will present a more comprehensive vision of the coca cultivation dynamics and their impact in the vicinities.

Coca cultivation fields in the Sierra Nevada region.

Coca cultivation risk map for Sierra Nevada



Sources: for coca cultivation Government of Colombia - National monitoring system supported by UNODC.
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

2.6 ILLICIT CROPS AND ALTERNATIVE DEVELOPMENT

Alternative development programmes

In 1985, alternative development projects started in Colombia with the aim to substitute illicit crops and to complement spraying and eradication activities. The first department was Cauca followed by Guaviare, Caqueta and Putumayo.

According to the PCI, 63% of the alternative development projects were finalized or in process of finalization, 29% are ongoing projects and 8% are approved and ready to start. 35% of the investment of the finalized projects was executed in the department of Putumayo where the largest coca area in the country was found during the period 1999-2001. However, the budget of ongoing projects in Putumayo represents only 0.4% of the national budget available for alternative development while the spraying activities maintain the same high level of past years.

Table 30. Changes in coca cultivation, aerial spraying and alternative development budget 2000-2006

Department	Changes in coca cultivation 00-06 (hectares)	% of budget in ongoing Projects (COP)	Total aerial spraying of coca 00-06(hectares)
Putumayo	-53,768	0.4%	182,025
Guaviare	-8,142	-	117,889
Meta	-60	-	57,321
Nariño	6,263	7.6%	218,332
Caquetá	-21,636	-	71,295
Norte de Santander	-5,792	33.5%	51,172
Vichada	588	-	9,751
Antioquia	3,610	20.4%	65,318
Bolívar	-3,578	4.5%	31,891
Cauca	-2,472	3.9%	11,638
Córdoba	1,099	3.4%	8,639
Arauca	328	-	21,054
Vaupes	-1,033	-	1,096
Santander	-1,960	11.1%	6,518
Guainía	-100	-	-
Amazonas	-	-	-
Magdalena	71	1.7%	2,015
Chocó	566	0.3%	425
Boyacá	119	0.3%	1,878
Guajira	-155	-	1,021
Caldas	461	-	2,348
Valle del Cauca	205	-	5
Cundinamarca	54	8.5%	84
Tolima	-	4.5%	-

Sources: PCI- Social Action, SIMCI for coca area and DIRAN for opium poppy area.

The overall budget of ongoing alternative development projects has reached an amount of COP 285,882 million, of which COP 100,319 million come from national and international contributions (PDA contribution) and COP 185,562 million from farmers' savings, in-kind contributions and private sources

(Other Contributions). Most of the international cooperation funds come from the Agency for International Development -USAID aiming to finance sustainable private projects.

Table 31. Illicit crops and finalized or ongoing alternative development projects budget

Department	Coca cultivation 00-06 (ha)	Opium poppy cultivation 02-06 (ha)	Finalized Projects % of investment	Ongoing Projects % of investment
Putumayo	160,029		34.5%	0.4%
Guaviare	114,620		1.8%	
Meta	91,692		3.4%	
Nariño	93,231	3021	3.7%	7.6%
Caquetá	73,216	289	4.9%	
Norte de Santander	32,324		6.3%	33.5%
Vichada	40,870		0.2%	
Antioquia	30,760		8%	20.4%
Bolívar	27,443		5%	4.5%
Cauca	17,353	3,191	5.1%	3.9%
Córdoba	7,880			3.4%
Arauca	11,221			
Vaupes	8,268			
Santander	7,307		3.1%	11.1%
Guainía	5,872		0.2%	
Amazonas	4,313			
Magdalena	2,998		0.3%	1.7%
Chocó	3,221			0.3%
Boyacá	2,421			0.3%
Guajira	2,386	343		
Caldas	1,062	8	0.8%	
Valle del Cauca	762		0.7%	
Cundinamarca	449		0.4%	
Huila		2,829	4.4%	8.5%
Tolima		3,486	4.3%	4.5%
Cesar		1,935	4.7%	0.1%

Sources: PCI- Social Action, SIMCI for coca area and DIRAN for opium poppy area.

Norte de Santander, Antioquia and Santander departments obtained about 65% of the total budget of ongoing projects, though the coca cultivated area decreased in 2006 to 10% of the national total. On the other hand, 4% of the investments in finalized projects and 8% of the investment in ongoing projects were addressed to the department of Nariño, where coca cultivation area in 2006 has reached 15,606 hectares (20% of the total coca cultivation) in comparison with 4,000 hectares cultivated in 1999.

Meta, Caqueta, Guaviare and Vichada departments with 40% of the total coca cultivation in Colombia have no ongoing alternative development projects and their participation in finished projects represents 3% for Meta and 7% for the other three departments.

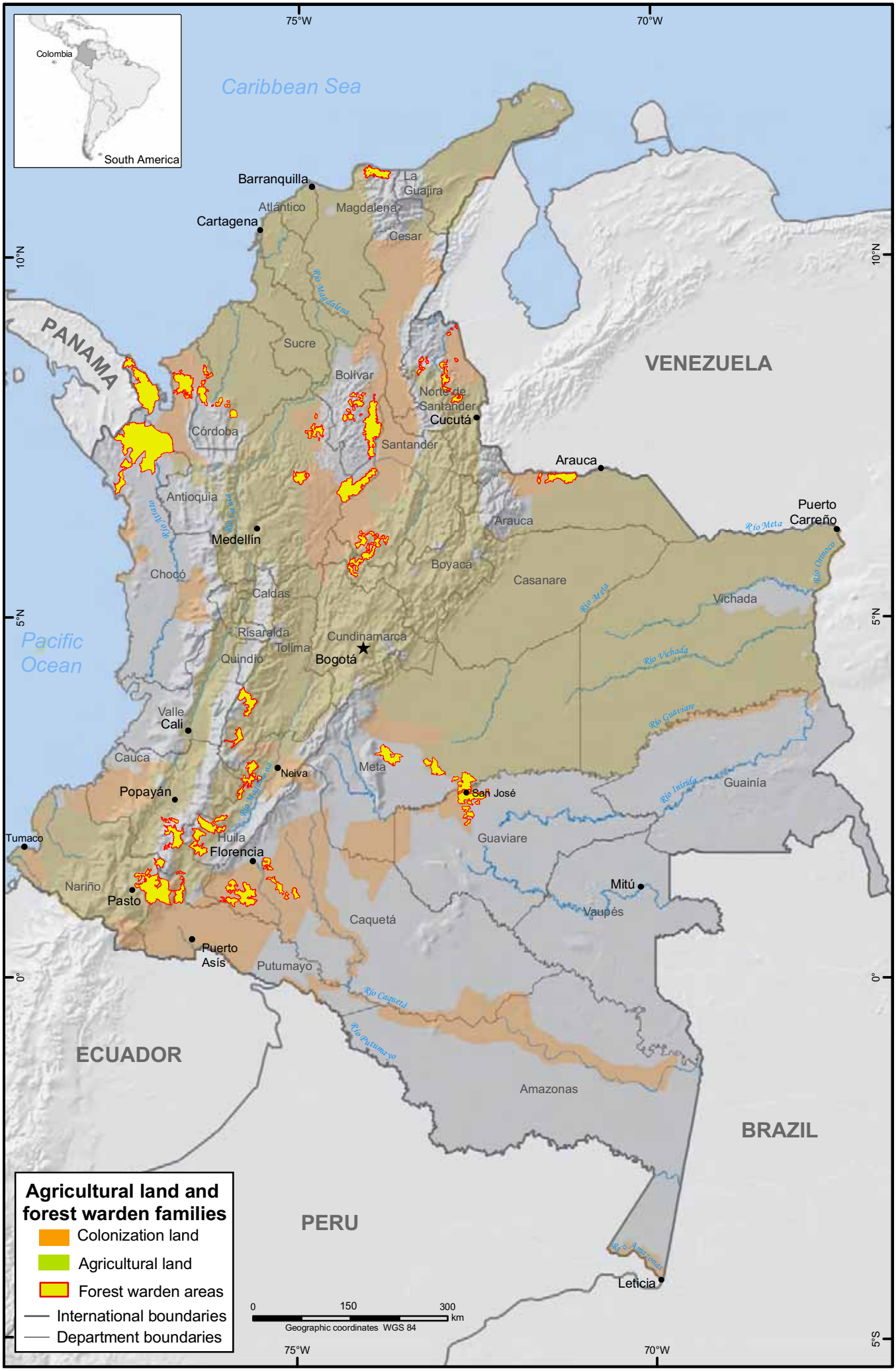
Investments in finished or finalized projects were aimed mainly to fund coffee, food security, palm, cacao and rubber. These five alternative productions represented 82% of total budget. At present, ongoing projects are mainly aimed to fund long-term products like palm, cacao and rubber with 67% of the total budget allocated to the Central region (Antioquia, Norte de Santander, Bolivar and Magdalena). Coffee with 14% and forest management with 7% appear in second place of importance.

The approved budget for alternative development projects will be used for cacao, palm, rubber, forest management and coffee, in Huila (28%), Cauca (16%), Cordoba (14%), Santander (13%), Antioquia (12%) and Bolivar (10%).

Alternative development activities

Productive Projects in Tumaco. COCOGUADUAL Source: FWFP

Agricultural land and forest warden families programme in Colombia, 2006



Source: Government of Colombia for Agricultural land - National monitoring system supported by UNODC for coca cultivation.
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Coca cultivation and the Forest Warden Families Programme

Since 2003 UNODC carries out the monitoring of the Government's "Forest Warden Families Programme" by verifying the absence of illicit crops in selected districts. The main objective of the programme is to motivate farmers to keep their land free of illicit crops. The programme also aims at the recovery of the forest in areas that are environmentally and socially vulnerable. The government and the families sign a contract with payments of a bimonthly salary (US$ 254) per family for a three years period. The programmes started in 2003 and 58,000 families have participated until now. In December 2006, 45,986 individual contracts were running to whom approximately 134 million US$ were paid.

The FWFP has three main components: The first one is the preservation of the environment with technical support of expert entities in the training of families for the establishment of productive and sustainable projects. The second component deals with the increase of the social capital, by a permanent training of families in community savings, leadership, project managements among others. The economic component consists in a temporary financial aid to the beneficiary families.

The selection criteria for the areas of each project is based on the identification of a number of districts within one or two municipalities that constitute a geographic unit along with the commitment of the inhabitants to keep all farms of their own district free of illicit crops. A break of this commitment from just one family in a given district implies the withdrawal of all families of that district from the project. However, in practice, this criterion has been replaced by the consideration of lists of families willing to enter into the agreement.

SIMCI Project supports the monitoring activities of the Programme with thematic cartography, satellite images and annual classification of vegetation coverage in the selected areas. The UNODC monitoring project shows that 1,515 hectares of secondary forest and 31,451 hectares of high shrubs have been recovered as well as 1,979,000 hectares in the selected areas are free of illicit crops.

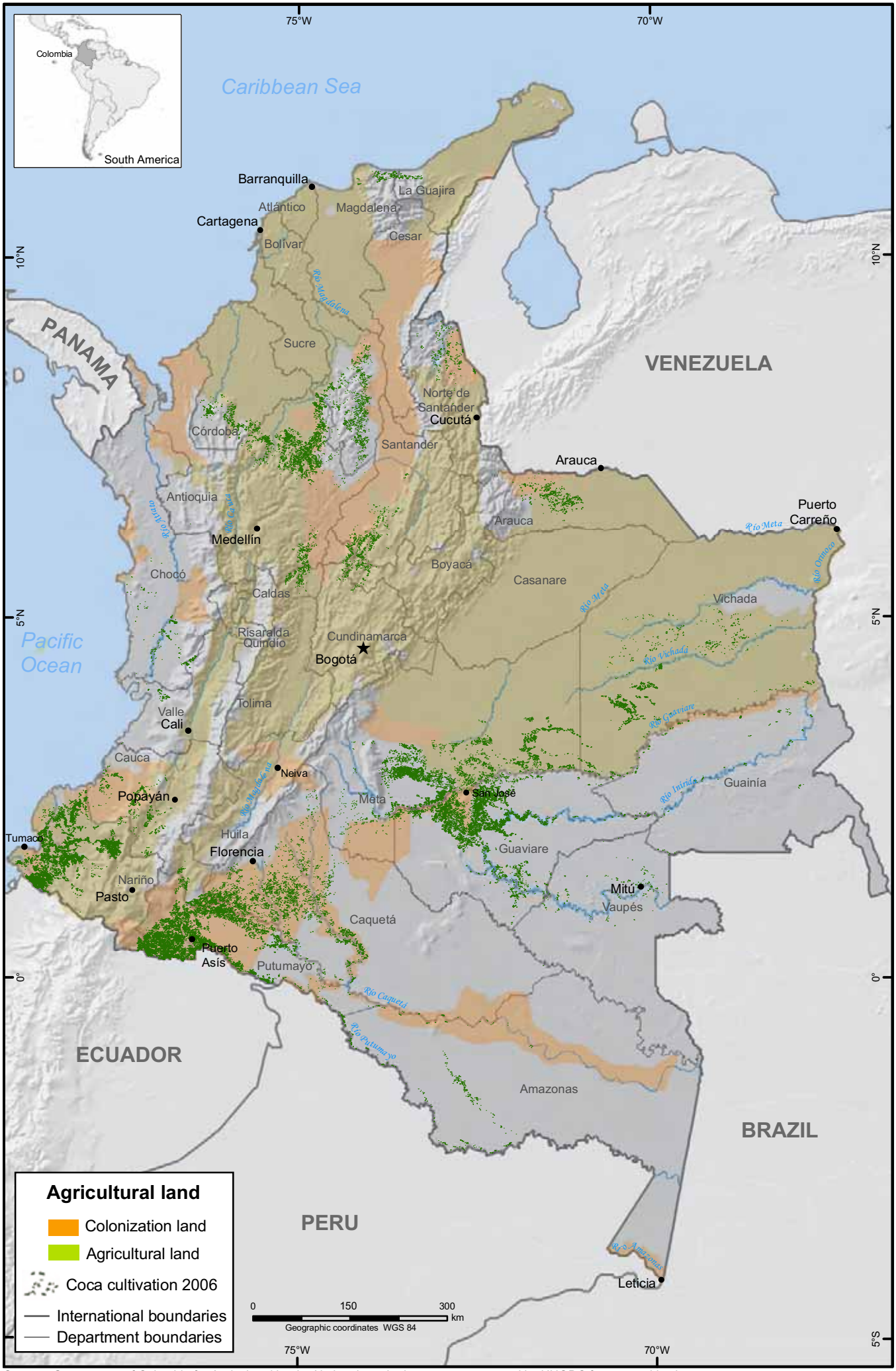
The map shows the location of the 60 districts registered in the PFGB and the coca fields over the official classification of Agricultural and Forest lands in Colombia.

Table 32. Consolidated contracts of the forest warden families programme by department

Department	Active Individual Contracts	Payments (´000COP)	% payments
Putumayo	4,930	48,141,344	15
Nariño	5,337	44,845,772	14
Antioquia	5,609	44,353,857	14
Tolima	3,182	41,214,728	13
Bolivar	2,682	29,255,406	9
Huila	4,391	28,642,800	9
Madalena	1,571	16,090,335	5
Norte de Santander	2,051	12,306,600	4
Cauca	2,641	10,471,800	3
Choco	4,746	9,480,000	3
Caqueta	1,732	6,871,800	2
Guaviare	848	6,399,607	2
Cordoba	930	6,333,000	2
Boyaca	711	4,837,200	2
Arauca	1,012	3,517,200	1
Santander	2,667	511,800	0
Meta	946	268,200	0
Total COP	**45,986**	**313,541,450**	**100**
Total US$		**124,000**	

Source: PCI

Agricultural land and coca cultivation in Colombia, 2006



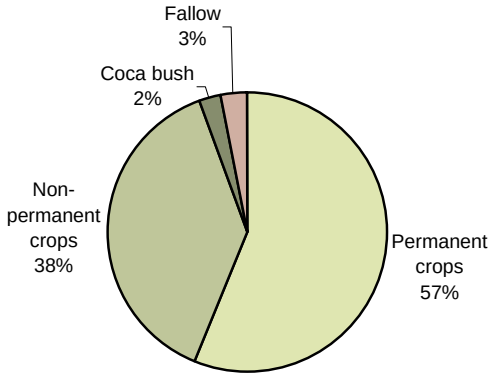
Source: Government of Colombia for Agricultural land - National monitoring system supported by UNODC for coca cultivation.
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Land use and coca cultivation

By combining the coca field maps with a recent land use map and statistics from the Multitemporal Analysis it is proven that coca crops are increasingly planted in forest-free areas. In the period 2000-2001, 55,000 hectares of forests were cleared for coca cropping, while only 8,332 hectares were deforested in the period 2005-2006 for the same purpose[8]. A possible explanation is that the felling of forests results is too costly. There is also a trend towards stabilization of nuclei of land with coca crops in the last years since in 2006 no new nuclei were detected. The land use analysis also shows that between 2000 and 2006, coca bushes were planted at a distance of approximately 25 km from urban areas while in 2006 the distance decreased to 20 km.

Recent trends show changes in the ownership of coca crops; the owners are no longer "colonos" but land tenants in 74% of the cases. The stabilization of coca fields is reflected in this consolidation of land tenure, while mobilization basically affects "raspachines" or leaf pickers who move from one region to another, according to coca productive phases.

