UNODC
United Nations Office on Drugs and Crime

Government of Colombia

Colombia

Survey of territories affected by illicit crops – 2016

August 2017

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Photos: UNODC/SIMCI unless otherwise specified.
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Abbreviations

CNE	National Drug Enforcement Board
COP$	Colombian Pesos
DAICMA	Directorate for Comprehensive Action against Landmines
DANE	National Administrative Statistics Department
DEA	US Drug Enforcement Agency
DIRAN	Colombian National Police – Drug Enforcement Directorate
DNP	National Planning Department
EVOA	Evidence of Alluvial Gold Exploitation (by its Spanish acronym).
GME	Mobile Eradication Groups
IGAC	Agustín Codazzi Geographic Institute
INCB	International Narcotics Control Board
APM	Anti-Personnel Mine
UXO	Unexploded Ordnance
NPS	New Psychoactive Substances
OAS	Organization of American States
ODC	Colombian Drug Observatory
IOM	International Organization for Migration
PAC	Agricultural Coca Producer
PCI	Program Against Illicit Crops
PDET	Development Programs with a Territorial Approach
PECIG	Illicit Crop Eradication Program through Aerial Spraying with Glyphosate

PRELAC	Prevention of the Diversion of Drugs Precursors in the Latin American and Caribbean Region
PFGB	Forest Ranger Families Program
GDP	Gross Domestic Product
ICMP	Illicit Crop Monitoring Program
PNCT	National plan for Territorial Consolidation
PNCRT	National Policy for Territorial Consolidation and Reconstruction
PNN	National Natural Parks
PTN	Temporary Normalization Points
SAT	Early Warning System
GIS	Geographic Information System
SIMCI	Integrated System for Illicit Crop Monitoring
tm	Metric Tons
TRM	Market Exchange Rate
EU	European Union
UPAM	Agricultural and/or Mineral Production Unit
USAID	United States International Development Agency
UNODC	United Nations Office on Drugs and Crime
US$	United States Dollars
UPA	Agricultural Production Unit in a zone affected coca crops
UPAC	Agricultural Production Unit with Coca
ZVTN	Transitional Normalization Concentration Zones

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COLOMBIA COCA CULTIVATION SURVEY, 2016

	2015	Variation	2016
Net coca cultivation area calculated on 31st December (rounded to the nearest thousand)[1]	96,000 hectares	52%	146,000 hectares[2]
Pacific region	40,594 hectares	42%	57,777 hectares
Central region	16,397 hectares	147%	40,526 hectares
Putumayo – Caqueta region	27,780 hectares	24%	34,505 hectares
Meta – Guaviare region	10,425 hectares	18%	12,302 hectares
Orinoco region	700 hectares	1%	708 hectares
Amazon region	181 hectares	58%	286 hectares
Sierra Nevada region	7 hectares	400%	35 hectares
Average fresh coca leaf yield	4.8 mt/ha/year	-	4.8 mt/ha/year
Potential fresh coca leaf production[3]	454,000 mt (357,600 mt – 550, 500 mt)	33.5%	606,100 mt[4] (522,900 mt – 719,100 mt)
Potential cocaine hydrochloride production	646 mt (505 mt – 787 mt)	34.1%	866 mt (747 mt – 1,028 mt)
Average potential cocaine hydrochloride/hectare harvested	6.8 kg/ hectare harvested	1.5%	6.9 kg/ hectare harvested
Cocaine seizures	253,591 kg	49%	378,260 kg
Illegal laboratories destroyed[5]	3.827	26%	4,842
Reported manual eradication of illicit crops	14,267 hectáreas	28%	18,227 hectáreas
Accumulated aerial spraying[6]	37,199 hectares	-	0
Heroine seizures	393 kg	33%	521 kg

1 It corresponds to the area with coca found on December the 31st, 2015, vis-à-vis December the 31st, 2016.
2 The values are rounded to thousands.
3 For in-depth information on interval determination, please refer to Chapter 4. Methodology.
4 The values are rounded to thousands.
5 It only includes cocaine laboratories and infrastructures for the production of basic cocaine paste and cocaine base.
6 Aerial spraying operations in Colombia have been suspended since the end of the year 2015 pursuant to a decision of the National Government.

	2015	Variation	2016
Average coca leaf price at production sites	COP$3,000/kg US$1.09/kg[7]	-3.3%	COP$2,900/kg US$0.95/kg
Average cocaine paste price	COP$2,005,700/kg US$732/kg	-5.5%	COP$1,895,700/kg US$621/kg
Average cocaine hydrochloride price	COP$4,747,300/kg US$1,732/kg	5.0%	COP$4,984,600/kg US$1,633/kg
Total value of coca leaf production and coca derived farm products[8]	US$478 million	17.0%	US$560 million
Percentage in GDP	0.3%[9]	-	0.4%
GDP within agricultural sector	3%	-	3%[10]
Number of households involved in coca cultivation[11]	74,500	43.5%	106,900
Gross average annual income per person of coca leaf production and paste/base	US$ 1,180	-18.6%	US$960
Poppy cultivation area	595 hectares	-22%	462 hectares[12]
Potential opium latex production[13]	16.6 mt	-	n.d
Potential heroin production	2.1 mt	-	n.d
Average price of opium latex within the production site	US$797/kg	-6.4%	US$746/kg
Average price of heroin	US$6,342/kg	-11.5%	US$5,615/kg

7 The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741/ USD 1 in 2015 and COP $ 3,052/ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.
8 Value calculated from the factor of production quantities available in the market (minus seizures as product loss) and current prices. Conversion to US dollars (USD) was estimated based on the annual EMR average as reported by the Central Bank (Banco de la Republica).
9 GDP of the year according to the Government of Colombia (DANE). Enclave of Illicit Crops.
10 In % of the GDP - agricultural sector. It was estimated based on the growth of the income of the agricultural units with coca (UPAC – from its original Spanish language initials - Unidades Agropecuarias con Coca), between the years 2015 and 2016.
11 Household growth is estimated based on a multivariate indicator, which is built taking into account the behavior of the affected area (as calculated by UNODC) and the population projection (as performed by DANE) of the municipalities affected by coca, as well as the growth trend as reported in each phase of the productivity studies.
12 Estimations of areas with poppy crop are carried out by the Colombian government by means of overflights.
13 It corresponds to kiln dried opium.

Executive Summary

The 2016 coca crop monitoring survey comes at an important historical time for Colombia. The signing of a peace agreement with the Farc - Ep guerrillas, in addition to the expectation for a successful process with the ELN, are key elements in understanding the statistics and trends provided by this report.

In 2016, the United Nations General Assembly Special Session on the World Drug Problem (UNGASS) discussed the need to achieve the Sustainable Development Goals (SDGs), while effectively addressing the solution on the drug problem, understanding that both issues are complementary and mutually supportive. Within this context, the Government of Colombia raised the need to address the drugs phenomenon from a broad perspective, in order to tackle the complexities of the individuals and territories affected by illicit drugs, as well as to find tools to address it with a focus on public health and advocacy of human development, within a framework of respect for human rights.

In this context, a search has begun for new strategies and the revision of those in force. For instance, the suspension of the glyphosate spraying program, the initiation of dialogues with communities affected by illicit crops, and a change in the drug enforcement policy by focusing efforts on combating the middle and upper links of the drug trafficking chain, strengthening the transformation of territories and fully addressing the problem of consumption.

In recent years, a transition scenario has had a direct impact on the dynamics of illicit crops: a densification of cultivations in more traditional areas, thereby increasing the availability of biomass with a consequent increase in production, more active participation of communities affected, reactivation of illegal markets in regions affected by illicit crops, the emergence of new groups or the struggle of existing ones to take over the business and the perception of lower risk for illicit activities.

It is impossible to understand the 2016 coca survey without considering this complex framework; differentiating between trends and historical moments is one of the main challenges that the report poses for analysts.

The number of coca crops in Colombia increased significantly from 96,000 ha in 2015 to 146,000 ha in 2016; i.e. a 52% increase. Nevertheless, 2016 constitutes one of the years with the smallest territory affected in all the historical series; this means that the trend to have more coca in less territory is confirmed.

There are still three coca-free departments: Caldas, Cundinamarca and Guajira, and Cundinamarca has reached its 5th year without coca crops. Six departments have less than 50 ha of coca, and are close to becoming free of illicit crops: Santander, Magdalena, César, Guainía, Boyacá and Arauca.

The biggest increase in coca cultivation occurred in areas that already had the largest amount of coca in 2015, as well as areas that have had coca continuously over the past 10 years. 80% of the lots identified in 2016 had already been previously detected, sprayed or eradicated.

This means that, albeit there has been a sharp increase in areas with coca, the affected communities remain the same. These communities have found new drivers to increase the area planted with coca.

Possible Drivers:

1. A perception of reduced risk associated with illicit activities, due to the suspension of aerial spraying and the possibility of avoiding forced eradication by means of blockades against law enforcement agencies. In addition, terms have been coined such as “crops for illicit use”, as opposed to “illicit crops”. Thus, some communities interpreted this as an authorization to grow coca, since what is illegal is the use of the crop, and not the crop per se.

2. An increase in expectations for benefits as compensation for the replacement of coca crops, in particular in relation to the expectations derived from point 4 of the Peace agreement[14].

3. A reduction of efforts in alternative development throughout the country, due to the transition from a crop-elimination based strategy to one focused on the transformation of the territory.

4. Although the price of the leaf decreased in 2016 as compared to 2015, it remains at a high level (from COP$ 2,014/kg paid in 2013, when the increase in coca cultivation began, it changed to COP$ 2,900/Kg in 2016).

Affectation from coca crops in areas with special legislation continues to be a threat to the country’s biological and cultural biodiversity. Although in a smaller proportion than the national total, the three categories of special management areas have had an increase in areas with coca: 32% in Indigenous Reserves (from 11,837 ha in 2015 to 15,665 ha in 2016), 45% in Lands of the Afro-Colombian Communities (i.e. a change from 16,030 ha to 23,164 ha in 2016), and 27% in Natural National Parks, from 6,214 ha in 2015 to 7,873 ha in 2016.

14 The final agreement for the ending of the conflict and the construction of a stable and lasting peace – Point 4: Solution to the problem of illicit drugs, establishes that the National Government shall prioritize voluntary illicit crop substitution programs, through a strategy that sets forth the provision of an economic subsidy in its first stage, as well as support in food security for people who join the program.

Potential production of fresh coca leaf[15] went from 454,040 MT in 2015 to 606,130 MT in 2016[16], i.e. an 33.5% increase. Chiefly, this is explained by the increase in the productive area. Due to the interruption of the spraying program, the increase of the areas with coca and the modifications in the agricultural conditions detected in the land[17], it is very likely that yields of coca crops have had significant changes which are yet to be measured[18].

Albeit potential cocaine production is high, the efforts made in terms of seizings is equally high; cocaine confiscations this year increased by 49% vis-à-vis FY 2015.

15 In 2016, the productivity studies scheduled for that period were postponed due to funding constraints.
16 Potential production of estimated fresh coca leaf in 2015 is between 357,600 mt - 550,500 mt, and between 522,900 mt - 719,100 mt in the year 2016.
17 Associated mainly to renewal of lots in strategic zones, with new cultivars whose yields are yet to be known. In some regions, changes in the use of agrochemicals and modifications in planting methods (increase of the density of plants per hectare) are evidenced.
18 Productivity and yield studies initiated a third national updating phase in 2015. However, said studies did not progress to operational stages in the year 2016 due to financial problems.

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Introduction

UNODC works in partnership with the countries most affected by the production of natural-origin drugs in order to monitor the spread and evolution of illicit crops, through the implementation of the global Illicit Crop Monitoring Program (ICMP). The program is currently present in Colombia, Peru and the Plurinational state of Bolivia for coca cultivation; Afghanistan, Mexico, and Myanmar for poppy cultivation.

The objectives of the Illicit Crop Monitoring Program include the establishment of methodologies for data collection and analysis, aiming to increase the capacity of governments to monitor illicit crops in their territories. In addition, the program seeks to assist the international community in monitoring the extent and evolution of illicit crops, within the context of the elimination strategy adopted by Member States under the action plan of Session 53 of the United Nations Drug Commission held in March, 2009.

UNODC has supported the monitoring of coca crops in Colombia since 1999, and has produced eighteen annual surveys based on satellite image analysis. The entirety of the country was not evaluated in the first two surveys (1999 and 2000), but starting 2001 coverage was extended to the whole national territory, in order to ensure the monitoring of the potential expansion of illicit crops.

The Government of Colombia has promoted a comprehensive approach to the problem of illicit crops, based on the study of territories as scenarios where different characteristics combine to facilitate or limit the sustainability of actions to combat illicit crops.

As a result, this document goes beyond an emphasis on hectares planted with coca and proposes a broader and focused view on the territories affected by illicit crops.

Thus, UNODC and the Government of Colombia through SIMCI have undertaken to provide a broad vision of the territory, in order to enable public policy designers, policy evaluators, the academic community and the civil society to access reliable and complementary data that help to understand the complex dynamics of drug production and its relationship with the territories.

The monitoring framework includes territories that – due to their vulnerability – are a scenario not only for illicit crops but also for other phenomena of crime, conflict and restrictions on development. These territories will have a fundamental role in the materialization of the agreements between the Government of Colombia and the Farc-Ep Guerrilla.

SIMCI is a joint project of UNODC and the Colombian Government. The national counterpart is the Ministry of Justice and Law which also chairs the National Drug Enforcement Board (CNE –from its original Spanish language initials – *Consejo Nacional de Estupefacientes*). The project is supported by an inter-agency group in charge of ensuring the transfer and adoption of technologies in beneficiary national institutions; it is supported by experts in remote sensing, geographic analysis, economic, social and territorial analysis; and in recent years a team dedicated to information technologies that works directly with the provision of information through the Colombian Drug Observatory (ODC - from its original Spanish language initials – *Observatorio de Drogas de Colombia*) and other information channels that manage the project.

The report is divided into four chapters. The first chapter focuses on the dimensions and specificities of the cocaine production problem, including the variables of area planted with coca crops, potential production and market dynamics. The second chapter is dedicated to the relations with the territory and responds to the intention to achieve control of the production of drugs through the transformation of the territories. This chapter develops information on the vulnerabilities of territories affected by illicit crops and provides information generated by SIMCI on other illegal activities in these territories.

The third chapter summarizes the actions of the Government of Colombia to address the drug problem. This chapter places particular emphasis on the Government's strategic vision to implement the fight against drug production, with the particularities required by the signing of the Peace Agreements.

Finally, chapter four presents the main innovations in matters of methodological aspects.

It is worth mentioning that a web version with links to more information is available at www.biesimci.org.

Context

The 2016 Coca Crop Survey comes at a key historical moment for Colombia. First, the signing of the Peace agreement with the FARC - Ep guerrillas, as well as the expectation of a successful process with ELN, mean the possibility to access some territories in a conflict-free environment. Secondly, the increase in drug use (not only in the region but also in the country) imposes the need for a new vision on the phenomenon, and a global support-based vision of sustainable development goals – which enhances the value of territories affected by illicit crops – are part of the context to be born in mind in order to understand the statistics and trends presented by the report.

The Peace Agreements[19] acknowledge the importance of the drug problem in Colombia by dedicating a whole chapter to this specific problem. Point 4 recognizes that the presence of illicit crops is a consequence of poverty in the countryside, the marginal conditions of the territories affected, poor institutional presence and the persistence of illegal armed groups. Point 4 also recognizes that the drug production problem is not circumscribed to illicit crops, and that its solution requires the development of strategies against drug use, production, trafficking and money laundering. One of the fundamental contributions of the agreements is the emphasis on the fact that the sustainability of solutions is reliant on the transformation of territories; in this vein, Point 4 is closely related to Point 1 – Comprehensive Rural Reform.

The vision of transforming territories to make the fight against illicit crops sustainable is a turning point in the way Colombia has been tackling the problem. It is also a great opportunity to align the fight against drug production with the Sustainable Development Goals, as adopted by the United Nations' Member States in September 2015; particularly, Objectives 1 - End of poverty; 2. Zero hunger; 10. Reduced inequalities, 15. Sustain Life on Land - Forest, Ground and Animals and 16. Peace, Justice and Strong Institutions – are the most recognizable goals under the new strategic framework.

19 Further information available at http://www.acuerdodepaz.gov.co.

Moving forward on this vision entails an additional effort in the generation of information that facilitates actions on the part of State entities that partake in the action strategy against drugs in Colombia. UNODC and the Government of Colombia work together to generate more and better information on the phenomenon itself, as well as on the affected territories. This report dedicates a complete chapter to the territories affected by illicit crops.

In this context, the Colombian Government addresses the need to integrate interventions to address the drug problem – particularly supply control measures related to the reduction of illicit production, stopping the expansion of the phenomenon in the territory, and the reduction of the territorial vulnerability which facilitates its presence. In addition, this challenge must be backed by the peace agreements with the Farc - Ep guerrillas, Colombia's call to the international community to review the way the world faces the drugs problem and an increasingly stronger domestic increase in drug use[20].