Figure 13: Coca cultivation area as % of agricultural land



Source: Government of Colombia for agricultural land

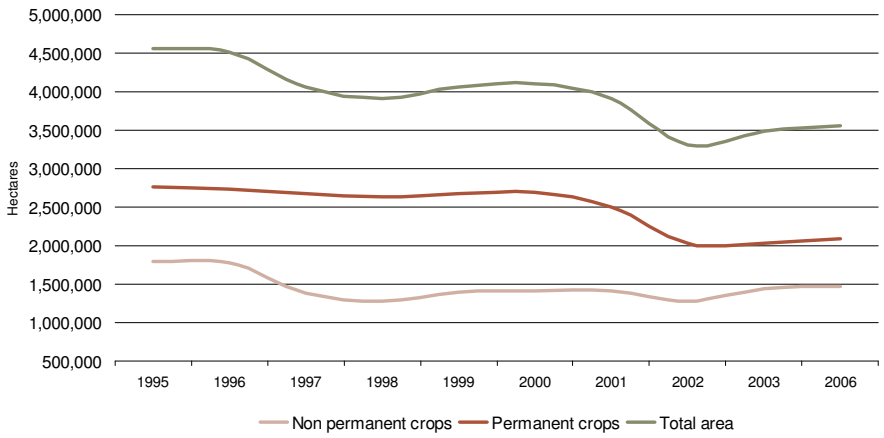
According to the Colombian Ministry of Environment, identification of agricultural and colonization lands in 2003, 32% of coca crops fall within the agricultural area, 14% in colonization area and the remaining 44% in forest areas, as seen on map 19.

The coca cultivation area in Colombia is estimated at 0.2% of the total area used for livestock and agricultural purposes, or 2% of the total area for agricultural exploitation[9]. Nevertheless, the impact of coca crops on the local economy is enormous and coca cultivation has become an alternative of income in zones affected with low profitability and lack of marketing possibilities for licit products.

[8] The figure refers to the area that passed from forest to coca but it does not include indirect effects caused by coca crops to deforestation. Source: SIMCI, Multi-temporal analysis, years 2005-2006

[9] According to the ENA 2006, there are 42 million hectares in use for agricultural and livestock purposes in Colombia.

Figure 14: Crop area of licit cultivation



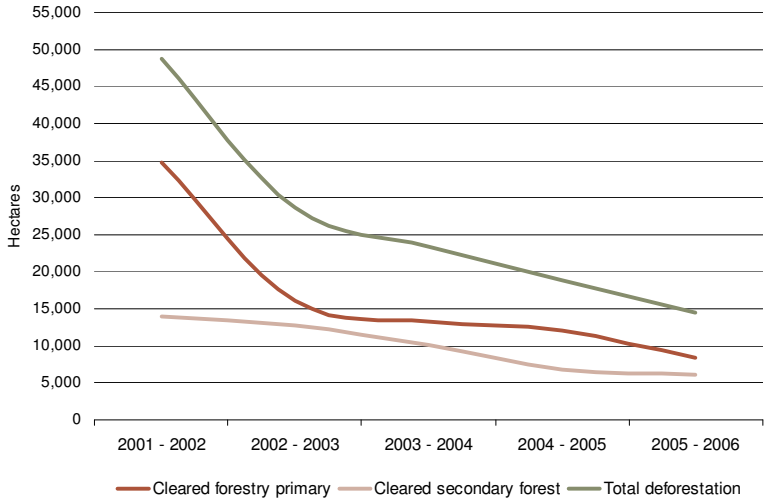
Source: Government of Colombia

The area for agricultural use in Colombia decreased by 22% in the period 1995-2006, passing from 4,565,644 to 3,556,000 hectares[10]. There is a trend to increasing pasture areas while reducing agricultural ones, although pastures are not always associated with livestock activities.

The livestock activity shows less dynamism in comparison to other sectors of the economy since it only grew 3.1% during the same period. This is reflected in the income of the rural population. Although rural poverty shows a substantial reduction, passing from 75% to 68% in the period 2002-2006, most of the population in conditions of poverty and extreme poverty live in rural areas.

In general, coca growers have coca crops as their sole source of income; they only dedicate 6% of their farms to licit crops, while is common to find shrubs in 16 % of their land**.**

Figure 15: Forest felling replaced by coca cultivation



[10] According to ENA 2006, land suitable for agricultural and livestock use in Colombia corresponds to 37% of the total area of Colombia. Out if this, only 7% is suitable for agricultural use and 76% for livestock use.

Coca cultivation in coffee plantation areas in Colombia, 2006

Source: Government of Colombia - National monitoring system supported by UNODC. For Coffee plantation areas: Colombian National Coffee Growers Federation

Coca cultivation in coffee plantation areas

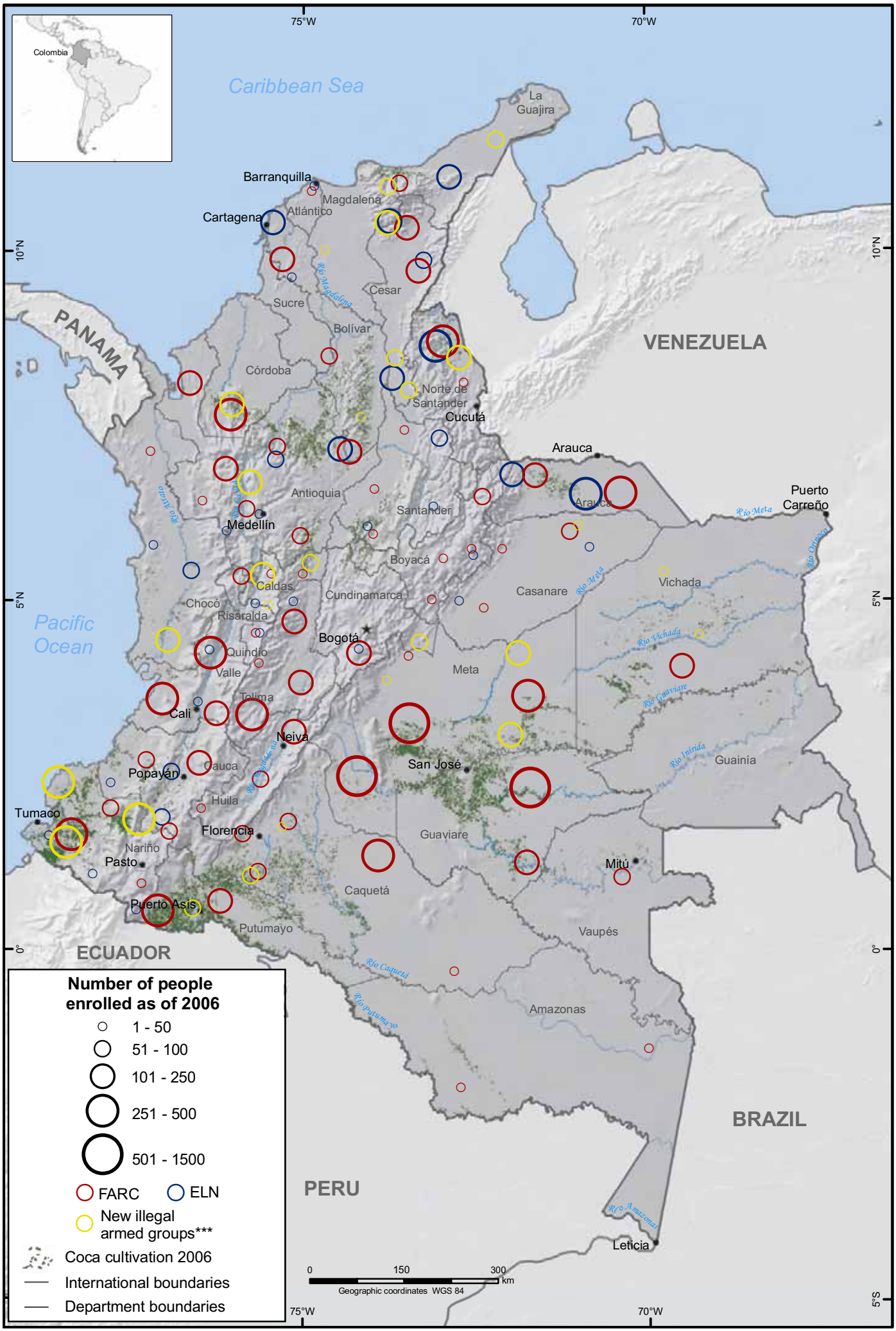
In Colombia, coffee cultivation is the most important agricultural product and there is a national concern about the possible penetration of illicit coca crops in territories ecologically suitable for coffee cultivation (*ecotopos*) with the subsequent impact on the agricultural economy of Colombia.

Though the amount of coca cultivation in coffee lands reaches only 0.8% of total coca crops (660 hectares) this situation represents an early alert to intensify the implementation of prevention and forced or voluntary eradication projects.

Table 33. Coca cultivation in coffee plantation areas

Department	Coffee cultivation area (hectares)	Coca cultivation area (hectares)
Antioquia	1,205,099	165
Boyaca	324,190	29
Caldas	257,571	49
Caqueta	196,509	26
Cauca	668,825	155
Cundinamarca	471,077	0.4
La Guajira	118,228	38
Magdalena	157,621	18
Nariño	154,046	116
Norte de Santander	475,130	25
Santander	624,649	38
Total	**4,652,945**	**659**

Illegal armed groups and coca cultivation in Colombia, 2006



Sources: for coca cultivation Government of Colombia - National monitoring system supported by UNODC; for number of persons enrolled in armed groups Ministry of defence
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations
*** The illegal armed group AUC demobilized in November 2003. The OAS declared that after demobilization the following new illegal armed groups appear: a) Remobilization of some groups b) bastions of non demobilized c) New armed groups of strenghtening or existent ones. Source: 6th OAS report, February 2006.

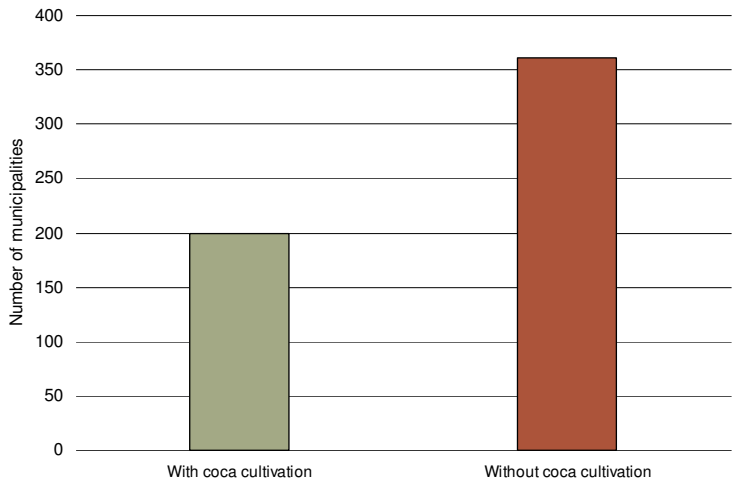
Armed groups and coca cultivation

Although not directly involved in coca cultivation per se, illegal armed groups controlled the business and prices of coca leaf and their derivates offered to the coca farmers. It is extremely difficult to know which of the links in the chain of the cocaine business of production and sale are managed by these groups, but it is well known that the illegal armed groups guarantee territorial control.

According to Government sources, in 2006, there were around 15,100 people enrolled in illegal armed groups (Revolutionary Armed Forces of Colombia- FARC- and National Liberation Army-ELN-) distributed over 561 municipalities (200 of which have illicit coca crops). The FARC group is present in 428 of these municipalities (128 of them have illicit coca crops) and the ELN is present in 228 municipalities (63 with coca crops). In some of them the presence of both groups has been reported.

The United Auto-Defense of Colombia-AUC- started a process of demobilization in 2003, but the OAS and the security agencies of Colombia reported the emergence of new groups or gangs that control some communities and the illicit economy. The OAS[11] reported that these illegal armed structures in Norte de Santander, Nariño, Cordoba, Guajira, Meta, Bolivar, Valle and Choco departments are still involved in narco-trafficking activities, and included about 3,080 people in 19 departments and 98 municipalities (40 of them with coca crops).

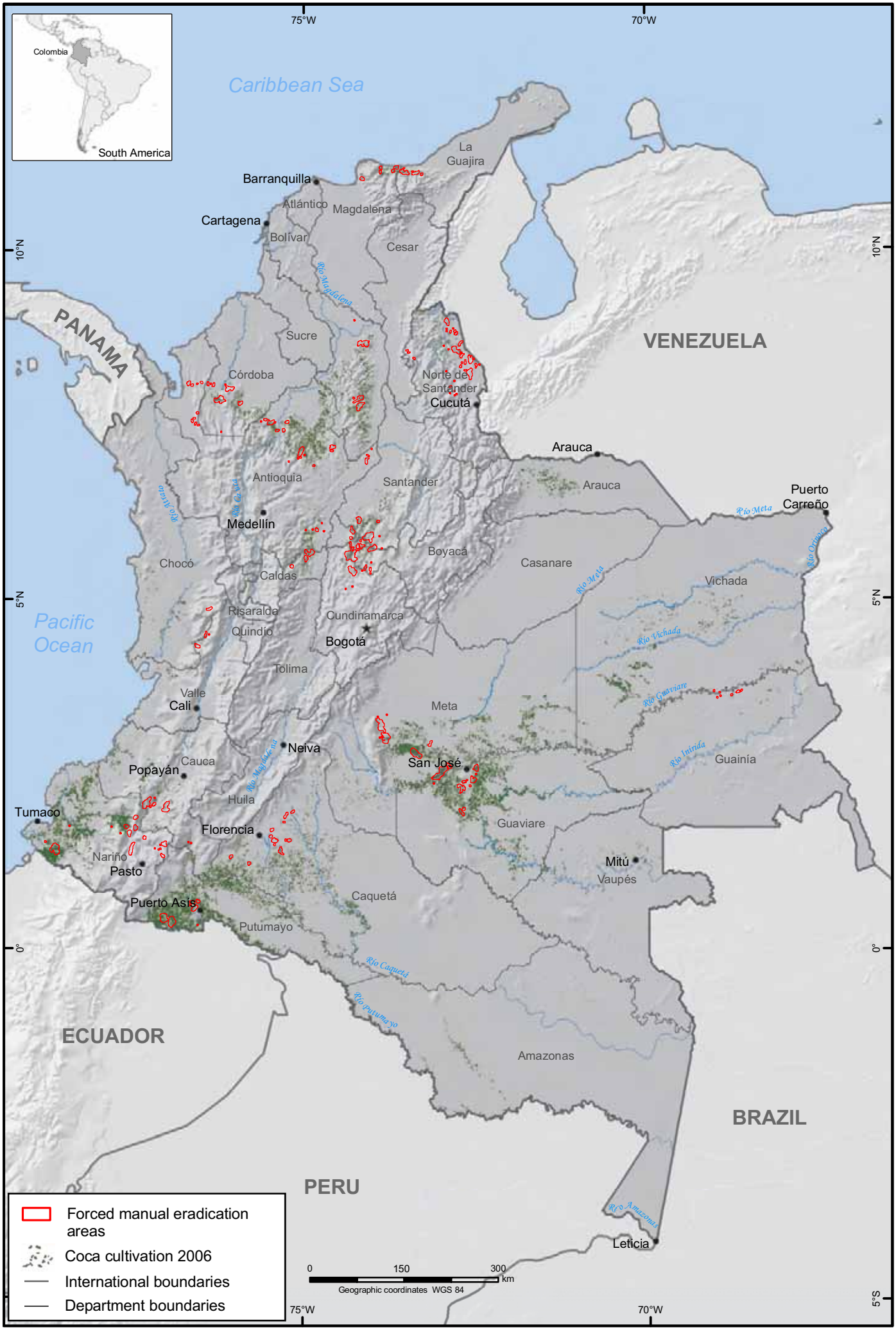
Figure 16: Number of municipalities with presence of illicit armed groups.



Source: Ministry of Defense

[11] Sixth and Seventh Report of the OAS General Secretary about the Support Mission to the Peace Process in Colombia, February 16 and August 30, 2006.

Forced manual eradication and coca cultivation in Colombia, 2006



Sources: for coca cultivation Government of Colombia - National monitoring system supported by UNODC; for manual eradication areas PCI
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

2.6 SUPPLY REDUCTION

Reported forced manual eradication

For the third consecutive year, forced manual eradication increased again in 2006 and summed up to 41,346 hectares. This was an increase of 32% compared to 2005 (31,285 hectares). The eradication activities have been extended to 20 departments (17 in 2005) and 85 municipalities (21 in 2005). About half of the total eradicated area is located in 4 departments: Nariño, Meta, Putumayo and Cauca.

Forced manual eradication is the responsibility of the Presidential Agency for Social Action, and is executed by Mobile Eradication Groups-GME- that consist of farmers and ex- illegal armed group members with the help of the Anti Narcotics Police (DIRAN) and the army. In addition, the national police implemented an institutional plan "Everybody against coca", by which police departments are instructed to assist in the manual eradication programmes.

In 2006, UNODC has monitored and verified the manually eradicated fields on a sample base, but this was recently extended to 100% verification.

Table 34. Reported forced manual eradication of coca areas, by department, 2006

Department	Manual Eradication by GME (hectares)	Manual Eradication by the Police (hectares)	Total (hectares)	Share %
Amazonas	-	15	15	0.04
Antioquia	2,506	640	3,146	7.6
Arauca	-	362	362	0.9
Bolivar	1,819	132	1,952	4.7
Boyaca	1,389	508	1,897	4.6
Caldas	521	31	552	1.3
Caqueta	1,028	263	1,291	3.1
Cauca	4,090	85	4,174	10.1
Casanare	-	3	3	0.01
Cesar	-	15	15	0.04
Choco	181	422	603	1.5
Cordoba	2,052	90	2,142	5.2
Cundinamarca	668	74	742	1.8
Guainia	193	111	303	0.7
Guajira	671	8	679	1.6
Guaviare	843	260	1,103	2.7
Huila	-	10	10	0.02
Magdalena	463	10	473	1.1
Meta	5,170	6	5,176	12.5
Nariño	6,132	873	7,005	16.9
Norte de Santander	1,509	139	1,648	4
Putumayo	4,969	149	5,118	12.4
Santander	1,388	1,242	2,630	6.4
Sucre	-	4	4	0.01
Tolima	-	16	16	0.04
Valle	364	63	427	0.6
Vichada	-	44	44	0.1
Total	**35,956**	**5,575**	**41,530**	100

Sources: PCI- Social Action, National Police

Manual eradication has a major impact on coca production since the bushes are completely uprooted. Replanting means significant costs for the farmer since it takes about 8 months between planting and the

first harvest, moreover with low productivity in the initial stage. However, in some eradicated areas, replanting and new coca plantations have been observed and UNODC recommends in its eradication report[12] to accompany eradication with alternative production projects.

Table 35. Analysis of replanting in forced manual eradicated coca areas by GME

Nucleus	Reported eradication	Without replanting	%	Replanted	%	Erased or not identified	%	Without info	%
Amazonia	194	101	52	31	16	38	20	24	12
Centro	11,852	7,381	62	550	5	930	8	2,991	25
Meta - Guaviare	6,013	3,139	52	1,624	27	0	0	1,250	21
Pacìfic	10,586	6,039	56	640	6	2,455	23	1,632	15
Putumayo - Caqueta	5,998	4,871	81	863	14	0	0	264	5
Sierra Nevada	1,132	713	63	157	14	0	0	262	23
TOTAL	**35,955**	**22,244**	**62**	**3,865**	**11**	**3,423**	**9**	**6,423**	**18**

Source: PCI,UNODC

The behavior of the replanting activities of coca farmers in forced eradicated areas was measured by the overlay of coca cultivation and GME reported coordinates on eradication, considering the dates of image acquisition and eradication. This comparison showed that 73% of the total eradicated area (26,109 hectares) was useful to perform the assessment of replanting; 3,423 hectares (10%) were erased because eradication took place after the date of the image and 18% were covered by clouds or gaps.

The analysis showed that 3,865 hectares (15%) were replanted in the same field whereas 22,244 hectares (85%) have no evidence of being replanted. However, 10,283 hectares of this last group were eradicated a few months before the date of acquisition of the images , which causes some uncertainty about the replanting.

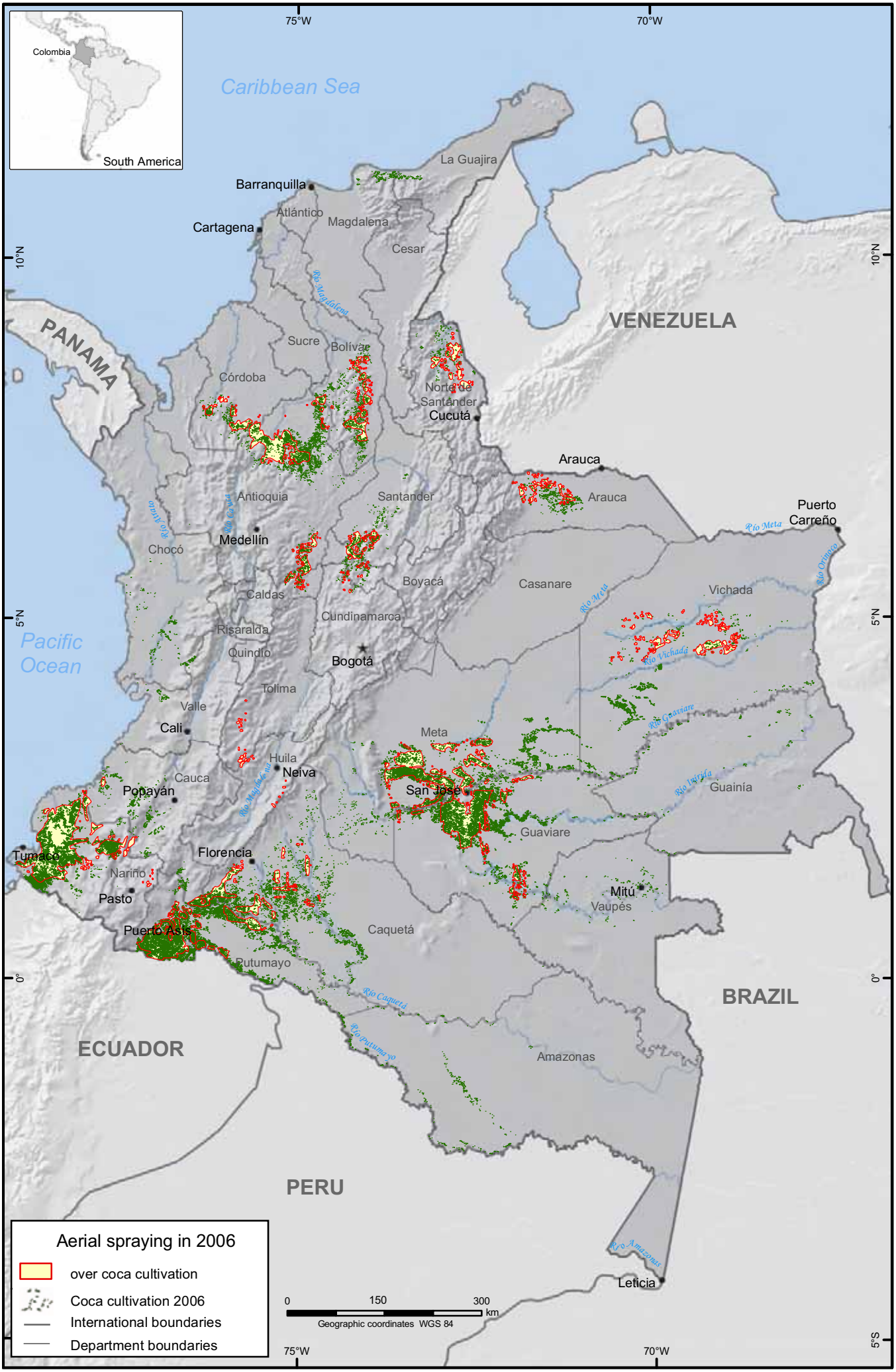
Table 36. Reported forced manual eradication of opium poppy cultivation by department, 2006

Department	Manual eradication by GME (hectares)	Manual eradication by the Police (hectares)	Total (hectares)	Participation %
Antioquia		12	12	1%
Cauca	1	799	800	47%
Huila	170		170	10%
Nariño	167	550	717	42%
Total	**338**	**1,360**	**1,698**	**100%**

Source: PCI,UNODC and National Police.

[12] *Report on monitoring and assessment of the manual eradication conducted in 2006 (GME)*

Aerial spraying and coca cultivation in Colombia, 2006



Sources: for coca cultivation Government of Colombia, National monitoring system supported by UNODC; for aerial spraying DIRAN
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Reported aerial spraying

The Colombian anti-drugs strategy includes a number of measures ranging from aerial spraying, to forced or voluntary manual eradication, including alternative development and crops substitution programmes. UNODC did not participate in or supervise the spraying activities. All data were received directly from the Antinarcotics Police –DIRAN-.

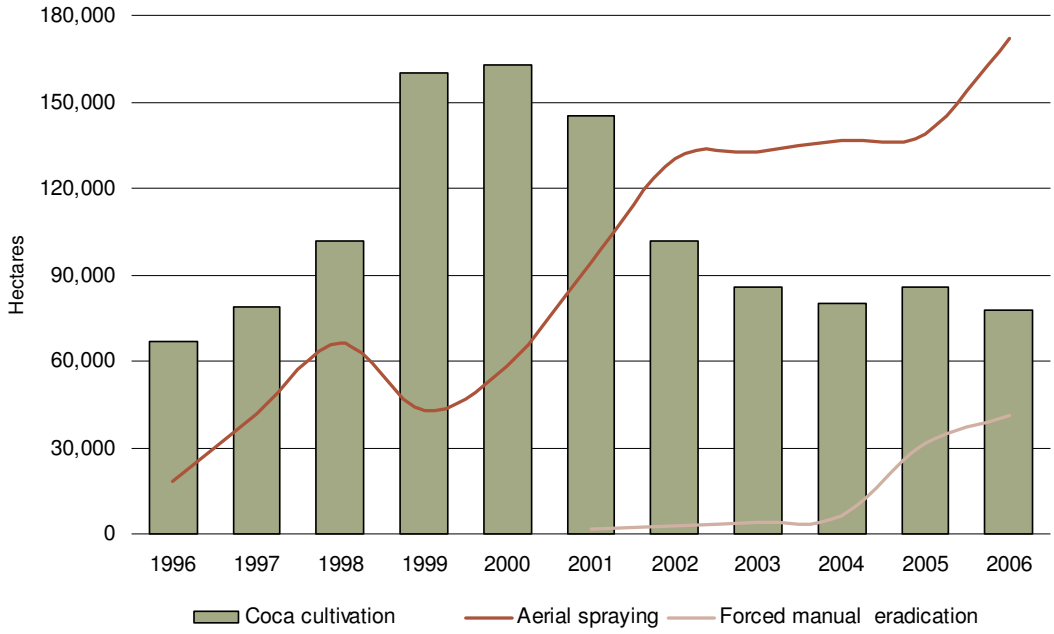
The spraying programme carried out by DIRAN is realized through aerial spraying with a mixture of products called Round up – composed of an herbicide called glyphosate - and a surfactant called Cosmoflux and other additives. In late 2002, the National Narcotics Council approved an herbicide concentration of 2.5 litres per hectare for opium poppy and 10.4 litres per hectare for coca, with a view to increase the spraying effectiveness rate, which was reported to be 91% in 2004. The chemical mixture affects the leaves and not the roots or the soil, and therefore the bush can be pruned at about one feet above the ground to obtain a renewal of the bush in about six months. In 2006, the spraying effectiveness rate was estimated by the Government as being 88 %.

The Illicit Crop Eradication Programme foresees an Environmental Management Plan and environmental auditing, as well as periodic verifications on the ground of the effectiveness of spraying activities and their environmental impact. The Ministry of Environment certified in July 2004 to the "Eradication of Illicit Crops Programme by Aerial Spraying with Glyphosate", the observance of the environmental obligations required in the Management Plan. In 2006, the government of Colombia authorized the aerial spraying of 2,090 hectares of coca cultivation into the National Natural Park Sierra La Macarena.

Reports from DIRAN showed that, for the sixth consecutive time, spraying activities reached record level in 2006. The DIRAN sprayed a total of 172,025 hectares, representing an increase of 24% compared to last year aerial spraying levels. 50% of spraying activities were implemented in the departments of Putumayo, Meta, Antioquia and Guaviare. In the department of Nariño, 59,865 hectares (or 35%) of coca cultivation were sprayed although the potential production of cocaine of Nariño is the lowest in the country. On the other hand, 25,195 hectares (or 15%) of coca cultivation were sprayed in the department of Meta, which has the highest cocaine productivity rates in Colombia. The Government also reported the aerial spraying of 231 hectares and the manual eradication of opium poppy cultivation.

Aerial sprayed coca fields.

Figure 17: Comparison of net coca cultivation and cumulative sprayed and eradicated areas (in hectares)



The cumulative sprayed area is the sum of areas during a given time period (calculated by multiplying the length of flight lines by their width), and it differs from the effective sprayed area, which disregards the overlap between adjacent sprayed bands and areas sprayed several times in the same calendar year.

Forced manual eradication. Source: UNODC.

Table 37. Reported aerial spraying of coca cultivation in Colombia, by department and year (in ha)

Sources	Environmental Audit of the National Narcotics Bureau		Antinarcotics Police Department						
Department	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Guaviare	37,081	17,376	8,241	7,477	7,207	37,493	30,892	11,865	14,714
Meta	5,920	2,296	1,345	3,251	1,496	6,973	3,888	14,453	25,915
Caquetá	18,433	15,656	9,172	17,252	18,567	1,059	16,276	5,452	4,575
Putumayo	3,949	4,980	13,508	32,506	71,891	8,342	17,524	11,763	26,491
Vichada	297	91	-	2,820	-	-	1,446	-	5,485
Antioquia	-	-	6,259	-	3,321	9,835	11,048	16,833	18,022
Córdoba	-	-	-	-	734	550	-	1,767	5,588
Vaupés	349	-	-	-	-	-	756	340	-
Cauca	-	2,713	2,950	741	-	1,308	1,811	3,292	1,536
N. Santander	-	-	9,584	10,308	9,186	13,822	5,686	899	1,687
Nariño	-	-	6,442	8,216	17,962	36,910	31,307	57,630	59,865
Santander	-	-	470	-	-	5	1,855	2,042	2,146
Boyacá	-	-	102	-	-	-	-	925	831
Bolívar	-	-	-	11,581	-	4,783	6,456	6,409	2,662
Arauca	-	-	-	-	-	11,734	5,336	2,584	1,400
Magdalena	-	-	-	-	-	-	1,632	383	-
Guajira	-	-	-	-	-	-	449	572	-
Caldas	-	-	-	-	-	-	190	1,090	1,068
Valle	-	-	-	-	-	-	-	5	-
Chocó	-	-	-	-	-	-	-	425	-
Cundinamarca	-	-	-	-	-	-	-	43	41
Total	**66,029**	**43,111**	**58,073**	**95,898**	**133,116**	**136,828**	**139,141**	**138,772**	**172,025**
Net cultivation	102,000	160,000	163,000	145,000	102,000	86,000	80,000	86,000	78,000

Source: DIRAN

Once coca fields are sprayed, it takes approximately six to eight months to recover productive crops when the bushes are pruned or replanted. However, when heavy rain occurs or bushes are washed by the farmers immediately after the spraying, the loss in coca leaf can be reduced and the crop recovers quickly. The sustainability of the eradication efforts depends to a large extent on the real alternatives open to the farmers and to the displacement of the cultivation into new and more remote areas of the country (balloon effect).

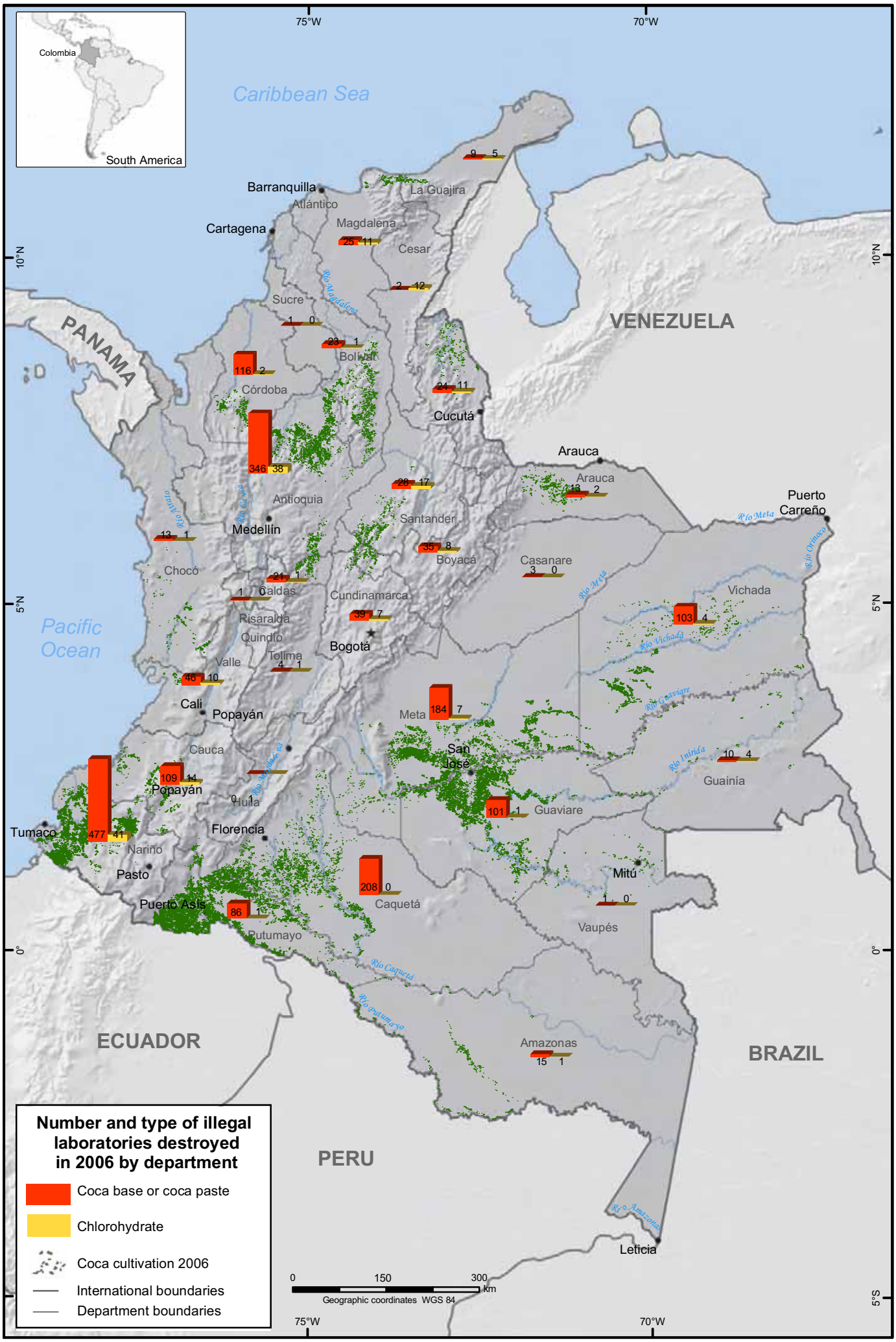
Table 38. Reported aerial spraying of opium poppy cultivation in Colombia, by department (in ha)

Dept	Aerial Spraying												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Tolima	40	41	48	-	-	-	-	-	-	-	-	-	**129**
Huila	53	25	-	-	-	-	-	-	-	-	-	-	**78**
Nariño	6	18	-	-	-	-	-	-	-	-	-	-	**25**
Total	**99**	**85**	**48**	-	-	-	-	-	-	-	-	-	**231**

Source: DIRAN

In order to neutralize or reduce the impact of the aerial spraying, several actions are taken by the farmers such as: to plant coca bushes interspersed with other plants, to apply protective substances on leaves, to wash the leaves, to reduce the size of the fields, to rotate coca crops with other licit crops in the same field, etc. The aerial spraying may cause the loss of one or more harvests, the reduction of productivity or the total loss of crops but it has become clear that the impact varies considerably from one region to another and that it is not the only cause for reduction or loss of coca crops.