The first effect of this framework is transitioning from a strategy focused on the elimination of coca crops towards a strategy focused on the transformation of territories. This was explicitly stated under the Peace Agreements and the academic and institutional agenda in Colombia. Said transition began with the dismantling of the glyphosate aerial spraying program, a reduction of efforts on forced eradication, a community consultation process, the development of new strategies mainly associated with the National Plan for illicit crop substitution of and the implementation of strategies such as *"Formalizar para Sustituir"* (Becoming formalized to Substitute) which integrates the formalization of land tenure with the solution to the illicit crops problem.

During 2016, 755 farms were formalized under the *Formalizar para Sustituir* program. 18,227 ha were eradicated under the forced eradication model, and 17,970 families received attention as a continuation of the 2014-2015 alternative development program. However, implementation of the main strategy (National Plan for illicit crop substitution) had its greatest efforts in terms of design and coordination with the communities, though it only reached final agreements in the department of Vichada by the end of 2016. At any rate, it is impossible to conduct an assessment of the strategy based on the results of 2016; there has been an "undesirable effect" during the first phase of the transition process which hampers the dynamics of the phenomenon. Such effect consisted of a perception of lower risk for illicit activity, which in some cases even led to the perception that it was easier to access state services through illicit activities. It is very important to implement strategies aiming to correct this perception.

This transition period also aims at strengthening capacities in order to intervene the chain in the strongest links. Strategies to attack drug-processing complexes, the supply chain, and key transformation and marketing actors are increasingly strengthened under the Colombian government agenda.

20 2015 National Drug Use Survey. Ministry of Justice and Law.

On the other hand, the movement of Farc - Ep towards the concentration zones has generated a tendency towards the rearrangement of forces and powers in some territories. This phenomenon includes not only great efforts on the part of the state to legally occupy these spaces, but the appearance of strategies by other illegal armed groups to cover the spaces vacated by Farc - Ep. The peace talks have generated a clear sense of well-being and security in many regions of Colombia[21]; conversely, people leave in an environment of uncertainty and change of the rules of the game in other regions.

Changes in territorial control structures in some areas affected by coca cultivation promote dynamization of markets. Areas that typically operated within a model of many sellers with a single buyer, have moved towards a model with many sellers and many buyers, wherein prices are is increasingly adjusted to market conditions, thereby generating new incentives for illegal activity.

This dynamic has also led to changes in the power structure, which has gone from one based on territorial control to one based on control over illegal chains. The territories most affected by coca crops - particularly Nariño, Cauca and Catatumbo – have control of illegal chains which is reflected in a growing relationship of growers not only with coca cultivation but with stages of transformation and commercialization. This promotes the integration of all links in the chain, thus creating greater economic and social dependence, and making it difficult for the state to correct this situation. This generates warnings for the consolidation of price-related incentives, as well as incentives associated with coercion by illegal armed groups to remain in the illegal activity.

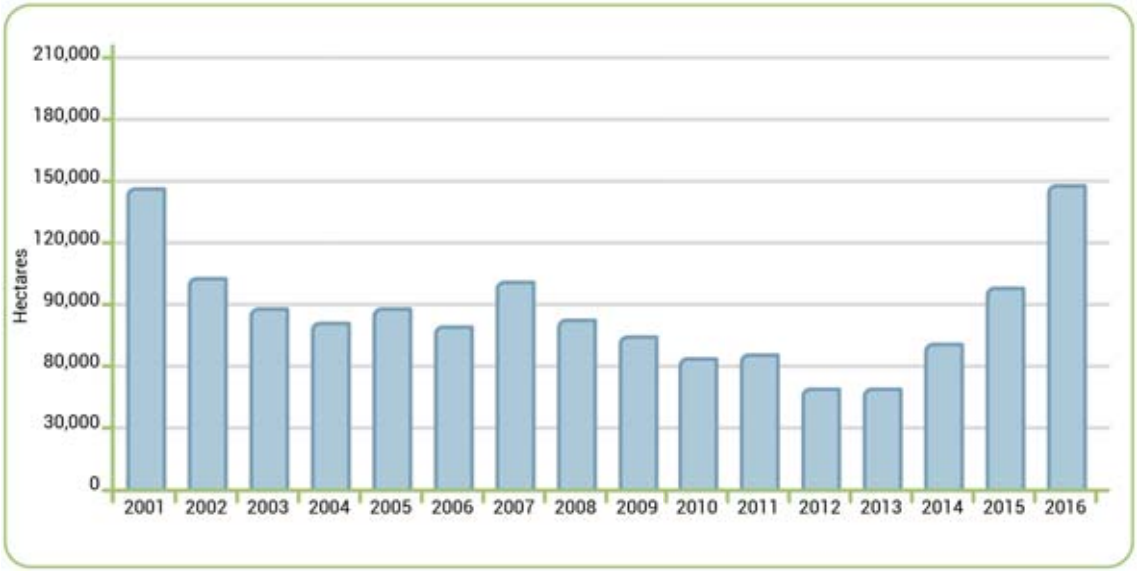
Within this context, it is worth mentioning that prioritization of concerted action with communities as a strategy to seek sustainability of actions against drug production has generated the emergence of new actors/associations that may be a good option, but also an obstacle. It is necessary to build capacities with these organizations, so that leadership, representativeness and management capabilities are enough to achieve transformation of the territories.

21 The development of the final stage of the peace talks to end the armed conflict with the FARC - Ep guerrilla in 2016 was characterized by the signing of the ceasefire and bilateral and definitive hostilities between this guerrilla and the National Government, accompanied by verification of the United Nations among other things. This led to the establishment of concentration zones for the insurgent group, the characteristics of the process for the laying down of arms and the security guarantees for ex-combatants.
The bilateral ceasefire and the signing of the final agreement allowed an unprecedented process of de-escalation of the armed conflict in the country. According to the Conflict Analysis Resource Center (CERAC), in the 2015/2016 period the country went from 25 civilian fatalities to 0 civilian fatalities, 50 to 3 military fatalities and 101 to 3 fatal victims of the Farc - Ep, in events of the armed conflict with direct participation of this guerrilla. In addition, CERAC reported that FARC went from committing 80 armed actions in June 2016 to 0 armed actions in August of that year. In turn, the Law Enforcement Forces went from 83 offensive actions against FARC to 1 action in 2016. In addition to this, the Single Victims Registry (RUV, from its Spanish initials – Registro Único de Victimas) issued by the Victims Unit reported a 58% reduction in just one year, from 174,777 in 2015 to 73,790 people identified as victims in 2016.

Inicio

Chapter 1
COCA CROP SURVEY

Coca crops in Colombia increased sharply, from 96,000 ha in 2015 to 146,000 ha in 2016. This represents a 52% increase as compared to the 2015 measurement, and three times that of 2012, when the lowest level of the historical series was reached - 49,000 ha[22].



Graph 1. Historical series of area with coca as of December 31, 2001 – 2016.

Half of the increase is concentrated in two departments: Norte de Santander and Nariño; However, coca increased in 15 departments, it was stable in 3 departments and was reduced in 3 departments. The following table shows the historical departmental series of coca crops.

Nariño, Putumayo and Norte de Santander are still the departments which

22 Aerial spraying operations in Colombia have been suspended since the end of 2015, by decision of the National Government. Please refer to Resolution 0006, May 29, 2015 (https://www.odc.gov.co/Portals/1/Docs/pesig/resolucion_0006_29mayo_2015_suspension_aspersion.pdf).

have been most affected by coca crops; as 63% of all coca in the country is concentrated in these three departments. On the other hand, the following departments have less than 50 hectares planted with coca and are close to getting rid of illicit crops: Santander, Magdalena, Cesar, Guainía, Boyacá and Arauca. It is important to mention that Cundinamarca, Caldas and La Guajira, remained free of coca in 2016.

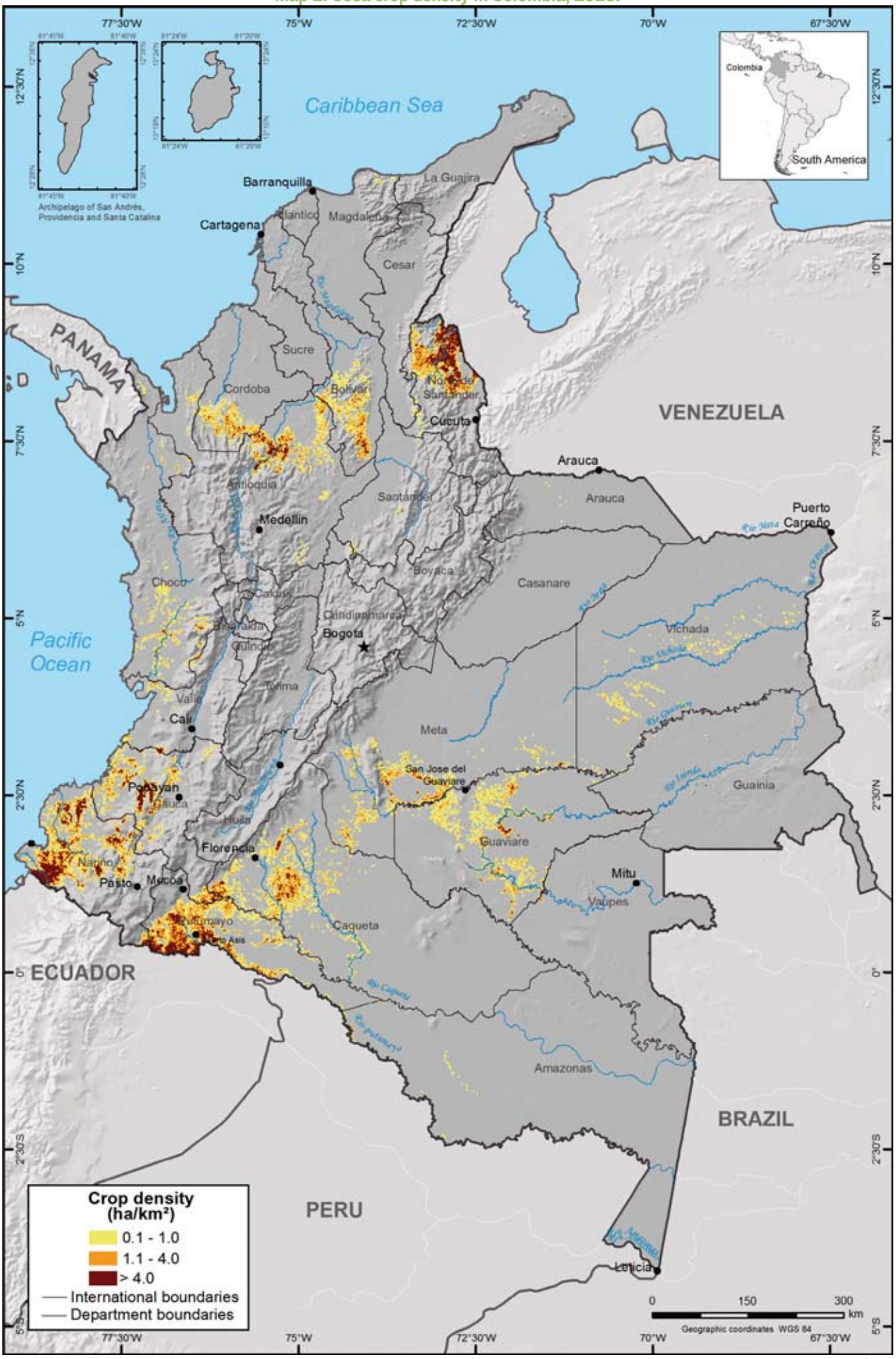
The highest growth of coca crops occurred in areas that already had the largest amount of coca in 2015, and that have continuously had coca over the past 10 years

Department	Dec.-2008	Dec.-2009	Dec.-2010	Dec.-2011	Dec.-2012	Dec.-2013	Dec.-2014	Dec.-2015	Dec.-2016	%change 2015-2016	% of the total 2016
Nariño	19,612	17,639	15,951	17,231	10,733	13,177	17,285	29,755	42,627	43%	29%
Putumayo	9,658	5,633	4,785	9,951	6,148	7,667	13,609	20,068	25,162	25%	17%
Norte de Santander	2,886	2,713	1,889	3,490	4,516	6,345	6,944	11,527	24,831	115%	17%
Cauca	5,422	6,597	5,908	6,066	4,325	3,326	6,389	8,660	12,595	45%	9%
Caqueta	4,303	3,985	2,578	3,327	3,695	4,322	6,542	7,712	9,343	21%	6%
Antioquia	6,096	5,096	5,350	3,104	2,725	991	2293	2,402	8,855	269%	6%
Guaviare	6,629	8,660	5,701	6,839	3,851	4,725	5,658	5,423	6,838	26%	5%
Meta	5,525	4,469	3,008	3,040	2,699	2,898	5,042	5,002	5,464	9%	4%
Bolivar	5,847	5,346	3,324	2,207	1,968	925	1565	1,044	4,094	292%	3%
Cordoba	1,710	3,113	3,889	1,088	1,046	439	560	1,363	2,668	96%	2%
Choco	2,794	1,789	3,158	2,511	3,429	1,661	1,741	1,489	1,803	21%	1%
Valle del Cauca	2,089	997	665	981	482	398	561	690	752	9%	0.51%
Vichada	3,174	3,228	2,743	2,264	1,242	713	511	683	699	2%	0.48%
Amazonas	836	312	338	122	98	110	173	111	167	50%	0.11%
Vaupes	557	395	721	277	254	184	109	33	97	194%	0.07%
Santander	1,791	1,066	673	595	111	77	26	21	37	76%	0.03%
Magdalena	391	169	121	46	37	37	9	7	35	400%	0.02%
Cesar	5	0	0	0	13	13	10	32	26	-19%	0.02%
Guainia	625	606	446	318	301	81	66	37	22	-40%	0.02%
Boyaca	197	204	105	93	10	17	14	8	15	88%	0.01%
Arauca	447	430	247	132	81	69	25	17	9	-47%	0.01%
Caldas	187	186	46	46	16	8	0	0	0	n.a	n.a
La Guajira	160	182	134	16	10	6	0	0	0	n.a	n.a
Cundinamarca	12	0	32	18	0	0	0	0	0	n.a	n.a
TOTAL	**80,953**	**73,139**	**61,812**	**63,762**	**47,790**	**48,189**	**69,132**	**96,084**	**146,139**	**52%**	
Rounded total	**81,000**	**73,000**	**62,000**	**64,000**	**48,000**	**48,000**	**69,000**	**96,000**	**146,000**	**52%**	
Number of affected departments	**24**	**22**	**23**	**23**	**23**	**23**	**21**	**21**	**21**		

Table 1. Area with coca per department in Colombia, 2008 – 2016[23] (hectares).

23 The historical series of coca crops by department from 2001 to 2016 can be found in Annex 5.

Map 1. Coca crop density in Colombia, 2016.



Source: Colombian Government – UNODC-supported monitoring system.
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The problem of illicit crops continues to be concentrated in areas where there has been historical presence (see Dynamics of Coca Crop Permanence). Firstly, it is worth mentioning that the municipalities most affected[24] by coca crops remain the same as in 2015. In fact, Tumaco, the municipality which most affected by coca crops in the country, has remained on the list of most affected municipalities since 2002. 4 of the 10 most affected municipalities in 2016 have remained on the list for over 5 years, and the share of the 10 most affected municipalities nationawide went from 37% in 2012 to 48% in 2016.

Secondly, the cores with the highest density of coca crops remain basically the same since 2012: Catatumbo, south of Nariño, south of Putumayo and the mountainous area of Cauca. The following chart compares the coca density map in 2012 (when the lowest point in the historical series was reached), with the map of changes in coca crops between 2012 and 2016. The scheme allows us to observe not only that the cores are constant, but that the areas with the highest growth match the areas that were already the centers with the highest density of coca in 2012.