Destruction of clandestine laboratories and coca cultivation in Colombia, 2006



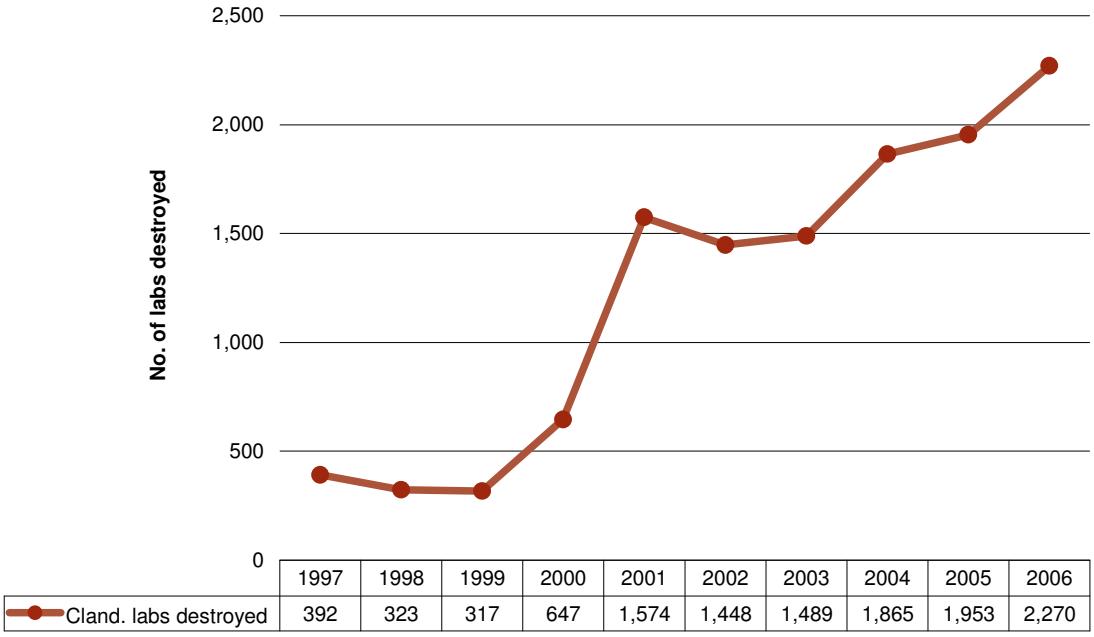
Source: Goverment of Colombia - National monitoring system supported by UNODC, for destruction of illegal laboratories: DNE

Reported seizures

UNODC is not involved in the collection of data on seizures and destruction of laboratories. However the data provided by the Colombian government are presented here to show the existence of possible trafficking corridors and allow for a better understanding of the dynamics that surrounds the drug business.

According to DNE, in 2006, a total of 2,270 clandestine laboratories were destroyed. Out of these, 2,045 laboratories processed coca paste or cocaine base, 202 cocaine hydrochloride, 15 potassium permanganate, and 7 heroin and 1 marihuana. Compared to 2005, this represented an increase of 16% in the number of illegal laboratories destroyed, demonstrating the high intensity of the actions taken by the Colombian Government against illicit drug production.

Figure 18: Number of clandestine laboratories destroyed, 1997-2006



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Cland. labs destroyed	392	323	317	647	1,574	1,448	1,489	1,865	1,953	2,270

Most of the laboratories for coca leaf processing (basic paste, cocaine base and cocaine) and also for potassium permanganate were detected and destroyed in the departments of Nariño and Antioquia, where 28% of coca crop cultivation was found. 50% of the laboratories were found in the Central Region[13], followed by the Pacific Region[14], which is strategically well located.

Illegal laboratory. Source: DIRAN.

[13] Central Region: Antioquia, Bolívar, Córdoba, Santander, Boyacá, Caldas, Cundinamarca, Tolima

[14] Pacific Region: Nariño, Cauca, Chocó y Valle.

Table 39. Illegal laboratories destroyed by department and by drug type

Department	Coca paste or cocaine base laboratories destroyed	Cocaine laboratories destroyed	Heroin laboratories destroyed	Marihuana	Permanganate of potassium laboratories destroyed	TOTAL
Nariño	477	41	7	-	8	533
Antioquia	346	38	-	-	4	388
Santander	28	17	-	-	1	46
Cauca	109	14	-	-	-	123
Cesar	2	12	-	-	-	14
Magdalena	25	11	-	-	-	36
Norte de	24	11	-	-	-	35
Valle	46	10	-	-	-	56
Boyaca	35	8	-	-	-	43
Cundinamarca	39	7	-	1	-	47
Meta	184	7	-	-	2	193
La-guajira	9	5	-	-	-	14
Guainia	10	4	-	-	-	14
Vichada	103	4	-	-	-	107
Arauca	13	2	-	-	-	15
Bogota	1	2	-	-	-	3
Cordoba	116	2	-	-	-	118
Amazonas	15	1	-	-	-	16
Bolivar	23	1	-	-	-	24
Caldas	21	1	-	-	-	22
Choco	13	1	-	-	-	14
Guaviare	101	1	-	-	-	102
Putumayo	86	1	-	-	-	87
Tolima	4	1	-	-	-	5
Caqueta	208	-	-	-	-	208
Casanare	3	-	-	-	-	3
Huila	1	-	-	-	-	1
Risaralda	1	-	-	-	-	1
Sucre	1	-	-	-	-	1
Vaupes	1	-	-	-	-	1
Total	2,045	202	7	1	15	2,270

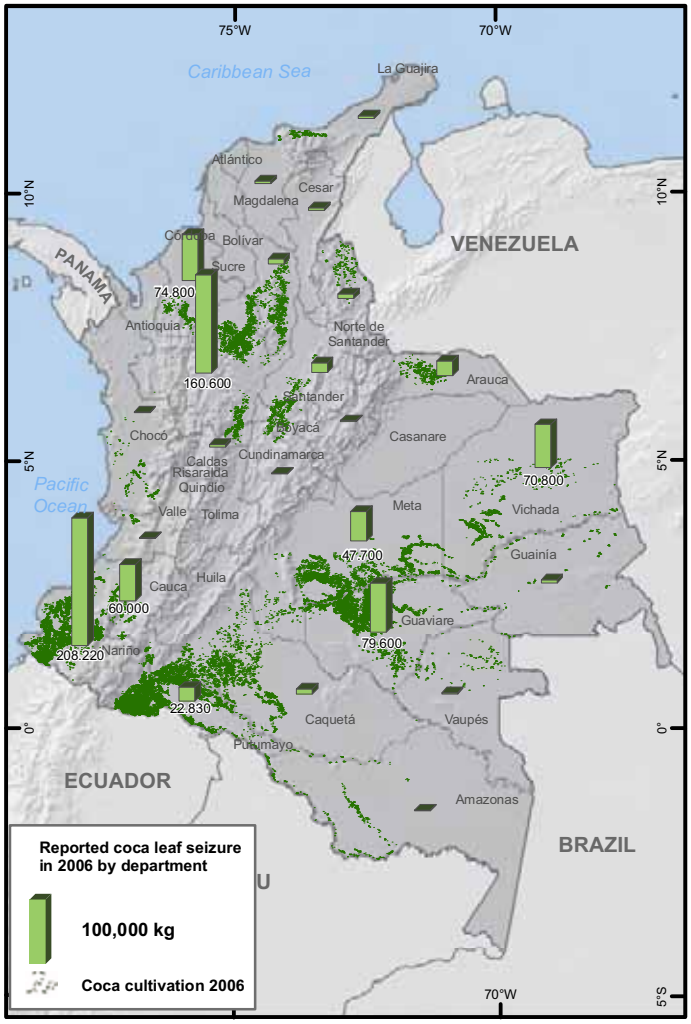
Source: DNE

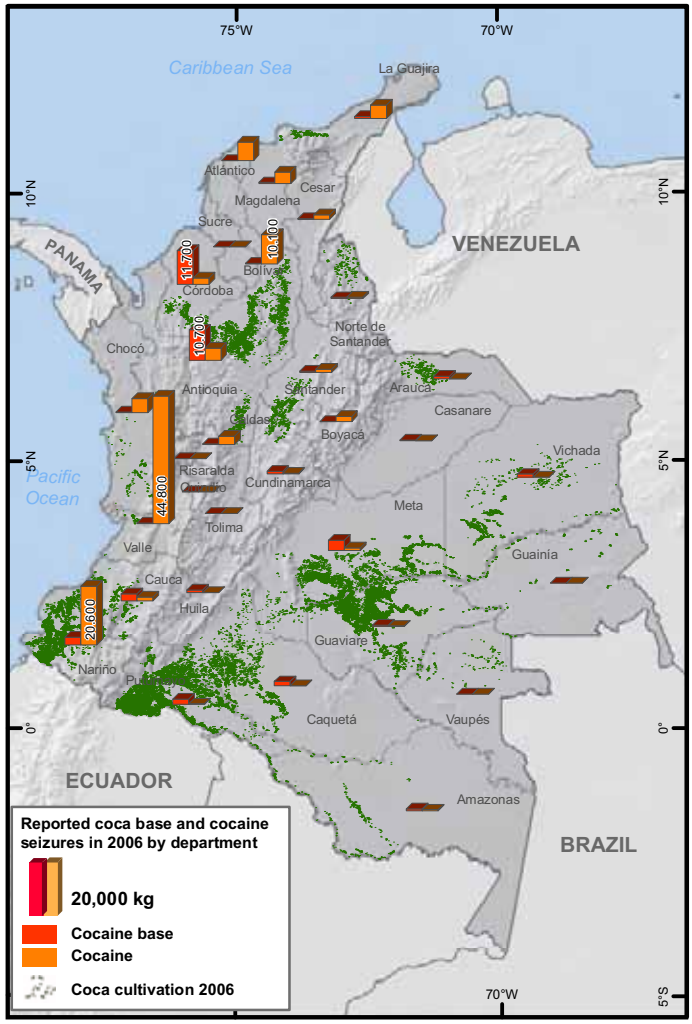
Data provided by National Narcotics Bureau –DNE- show a decrease of 27% from 2005 to 2006 in cocaine seizures from 173 mt to 127 mt. However, there were important increases in coca leaf and base or paste seizures (20% and 105%) and decreases in the rest of the drugs.

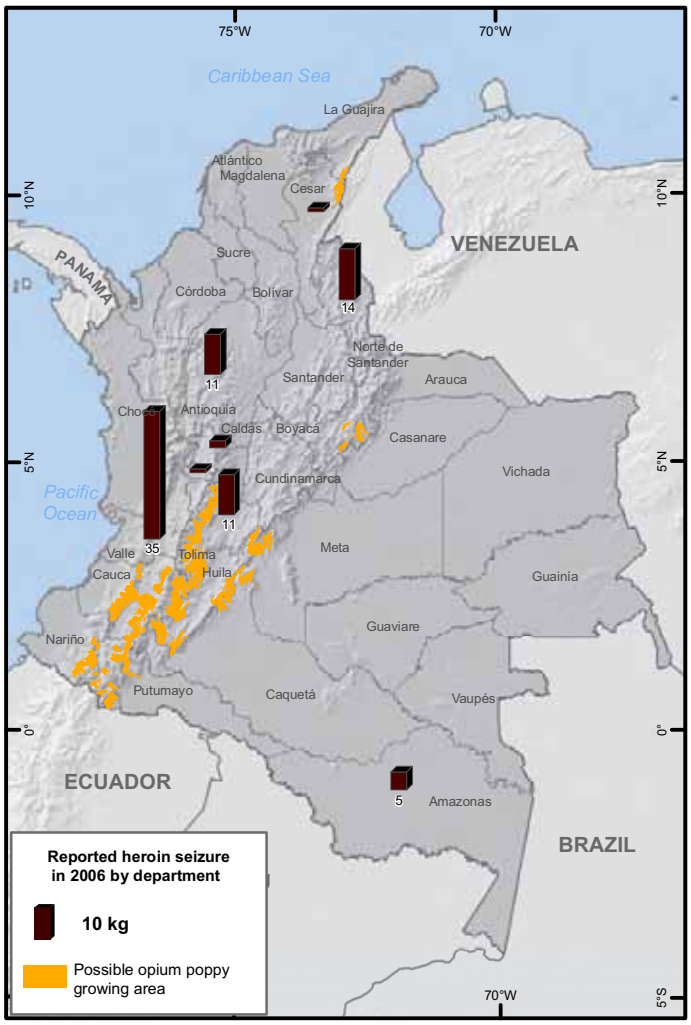
In the last three years, the departments of Valle del Cauca and Nariño have been the leaders in drug seizures with 51% of total due to their strategic locations for production and easy exportation to international markets. The Pacific Corridor continues to be the most commonly used route for drug transport (81% of seizures take place at sea).

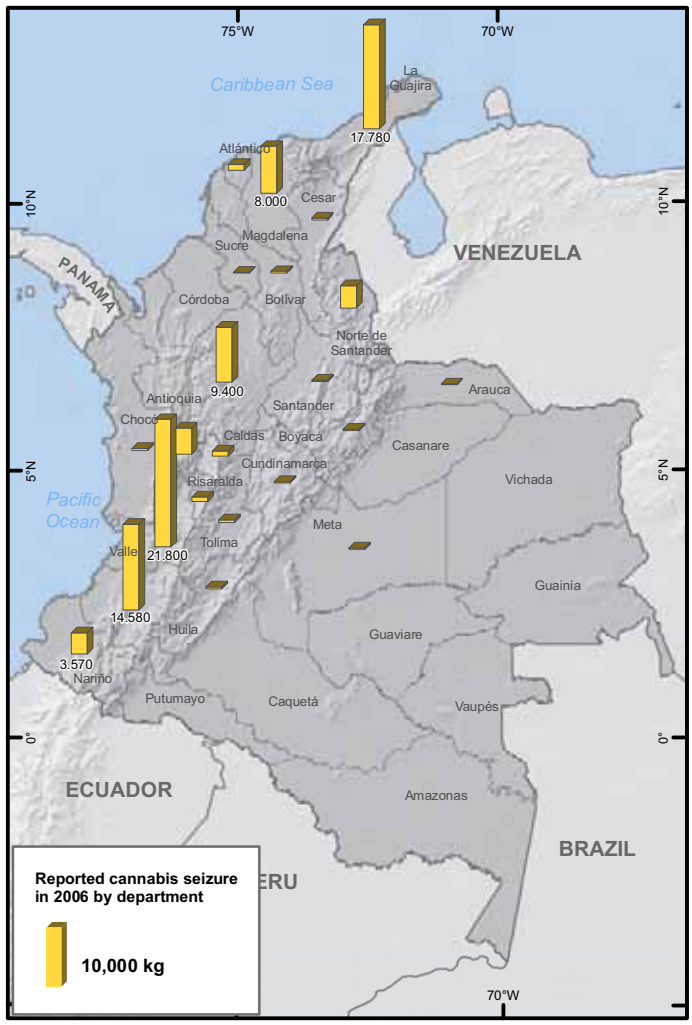
Heroine seizures decreased by 41% in relation to 2005. Most of them took place in Bogota and San Andres Island.

Drug seizures by department and by drug type, Colombia 2006









Source: Government of Colombia - National monitoring system supported by UNODC, for drug seizures: Colombia Drug Observatory DNE.
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

Table 40. Reported seizures of illicit drugs, 2001-2006

Drug	unit	2001	2002	2003	2004	2005	2006
Coca leaf	kg	583,165	638,000	688,691	567,638	682,010	818,544
Coca paste	kg	53	974	2,368	1,218	2,651	5,451
Cocaine base	kg	16,572	22,615	27,103	37,046	106,491	42,708
Basuco	kg	1,225	1,706	2,988	2,321	19,607	1,476
Cocaine hydrochloride	kg	57,140	95,278	113,142	149,297	173,265	127,326
Opium latex	kg	4	110	27	57	1,632	118
Morphine	kg	47	21	78	39	93	27
Heroin	kg	788	775	629	763	745	442
Raw cannabis	kg	86,610	76,998	108,942	151,163	150,795	93,745
Synthetic drugs	unit	22,750	175,382	5,042	19,494	-	-

Source: DNE

Table 41. Reported seizures of cocaine on the Pacific and Atlantic routes, 2002-2006

	2002	2003	2004	2005	2006	% seizures
Pacific	43,435	47,137	46,128	61,042	61,758	81%
Atlantic	16,065	23,157	30,928	35,856	14,150	19%
Total seized by sea	59,500	70,294	77,056	96,898	75,908	100%
Total seizures	95,278	113,142	149,297	173,265	127,326	
% of seizures	62%	62%	52%	56%	60%	

Source: Colombian Navy, Intelligence Division

Out of the total 127 mt of cocaine seized in 2006, 76 mt (or 60%) were seized at sea or in maritime ports, which leads to the conclusion that most of coca shipments are transported over sea.

Figure 19: Reported seizures of cocaine on the Pacific and Atlantic routes, 2002-2006

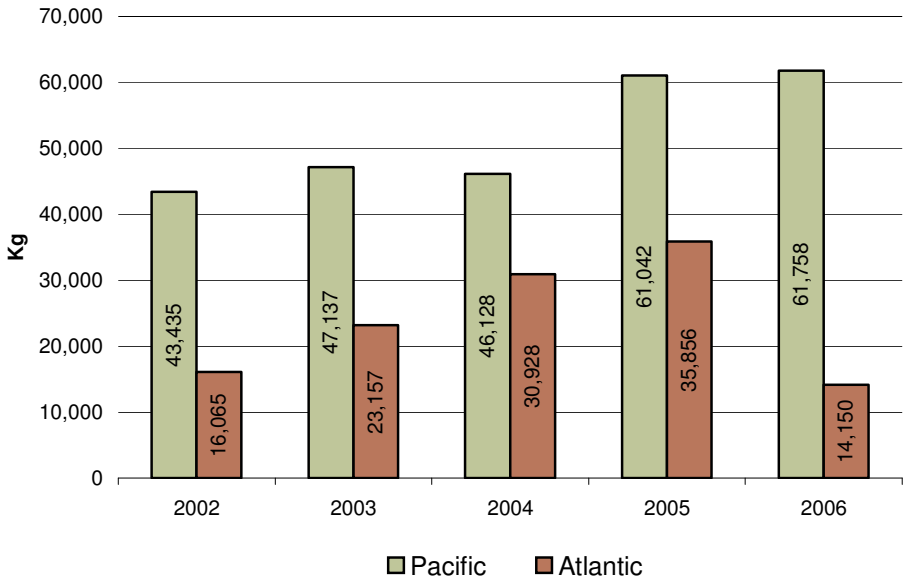


Table 42. Drug seizures by department and by drug type, 2006

Department	Coca leaf		Cocaine paste		Cocaine base		Basuco	Cocaine		Heroin	Morphine	Latex		Cannabis
	Kg	Gallon	Kg	Gallon	Kg	Gallon	Kg	Kg	Gallon	Kg	Kg	Kg	Gallon	Kg
Amazonas	800	200	1,013	-	693	-	2	303	-	5	-	-	-	40
Antioquia	160,558	220	459	-	10,681	11,866	172	4,341	3,542	11	-	-	-	9,471
Arauca	23,968	2,440	-	-	910	1,465	5	4	-	-	-	-	-	104
Atlantico	-	-	-	-	125	-	18	6,586	-	7	-	-	-	975
Bogota	-	-	43	-	42	-	230	6,635	-	175	-	-	-	3,759
Bolivar	7,794	-	6	-	196	440	18	10,166	351	28	-	-	-	297
Boyaca	1,489	165	15	-	74	43	8	1,744	107	-	-	-	-	168
Caldas	3,589	165	1	-	142	-	59	2,841	295	2	-	-	-	863
Caqueta	8,236	-	418	-	1,504	325	4	115	13	-	-	-	-	74
Casanare	-	-	-	-	212	-	3	111	-	-	-	-	-	15
Cauca	59,627	11,127	27	-	2,390	2,921	66	1,389	4,265	-	1	1	2,764	14,575
Cesar	4,892	325	-	-	109	2,110	5	1,506	-	1	-	1	-	290
Choco	1,400	-	-	-	215	25	18	5,060	15	34	-	-	-	350
Cordoba	74,809	-	23	-	11,767	3,701	42	2,223	-	-	-	-	-	98
Cundinamarca	1,653	100	-	-	904	952	69	262	1	-	-	-	-	250
Guainia	5,150	-	4	-	108	-	7	-	-	-	-	-	-	4
Guaviare	79,577	2,175	263	-	405	2,665	2	19	1,263	-	-	-	-	44
Huila	-	-	5	-	818	-	46	4	-	-	2	-	-	395
La Guajira	3,776	395	-	-	722	-	1	4,636	110	-	-	-	-	17,773
Magdalena	4,265	165	10	-	448	55	8	4,203	52	-	-	-	-	8,015
Meta	47,685	11,085	40	-	3,572	13,780	37	1,042	5,610	-	-	-	-	305
Nariño	208,219	32,338	2,811	100	2,743	4,151	14	20,611	1,830	8	20	115	-	3,570
N. de Santander	7,884	1,845	196	-	455	3,555	23	637	10	14	-	-	-	3,779
Putumayo	22,830	5,225	56	-	1,640	100	2	42	1,550	-	-	2	-	54
Quindio	-	-	-	-	21	-	16	15	-	-	-	-	-	751
Risaralda	-	-	-	-	94	-	44	61	-	1	-	-	-	4,434
San Andres	-	-	-	-	2	-	1	6,940	-	110	-	-	-	580
Santander	15,651	-	15	-	359	527	33	1,068	-	-	-	-	-	234
Sucre	-	-	-	-	13	-	6	4	-	-	-	-	-	155
Tolima	388	-	-	-	19	-	79	13	-	11	5	-	-	472
Valle del Cauca	790	1,400	-	-	264	55	437	44,741	165	35			-	21,841
Vaupes	2,750	-	-	-	23	-	0	-	-	-	-	-	-	-
Vichada	70,765	375	46	-	1,019	2,478	2	2	112	-	-	-	-	9
Grand Total	818,545	69,745	5,451	100	42,689	51,214	1,476	127,324	1,476	442	27	119	2,764	93,744

Source: DNE

3 METHODOLOGY

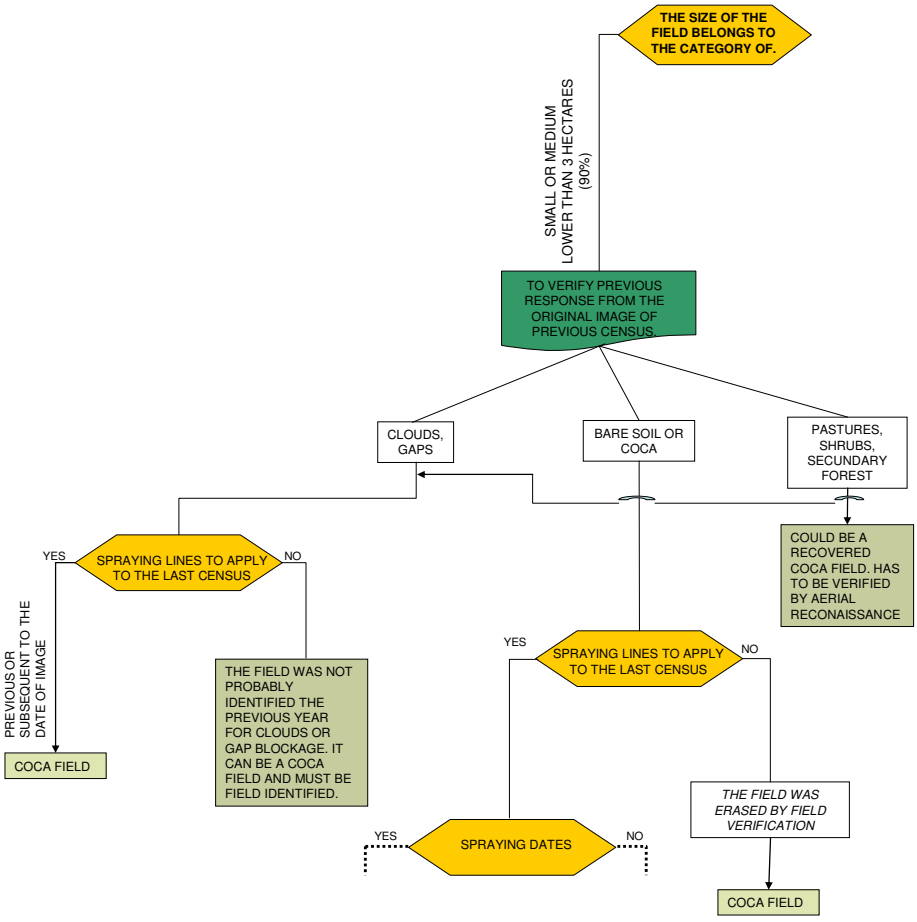
3.1 Coca cultivation

The monitoring of coca cultivation in Colombia is based on the interpretation of various types of satellite images. For the 2006 census, the project analyzed a total of 68 LANDSAT images, 17 ASTER images, 8 SPOT-4/5 images and 2 IRS images, acquired between August 2006 and February 2007. The images cover the whole national territory (excluding the islands of San Andres and Providence) equivalent to 1,142,000 square km.

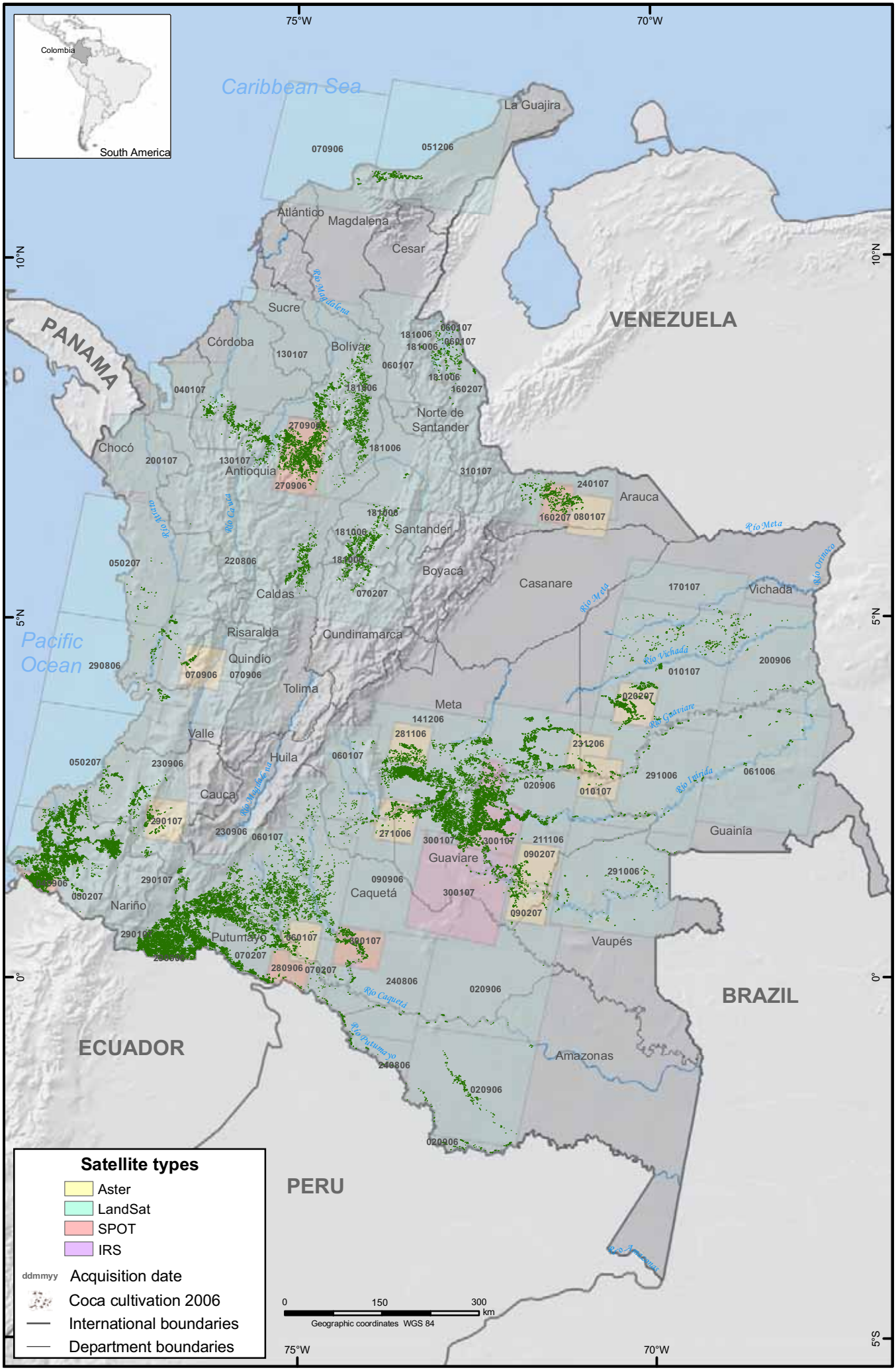
In September 2004, the Institute of Surveying, Remote Sensing and Land Information of the University of Natural Resources and Applied Life Sciences, Vienna (BOKU, Austria), conducted a technical evaluation of the methodology developed for the assessment of coca cultivation. The Institute concluded that the methodology is appropriate and commended the work of the remote sensing team performing the interpretation of the satellite images. The Institute also made some recommendations that will be addressed during the next survey, in particular the use of aerial photography for quality control.

The project staff continues working in the development of a decision tree for the interpretation of coca crops in satellite images with the support of the BOKU University. The identification of the different factors that determine the interpretation of the coca fields in two regions (Meta-Guaviare and Cauca-Nariño) as well as the decision tree with the data obtained is already finished.

Figure 20: Part of the decision tree designed for the interpretation key study



Satellite images used for the Colombian coca cultivation survey 2006



Source: Government of Colombia - National monitoring system supported by UNODC

The estimation of the total area under coca cultivation in Colombia in 2006 is the result of the following steps:

1) Identification and acquisition of satellite images

The survey relied mostly on Landsat 7 ETM+ images and to a lesser extent on ASTER SPOT- 4/5 and IRS images.

Table 43. Satellite images used for the 2006 survey in Colombia

Sensors	Total area (km²)	% of total
LandSat 7 ETM+	715,255	89%
ASTER	40,327	5%
SPOT 4	18,619	2%
IRS6 - LISS III	28,422	4%
Total	802,623	100%

One of the major difficulties in data acquisition is the frequent cloud cover over the Colombian territory. Therefore, satellite with a frequent view and a continuous recording of the area were favoured. The relatively low prices of Landsat 7 ETM+ and ASTER images also contributed to their larger selection than SPOT images.

Landsat 7 ETM+ data are collected in 6 spectral bands of 30 meter spatial resolution and an additional panchromatic band of 15 meter spatial resolution. The satellite has a 16-day repeat cycle, which enhances the chance for cloud free images. The swath width of 185 km is appropriate for regional studies. The project identified suitable images by consulting frequently the on-line catalogue of available Landsat 7 images at the US Geological Survey.

As of May 2003, the Scan Line Corrector (SLC) of the Landsat 7 ETM+ instrument failed. This malfunction is leading to gaps in the image, gradually diminishing towards the centre of a scene. The assessment of coca cultivation under these gaps (without information) is described in the below section on correction. For future surveys gap-filled products or Landsat 5 data may be used, if available.

ASTER images consist of 14 spectral bands with a spatial resolution ranging from 15 to 90 meters. The monitoring of vegetation covers relies mostly on the spectral bands 1, 2 and 3 with a pixel size of 15 meters and bands 4,5,6,7,8 and 9 with a pixel size of 30 meters. The swath width of 60 Km requires the acquisition of more images than with Landsat 7 ETM+ to cover equivalent area. About 500 ASTER images would be needed to cover the entire country.

SPOT 4 or 5 has a spatial resolution of 20 meter and a swath width of 60 km. About 500 SPOT images would be necessary to cover the entire country.

IRS Images of the spectral sensor LIS III on board of the Resourcesat-1 have four bands and a spatial resolution of 25 meters with a swath width of 141 km. They are comparable with Spot in spectral resolution and with Landsat in the area covered by one image.

2) Spatial Information Data Base -BIE- (www.biesimci.org)

The BIE is an infrastructure of spatial data that aims to guarantee the knowledge and access of anyone to the spatial information gathered by SIMCI, framed into the recommendations of the United Nations Seventh Regional Cartographic Conference for the Americas, held in New York in September 1999.

The BIE is divided into five sections: Satellite Data, Thematic Cartography, Altimetry Cartography, Illicit Crops Spatial Data and Documents. It may be consulted at the web page of UNODC Colombia shown in the last page of this report.

3) Image pre-processing

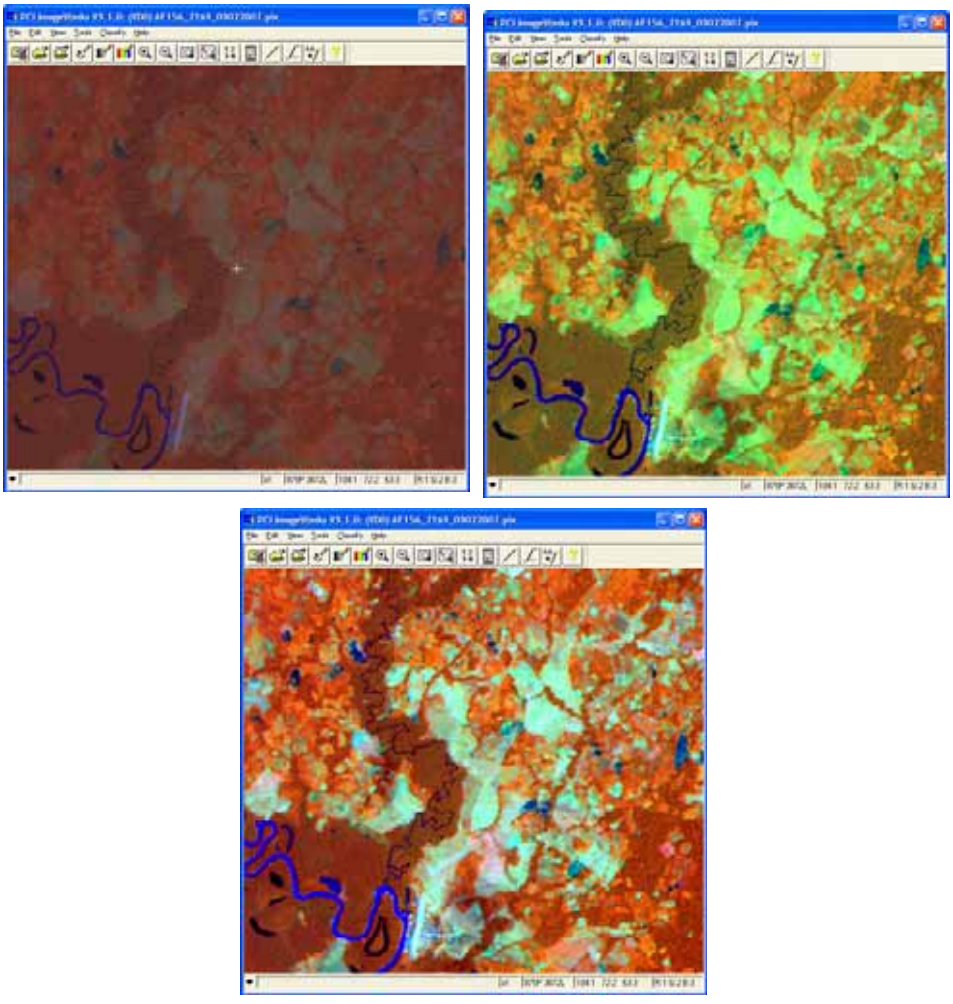
Geo-referencing

In order to use image datasets in conjunction with other spatial data available (e.g. digital elevation model), it is necessary to align the image data to the same map coordinate system. The satellite images are geo-referenced on the basis of mosaics built with geo-referenced images with the less cloud coverage used in previous census. The Digital Terrain Model –DTM- from the Space Shuttle Radar Mission was used for spatial enhancements.