KEY CONCEPTS

- Area with coca: Hectares with coca in the country, grown as of December the 31st,
- Affected area: Geographic sum of reports on presence of illicit crops derived from aerial spraying, manual eradication and annual survey, UNODC produces the data under the latter two; the aspersion report is conducted by Diran,
- Area of Influence: Area derived from the application of a 1 Km buffer to each one of the centroids of coca lots,
- Territory affected: It refers to 25 Km² grids which have been reported to have coca crops at some point in time over the last 10 years,

24 The problem of the 10 most affected municipalities is developed in greater depth on page 29 of this document.

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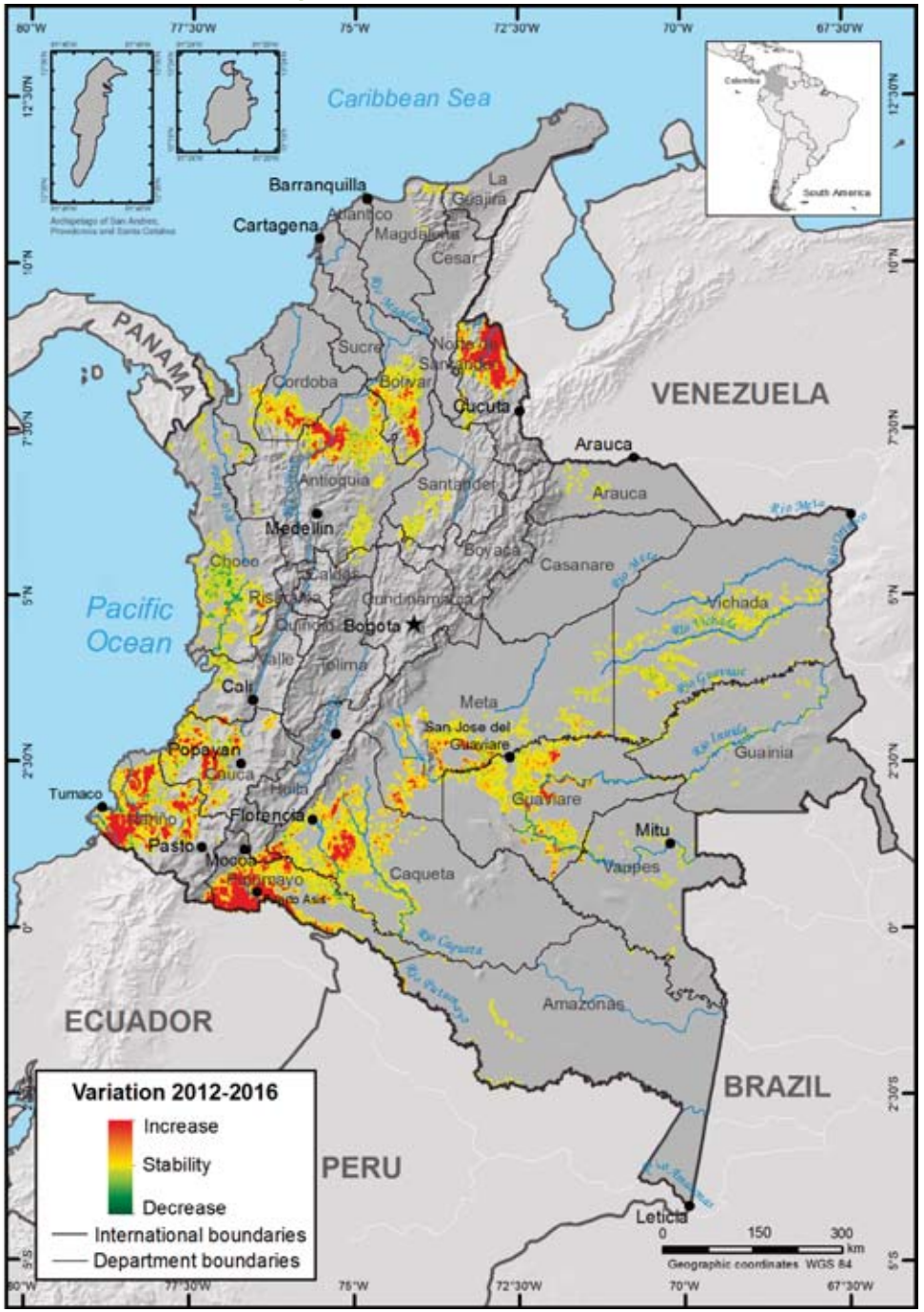
Map 2. Coca crop density in Colombia, 2012.

Coca crop variation in Colombia, 2012 – 2016.



Source: Colombian Government – UNODC-supported monitoring system.
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Finally, it is worth mentioning that 80% of the lots identified in 2016 had already been detected, sprayed or eradicated previously. This indicates that the increase in coca cultivation is due to a reactivation of activity in areas where some level of control has been achieved – not only as an effect of aerial spraying and eradication, but also as an effect of development and safety actions in previously affected territories. It is important to note that this reactivation happened with much more force in the territories with the following characteristics:

- Territories where different links of the chain of production, transformation and trafficking have been integrated[25].
- Where there are no hegemonic groups that control the territory; in particular, where there was no hegemonic control by Farc - Ep.
- Territories associated with border areas or drug exit corridors.
- Territories where the phenomenon of coca cultivation has remained for more than ten years (see Dynamics of Coca Crop Permanence).

These territories correspond mainly to Cauca - Nariño and the Central region (which includes Catatumbo). By 2015, the price of coca leaf in the central region was the highest in the country and the historical series in the region ($ 4,150 / kg), although there is a price reduction for 2016. Said reduction is still higher than the national average. In the Cauca - Nariño core, coca leaf prices remain close to the national average. However, they are 11% higher than in 2011 when the core reached the lowest point in area grown in the last 10 years. The price dynamics show a system of incentives to maintain coca crops in this territory; field observations also show the activation of markets, from an oligopsony model, to a more open model with several buyers competing to take coca leaf or pasta.

It is very important to mention that in Cauca - Nariño and in the Central region there are different illegal actors. In Cauca – Nariño, the presence of ELN, EPL, and BACRIM is reported, and they have even reported the presence of foreigners invigorating the local markets of coca leaf and cocaine paste. The central region (in particular Catatumbo, southern Bolivar and Bajo Cauca) is characterized by an increasingly hegemonic presence of criminal gangs such as the so-called "Clan del Golfo". The dynamics of prices and illegal actors show a trend in which territorial control is less important but maintains its interest in drug production.

There were increases in the east of the country, but in a much smaller proportion to those of the west of the country...

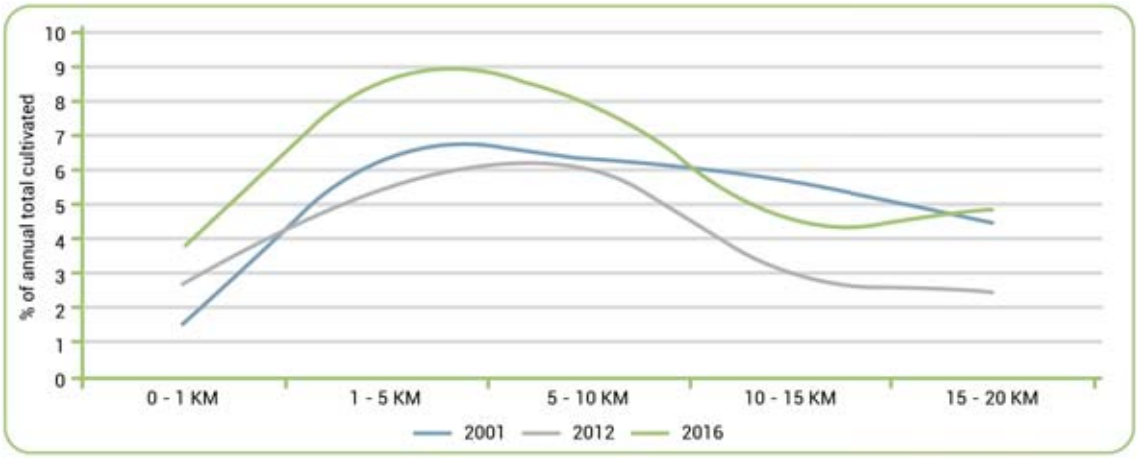
The geographical distribution of changes shows a clear trend; the strengthening of the cores located to the west of the mountain range of the Andes, against a less accentuated growth in the Orinoco and Amazon region. This differentiation is important in light of the geography of the conflict in Colombia; in general, the east of the country is associated with the presence of the Farc - Ep guerrillas, while the West - in particular the "Bajo Cauca - Sur Bolivar – Catatumbo" area is more associated with the presence of criminal gangs and extreme

25 Information collected in field operations and work with the intelligence divisions of the Armed Forces and National Police, in the framework of the Departmental Characterizations available at http://www.odc.gov.co/TERRITORIOS/Caracterizaci%C3%B3n/Documentos.

right-wing groups. The Peace agreements with Farc - Ep constitute an important opportunity for the transformation of the territories. However, this will not homogeneously affect the processes in all the territories.

In 2016, coca cores associated with border areas continue to be consolidated, especially in Nariño, associated with the populated centers of La Balsa and Llorente; in Putumayo, associated to the towns of Puerto Vega and Puerto Asís, and in Norte de Santander, associated with the populated center of La Gabarra. The following graph shows the distribution of coca crops according to the distance to the borders in 3 moments of the historical series - 2001, 2012 and 2016 .

The areas with the highest concentration of coca crops are associated with border areas ...



Graph 2. Distribution of coca crops according to distance to a border, 2001 - 2012 - 2016.

It is important to note that 30% of coca crops in Colombia is less than 20 km away from some border.

The 10 most affected municipalities are in the areas classified as permanently affected, and concentrate 48% of all the country's coca.

The trend of concentration identified in the country shows the problem of 10 critical municipalities, in which 48% of the area with coca in 2016 is located. In these territories, the impact has been continuous and increasing in recent years – this fact that has favored the establishment of illegal economies that have indirectly permeated local legal economies, thereby creating a certain degree of dependence.

The area with coca in the 10 municipalities with the highest incidence changed from 45,748 ha in 2015 to 70,579 ha in 2016. Although the participation of these municipalities in the national total is 48% both in 2015 and 2016, for this year, there is a 55% increase in the number of hectares with coca.

The 10 most affected municipalities are the same as 2015, with the exception of Sardinata (Norte de Santander) which replaced Olaya Herrera (Nariño) in the

ranking. Tumaco continues to be the municipality with the greatest impact in the country, with 23,148 ha, representing 16% of the country's total. Four of the municipalities in the list are border towns: Tumaco, Tibú, Valle del Guamuez and San Miguel.

Department	Municipality	Coca crops 2016	Coca crops (ha) % of the total 2016
Nariño	Tumaco	23,148	16
Norte de Santander	Tibu	12,787	9
Putumayo	Puerto Asis	7,453	5
Cauca	El Tambo	5,300	4
Putumayo	Valle del Guamuez	4,886	3
Norte de Santander	Sardinata	3,847	3
Norte de Santander	El Tarra	3,683	3
Nariño	Barbacoas	3,359	2
Putumayo	San Miguel	3,128	2
Putumayo	Orito	2,988	2
Total		**70,579**	**48%**

Table 2. The ten municipalities with the largest amount of coca, 2016.

As of 2009, these municipalities record actions that limited the operation of interdiction strategies such as aerial spraying and forced manual eradication. On the one hand, the aerial spraying restriction within 10 km from the border with Ecuador in the departments of Nariño and Putumayo, restrictions of operation in the mountainous area of Cauca and the suspension of aerial spraying since 2010, due to public order conditions in Norte de Santander.

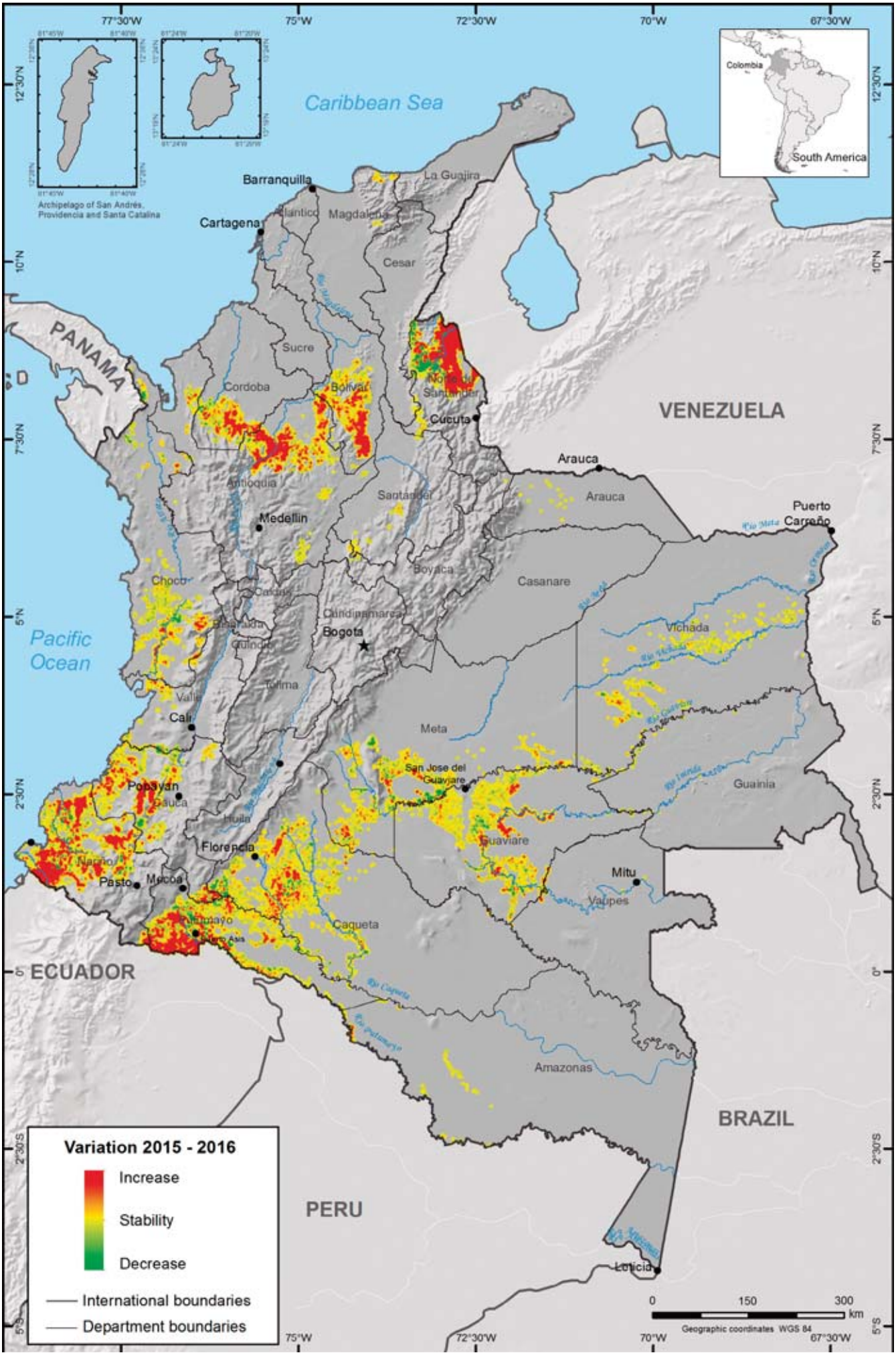
Caquetá, Antioquia, Vichada and Meta are the departments with the greatest proportion of recidivism in affectation by coca

6% of the territory that had been classified as abandoned in 2015, is again affected by coca in 2016. This behavior implies sustainability problems that are directly associated with the permanence of the conditions of vulnerability in the territories. This pattern favors not only recidivism in the area planted but also the implantation of new illegal economies.

Caquetá and Antioquia are the departments in which a greater proportion of recurrence of the phenomenon is evidenced, with 21% and 14%, respectively. In municipalities like Briceño, El Bagre and Nechí in Antioquia, Valparaíso and Florencia in Caquetá; Puerto Lleras, Puerto Concordia and Mapiripán in Meta and Cumaribo in Vichada; recidivism is strong. Although recidivism is dispersed and distributed in the periphery of more consolidated cores, this behavior is configured as an alert because these territories were progressing toward a consolidation of territories free of coca.

The results of the 2016 survey, as well as the way in which coca crops behaved as compared to the historical series, are further developed in the following sub-chapters. The next chapter shows the map of permanence, which is a synthesis of the historical series of coca crops.

Map 3. Coca crop variation, 2015 - 2016.



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DYNAMICS OF COCA CROP PERMANENCE

The dynamics of permanence analyzes 25km² areas that at some point during the last 10 years have presented coca crops. The pattern in the establishment and abandonment of coca crops is associated with processes of occupation of the territory. During the 16 years of monitoring processes, these patterns allowed to define four scenarios in which the establishment of crops is facilitated or made difficult.

1. The areas of ruralization where the abandonment of coca crops is promoted, which gives way to the incorporation of land in processes of legal production.
2. The fronts of colonization, where activities such as deforestation, grassland development and subsistence crops are combined with illicit crops.
3. The points of colonization, which constitute the advance of illicit crops along water sources.
4. Jungles or land forests, which are the new areas for the establishment of illicit crops.

Region	Total		Abandoned Territory in the last 3 years		Permanently affected territory		Intermittently affected territory		Territory recently affected in the last 3 years	
	km²	%	km²	%	km²	%	km²	%	km²	%
Amazon	21,450	9.0	17,300	19.6	325	0.6	3,425	4.0	400	3.4
Catatumbo	10,075	4.2	1,350	1.5	3,225	6.1	5,125	6.0	375	3.2
Central	40,225	16.9	18,075	20.4	6,150	11.6	15,125	17.8	875	7.5
Meta - Guaviare	42,975	18.0	14,225	16.0	11,225	21.2	13,900	16.3	3,625	30.8
Orinoco	26,475	11.1	15,825	17.9	1,700	3.2	7,850	9.2	1,100	9.4
Pacific	50,700	21.3	10,800	12.2	15,700	29.6	21,525	25.3	2,675	22.7
Putumayo - Caqueta	43,125	18.1	8,150	9.2	14,600	27.6	17,675	20.7	2,700	22.9
Sierra Nevada	3,200	1.3	2,675	3.0	25	0.05	500	0.6	0	0.00
Total	**238,225**	**100**	**88,400**	**100**	**52,950**	**100**	**85,125**	**100**	**11,750**	**100**

Table 3. Regional distribution of permanence of areas with coca (2007 - 2016).