Radiometric and spatial enhancements

To improve the visual and supervised interpretation process, various radiometric enhancements (color or spectral) are applied to enhance the contrast of the image.

Example of radiometric enhancement

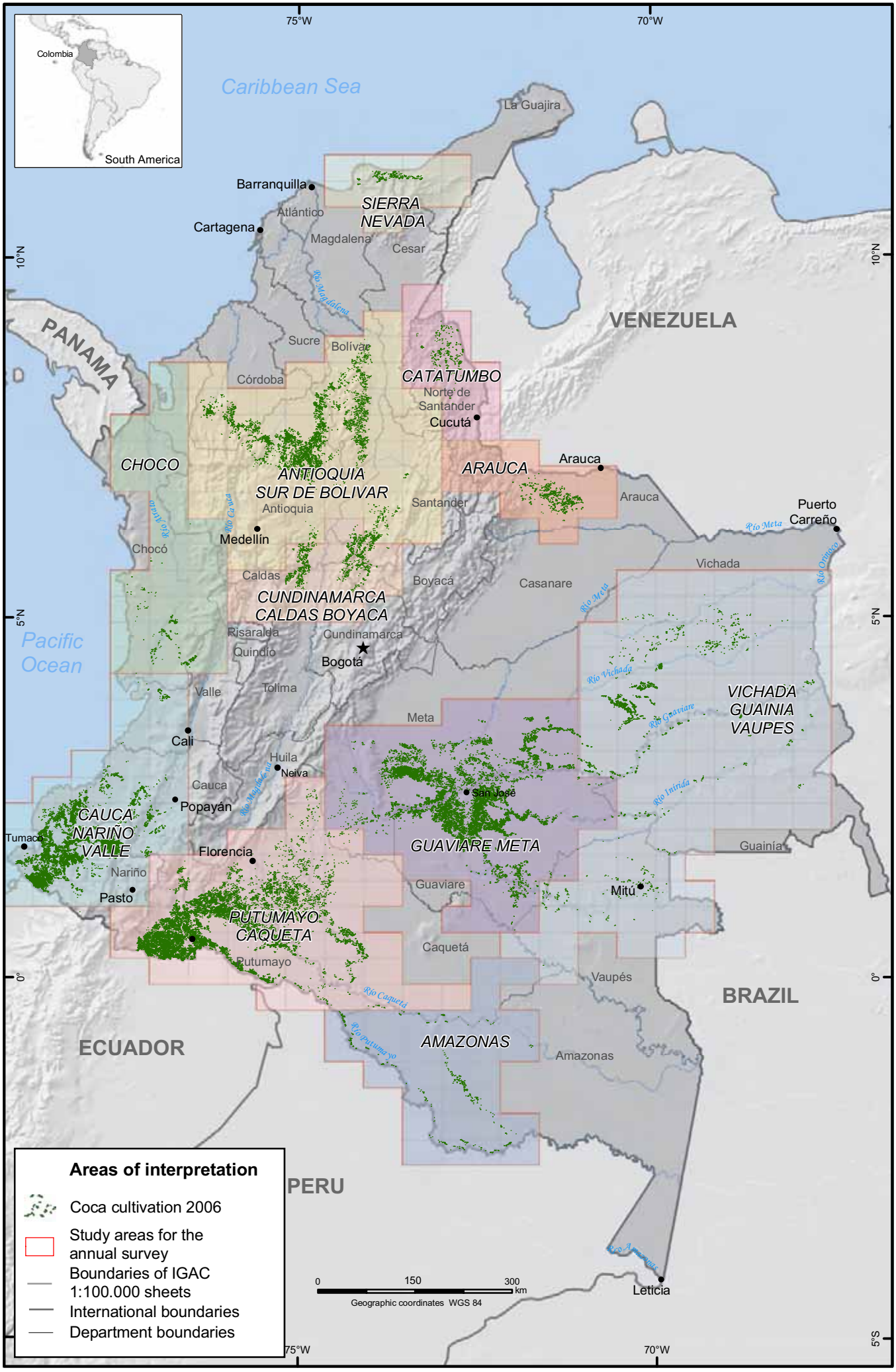


To enhance the spatial characteristics of an image various filters that modified the value of a pixel using the values of surrounding pixels, were used.

Band combinations

To allow an easy interpretation of the displayed image, it is possible to assign which band is displayed with which colour.

Study area distributed by region and coca cultivation in Colombia, 2006

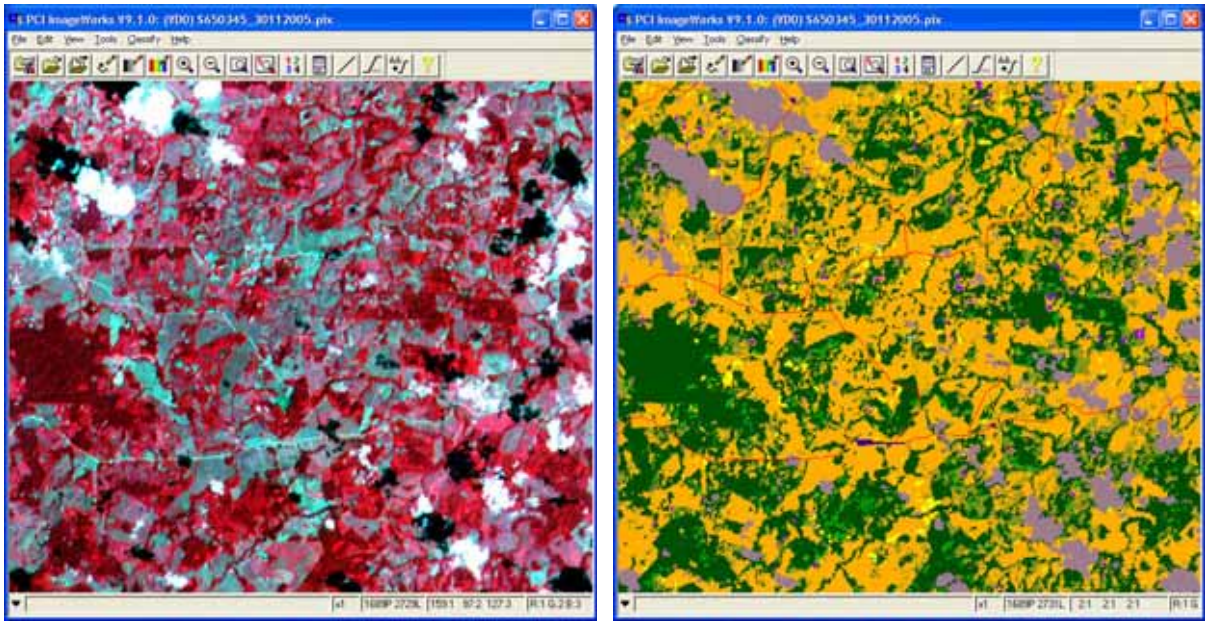


Sources: for coca cultivation Government of Colombia - National monitoring system supported by UNODC; for boundaries of 1:100.000 sheets IGAC
The boundaries and names shown and the designations used in this map do not imply official endorsement or acceptance by the United Nations

4) Digital land cover classification of land use and vegetation

One of the difficulties for an automatic or supervised classification of vegetation in Colombia is the absence of well defined crop calendar. Most crops, including coca, are cultivated throughout the year. This makes it difficult to separate coca from other crops based on phenological differences. The automatic land cover classification is not used to detect coca cultivation, but rather to study broadly the various land cover present on an image.

The project performed a supervised classification, where training areas represent the features to be mapped in advance and class signatures are calculated. Each pixel is then assigned to a land cover class depending on an algorithm. In this case, based on the maximum likelihood algorithm, 18 land cover classes are classified within each image: primary forest and rainforest, secondary forest and shrubs, grassland and shrubs, water bodies, sand banks, clouds and shadows, roads, urban and populated areas, inundated areas, rock outcrops, bare soils, crops, other.



SPOT Scene with the land use interpretation

5) Visual interpretation of the coca fields

The classification of coca fields relies on the visual interpretation of satellite images. The detection is based on the spectral characteristics, texture, patterns and the surroundings of the fields. The class 'coca' can be considered to be composed of bare soils and small rows of bushes. No distinction is made between the different phenological stages of coca bushes.

The interpreter verifies the coca crops based on spectral characteristics, texture, shape, size of the fields and contextual information, like information from previous surveys and geographic information on spraying. The result of training is a set of signatures. Each signature corresponds to a class and is used with a decision rule to assign the pixels to a class.

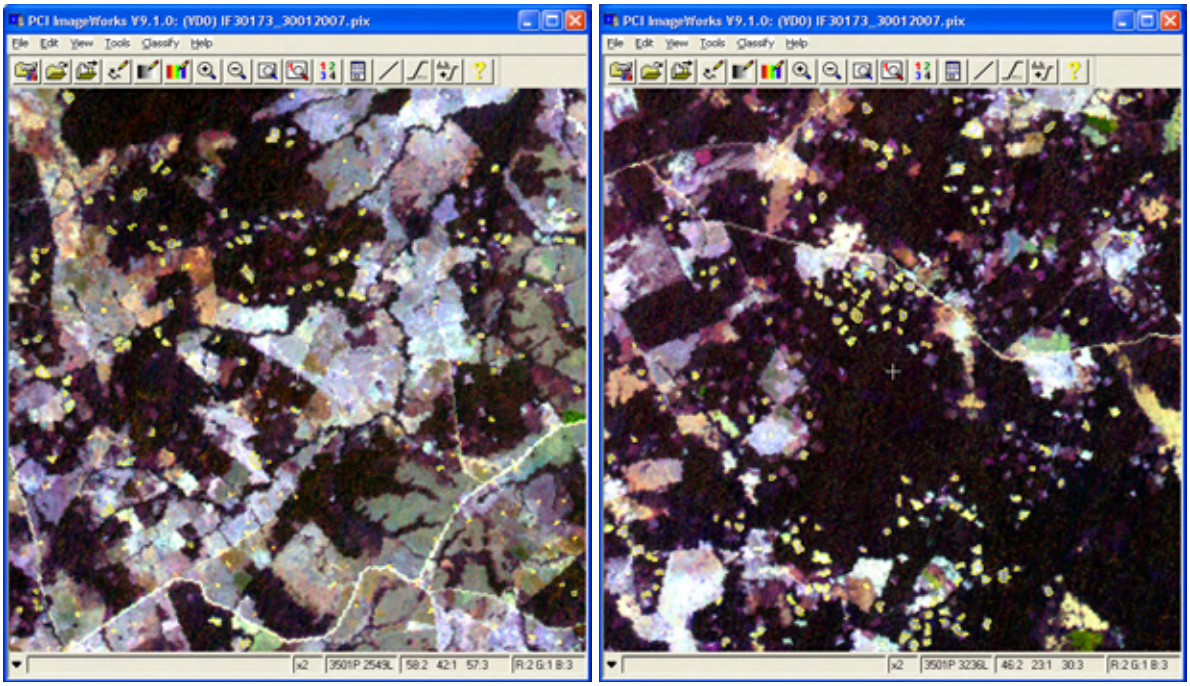
Coca fields are digitized on screen with the help of semi-automatic software tools (e.g. pixel seeding). Small polygons of less than 0.25 hectares (2 or 3 Landsat-7 pixels) are deleted because the interpretation is not enough reliable due to the coarse spatial resolution of the sensor.

Coca fields are digitized on screen. For this purpose a software tool called 'pixel seeding' is used to delineate the fields. This means that pixels are grouped together automatically by the software if their spectral value is similar. The similarity threshold for grouping pixels is determined by the interpreter.

In addition, aerial photos taken by the Antinarcotics police (DIRAN) and SIMCI, recording of aerial spraying path, manual eradication and Forest Warden Families reports and coca polygons interpreted for the census of previous years are also used to facilitate the interpretation, as well as the information supplied by different government and UN agencies.

The interpretation process relies on the profound knowledge of the area by the interpreter. This knowledge is gained through many years of experience analysing satellite images and frequent over-flights. Interpreters have several years of experience with the project.

Coca fields visually interpreted (outlined in yellow) IRS LIS III satellite image



6) Verification flights

Verification flights are required for editing and improving the initial interpretation. The verification is based on direct visual inspection of the ground from a plane. Paper maps are used for orientation and as a data base for verification.

In addition to visual inspection from the aircraft, a video camera and a digital camera combined with GPS was used for documentation. The preliminary interpretation results are edited and corrected with the verification findings.

7) Corrections

Following the interpretation process, a number of corrections are applied to account for the effects of spraying activities before or after image acquisition, for missing image information due to clouds or gaps (SLC-off) and for differences in acquisition date of the images with respect to the census cut of date of 31 December. These corrections are necessary to improve the final statistics.

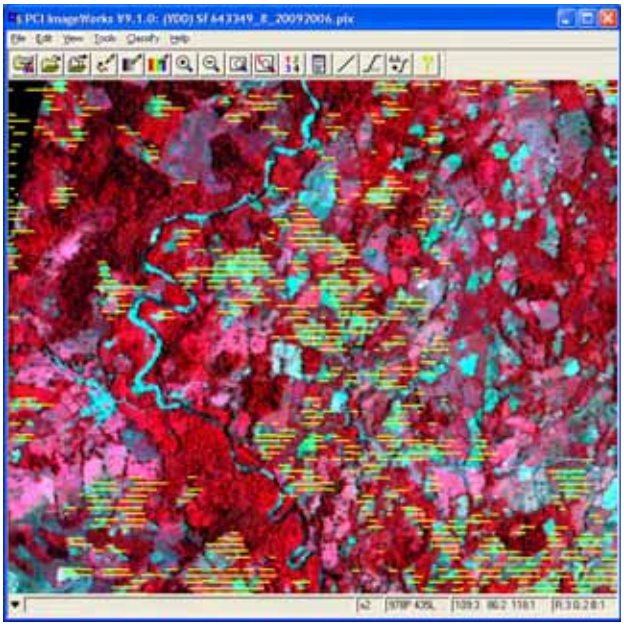
7.1) Correction for manual eradication

As part of the illicit crop eradication activities, coca fields are pulled out by hand and their coordinates are registered and reported to UNODC. Corrections are then performed depending on the date of image acquisition and on the date of eradication. Reported eradicated coca fields are ignored in images acquired after manual eradication and deleted from the interpretation when the eradication takes place after the date of the image.

Coca fields outlined in black and manual eradication sites (ocurred after the date of the image) in yellow

7.2) Correction for spraying

Another activity aimed to destroy coca fields consists in spraying them from aircraft. The spraying lines are automatically recorded. After transforming the coordinates into the coordinate system of the satellite images, a buffer is calculated depending on the type of the plane and the recorded spraying line. The buffer is placed over the coca interpretation. Corrections are then performed depending on the date of image acquisition and on the date of spraying. Coca areas that were identified in the satellite images are excluded if the images were acquired before spraying, except for an estimated survival rate of 12%.



Coca fields with the aerial spraying lines in yellow

7.3) Corrections for cloud cover and gaps in Landsat 7 images (SLC-off)

Clouds and shadows are delineated during the land cover classification process. In a first step, buffers of one kilometre width around the clouds are calculated. The coca cultivation area within this buffer is measured. By comparison with the previous survey, trends for coca cultivation are calculated for the buffer area. This trend is used to estimate recent area under the clouds from corresponding area in the previous survey. Old coca fields under clouds or gaps are preserved in position and size, when trends indicate an increase in the surroundings areas.

In the 2006 survey, the corrections for the gaps of the Landsat 7 scenes were treated like clouds. The only difference is in a buffer of 300 meter instead of 1000 meter for the clouds. The definition of the buffer is based on experience in both cases.

7.4) Corrections for differences in acquisition dates of images

The satellite image only reflects the cultivation at their acquisition date. A correction factor should be applied to get the estimates at the cut-off date of 31st December. A monthly coca rate of increase or decrease is calculated from the difference in coca cultivation between images acquired over the same area at different dates. This rate is then applied to the initial interpretation for the number of months separating the acquisition date and the cut off date of 31 December.

Table 44. Corrections applied

	Area (hectares)	% of initial result
Initial results	64,968	83.4%
Correction for spraying	3,349	4.3%
Correction for cloud cover	8,418	10.8%
Correction for difference in	1,135	1.5%
Final results	77,870	100%

Accuracy assessment

The assessment of the accuracy of the interpretation results is part of a quality control. The accuracy assessment has two aspects: a geometric accuracy which is the accuracy of the interpreted boundaries (or size) of land cover units and a thematic accuracy which measures the reliability of the identification of land cover classes.

The images are geo-referenced on the basis of ground control points extracted from the adjusted mosaics built by the project. In this case, for Landsat 7 ETM+ images a maximum positional deviation of the order of 1/10 of elevation difference can occur. During its revision of the methodology, the Institute of Natural Resources and Applied Life Sciences of Vienna (Austria) recommended to ortho-rectify the images with detailed Digital Elevation Model to increase the geometric accuracy to below 1.5 pixels.

Thematic accuracy is usually specified in terms of error matrix, giving frequency (probability) of misclassification between different classes. The compilation of the error matrix must be based on a representative, unbiased sample of reference data. The collection of reference data is difficult where access to the ground is not possible due to security reasons.

Although the thematic accuracy is a good indicator of the quality of the interpretation, it does not provide for a range of the results, and therefore it cannot be used to correct the results.