Notes to the Dynamics of Permanence

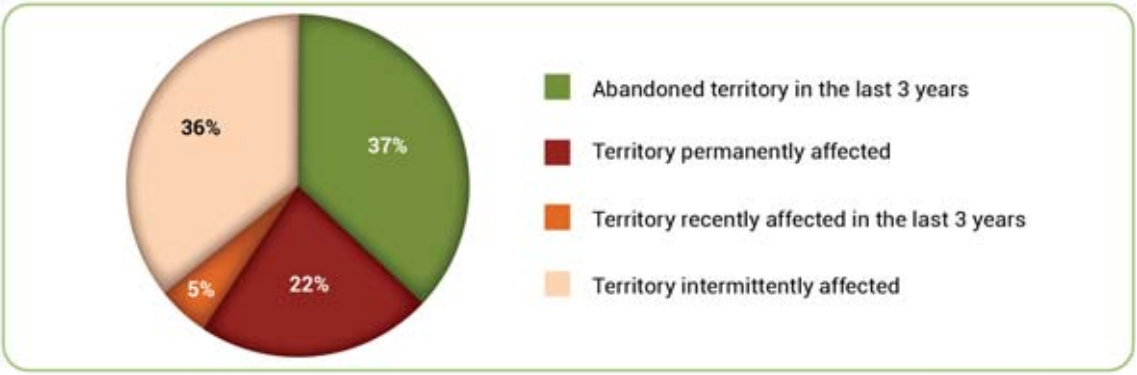
1. Dynamics analysis are conducted based on the year 2007.
2. The territory is considered abandoned within the last 3 years, when there have been no coca crops within the last three years, and it is expressed as the percentage of the total territory affected over the last 10 years.
3. The territory is considered permanently affected, when there have been coca crops continuously since the year 2007, and it is expressed as the percentage of the total territory affected over the last 10 years.
4. The territory is considered intermittently affected, when there have been coca crops interruptedly since the year 2007, and it is expressed as the percentage of the total territory affected over the last 10 years.
5. The territory is considered affected for the first time within the last 3 years, when there have been coca crops for the first time in the last 3 years, and it is expressed as the percentage of the total territory affected over the last 10 years.

In 2016, the territory affected by coca crops was 238,225 km^2, 2% less vis-à-vis 2015, 242,725 km^2, and 3% less that in 2014, i.e. 246,125 km^2. This behavior reinforces the theory of a process of concentration of coca crops.

22% of the territory has been permanently affected by coca crops during the last 10 years. Regarding the year 2015, this category increased by 2%. The greatest amount of crops are found in these areas, 79% of the national total, and are presented in a greater percentage (80% of the national total) in the departments of Nariño, Putumayo, Guaviare, Caqueta, Cauca, Meta and Norte de Santander.

79% of coca crops (115,684 ha) are located in territories classified as permanently affected

Areas were identified in all the departments where coca crops appear and disappear, i.e. they have an intermittent behavior. These areas correspond to 36% of the territory. The Putumayo-Caquetá and Pacific regions have the highest presence in this category. With respect to 2015, it decreases by 3%. 20% of the crops in the year 2016 are in these territories.



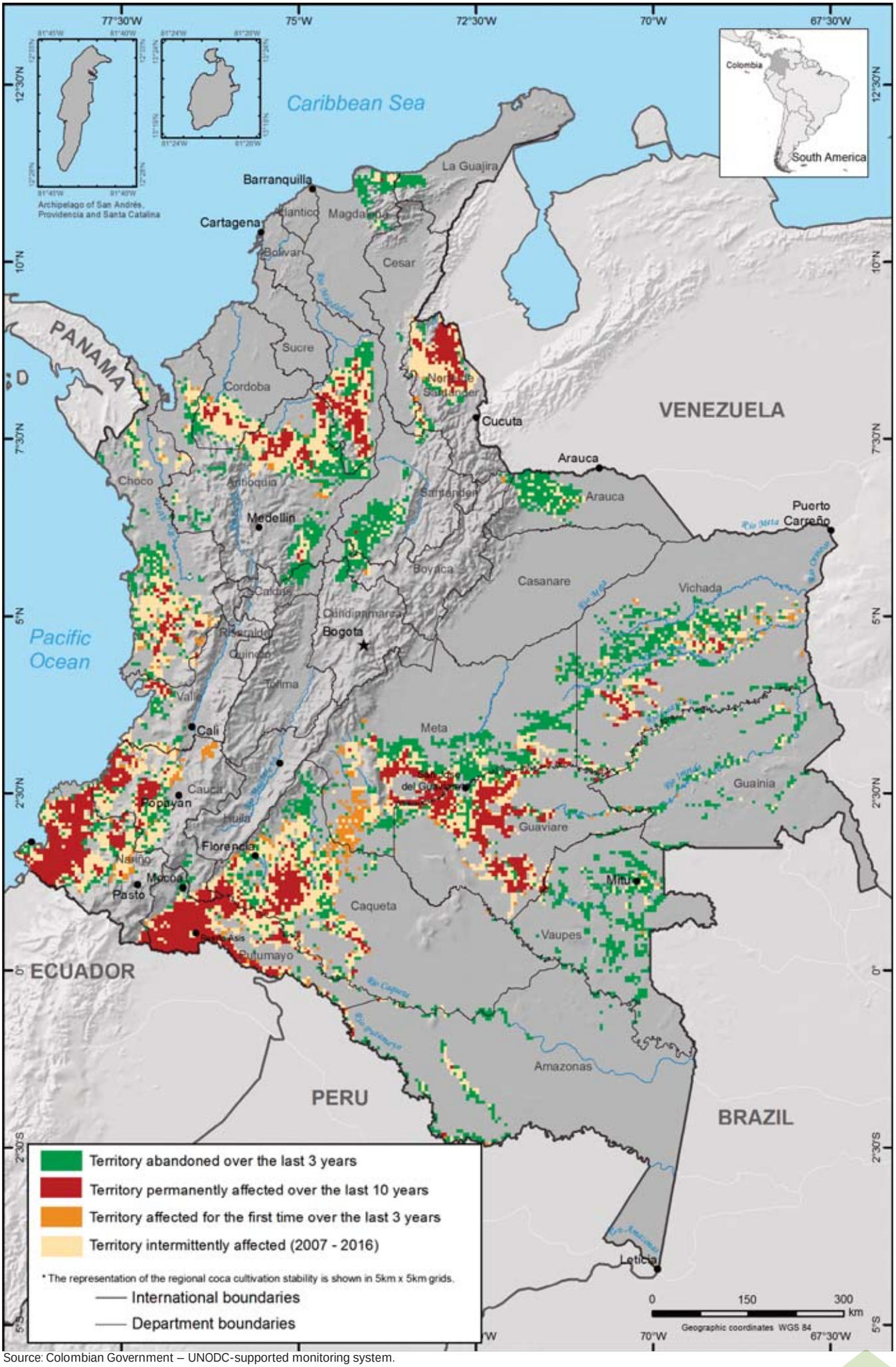
Graph 3. Regional distribution of permanence in affected territories, 2007 - 2016.

Abandoned areas encapsulates those areas that did not present coca crops during the last three years. In 2016, 37% of the territory is in this category. These territories are present in a high percentage in the Central regions, Magdalena Medio subregion; Amazon; Orinoco – especially Arauca – and north of Vichada, as well as in the department of Meta.

The new areas with coca crops considered as zones of expansion of the phenomenon represent 5% of the national territory affected. This behavior is concentrated between the departments of Meta and Caquetá, in the area known as *Sabanas del Yarí*, former zone of distention. This area presented coca crops at the beginning of the historical series, and was classified as abandoned. However, since 2014 it has reactivated as an area of expansion, and by 2016 it accumulates 57% of coca in this category; it is also configured as an alert for the Tinigua National Natural Park, where these areas have been located, to allow the connection between the southern cores, Putumayo Caquetá, and the Meta-Guaviare region.

Other zones of expansion are located in the municipalities of Corinto, Caloto and Toribio in Cauca. These areas have presented marijuana crops in previous years and, in addition, their upper parts they have favorable conditions for planting poppy.

Map 4. Regional distribution according to coca crop permanence, 2007-2016.



Source: Colombian Government – UNODC-supported monitoring system.

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REGIONAL ANALYSIS OF THE AREA WITH COCA

This chapter provides a more detailed review of the behavior of coca crops in the regions: In particular, it seeks to highlight local trends as an introduction to the municipal report prepared by UNODC[26].

39% of coca is in the Pacific region – the most affected region – followed by the central region (28% of coca) and the Putumayo - Caquetá region (24% of coca). In relation to the regions most widely affected by coca, the most significant increase occurred in the central region.

The participation of the eastern regions of the country (Meta - Guaviare, Orinoco and Amazon) has been considerable reduced. In 2001, 36% of coca was located in these regions; in 2012, participation had been 18% and by 2016 it was at 9%. In contrast, the western cores show a strong tendency to increase, marked by the behavior in Norte de Santander and Nariño.

The Central region has been growing; in 2001 it had 12.3% of the country's coca; in 2012 – despite reaching the lowest point of the historical series – the region's share rose to 22% and in 2016 it is at 28%.

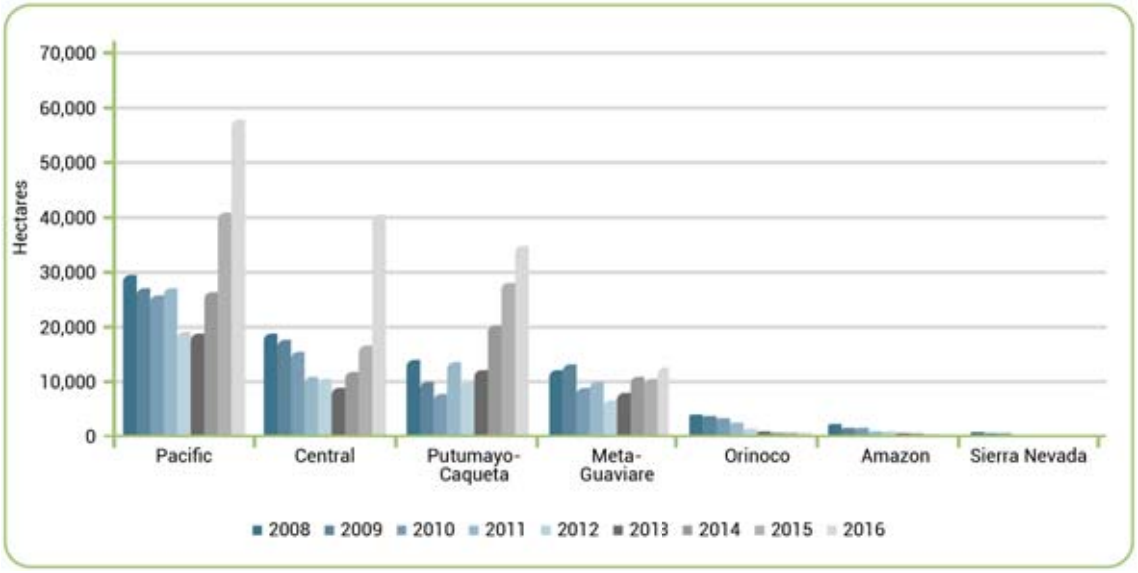
Unlike the Pacific and Central regions, the participation of Putumayo - Caquetá in the area planted with coca in Colombia has been decreasing. In 2001, the region had a 43% share of the country's coca. This share 21% in 2012 and remains close (24%) by 2016.

As in the case of Putumayo - Caquetá, the participation of Meta - Guaviare in the coca crop survey has been decreasing. In 2001, 25.5% of the country's coca was in this region; by 2012, that share fell to 13.7% and by 2016 it continues to decline to reach 8%.

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	% of the total	Change 2015-2016
Amazon	2,018	1,313	1,505	717	653	375	348	181	286	0.2	58
Central	18,731	18,048	15,308	10,641	10,405	8,815	11,412	16,397	40,526	28	147
Meta-Guaviare	12,154	13,129	8,709	9,879	6,550	7,623	10,700	10,425	12,302	8	18
Orinoco	3,621	3,658	2,990	2,396	1,323	782	536	700	708	0.6	1
Pacific	29,917	27,022	25,682	26,789	18,969	18,562	25,976	40,594	57,777	39	42
Putumayo- Caqueta	13,961	9,618	7,363	13,278	9,843	11,989	20,151	27,780	34,505	24	24
Sierra Nevada	551	351	255	62	47	43	9	7	35	0.02	400
Rounded Total	**81,000**	**73,000**	**62,000**	**64,000**	**48,000**	**48,000**	**69,000**	**96,000**	**146,000**		**52**

Table 4. Area with coca in Colombia by region (hectares), 2008-2016.

26 Municipal statistics are available at http://www.odc.gov.co/sidco/oferta/cultivos-ilicitos/departamento-municipio.



Graph 4. Area with coca in Colombia by region (hectares), 2008-2016.

Within the framework of the Peace agreement with the Farc - Ep guerrillas, the establishment of the insurgent group took place in specific areas of the country known as Transitional Standardization Zones *(ZVTN - Zonas Veredales Transitorias de Normalización)* or Transitory Points of Standardization *(PTN - Puntos Transitorios de Normalización),* in which Farc-Ep could regroup, lay down their arms and, finally, transition to civil life – the latter stage is still is in process.

On June 23, 2016, the establishment of these areas was agreed on paper by means of the signing of the agreement – point 3, titled "End of the Conflict". Between this date and the signing of the final agreement – November 24, 2016, there began in the territories a work of rapprochement with the communities, authorities and members of the guerrilla group to define the ZVTN/PTN.

24 out of 26 ZVTN/PTN[27] are in the area of influence of coca crops; only La Fila and Jordán are outside the area influenced by coca crops. La Variante, located in Nariño, is the concentration zone which is most widely affected by the presence of coca, in a radius of 50 km with 26,354 ha, of which 60% is within less than 15 km.

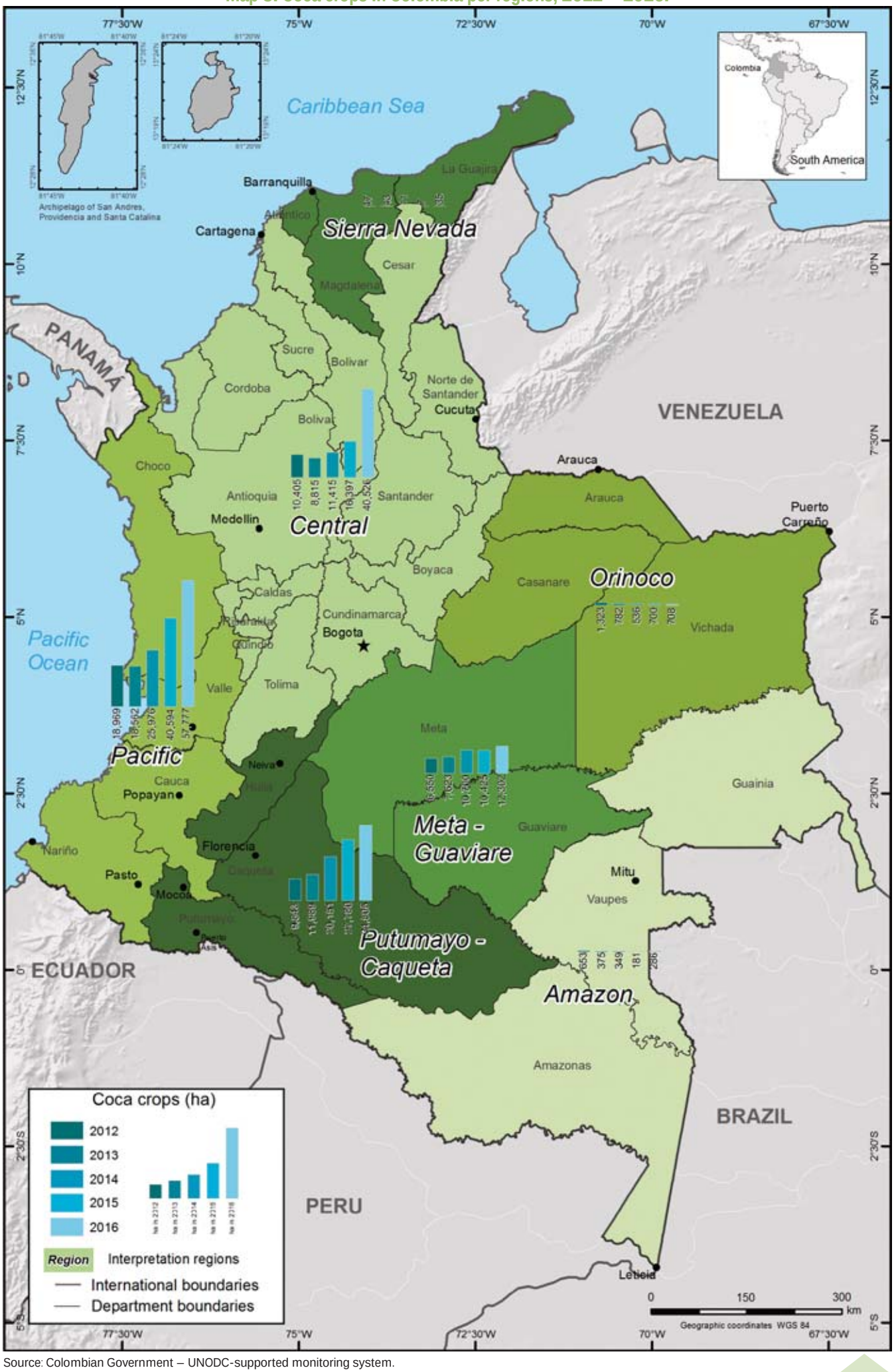
The ZVTN/PTNs most affected by coca crops in 2016 within less than 5 km are: The Variante in Nariño, Caño Indio in Norte de Santander and La Pradera in Putumayo. In the 0-15 km range of ZVTN/PTN, crops increased from 3,506 ha in 2010 to 26,854 ha in 2016.

In this chapter, we identify populated centers[28] with which the territory affected by illicit crops is articulated. Populated centers are a key element in the planning of actions related to institutional strengthening and the integration of lawful activities in the regions.

The regional analysis seeks to identify the differences and similarities of the phenomenon in the regions, and promotes the utilization of useful information for the design of policies and strategies that respond to these particularities.

27 The geographical reference for the ZVTN/PTN was facilitated by the Peace Mission in Colombia, as of June, 2017.
28 The estimate of the populated centers articulated with affected territories was made from an update of populated centers IGAC 2012 and DANE 2012.

Map 5. Coca crops in Colombia per regions, 2012 – 2016.



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Pacific Region

39% of the country's coca is in the Pacific region[29]. By 2016, the highest point of the historical series is reached with 57,777 ha. This is 5 times the amount detected in 2001 – the lowest point in the series. The region, but in particular the department of Nariño, shows a sharp increase in coca crops since 2013.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Nariño	19,612	17,639	15,951	17,231	10,733	13,177	17,285	29,755	42,627
Cauca	5,422	6,597	5,908	6,066	4,325	3,326	6,389	8,660	12,595
Choco	2,794	1,789	3,158	2,511	3,429	1,661	1,741	1,489	1,803
Valle del Cauca	2,089	997	665	981	482	398	561	690	752
Total	**29,917**	**27,022**	**25,682**	**26,789**	**18,969**	**18,562**	**25,976**	**40,594**	**57,777**
% of change	**15%**	**-10%**	**-5%**	**4%**	**-29%**	**-2%**	**40%**	**56%**	**42%**

Table 5. Coca crops in Pacific, 2008 - 2016 (hectares).

The geostrategic position of the Pacific region is both vulnerable to problems of illegality and a great opportunity for development. It has an extensive coastline, but it is poorly connected to the center of the country[30]. The Pacific region has the most important port of the country (Buenaventura); however, the region's production has no prospect of export.

Tumaco is the municipality which is most widely affected by coca crops in the region. However, the populated centers in which the problem is concentrated are La Balsa, Llorente, Guayacana and Restrepo. In Nariño, coca cores have been consolidated around the center of Bolivar (El Charco) and Sidón (Cumbitara).

The municipality of Cauca which is most widely affected is El Tambo, in particular the "El Plateado" populated center. This populated center is associated with a third of all the coca in the department. It is important to highlight coca cores in Sinaí (Algeria), Uribe (El Tambo), Santa Cruz de Sagun (López de Micay) and Brisas (Patía).

The municipality which is most widely affected in Valle del Cauca is Buenaventura, where half of the coca crops are associated with the "Concepción" populated center.

The municipality which is most widely affected in Chocó is Istmina, in particular the populated centers of San Agustín and Cucurrupí. It is also important to mention the involvement in San José del Palmar and in the El Tambito town center.

There are six ZVTN/PTNs in the Pacific region: Brisas / La Florida, El Ceral, Los Monos, Betania / Madrigal, La Variante and Monterredondo.

Generally speaking, the area surrounding the concentration zones has had an increase in the area planted with coca in the last five years, with the exception of

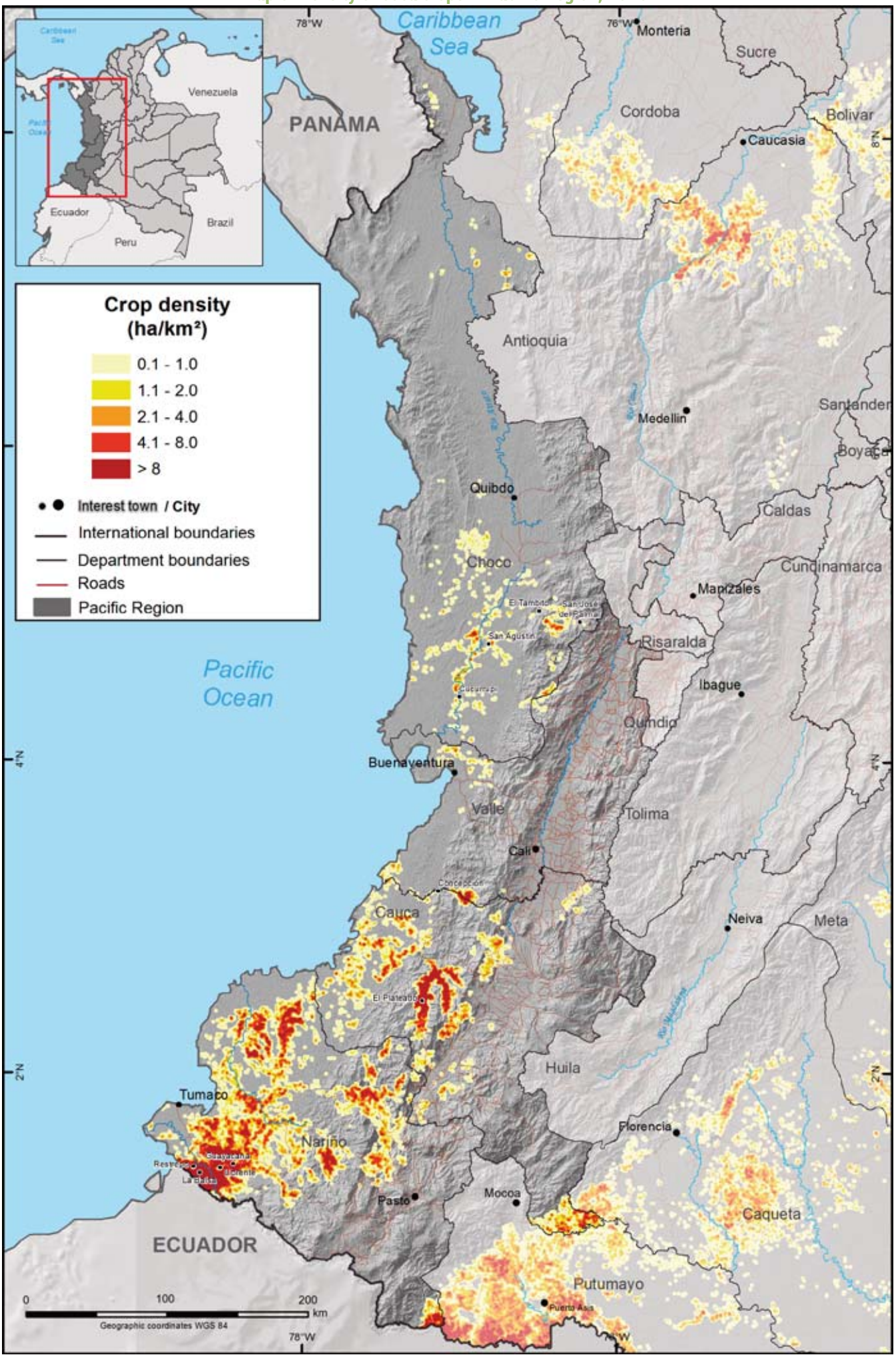
29 For more information related to the regional characterization of the problem associated with illicit drugs in the departments of the region, please refer to: http://www.odc.gov.co/TERRITORIOS/Caracterizaci%C3%B3n/Documentos.
30 Road connection with the center of the country goes through the following roads: Pasto - Tumaco, Cali - Buenaventura and Medellin – Quibdo.

Monterredondo, which had no report of presence of coca before 2015.

La Variante, located in Nariño, is the concentration zone which is most affected by the presence of coca. 1,415 ha are located less than 5 km; there were 325 ha within this distance range in 2014. Betania / Madrigal – located in Nariño – is the second area most affected by the presence of coca; there are 98 ha within less than 5 km of the concentration zone.

Lots of coca with high leaf density in Tumaco.

Map 6. Density of coca crops in Pacific Region, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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Central Region

28% of the country's coca is in the central region[31], which in turn is made up of three subregions: Catatumbo (Norte de Santander and César), where 61% of coca in the region is found, Bajo Cauca (Antioquia, Bolívar and Córdoba) are found, 39% and Magdalena Medio (Santander, Boyacá, Caldas and Cundinamarca) which is less than 1% of the coca in the region.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Norte de Santander	2,886	3,037	1,889	3,490	4,516	6,345	6,944	11,527	24,831
Antioquia	6,096	5,096	5,350	3,104	2,725	991	2,293	2,402	8,855
Bolivar	5,847	5,346	3,324	2,207	1,968	925	1,565	1,044	4,094
Cordoba	1,710	3,113	3,889	1,088	1,046	439	560	1,363	2,668
Santander	1,791	1,066	673	595	111	77	26	21	37
Cesar	-	-	-	-	13	13	10	33	26
Boyaca	197	204	105	93	10	17	14	7	15
Caldas	187	186	46	46	16	8	0	0	0
Cundinamarca	12	0	32	18	0	0	0	0	0
Total	**18,726**	**18,048**	**15,308**	**10,641**	**10,405**	**8,815**	**11,412**	**16,397**	**40,526**
% of change	**-11%**	**-4%**	**-15%**	**-30%**	**-2%**	**-15%**	**29%**	**44%**	**147%**
Total sub - region Catatumbo	**2,886**	**3,037**	**1,889**	**3,490**	**4,529**	**6,358**	**6,954**	**11,560**	**24,857**
Total sub - region Bajo Cauca	**13,653**	**13,555**	**12,563**	**6,399**	**5,739**	**2,355**	**4,418**	**4,809**	**15,617**
Total subregión Magdalena Medio	**2,187**	**1,456**	**856**	**752**	**137**	**102**	**40**	**28**	**52**

Table 6. Coca crops in the Central Region, 2008 - 2016 (hectares).

The lowest point in the historical series came in 2013, when the area planted with coca was estimated at 8,815 ha – about a fifth of the amount detected in 2016. This strong increase is mainly marked by Norte de Santander, where crops have been growing since 2006. However, Antioquia, Bolívar and Cordoba had strong increases in 2016.

Between 2015 and 2016, coca crops were doubled in Córdoba and Norte de Santander and tripled in Antioquia and Bolívar.

The Catatumbo subregion has shown one of the strongest increases in the country. In 2004, paramilitary groups that had influence in the region were demobilized; the lowest point of the series was achieved in 2006, but since then crops have shown a continuous increase. There are relevant factors to contextualize the subregion. The restriction for aerial spraying operations implemented in 2010, the dialogues with the MIA (Interlocution Agreement Working Groups) that were initiated in 2010 but were implemented in 2013, and the limitation of forced eradication operations in some areas associated with the agreements reached with peasants seeking a concerted and gradual program to replace coca crops.

31 For more information related to the regional characterization of the problem associated with illicit drugs in the departments of the region, please refer to: http://www.odc.gov.co/TERRITORIOS/Caracterizaci%C3%B3n/Documentos.

Tibú is the most widely affected municipality with 12,787 ha, representing 52%, of the coca in the subregion. The crops are associated with the populated centers of La Gabarra, Versalles and the municipality of Tibú.

The coca crops in Cesar are presented as an extension of the crops in Norte de Santander. The most widely affected municipality is San Martín, where crops are associated with the populated center of Los Bagres.

The Bajo Cauca subregion had the highest point in the series of coca crops in 2007, with 17,416 ha, and the lowest point in 2013 with 2,355 ha. As of 2013, a strong process of increase of coca cultivation has been initiated, mainly represented by the behavior of Antioquia.

The most affected municipalities of Antioquia are Tarazá, Valdivia and Cáceres, where 63% of the department's coca (8,855 ha) is located. Specifically, coca crops are mainly associated with the populated centers of Barro Blanco and El Doce in Tarazá and Raudal Viejo, La Caucana and Puerto Valdivia in Valdivia. After several years, coca was detected again in Chigorodó and Caucasia in 2016.

San Pablo, specifically the populated center of Cañabraval and Santa Rosa del Sur (in its municipality), are the most affected municipalities in Bolívar.

The most widely affected municipality by coca crops in Cordoba is Tierralta. However, coca crops are mainly associated with the populated centers of Juan José (Libertador Puerto), Nuevo Frasquillo (Tierralta) and Tierradentro (Montelíbano).

In contrast to the Catatumbo and Bajo Cauca subregions, the trend of coca crops in the Magdalena Medio is maintained towards its reduction. Cundinamarca and Caldas remain free of coca, and albeit there was an increase in Santander and Boyacá, these departments remain below 50 ha. The most affected territories are the town center of Betania in Otanche – Boyacá.

The largest number of ZVTN/PTNs in the country is located in the Central region, with eight concentration zones: Llano Grande, San Lucia, Carrizal, La Plancha, El Gallo, Caño Indio, Vidiri/Egaez and San José de Oriente.

In a distance range between 0 - 15 km, San José de Oriente has never been affected by coca, Vidiri/Egaez has no presence of coca since 2014, and Llano Grande has the same behavior since 2012. In Carrizal, there is a reduction of the area from 17 ha in 2015 to 11 in 2016.

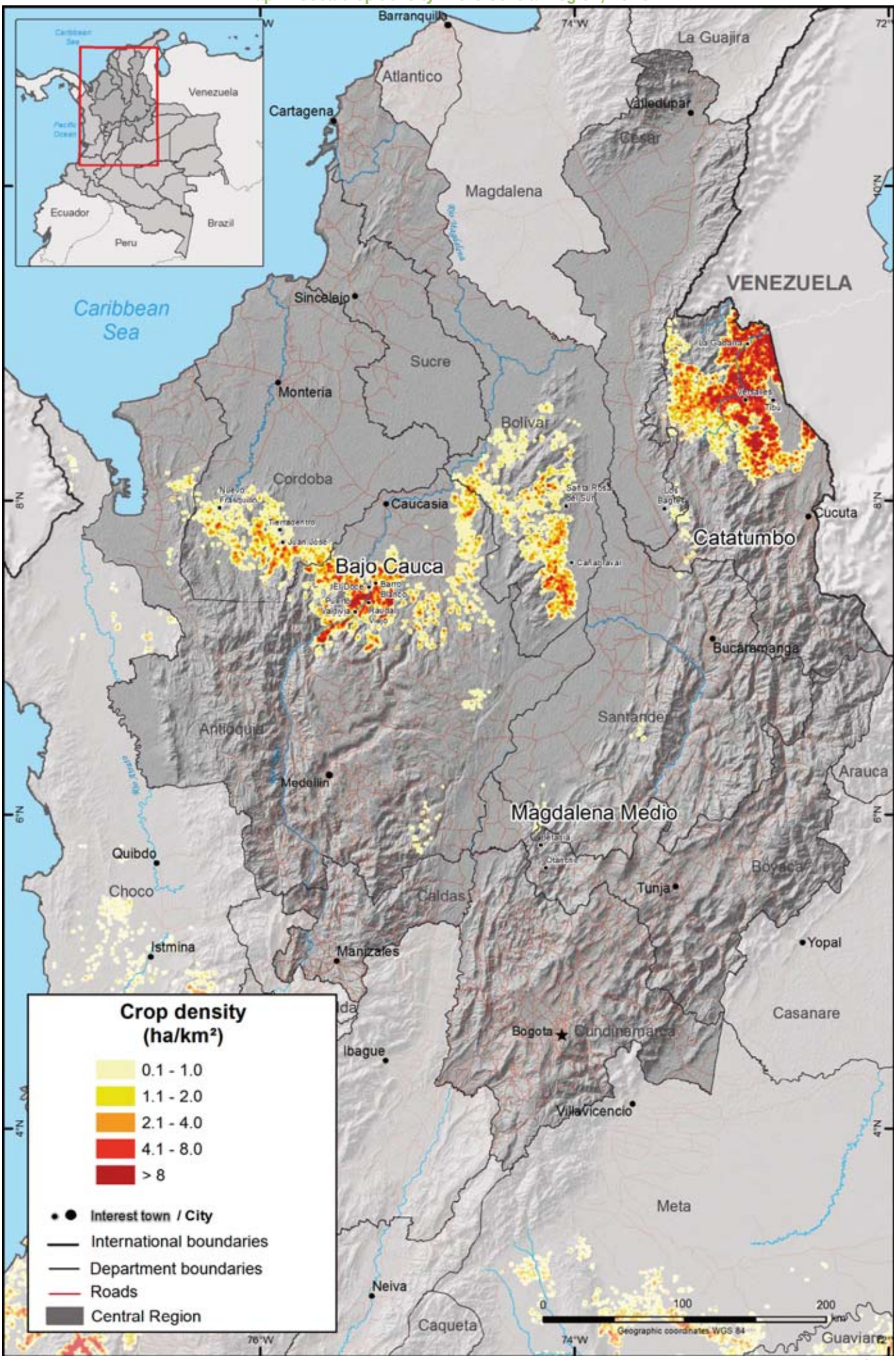
In four concentration zones between 0 - 15 km distance, there is a significant increase in the area with coca, especially between 2015 and 2016. Santa Lucia went from 9 ha to 14 ha. In La Plancha, 108 ha were recorded in 2015 and in 2016 there was a significant increase with 453 ha. El Gallo went from 362 ha to 438 ha in 2016. Lastly, Caño Indio has the largest change in relation to 2015, from 1,845 ha to 4,917 ha in 2016.