Following the recommendations of the Institute of Natural Resources and Applied Life Sciences of Vienna (Austria), the project is currently developing an accuracy assessment method relying on aerial photography as surrogate ground data that might provide for such a bias-correction factor.

The project obtained large scale multispectral aerial photography (one meter of spatial resolution) taken by the Colombian Air Force in January 2006 over the northern surroundings of the Sierra La Macarena National Park to compare the results of the interpretation of coca fields in the aerial photography with

the results of the interpretation in the Landsat image taken in the same date and used in the 2005 coca survey.

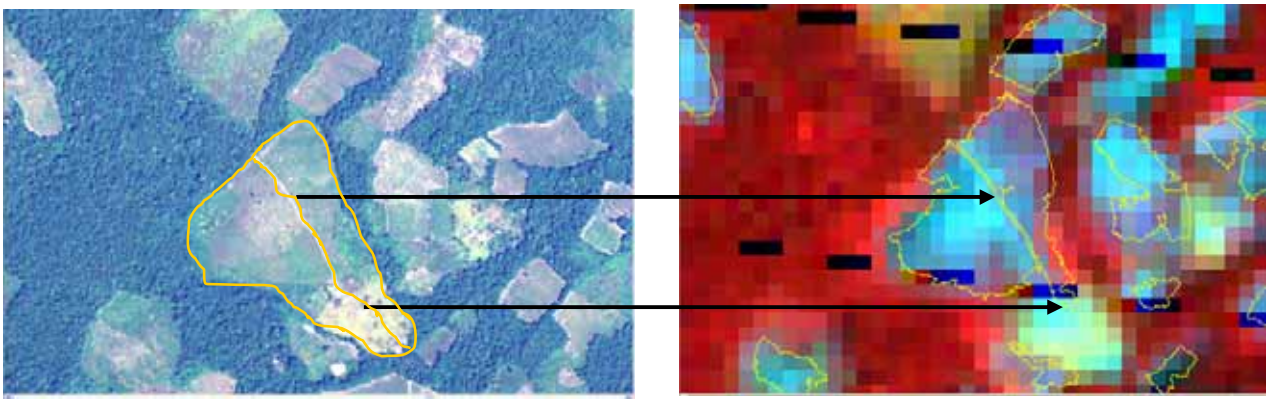
In the trial study, over the same area, 323 hectares of coca cultivation area were identified in the Landsat image and 320 hectares of coca cultivation were identified in the aerial photography. However, there were several fields that were not identified in the satellite images or not identified in the aerial images; moreover, there were differences in the delimitation of the fields resulting in fragmented fields in the aerial images, where the interpreters identified them as larger fields in the satellite image.

Table 45. Comparison of coca fields interpretation in aerial photography and satellite image

Fields	Interpreted in aerial photography (hectares)	Interpreted in LandSat images (hectares)
Identified in LandSat 7 only		15
Identified in aerial photography only	41	
Fragmented fields	90	115
Coincident fields	189	194
Subtotal Common Fields	280	309
TOTAL	**320**	**323**

The exercise requires a simultaneous field verification of the interpretation, which could not be carried out over the aerial photography in the present investigation but will be pursued in the next steps.

The results of this study are a first approximation to the proposed measurement of the interpretation accuracy of coca cultivation using high-resolution aerial photography interpretation as reference for accuracy assessment of the interpretation of satellite imagery and will be continued with an appropriate statistical design.



Comparison of coca fields interpretation (outlined in yellow) in aerial photography and in satellite image.

Analysis of the dynamics of cultivation

Table 46. Stable and new fields of coca bush in 2006 by region

Region	Identified in 2005 and 2006				Not detected in 2005				Total 2006	
	Number of fields	% of total fields	Area (hectares)	% of total area	Number of fields	% of total fields	Area (hectares)	% of total area	Total Fields	Total Area (hectares)
Meta-Guaviare	11,065	47	7,189	35	12,479	53	13,351	65	23,544	20,540
Pacific	7,687	28	3,385	18	19,767	72	15,422	82	27,454	18,807
Putumayo-Caquetá	5,378	24	2,928	17	17,029	76	14,293	83	22,407	17,221
Central	2,200	17	1,092	9	10,744	83	11,039	91	12,944	12,131
Orinoco	1,708	47	2,800	41	1,927	53	4,029	59	3,635	6,829
Amazonia	682	44	572	30	868	56	1,333	70	1,550	1,905
Sierra Nevada	253	46	122	28	297	54	315	72	550	437
TOTAL	28,973	31	18,088	23	63,111	69	59,782	77	92,084	77,870

The comparison of the position of the coca fields in 2005 and 2006 revealed that about 69% of the fields (76% of the total cultivated area), were in a different position or at least not observed in 2005 for various reasons (aerial spraying, recently harvested, recently planted, etc) and therefore not in production and not accounted for in the 2006 census. Therefore not necessary all of these coca fields can be qualified as new fields planted in 2006 because the identification as "new" is not referred to the age of the cultivation but to the position of the field. The higher percentage of the area over the number of fields indicates that the average area of new fields is higher than the total average.

Table 47. Stable and new fields of coca bush in 2001-2006 by region

Region	Stable 2001-2006				New in 2006				Total 2006	
	Number of fields	% of total fields	Area (hectares)	% of total area	Number of fields	% of total fields	Area (hectares)	% of total area	Total Fields	Total Area (hectares)
Meta-Guaviare	16,650	71	11,389	55	6,894	29	9,151	45	23,544	20,540
Pacific	12,824	47	6,020	32	14,630	53	12,787	68	27,454	18,807
Putumayo-	11,670	52	5,953	35	10,737	48	11,268	65	22,407	17,221
Central	3,914	30	1,788	15	9,030	70	10,343	85	12,944	12,131
Orinoco	2,243	62	3,885	57	1,392	38	2,944	43	3,635	6,829
Amazonia	849	55	1,324	69	701	45	581	31	1,550	1,905
Sierra Nevada	340	66	180	41	210	34	257	59	550	437
TOTAL	48,490	53	30,539	39	43,594	47	47,331	61	92,084	77,870

For a better assessment of the dynamic of coca cultivation in Colombia, a comparison was made between the position of the coca fields identified in 2006 and the position of the fields identified between 2001 and 2006. In total, 47% of the fields that covers 61% of the total cultivated area identified in 2006 had never been detected before. Such observation suggests a high mobility of coca cultivation in Colombia. The higher percentage of the area over the number of fields indicates that the average area of new fields is higher than the total average.

had never been detected before. Such observation suggests a high mobility of coca cultivation in Colombia. The higher percentage of the area over the number of fields indicates that the average area of new fields is higher than the total average.

4 ANNEXES

Annex 1: Correction for cloud cover, gaps, aerial spraying and date of imagery in 2006.

Annex 2: List of satellite images used for the Colombia coca cultivation survey 2006

Annex 3: Coca cultivation in indigenous territories

Annex 4: Pilot study to review the Coca leaf yield and cocaine production estimates

Annex 1: Correction for cloud cover, gaps, aerial spraying and date of imagery in 2006.

Departament	Interpretation	Corrections				Total 2006
		for clouds	for gaps in satellite images	for aerial spraying	for date of imagery	
Amazonas	663	3	0	0	26	692
Antioquia	4,227	657	120	908	245	6,157
Arauca	1,118	13	114	0	61	1,306
Bolívar	1,926	27	325	129	-25	2,382
Boyacá	429	6	7	1	-2	441
Caldas	384	1	24	17	35	461
Caquetá	4,883	18	75	114	-123	4,967
Cauca	1,556	427	193	20	-92	2,104
Chocó	466	44	166	0	140	816
Córdoba	705	163	116	232	0	1,216
Cundinamarca	131	1	0	1	-13	120
Guainía	634	45	54	0	20	753
Guajira	124	0	42	0	0	166
Guaviare	8,842	560	23	57	-5	9,477
Magdalena	245	0	20	0	6	271
Meta	9,264	1,003	201	612	-17	11,063
N. de Santander	464	9	37	0	-22	488
Nariño	11,674	2,490	43	210	1,189	15,606
Putumayo	10,880	17	1,223	410	-276	12,254
Santander	838	33	10	25	-40	866
Valle del Cauca	236	0	0	0	45	281
Vaupés	408	10	41	0	1	460
Vichada	4,871	27	30	613	-18	5,523
TOTAL	**64,968**	**5,554**	**2,864**	**3,349**	**1,135**	**77,870**

Annex 2: List of satellite images used for the Colombia coca cultivation survey 2006

LandSat 7 ETM+		
PATH	**ROW**	**Acquisition date (dd/mm/yyyy)**
3	58	03/01/2007
3	59	03/01/2007
4	56	11/02/2007
4	57	20/09/2006
4	58	03/10/2006
4	59	20/09/2006
4	60	20/09/2006
4	61	11/02/2007
4	62	11/02/2007
4	63	11/02/2007
5	56	17/01/2007
5	57	17/01/2007- 18/02/2007
5	58	29/10/2006
5	59	29/10/2006
5	60	18/02/2007
5	61	29/10/2006
5	62	13/10/2006
6	55	24/01/2007
6	56	02/09/2006
6	57	21/11/2006
6	58	02/09/2006
6	59	21/11/2006
6	60	02/09/2006
6	61	02/09/2006
6	62	02/09/2006
7	52	30/12/2006
7	54	16/02/2007
7	55	31/01/2007
7	56	31/01/2007
7	57	13/02/2006
7	58	09/09/2006 - 14/12/2006
7	59	09/09/2006
7	60	24/08/2006
7	61	24/08/2006
8	52	05/12/2006
8	53	03/01/2007
8	54	18/10/2006 - 06/01/2007
8	55	18/10/2006
8	56	18/10/2006 - 07/02/2007
8	57	/02/2007
8	58	06/01/2007-07/02/2007
8	59	06/01/2007-07/02/2007
8	60	31/08/2006-07/02/2007
9	52	07/09/2006
9	53	13/01/2007
9	54	13/01/2007
9	55	13/01/2007
9	56	26/08/2006
9	57	07/09/2006
9	58	23/09/2006
9	59	25/10/2006-29/01/2007
9	60	25/10/2006-29/01/2007
10	54	04/01/2007
10	55	20/01/2007
10	56	05/02/2007
10	57	26/08/2006
10	58	05/02/2007
10	59	14/09/2006-05/02/2007
TOTAL	**68**	

ASTER		
LATITUD	**LONGITUD**	**Acquisition date (dd/mm/yyyy)**
0.49°	-74.97°	06/01/2007
0.92°	-75.67°	25/10/2006
1.02°	-74.86°	06/01/2007
1.03°	-71.80°	09/02/2007
1.14°	-75.68°	18/10/2006
1.45°	-75.56°	25/10/2006
1.56°	-71.69°	09/02/2007
1.56°	-74.75°	06/01/2007
2.09°	-74.63°	06/01/2007
2.17°	-73.62°	27/10/2006
2.19°	-78.83°	29/01/2007
2.76°	-70.81°	01/01/2007
3.11°	-70.96°	23/12/2006
3.25°	-73.43°	28/11/2006
3.80°	-70.31°	02/02/2007
4.32°	-76.32°	07/09/2006
6.42°	-70.94°	08/01/2007
TOTAL	**17**	

SPOT 4 y 5		
J	**K**	**Acquisition date (dd/mm/yyyy)**
639	347 (5)	04/09/2006
643	349 (5)	20/09/2006
644	336	27/09/2006
644	335	27/09/2006
645	347	22/09/2006
649	349/8	28/09/2006
648	349/2	30/01/2007
651	336/8	16/02/2007
TOTAL	**8**	

IRS 6		
PATH	**ROW**	**Acquisition date (dd/mm/yyyy)**
301	73	30/01/2007
301	74	30/01/2007
TOTAL	**2**	

Annex 3: Coca cultivation in indigenous territories

INDIGENOUS TERRITORIES	HECTARES IN 2005	HECTARES IN 2006
AFILADOR CAMPO ALEGRE (YARINAL AFILADORES)	10	34
AGUA NEGRA	7	14
AGUACLARA Y BELLA LUZ DEL RIO AMPARO	6	0
AGUANEGRA	3	8
AGUAS NEGRAS	4	2
ALMIDON LA CEIBA	12	16
ALPAMANGA	1	1
ALTAMIRA	2	6
ALTO ALBI	10	59
ALTO CARTAGENA	0	1
ALTO LORENZO	0	6
ALTO ORITO	3	6
ALTO SINU, ESMERALDA CRUZ GRANDE E IWAGADO	34	2
ANDOUE DE ADUCHE	9	3
BACATI-ARARA	298	168
BACHACO BUENAVISTA	12	20
BARRANCO CEIBA Y LAGUNA ARAGUATO	10	29
BARRANCO COLORADO	13	17
BARRANQUILLITA	49	39
BELLA VISTA	3	10
BELLAVISTA Y UNION PITALITO RIO SIGUIRI SUA-DOCAMPADO	1	1
BUENAVISTA	49	36
CABECERAS O PUERTO PIZARIO	1	1
CACHIVERA DE NARE	0	1
CAICEDONIA	6	10
CALARCA	21	7
CALENTURAS	8	68
CALI-BARRANQUILLA	39	32
CALLE SANTA ROSA RIO SAIJA	15	12
CAÑAVERAL	2	12
CAÑO JABON	21	11
CAÑO NEGRO	1	3
CAÑO OVEJAS (BETANIA- COROCITO)	16	17
CARANACOA YURI-LAGUNA MOROCOTO	19	6
CARPINTERO PALOMAS	21	5
CARRIZAL	3	0
CECILIA COCHA	3	3
CHAGUI CHIMBUZA	0	2
CHARCO CAIMAN	5	6
CHIGORODO MEMBA	3	0
CHIGUIRO	16	20
CHINGUIRITO MIRA	24	118
CHOCON	69	70
CHONARA BUENA	0	4
CIBARIZA	18	8
CONCORDIA	21	8
CONSARA-MECAYA	7	7
COROCORO	12	19
COROPOYA	10	11
CUAIQUER INTEGRADO LA MILAGROSA	0	10
CUASBIL - LA FALDADA	9	3
CUCHILLA-PALMAR	0	4
CUENCA MEDIA Y ALTA DEL RIO INIRIDA	160	186

INDIGENOUS TERRITORIES	HECTARES IN 2005	HECTARES IN 2006
CUMARAL-GUAMUCO	95	52
DAMASCO VIDES	5	12
DOMINICO-DONDOBO-APARTADO	12	0
EL CEDRO,LAS PENAS,LA BRAVA,PILVI	213	44
EL DESCANSO	0	1
EL GRAN SABALO	22	55
EL HACHA	13	17
EL PROGRESO	1	1
EL QUINCE	1	0
EL TABLERO	1	4
EL TIGRE	13	12
EL UNUMA	499	389
GABARRA-CATALAURA	1	2
GRAN ROSARIO	284	105
GUACAMAYAS MAMIYARE	14	9
GUACO BAJO Y GUACO ALTO	13	10
GUELNAMBI-CARAÑO	3	1
HERICHA	2	0
HONDA RIO GUISA	6	6
INDAZABALETA	86	59
INFI	7	5
INGA-KASMA DE MOCOA	1	
INGA DE BLASIAKU	0	1
INGA DE CONDAGUA	0	1
INTEGRADO EL CHARCO	19	19
JAIDEZAVE	2	1
JIRIJIRI	2	1
KOGUI-MALAYO ARHUACO	164	160
LA AGUADITA	6	13
LA ASUNCION	1	2
LA ESPERANZA	3	0
LA FLORESTA-SANTA ROSA-RIO SANQUIANGA	34	44
LA FUGA	12	28
LA ITALIA	0	3
LA LLANURA	13	5
LA PAYA	0	2
LA SAL	6	11
LA TEËFILA	4	1
LA TURBIA	36	157
LA VORAGINE-LA ILUSION	18	16
LA YUQUERA	17	31
LAGARTO COCHA	2	1
LAGOS DEL DORADO LAGOS DEL PASO Y EL ROMANSO	272	228
LAGUNA NINAL,CUCUY,LOMABAJA	29	46
LAGUNA TRANQUILA	0	5
LOS IGUANITOS	3	0
LOS GUADUALES	0	1
MACUARE	41	40
MANDIYACO	2	11
MONOCHOA	6	1
MOTILON-BARI	4	0
NIÑERAS	2	0
NUKAK MAKU	28	38
NUNUYA DE VILLAZUL	7	1
PAMPON	0	1
PARTE ALTA DEL RIO GUAINIA	9	0

INDIGENOUS TERRITORIES	HECTARES IN 2005	HECTARES IN 2006
PATIO BONITO	5	0
PIALAPI-PUEBLO VIEJO-SAN MIGUEL-YARE	0	3
PIGUAMBI-PALANGALA	1	9
PORVENIR LA BARRIALOSA	9	41
PREDIO PUTUMAYO	1000	742
PUADO, MATARE, LA LERMA Y TERDO	2	2
PUEBLO NUEVO-LAGUNA COLORADA	3	8
PUERTO ALEGRE Y LA DIVISA	11	0
PUERTO NARANJO-PEÑAS ROJAS-CUERAZO-EL DIAMANTE	7	6
PUERTO NARE	53	28
PUERTO VIEJO Y PUERTO ESPERANZA	36	8
PUERTO ZABALO-LOS MONOS	34	46
PULGANDE CAMPOALEGRE	4	16
QUEBRADA QUERA	3	1
RAMOS-MONGON-MANCHURIA	0	2
REMANSO CHORRO BOCON	3	26
RIO GARRAPATAS	22	43
RIO GUANGUI	8	6
RIO PANGÛI	0	1
RIO PAVASA Y QUEBRADA JELLA	4	0
RIO PUERRICHA	7	3
RIO SIARE	8	16
RIOS CATRU Y DUBASA	144	13
RIOS JURUBIDA-CHORI Y ALTO BAUDO	0	4
RIOS MUCO Y GUARROJO	14	6
RIOS TOMO Y WEBERI	6	0
RIOS TORREIDO Y CHIMANI	21	6
ROQUEROS	1	1
SAN AGUSTIN-LA FLORESTA	3	0
SAN ANDRES - LAS VEGAS - VILLA UNION	0	16
SAN ISIDRO ALMORZADERO LA UNIËN	4	5
SAN JOAQUIN	1	0
SAN JOSÈ	0	1
SAN LUIS	0	1
SAN LUIS DEL TOMO	0	1
SAN MATIAS O JAI-DUKAMA	4	6
SAN MIGUEL	0	5
SAN QUININI	7	4
SANANDOCITO	10	6
SANQUIANGUITA	0	4
SANTA CRUZ DE PINUÑA BLANCO	9	3
SANTA ROSA DEL GUAMUEZ	6	1
SANTA ROSA SUCUMBIOS EL DIVISO	9	3
SANTA TERESITA DEL TUPARRO	31	5
SARACURE Y RIO CADA	484	591
SELVA MATAVAN	99	88
SELVA VERDE	3	3
SIBERIA	0	1
SIMORNA	0	8
SUANDE GUIGUAY	64	44
TONINA-SEJAL-SAN JOSE-OTROS	5	14
TRONQUERA PULGANDE PALICITO	0	6
TUCAN DE CAÑO GIRIZA LA PALMA	9	2
TUKANARE	0	0
VALLES DEL SOL	14	0

INDIGENOUS TERRITORIES	HECTARES IN 2005	HECTARES IN 2006
VAUPES	197	221
VILLA CATALINA	8	22
VUELTA DEL ALIVIO	5	6
WASIPANGA	0	4
YANACONA DE SANTA MARTA	1	1
YARINAL (SAN MARCELINO)	45	34
YAVILLA II	42	45
Z.E.	2	1
Z.E.D.	4	3
ZIT-SEL DEL QUECAL	0	3
Total area	**5571**	**4995**

Annex 4 Pilot study to review the Coca leaf yield and cocaine production estimates

At the beginning of 2007, a pilot study was performed on updating the yield figures. The evaluation of this new study is still ongoing at the time of printing of this report. Below, the methodology and preliminary results are described. Due to the high dynamics of the coca crops in Colombia and the impact of variables such as changes in the location of the coca crops, eradication, coca plants diseases, climate, a yearly update of the calculations of yields potential cocaine production is required.