Caño Indio, in Tibú, is the concentration zone most widely affected by the presence

of coca –going from 164 ha in 2015 to 714 ha in 2016 in less than 5 km. La Plancha, in Anorí, is the second most widely affected area, having gone from 15 ha to 42 ha within less than 5km in 2016.

Lots of coca in the Central region.

Map 7. Coca crop density in the Central Region, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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Putumayo - Caquetá region

This region[32] has 24 % of the country's coca crops. In 2001, 61,636 ha had been identified in the region; the lowest point in the series was reached in 2010 with 7,363 ha, but crops have increased 4.7 times since then, reaching 34,505 ha in 2016.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Putumayo	9,658	5,633	4,785	9,951	6,148	7,667	13,609	20,068	25,162
Caqueta	4,303	3,985	2,578	3,327	3,695	4,322	6,542	7,712	9,343
Total	**13,961**	**9,618**	**7,363**	**13,278**	**9,843**	**11,989**	**20,151**	**27,780**	**34,505**
% of change	**-34%**	**-30%**	**-23%**	**80%**	**-26%**	**22%**	**68%**	**38%**	**24%**

Table 7. Coca crops in Putumayo - Caquetá, 2008 - 2016 (hectares).

The behavior of the region is strongly related to the dynamics of the southern border in the department of Putumayo. Both Putumayo and Caquetá had moderate increases between 2015 and 2016.

In Putumayo, the municipalities most affected by coca crops are Puerto Asís, San Miguel and Valle del Guamuez; 61% of the department's coca is in these three municipalities, all associated with the southern border.mThe populated center of Puerto Vega and the municipality of Puerto Asís are the most heavily populated centers related to territories affected by coca crops in Putumayo. La Hormiga and Jordán de Guisía (Valle del Guamuez) and La Dorada (San Miguel) also have a strong relationship with the affected territories.

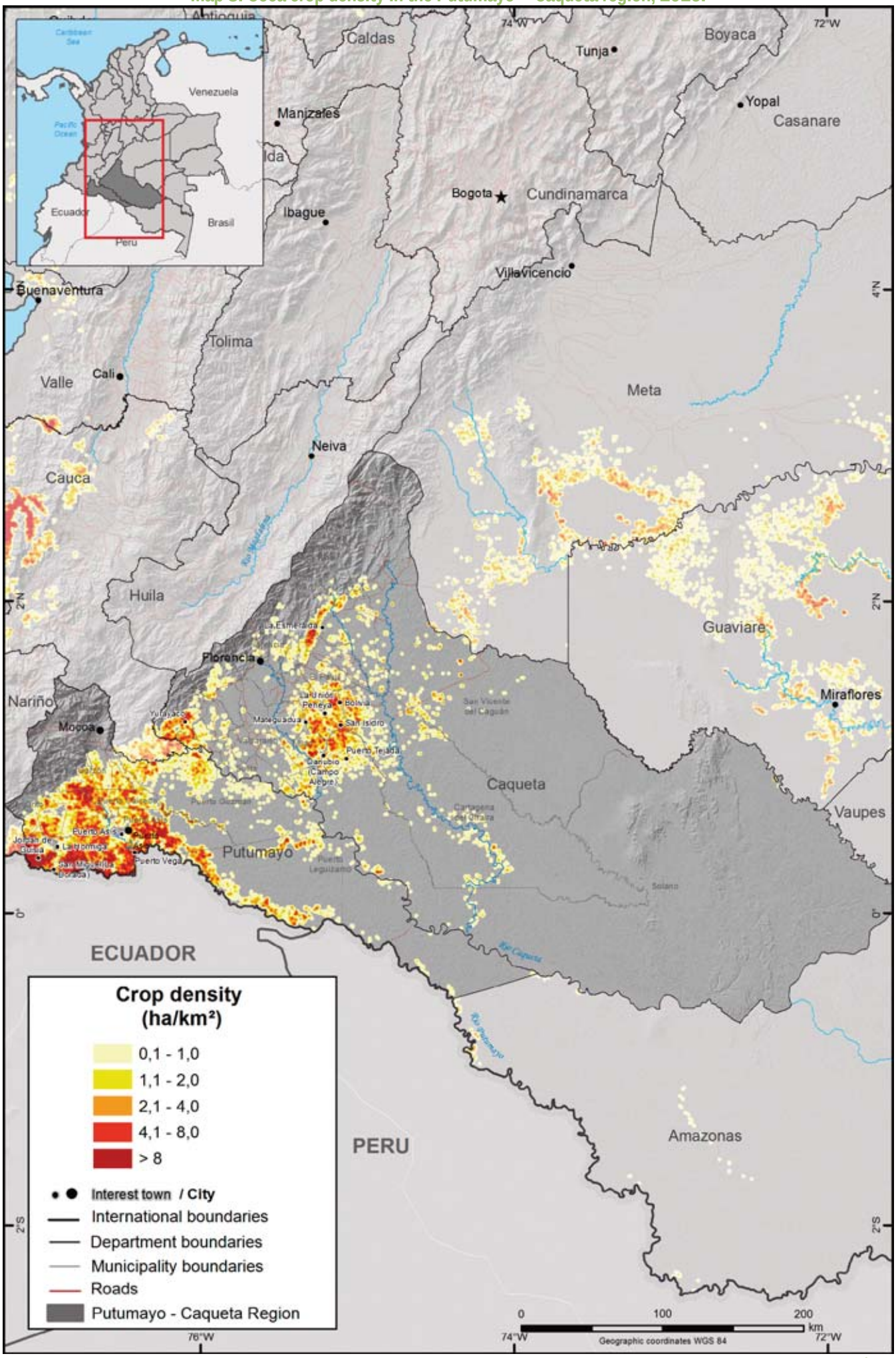
Unlike the other departments, coca crops in Caqueta tend to be dispersed. The most affected municipalities are La Montañita – where crops are associated mainly to the populated centers of San Isidro, La Unión Peneya and Mateguadua; Solano where they are associated with Puerto tejada and Danubio (Campoalegre); Cartagena del Chairá, associated to the municipality of Bolivia; San José del Fragua, associated with Yurayaco and Milan, associated with Danubio (Campoalegre). Despite the latter is not in Milan, it is the nearest populated center in relation to the zone with coca.

There are three ZVTN/PTN in the Putumayo - Caquetá region; Agua Bonita, La Pradera and Miravalle. La Pradera, located in Puerto Asís, has the largest presence of coca in the region, going from 251 ha in 2015 to 385 ha within less than 5 km. As for Agua Bonita, there has been a stable area within the same distance range from the year 2015 to the year 2016, with 9 ha in both periods.

Crops with high leaf density in Putumayo - Caquetá.

32 For more information related to the regional characterization of the problem associated with illicit drugs in the departments of the region, please refer to: http://www.odc.gov.co/TERRITORIOS/Caracterizaci%C3%B3n/Documentos.

Map 8. Coca crop density in the Putumayo – Caquetá region, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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Meta-Guaviare Region

Although coca crops grew as in the rest of the country, the increase in Meta - Guaviare[33] (18%) was lower than it was in the country (52%). By 2016, 12,302 have been planted with coca in this region, amounting to 8% of the national total.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Guaviare	6,629	8,660	5,701	6,839	3,851	4,725	5,658	5,423	6,838
Meta	5,525	4,469	3,008	3,040	2,699	2,898	5,042	5,002	5,464
Total	**12,154**	**13,129**	**8,709**	**9,879**	**6,550**	**7,623**	**10,700**	**10,425**	**12,302**
% of change	**-38%**	**8%**	**-34%**	**13%**	**-34%**	**16%**	**40%**	**-3%**	**18%**

Table 8. Coca crops in Meta - Guaviare, 2008 - 2016 (hectares).

The lowest point of the series was presented in 2012, when 6,550 ha were reported in the region; since then, the area planted with coca has doubled to reach 12,302 ha in 2016. Both Meta and Guaviare had increases in the area with coca.

Crops in this region show concentrations in Tomachipán (affecting Miraflores and San José del Guaviare), Charras and the perimeter of the Sierra de la Macarena National Natural Park. The expansion core between Meta and Caqueta continues to consolidate in 2016; this means a continuation of the two regions affected by coca. This core of expansion affects the populated centers of Campoalegre (San Vicente del Caguán - Caquetá) and La Sombra (La Macarena - Meta).

La Macarena is the most widely affected municipality in Meta, where the crops are mainly in the area of influence of the municipality and the La Sombra populated center. Vistahermosa was one of the most affected municipalities of the country, though coca crops were considerable reduced during the implementation of the PCIM[34] and maintains comparatively low levels, coca cores persist in association with the populated center of Caño Amarillo. Puerto Rico is the second most affected municipality in Meta; crops are associated with the populated centers of Barranco Colorado and Puerto Toledo.

The most widely affected municipality in Guaviare is Miraflores; coca crops are mainly associated with the populated centers of Barranquillita and Las Pavas-Caño Tigre.

Five ZVTN/PTNs are located in the Meta - Guaviare region, El Yarí, La Guajira, La Reforma, Charras and Las Colinas are located.

Within a distance from 0 to 15 km, the general behavior of the zones of concentration in the last five years tends to increase. Some peaks of significant growth are recorded, for example in El Yarí – which went from 6 ha in 2013 to 220 ha in 2014.

33 For more information related to the regional characterization of the problem associated with illicit drugs in the departments of the region, please refer to: http://www.odc.gov.co/TERRITORIOS/Caracterizaci%C3%B3n/Documentos.

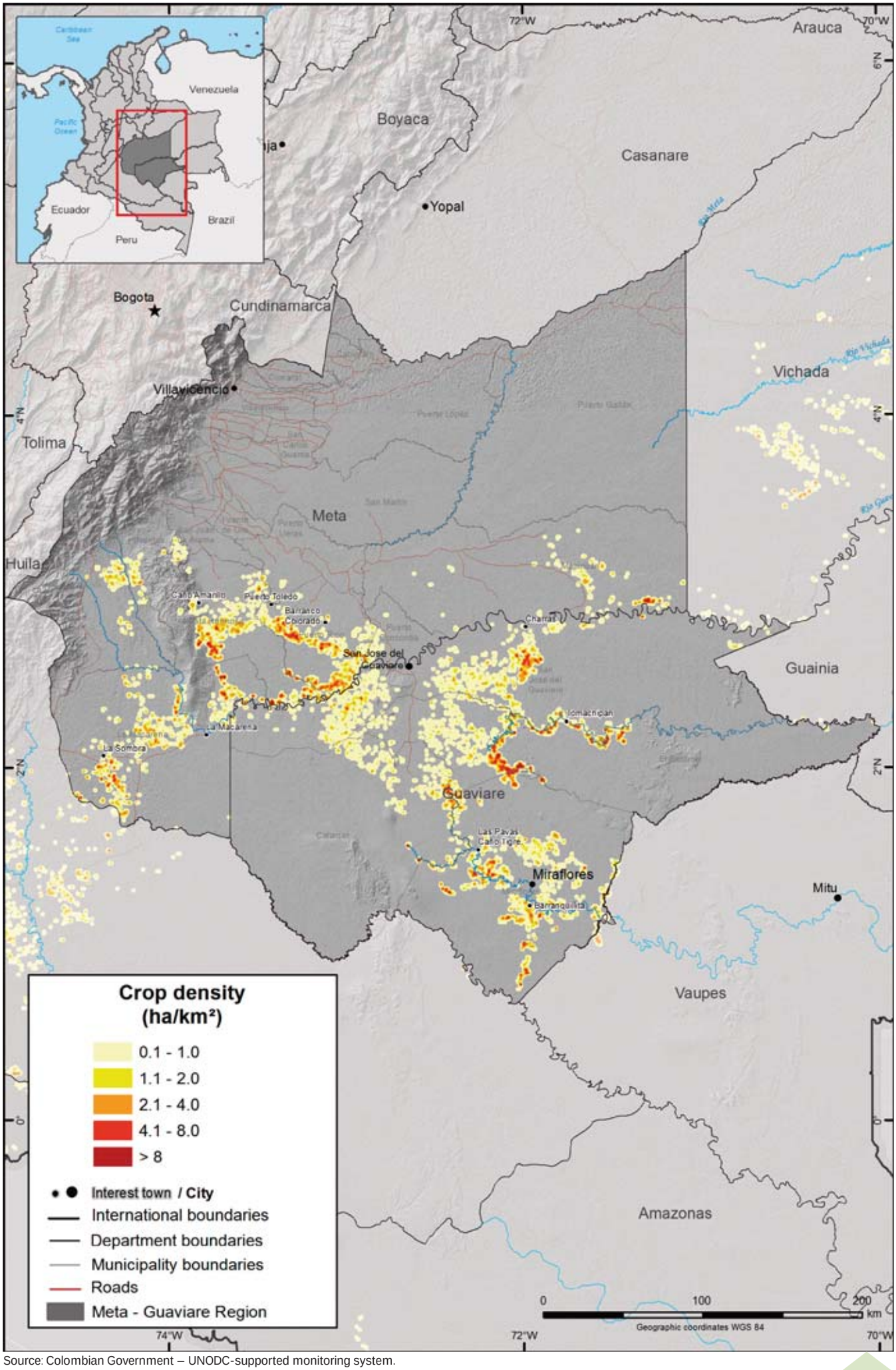
34 The Macarena Comprehensive Consolidation Plan *(PCIM – Plan de Consolidación Integral del Magdalena)* was an institutional strengthening program implemented in the municipalities of Mesetas, Uribe, La Macarena, Puerto Rico, Vista Hermosa and San Juan de Arama, in 2009. It promoted coordinated action in three areas: territorial security, citizen protection and economic and social development.

All the concentration zones report an increase of the area planted with coca between 2015 and 2016 in the distance range from 0 to -15 km, with the exception of La Guajira and Charras. El Yarí went from 148 ha to 273 ha; La Reforma went from 316 to 337 ha and Las Colinas went from 192 ha to 243 ha. La Guajira was reduced from 1 ha to 0 ha, and Charras from 139 ha to 118 ha in 2016.

La Reforma, located in Vistahermosa, is the concentration zone which is most widely affected by coca, followed by El Yarí, located in La Macarena.

Coca Crops in Meta - Guaviare.

Map 9. Coca crop density in the Meta – Guaviare region, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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Sierra Nevada Region

The region comprises the departments of Magdalena and Guajira. Since 2011, it has registered less than 100 ha. The highest point of the series was presented in 2004 when 1.262 ha were reported. The lowest point was reported in 2015, when only 7 ha were recorded.

The department of La Guajira completes 3 years without coca crops. In Magdalena, the cores associated to Machete Pelao and Perico Aguao persist, in spite of continuous actions of manual eradication. A ZVTN/PTN, Pondores, is located in the Sierra Nevada region. There are no reports of coca there.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Magdalena	391	169	121	46	37	37	9	7	35
La Guajira	160	182	134	16	10	6	0	0	0
Total	**551**	**351**	**255**	**62**	**47**	**43**	**9**	**7**	**35**
% of change	**51%**	**-36%**	**-27%**	**-76%**	**-24%**	**-9%**	**79%**	**-22%**	**400%**

Table 9. Coca crops in Sierra Nevada, 2008 - 2016 (hectares).

Orinoco Region

The region[35] comprises the departments of Arauca and Vichada. The area with coca remained stable as compared to the area detected in 2015. 708 ha were detected – half of the presence in 2012 and 6% of the presence in 2001 – the highest point of the series.

The behavior of the region is strongly marked by Vichada since Arauca has had under 100 ha since 2012. Crops have remained relatively stable since 2013, although there is an eastward expansion, thereby brining coca closer to the border with Venezuela.

There is only one ZVTN/PTN in the Orinoco region: Filipinas. Its affectation by coca has been declining since 2012. Between 2015 and 2016, it has decreased from 6 ha to 2.5 ha.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Vichada	3,174	3,228	2,743	2,264	1,242	713	511	683	699
Arauca	447	430	247	132	81	69	25	17	9
Total	**3,621**	**3,658**	**2,990**	**2,396**	**1,323**	**782**	**536**	**700**	**708**
% of change	**-61%**	**1%**	**-18%**	**-20%**	**-45%**	**-41%**	**-31%**	**31%**	**1%**

Table 10. Coca crops in Orinoco, 2008 - 2016 (hectares).

The most important core of the region is in Puerto Príncipe, in the municipality of Cumaribo (Vichada). However, there are also concentrations associated with Chupave and Palmarito.

35 For more information related to the regional characterization of the problem associated with illicit drugs in the departments of the region, please refer to: http://www.odc.gov.co/REGIONALIZACI%C3%93N/Caracterizaci%C3%B3n/Documentos.

Amazon Region

The region comprises the departments of Amazonas, Vaupés and Guainía. 286 ha of coca were detected in 2016 - 58% more than in 2015, but 8% of the area detected in 2001 – the highest point in the historical series.

Department	2008	2009	2010	2011	2012	2013	2014	2015	2016
Amazonas	836	312	338	122	98	110	173	111	167
Vaupes	557	395	721	277	254	184	109	33	97
Guainia	625	606	446	318	301	81	66	37	22
Total	**2,018**	**1,313**	**1,505**	**717**	**653**	**375**	**348**	**181**	**286**
% of change	**37%**	**-35%**	**15%**	**-52%**	**-9%**	**-43%**	**-7%**	**-48%**	**58%**

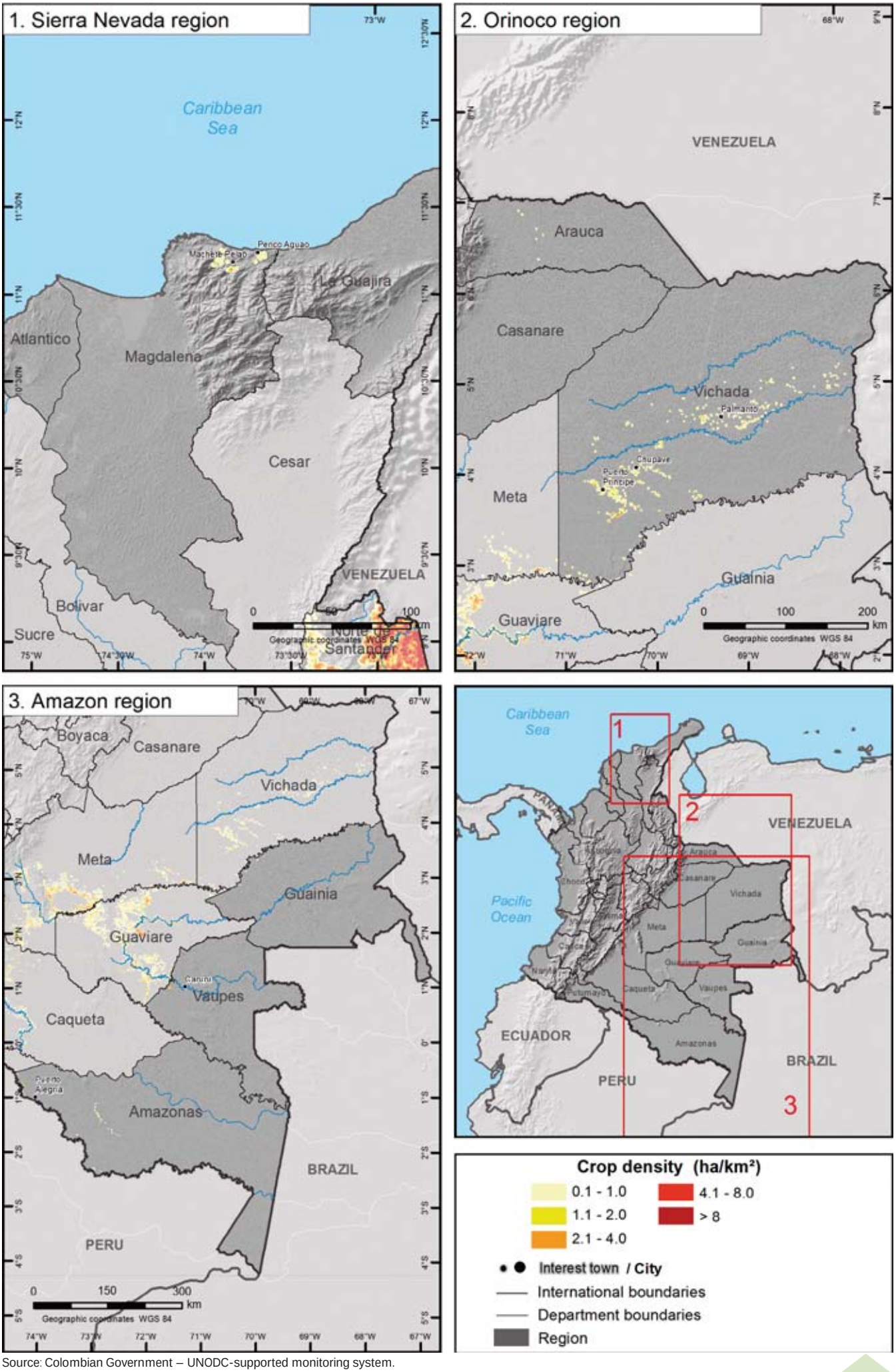
Table 11. Coca crops in Amazon, 2008 - 2016 (hectares).

The department of Guainía has a new reduction, and this trend has been maintained since 2006.

On the other hand, both Amazonas and Vaupés recorded increases associated with expansions of the Putumayo - Caquetá and Meta - Guaviare cores, respectively.

The main coca cores in the region are associated with the towns of Puerto Alegría, in Amazonas, and Carurú, in Vaupés.

Map 10. Coca crop density in the regions of Sierra Nevada, Orinoco and Amazon, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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COCA CROPS IN SPECIAL MANAGEMENT AREAS

The concentration of coca crops in special management areas such as National Parks, Indigenous Reserves and Afro-Colombian Community Lands continues to be a trend in the dynamics of coca cultivation in the country. Special management areas occupy 0.04% of the national territory. In these areas, actions by the State to achieve a reduction of the area with coca must comply with processes that include acceptance and participation of the communities that live there (prior consultation). The strategies developed should not lead to environmental damage, and should aim for the conservation of protected ecosystems. Similarly, the implementation of substitution plans should be achieved based on the environmental and social sustainability of the areas.

It was found that 32% of the area with coca in the country in 2016 was located in one of these three territorial structures. This value that has been decreasing since 2013 (40% then), and regarding the 2015 value (35%). Although national participation has been reduced, the area with coca within these areas tends to constant increase in the last years. There has been a 37% increase in 2016 vis-à-vis 2015, increasing from 34,081 ha to 46,702 ha.

Coca crops in National Natural Parks

The presence of coca crops in National Natural Parks (PNN) has been monitored by SIMCI since 2001. The data obtained are given to the competent authorities in support of the identification of actions and projects for the preservation of the social and environmental characteristics of the territory. The boundaries of Natural National Parks are defined by the official entity in charge of its preservation and maintenance; the data listed below is based on the most recent update.

Of the 59 protected areas with the National Natural Park category, 17 are affected by coca crops in 2016; this year saw no presence of coca in Cordillera de los Picachos, but Serranía de los Yariguíes enters the list again after two years without presence with 5 ha, and Serranía de Chiribiquete appears as a new area with coca, with 16 ha.

The share of National Natural Parks in area with coca is 5% nationwide – lower to that of 2015. However, the trend of concentration of the illegal phenomenon that is generally identified in the Colombian territory is also reflected in these areas, where there is a 27% increase in the area sown, from 6,214 ha in 2015 to 7,889 ha in 2016.

Eleven parks show an increase in the area with coca, as compared to 2015, one park has had stability and four show a tendency towards decrease. 70% of the area with coca in 2016 is concentrated in only three protected areas: Sierra de la Macarena, Nukak and Paramillo. Sierra de la Macarena is still the most affected area with coca, concentrating 30% of the area with coca, represented by 2,386 ha. Although it is 1.5% less than in 2015, it still remains a protected area with a high degree of threat to its object

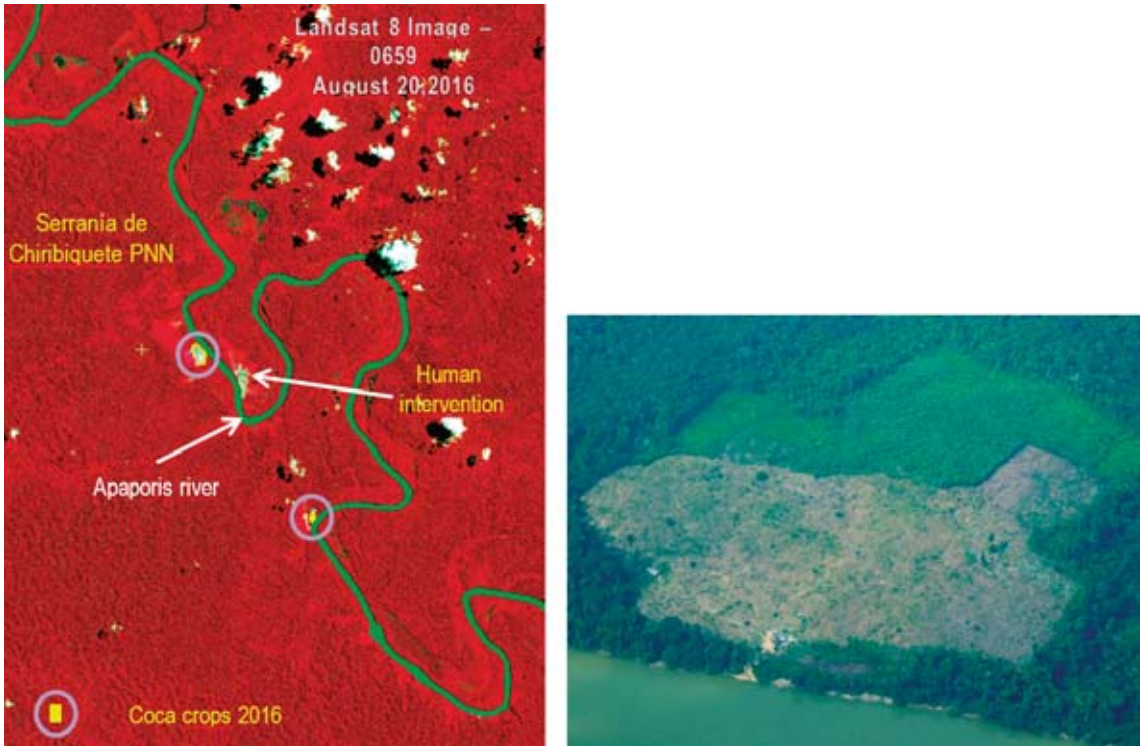
of conservation, not only because of the involvement of coca, but also other illegal activities that are dynamized in the territory, such as the development of infrastructure and the presence of extensive livestock industries.

In 2016, Paramillo, Catatumbo - Barí and Munchique present their maximum value in the 2001 - 2016 historical series, with 1,301 ha, 692 ha and 324 ha respectively. These parks are located in regions of the country with a strong tendency to increase and high concentration of the area with coca such as Bajo Cauca and the Catatumbo subregion in the Central region and the mountainous region of Cauca in the Pacific region.

Region	Park	2011	2012	2013	2014	2015	2016
Amazon	Puinawai	42	45	3	6	1	6
	Yaigojé Apaporis	6	9	0	0	0	0
Central	Catatumbo Bari	191	155	298	229	412	692
	Paramillo	446	408	284	367	772	1,301
	Serranía de los Yariguies	10	3	2	0	0	5
Meta - Guaviare	Nukak	786	634	882	1,145	1,169	1,765
	Sierra de la Macarena	971	1,466	1,649	2,449	2,422	2,386
	Cordillera de los Picachos	0	0	0	3	1	0
	Serranía del Chibiriquete	0	0	0	0	0	16
	Tinigua	0	5	31	246	258	277
Orinoco	El Tuparro	18	11	6	3	5	8
Pacific	Los Farallones de Cali	79	38	41	247	280	270
	Los Katíos	4	3	2	2	0	0
	Munchique	128	204	117	212	186	324
	Sanquianga	5	7	18	26	16	45
	Utría	1	2	0	0	0	0
Putumayo - Caqueta	Alto Fragua Indi Wasi	6	14	9	32	41	19
	La Paya	500	362	420	503	640	754
	Plantas Medicinales Orito Ingi - Ande	2	5	4	1	1	1
	Serranía de los Churumbelos	1	3	7	7	9	10
Sierra Nevada	Sierra Nevada de Santa Marta	11	4	18	2	1	10
Total		**3,207**	**3,378**	**3,791**	**5,480**	**6,214**	**7,889**

Table 12. Coca crops in National Natural Parks, 2011 - 2016 (hectares).

SIMCI's analysis of the dynamics of coca crops had detected a presence of coca crops in a range less than 13 km from the edge of the Serranía de Chiribiquete PNN since 2012. An alert was made in 2015, when it was found that said distance had been reduced to 10 km, taking the Tacunema creek as a vector of progress. In 2016, satellite monitoring, working together with the National Natural Park Risk Management and an aerial verification, allowed the identification of the presence of coca crops within the park on the northern boundary of the Apaporis river, between the Tacunma and Macaya creeks. Similarly, a lot of coca and some interventions associated with recent logging were found less than 1 km from the park boundary.



Scheme 1. Affectation by Coca in Serranía de Chiribiquete PNN (identification in satellite imaging and ulterior field evidence).

The involvement in this protected area – which has applied for declaration as a World Heritage Site by Unesco – is an alert to generate strategies that promote its conservation and allow to stop the advance of threats not only associated with the presence of coca crops, but also with other phenomena of illegality such as deforestation, road development and gold exploitation converge (in January 2017, two rafts dedicated to the extraction of gold within the protected area were destroyed).

Coca crops in Indigenous Reserves

Affectation by coca crops in indigenous reserves[36] shows an increase from 11,837 ha in 2015 to 15,665 ha in 2016, which represents 32%. In spite of the increase in its participation in the national total, there was a 1% decrease as compared to that reported in 2015, reaching 11%.

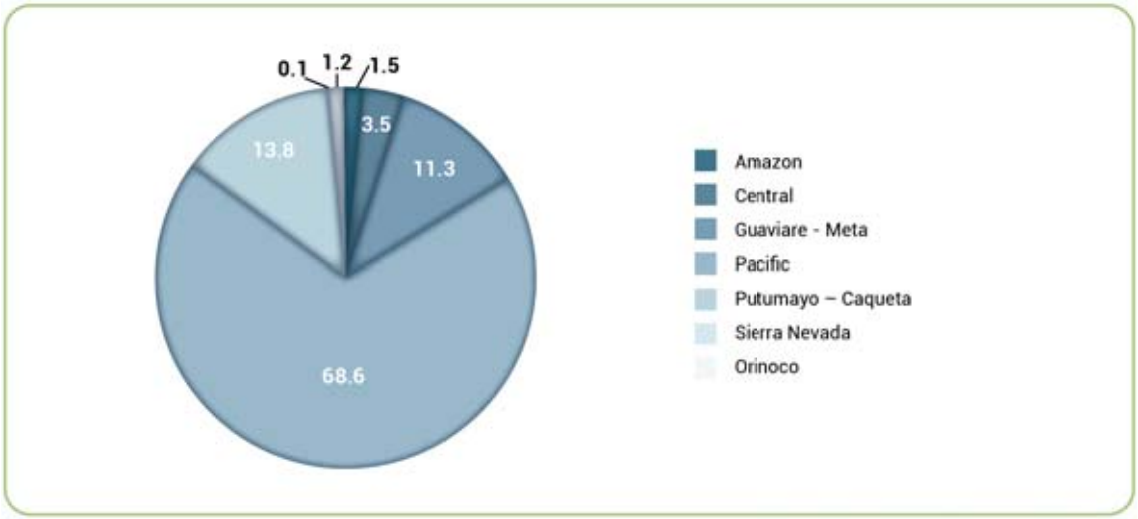
The indigenous reserves in the Pacific region are strong drivers of increase, and the general tendency to concentration of coca is reflected therein, with a greater increase in reserves that already had the greater amount of coca in previous years. This region continues to be the one with the highest concentration; 68% of the total area with coca is in indigenous reserves. Participation by region remained stable.

49% of the area planted with coca is concentrated in seven indigenous reserves, six of these belonging to Nariño – the department with the highest incidence in the country: Inda Zabaleta, Gran Rosario,

36 The geographical delimitation of the Indigenous reserves in Colombia is Reported by IGAC and the last update available to SIMCI is for the year 2010.