Therefore, a methodology was developed for these calculations to take care of endogenous changes, like varieties or agricultural management, and exogenous changes, where the farmers have little or no control, like forced eradication, plant diseases, etc. as well as the implementation of alternative development projects. The methodology consists in direct interviews with the farmers under the same 2005 sample design and variables but with a smaller sample size and the design of a multi-variable model of estimation of productivity based in the changes in size and location of the cultivated fields in 2006 survey, dates of aerial spraying and manual eradication and climatic data[1]. The main findings derived from this new study are currently assessed by the Crop Monitoring (ICMP) team.

Preliminary results on coca yield and production

Table1. Regional average coca leaf yield per harvest by region

Region	Average Yield per harvest (Kg /Ha)	Lowest limit of confidence interval (Kg/Ha)	Highest limit of confidence interval (Kg/Ha)	Coefficient of variation (CV in %)
Sur de Bolivar	1,899	1,836	1,967	1.7
Meta - Guaviare	1,613	1,559	1,662	1.6
Putumayo - Caqueta	1,552	1,460	1,635	2.8
Orinoco	1,529	1,454	1,598	2.4
Sierra Nevada	1,441	1,371	1,513	2.5
Pacific	1,070	983	1,157	4.1
Catatumbo	1,027	949	1,103	3.8
All regions	**1,446**	**1,402**	**1,490**	**1.5**

Catatumbo and Sur de Bolivar make up Central region

The average number of harvest per year was 4.3, equivalent to one harvest every 85 days. Important regional differences were found between the highest in Meta-Guaviare reaching 6 harvests per year (or every 55 days), and the lowest in the Pacific region with 2.5 harvests per year (or every 146 days).

Preliminary results on annual yield

Table 2. Regional average number of annual harvest

Region	Average number of harvests (2006)	Coefficient of variation (CV in %)
Meta - Guaviare	6,0	0.4
Orinoco	5,6	0.6
Catatumbo	5,3	2.7
Putumayo - Caqueta	3,5	1.0
Sur de Bolivar	3,3	1.2
Sierra Nevada	3,3	1.9
Pacific	2,5	0.6
All regions	**4,3**	**2.0**

Catatumbo and Sur de Bolivar make up Central region

The annual regional average yield of fresh coca leaf was calculated by assuming that all harvests during the year were equivalent. The average yield per harvest was multiplied by the average number of harvests. The regional averages showed below were calculated from the average yield per harvest and the number of harvests per year.

Table 3. Calculations for the average regional annual yield of fresh coca leaf

Region	Average annual yield (Kg/Ha/year)	Lowest annual yield (Kg/Ha/year)	Highest annual yield (Kg/Ha/year)	Coefficient of variation (CV in %)
Meta - Guaviare	9,900	9,506	10,260	1.8
Orinoco	8,552	8,152	8,934	2.3
Sur de Bolivar	6,288	6,069	6,514	1.8
Putumayo – Caqueta	5,559	5,237	5,874	2.9
Catatumbo	5,510	5,014	6,003	4.5
Sierra Nevada	4,840	4,604	5,076	2.5
Pacific	2,705	2,488	2,924	4.1
All regions	**6,343**	**6,018**	**6,666**	**2.6**

Catatumbo and Sur de Bolivar make up Central region

PRELIMINARY RESULTS ON COCA LEAF, COCA PASTE AND BASE PRODUCTION

The potential production of fresh coca leaf in Colombia for 2006 was calculated by multiplying the regional average annual yield of fresh coca leaf by the regional area under coca cultivation. The potential production of fresh coca leaf was estimated at 496,900 mt, Assuming 57% moisture content, the total production was equivalent to 214,000 mt of sun-dried coca leaf. Due to the high yield observed in Meta Guaviare, the region accounted for 41% of the total national production although it represented only 26% of the coca cultivated area.

Table 4 . Calculation of the 2006 production of fresh coca leaf in Colombia.

Region	Coca cultivation (hectares)	Annual yield (kg/ha/year)	Production (tons)*	% of 2006 total
Meta-Guaviare	20,540	9,900	203,300	41%
Putumayo-Caqueta	17,221	5,559	95,700	19%
Sur de Bolivar	11,643	6,288	73,200	15%
Orinoco	6,829	8,552	58,400	12%
Pacific	18,807	2,705	50,900	10%
Amazonia	1,905	5,559	10,600	2%
Catatumbo	488	5,510	2,700	1%
Sierra Nevada	437	4,840	2,100	0%
Country total	78,000	6,343*	496,900	100%

Catatumbo and Sur de Bolivar make up Central region

*Weighted average

Out of the total production of 496,900 mt of coca leaf, about 142,500 mt tons were processed into coca paste. Using the conversion rate of 1.63 kg of coca paste out of every ton of coca leaf, the total coca paste production from farmers was estimated at 233 metric tons. This was equivalent to 217 mt of cocaine base, based on a coca paste to base ratio of 93%.

The rest of the farmers either processed directly into cocaine base, or sell their production as leaf, corresponding to a total of 354,500 metric tons. Assuming that the production of coca leaf sold directly by the farmers was processed outside the farm into cocaine base at the same rate as within the farm of 1.52 kg per ton of leaf, the total amount of cocaine base was estimated at 548 mt.

Overall, either produced from coca paste or directly from coca leaves, the total production of cocaine base in Colombia in 2006 was estimated at 765 metric tons. Based on this data, the 765 metric tons of cocaine base were equivalent to 689 metric tons of cocaine hydrochloride or 585 metric tons of pure cocaine. This represented an average of 7.5 kg pure cocaine yield per hectare.

Since 2002, UNODC estimated the cocaine production in Colombia based on the average of the two cultivation figures recorded as of December of the previous year and December of the current year. This average was then multiplied by the estimated yield per hectare. This method enables to take into account that coca fields are harvested more than once in a given year and eradication activities are spread over several months. Therefore, based on an average coca cultivation level of 82,000 hectares, the pure cocaine production in Colombia for 2006 amounted to 615 metric tons.

The coca leaf yield survey carried out in 2005 jointly by the Colombian government and UNODC and the updating survey in 2006, helped to better assess the cocaine production in Colombia. It also enabled to understand better why the increasing rate of cocaine seizures reported to UNODC in the recent years did not lead to price increase or any significant decline in cocaine purity in the main consumer markets of the United-States and Europe.

Methodology of the preliminary study to update yield and production

YIELD AND PRODUCTION

In 2005, UNODC and the Colombian Government through DNE contracted the private company Agricultural Assessments International Corporation (AAIC) to conduct a survey to estimate the coca green leaf yield, general characteristics of the coca cultivation and the socio-economic variables regarding the coca growers. A stratified multi-stage sample was designed to conduct "crop-cutting" on 746 small parcels (5-9 sq m) selected systematically from 423 coca fields also selected systematically and to interview 1,300 coca growers.

For updating purposes, the alternative mathematical multivariate modeling techniques were used, which are also based on the rigorous statistical method. In 2006, a smaller sampling survey was conducted to collect data for the same variables of the 2005 survey, and to support the modeling techniques.

COCA YIELD SURVEY

The 2006 sampling survey design was the same used in 2005 survey, selecting systematically in the first stage Primary Sampling Units (PSUs) or squares of 1 sq km each, with Probability Proportional to Size (PPS) of their coca areas; selecting also systematically in the second stage only one coca field (Secondary Sampling Unit -SSU) with PPS of its coca area from each PSU included in the first stage sample.

A cluster of four coca growers around the coca fields included in the second stage sample was constructed by the enumerator on the field to conduct the interviews. Allocation of the sample size between seven regions is presented in table.

Table 5. Sample size allocation between regions.

Region	Squares of 1 sq km (PSUs)	Coca fields (SSUs)	Coca growers in clusters*
Putumayo-Caqueta	8	8	32
Catatumbo	8	8	32
Sur de Bolivar	8	8	32
Sierra Nevada	8	8	32
Orinoquia	8	8	32
Meta-Guaviare	8	8	32
Pacifico	8	8	32
All regions	**56**	**56**	**224**

**Four coca growers per cluster-Catatumbo and Sur de Bolivar make up Central region*

MATHEMATICAL MODEL FORMULATION

The mathematical model formulated to estimate 2006 coca green leaf yield was based on the data mining general techniques, which belongs to the artificial intelligence field, and on the specific technique known as Classification and Regression Trees (CART).

The starting point was the set of 2005 variables (around 80) on agricultural practices and socio-economic data, also including 2005 spraying, manual eradication and meteorological variables (not collected in 2005 survey, but coming from other sources), which were related to the 2005 coca green leaf yield. This set of variables was used to formulate the mathematical model to describe the 2005 coca green leaf yield

specifically that one obtained through the "crop-cutting" survey. For this reason, this 2005 yield was taken as the dependent variable of the set of independent variables explaining the conditions required to the interested parameter (yield), which will reach a certain level in 2006.

This mathematical supervised model was used to estimate the 2006 coca green leaf yield. In fact, introducing in this mathematical model the crop agricultural practices, the socio-economic and production conditions, all of them obtained in the 2006 survey (smaller sample than in 2005), and the spraying, manual eradication and meteorological data coming from other sources, it was expected to get, as a result, the objective coca green leaf yield more probable to be estimated under this context.

In Fact, the yield **R** being a positive variable without outliers, then, it was possible to consider that this variable followed a gamma distribution, and further on, that its parameter could be described based on a set of measurable variables from the environment where was produced.

This last assumption was established through the mathematical expression $\beta\mathbf{X}$, where **X** was a measurable independent variable vector and β was a parameter vector to be estimated. If μ is the mean parameter of **R**, then, it was assumed that:

$$\log(\mu) = \beta\mathbf{X}.$$

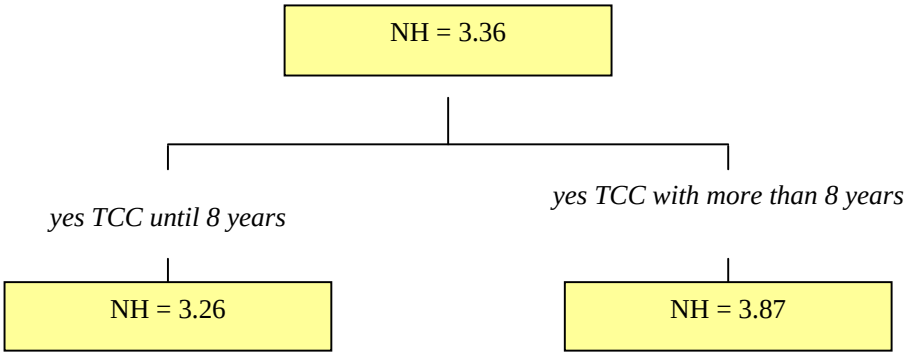
This model had **X** independent variables, both categorical and continuous variables. For example, between the first ones could be, the coca production end that could be to produce cocaine base or to sell the coca green leaf production; or the coca variety. Between the second ones could be the coca field size, the coca plantation age or the number of workers hired to grow the coca.

For this reason, the mathematical model included a wide spectrum of variables without any constraint regarding their type (categorical or continuous). Besides, the mechanism used to link μ y $\beta\mathbf{X}$ was the logarithm function **(log)** that was the link function.

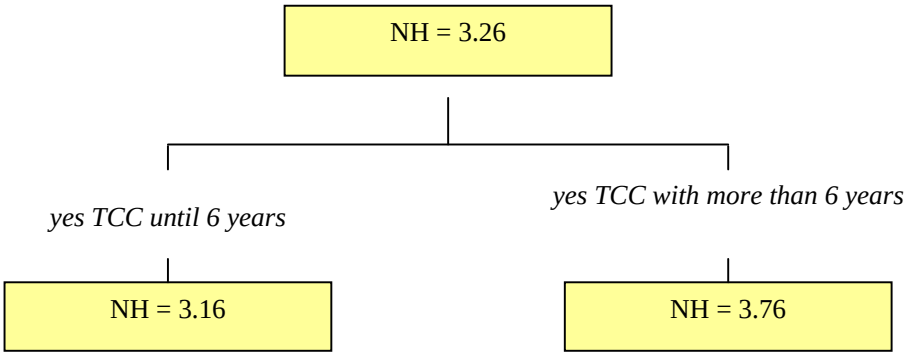
In the case of a continuous variable, the level of influence that could have on the dependent variable was evaluated deeply. In fact, if the above model is used, then, a unique parameter will be assigned through all the range of available values of the continuous variable, independently of the value that takes this explaining variable. This has been questioned traditionally, in the sense that the regression model could change according to the values taken by the continuous variable, which could give a certain level of heterogeneity to the data. In fact, it would be ideal to identify the model variability according to the values of the continuous variables, in such a way that the data adjustment would be more adapted, which would lead to a better description of behavior of the dependent variable. There was not this questioning problem with the categorical variables, since they were modeled independently.

To solve this problem with respect to the independent continuous variables, this study used as an analysis strategy, the construction of regression trees, which is a non-parametric method coming from the techniques CART, which construct the regression tree through the segmentation (partition) technique. Then, each data segment (partition) constructed produced a specific gamma regression model, which was not always equal from one segment to other.

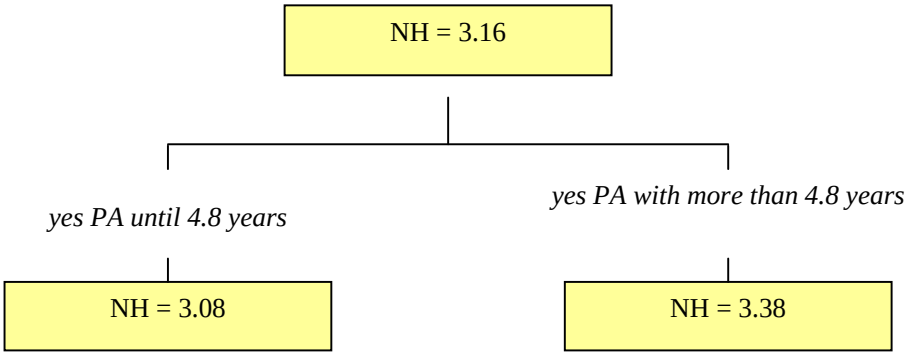
To show data heterogeneity problem, the Number of coca Harvest modeling was taken **(NH)** in the Sierra Nevada de Santa Marta. Then, it was found that the principal explaining independent variable accounting for the **NH** variations was the Time Cultivating Coca **(TCC)**. Under this scenario, two groups were identified: one having a **TCC** until 8 years and other having a **TCC** of more than 8 years. This result is presented in the following figure:



This procedure allowed to show that the **NH** behavior did not keep through all the data range of this continuous variable (time cultivating coca), since when the number of segments was constructed based on the **TCC** behavior, different levels of **NH** were obtained. The before procedure was applied again to the two data segments (partitions) obtained, finding that the segment corresponding to the condition "yes **TCC** until 8 years" showed differences in **NH**, and based still on **TCC**, as the following figure indicates.



A thought on the segments (partitions) constructed, took to consider the **NH** behavior related to the condition "yes **TCC** until 6 years". For this new case, the coca Plantation Age **(PA)** was the important one, being discriminated in the levels indicated on the below figure, where the regression tree construction ended in this example.



As was mentioned before, the mathematical model was formulated based on the 2005 survey data, having the following expression for each segment (partition) constructed in the regression tree, which followed the generalized linear model approach.

$$\log(\mu) = \beta_{2005} X,$$

where β_{2005} represented the 2005 conditions, but, it was supposed that could be kept in 2006.

If the 2006 data coming from the 2006 survey and the coca spraying, coca manual eradication and meteorological 2006 variables were **X'**, for each segment (partition) constructed in the regression tree, then, the expected 2006 coca green leaf yield estimation $\hat{\mu}$, was:

$$\log(\hat{\mu}) = \beta_{2005} X',$$

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