La Turbia, El Cedro - Las Peñas, La Brava, Pilví and La Pintada, La Floresta, Santa Rosa and San Francisco and El Gran Sábalo and a reserved from Guaviare, Nukak - Maku.

Inda Zabaleta, with 2,520 ha, is the most affected indigenous reserve – 23% more than in 2015, when 2,048 ha were identified.



Graph 5. Percentage share of coca crops in indigenous reserves by region, 2016.

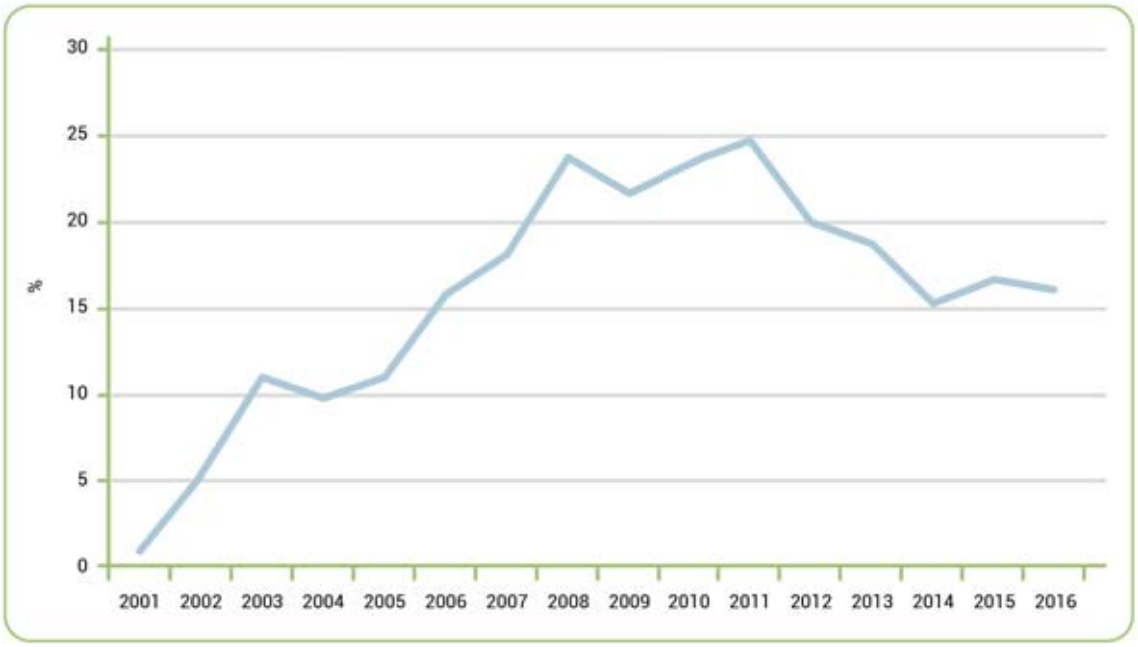
Coca Crops in Afro-Colombian Community Territories

The presence of Coca Crops in Afro-Colombian Community Territories[37] increased by 45% as compared to 2015, from 16,030 ha to 23,164 ha in 2016. Its participation in the national total, as in the other areas of special management, decreased by 1% as compared to the previous year (16%).

The communities that are most widely affected by coca are: Alto Mira and Frontera, Pro – defense del Río Tapaje, the Nariño Western Mountain Range, Union of the Basins of the Isagualpí and Satinga rivers, all located in Nariño, and which account for 57% of the total planted in these territorial entities. The presence of 13,274 is recorded in these communities - 42% more than 2015, when 9,359 ha were reported.

Alto Mira - Frontera continues to be the Afro-Colombian Community with the highest incidence of coca, with 31% of the total reported in these territorial entities as compared to the 2015 report - there was a 30% growth.

37 The geographical delimitation of the Afro-Colombian Community Territories in Colombia is reported by IGAC, and the last update available to SIMCI is for the year 2010.



Graph 6. Percentage participation of coca crops in Afro-Colombian Community territories nationwide, 2016.

Coca crops in special management areas, Pacific Region.

Map 11. National Natural Parks and coca crops in Colombia, 2016.

Sources: Colombian Government National coca crops – UNODC-supported monitoring system; for National Parks: PNN
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PRODUCTION OF COCA LEAVES, COCAINE PASTE, COCAINE BASE AND COCAINE CHLORHYDRATE

The section above focused on the variations of the area planted with coca, highlighting a strong increase of crops but concentrated in some specific regions. Said increase implies greater cocaine production potential. However, the area is only one of the variables that affect cocaine production; the amount of leaf that can be produced in each hectare, the amount of alkaloid in the leaves and the capacity to extract the alkaloid from leaves and transform it into cocaine, are also important variables for the determination of potential production.

Below are the estimates of potential cocaine production, integrating the available information and data of areas with coca. The estimate refers to cocaine at 100% purity and assumes that all the coca planted in Colombia is destined for cocaine production; it does not include any kind of losses by seizures.

The following factors were considered to estimate the annual cocaine production potential in Colombia: i) establishment of coca production area in hectares; (ii) the estimated leaf production capacity in tons per hectare; (iii) the efficiency of extraction of cocaine paste / cocaine base, estimated in kilograms of pulp or base per ton of leaf; and (iv) efficiency in the conversion to cocaine hydrochloride, estimated in kilograms of cocaine hydrochloride per kilogram of cocaine paste or cocaine base.

Since 2005, UNODC and the Government of Colombia have conducted studies to provide information related to productivity and main characteristics of Agricultural Units with Coca (UPAC)[38]. This is done by monitoring key factors that influence the ability of lots to produce coca leaf[39] and efficiency in the extraction processes, in the primary link. A probabilistic sampling methodology is used in the productivity studies, which allows to extrapolate information from the population by selecting a sample[40]. Due to the difficulty in knowing the universe of Agricultural Producers with Coca (PAC), the location of the crops in the surveys conducted by SIMCI, is used as reference.

The baseline of productivity studies was built in 2005, from the clustering of affected coca crop areas in eight regions.

38 The Agricultural Production Unit (UPA) is an economic unit dedicated wholly or partly to the development of agricultural activities: It may encompass one or more farms, located in one or more areas of the same municipality, provided that all of them are under one administration or management, and share the same set of means of production, such as labor, machinery and working animals, regardless of their title, legal form or size. Single administration or management may be exercised by a single person, by two or more persons, by a household or households jointly, by a community, or by a legal entity, such as a company, a cooperative or a public or private body. In the case of Agricultural Production Units with Coca (UPAC), these are UPAs dedicated totally or partially to the cultivation of coca and other agricultural activities under a single administration or management of the Agricultural Producer of Coca-PAC-.

39 Regarding agro-cultural practices, selection of varieties and planting densities, among other variables.

40 For an in-depth review, please refer to Annex 3.

Since then, one or two regions have been updated each year because of the high costs for their implementation and the limitations of access to the areas under study. Within the framework of the commitments agreed between UNODC and the Government of Colombia, updated regional information is available for the entire country every 4 years. To date, three national phases have been consolidated[41].

The Phase IV productivity studies were updated in the Sierra Nevada, Central and Catatumbo regions in 2015. Due to funding constraints, productivity studies were postponed in the Putumayo-Caquetá region, which was scheduled for 2016. Due to the interruption of the aerial spraying program, the increase of the areas planted and the modifications in the agricultural conditions detected in the field, it is highly possible that yields of coca lots have had significant changes that have not been measured, particularly in the Pacific area, where the last measurement was made in 2014, but since then there has been a sharp increase in crop age and crop density.

Region	Sierra Nevada	Central	Catatumbo	Putumayo-Caqueta	Amazon	Meta-Guaviare	Orinoco	Pacific
Year of study	2015	2015	2015	2012	2012[(1)]	2013	2013	2014

[1] Productivity studies do not carry out data collection in the Amazon region; for this reason, production estimates are made taking into account the results of the Putumayo-Caquetá region.

Table 13. Year of implementation of the productivity studies used as a reference in the 2016 report.

Productivity studies provide information on the yield of fresh coca leaf and characteristics of the process of transformation to cocaine paste or cocaine base carried out in the UPAC in each of the regions with influence of coca crops. It is necessary to continue with the implementation of phase IV of the productivity studies, in order to have information that allows to: i) update the indicators that contribute to the production estimates, ii) characterize the dynamics of the establishment of coca crops and their production; (iii) characterize the social and economic conditions of agricultural producers with coca. This information contributes to the understanding of the reasons associated with the persistence of coca crops in the regions of influence.

Taking the results of the productivity studies obtained as of 2015 as a reference, the potential production of coca leaf, cocaine base and cocaine hydrochloride is estimated by applying the methodological adjustments socialized: the permanence factor and the cocaine base conversion factor[42]. It is estimated that the potential production of fresh coca leaf increased from 454,050 mt in 2015 to 606,130 mt in 2016[43], i.e. a 33.5% increase which can be

41 In 2005, baseline information corresponds to Phase I of the productivity study, whereas the regional update carried out between 2007-2010 refers to Phase II; Phase III was conducted between 2011-2014.
42 It should be noted that the estimates made may be under-valued due to outdated information on productivity studies.
43 Estimated potential fresh coca leaf production is between 357,600 mt - 550,500 mt in 2015, and between 522,900 mt - 719,100 mt in 2016.

explained mainly by the 31.6% increase in the productive area during the year.

An important factor to understand the findings in the production estimates is the increase in leaf density as identified in the coca lots located mainly in Nariño, Putumayo and Norte de Santander. This change in leaf density, is a typical spectral dynamic, i.e. as a function of the natural phenological cycle reached by crops before the harvest[44]. In this cycle, plants produce more leaves (biomass) and greater maturation thereof, which is reflected in an increase in the concentration of the alkaloid content. In this regard, it is found that the higher the biomass available per hectare cultivated, the greater the yield and the longer maturation of the leaves, the higher the yield. This situation generates a national alert, mainly in the regions where the strongest increases in area with coca are presented.

Lot with high leaf density, Pacific region.

44 Further development of this spectral dynamics can be seen in more detail in chapter 4. Methodology.

Region	2015			2016		
	Estimated Productive Area	Annual yield coca leaf in Kg./ha/year*	Coca leaf production	Estimated Productive Area	Annual yield coca leaf in Kg./ha/year*	Coca leaf production
	Hectares		mt	Hectares		mt
Amazon	327	3,700	1,210	260	3,700	960
Catatumbo	10,779	5,400	58,210	17,456	5,400	94,260
Central	5,418	4,300	23,300	9,431	4,300	40,550
Meta-Guaviare	12,637	4,400	55,600	12,170	4,400	53,550
Orinoco	798	5,000	3,990	839	5,000	4,190
Pacific	37,450	5,600	209,730	51,945	5,600	290,890
Putumayo-Caqueta	27,563	3,700	101,980	32,885	3,700	121,670
Sierra Nevada	12	2,900	30	20	2,900	60
Total national	**94,984**	**4,800**	**454,050**	**125,004**	**4,800**	**606,130**

Table 14. Productive area, yields and production of coca leaf by region, 2015-2016.

Notes:

[1] The reference years in the update of the productivity study are shown in Table 13.

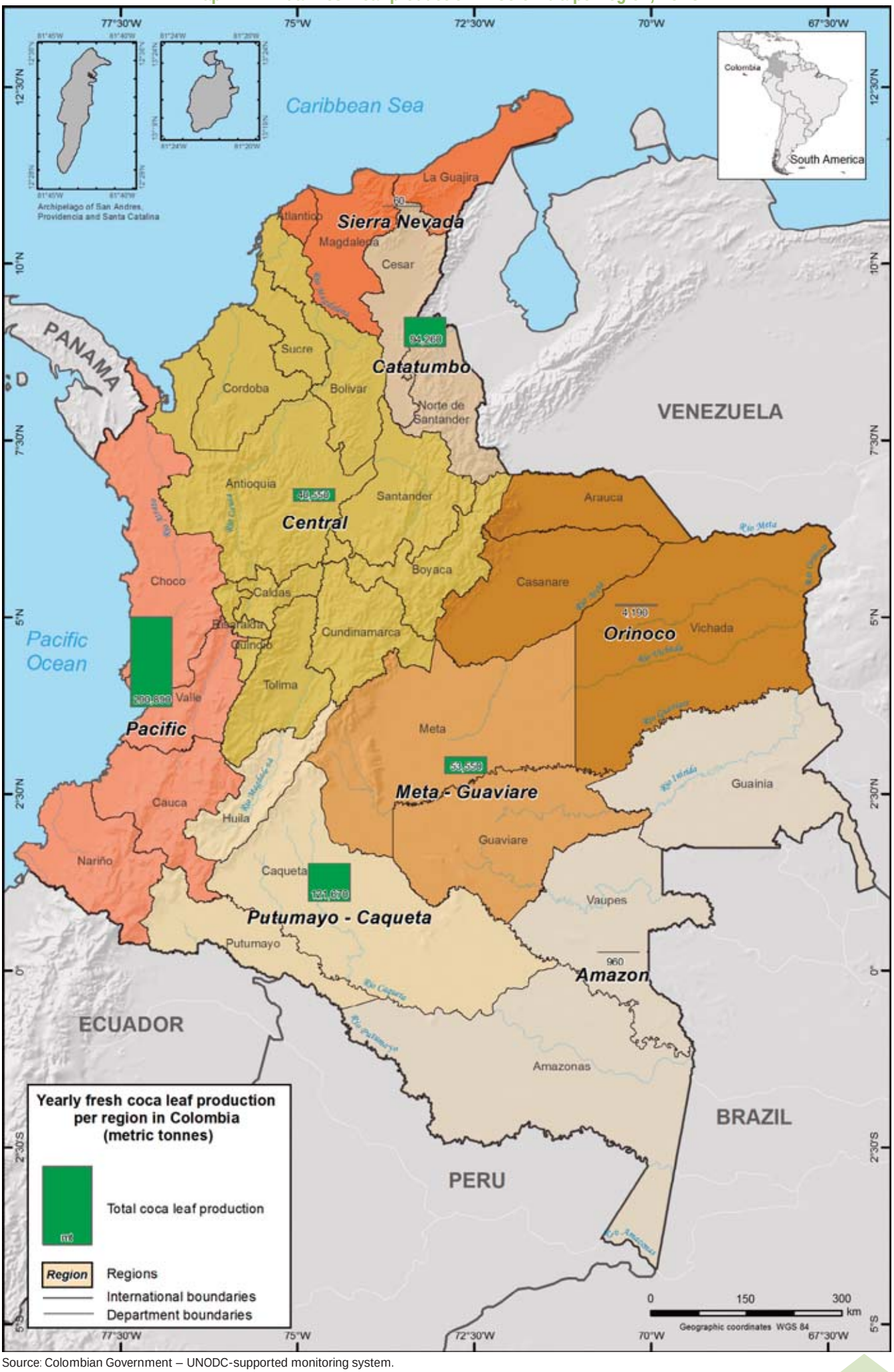
[2] Productivity studies do not survey information in the Amazon region; therefore, production estimates are made taking into account the results of the Putumayo-Caquetá region.

[3] The productive area during the year corresponds to the application of a spatial analysis methodology that allows the estimation of the permanence of coca cultivation through the construction of a factor that allows to model the dynamics of the area with coca in the year from lot to lot, based on the incorporation and systematization of information available on variables that directly affect stability such as forced eradication, aerial spraying and plant coverages, inter alia.

[4] Estimates of coca leaf production are made from the annual productive area, estimated based on permanence values and crop yield factors.

[5] Estimated leaf production was rounded to the nearest ten.

Map 12. Annual fresh leaf production in Colombia per region, 2016.



Source: Colombian Government – UNODC-supported monitoring system.
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As mentioned above, no research was carried out on coca crop production and yields in 2016. However, UNODC and the Government of Colombia developed research on cost and income of coca producing units that help identify variations in illegal market behaviors. In this regard, it is worth mentioning that the cost study confirmed the tendency in Putumayo - Caquetá to process the leaf directly on the farm, while leaf sale predominates in Catatumbo – particularly in UPACs with areas of less than 10 ha.

Based on available data, it is estimated that coca leaf production reached 606,130 tons in Colombia, i.e. 33.5% more than the coca leaf production reported in 2015. It is estimated that 389,190 mt were sold by the Agricultural Producers with Coca (PACs) in 2016 to be collected for purchase-sale or for processing (external to the UPAC that grows it). From this leaf volume, a potential production is calculated in about 701mt of cocaine base[45] processed outside the UPAC.

Additionally, it is estimated that 40% of growers process coca leaves on the farm. Of these, only 1% of growers transform coca leaf into cocaine base, i.e. they use potassium permanganate in the alkaloid refining process. It is estimated that approximately 8,770 mt of fresh coca leaf were converted to 24 mt of cocaine base by Agricultural Producers with Coca (PACs) in 2016. It is worth mentioning that less and less growers process coca leaf into cocaine base.

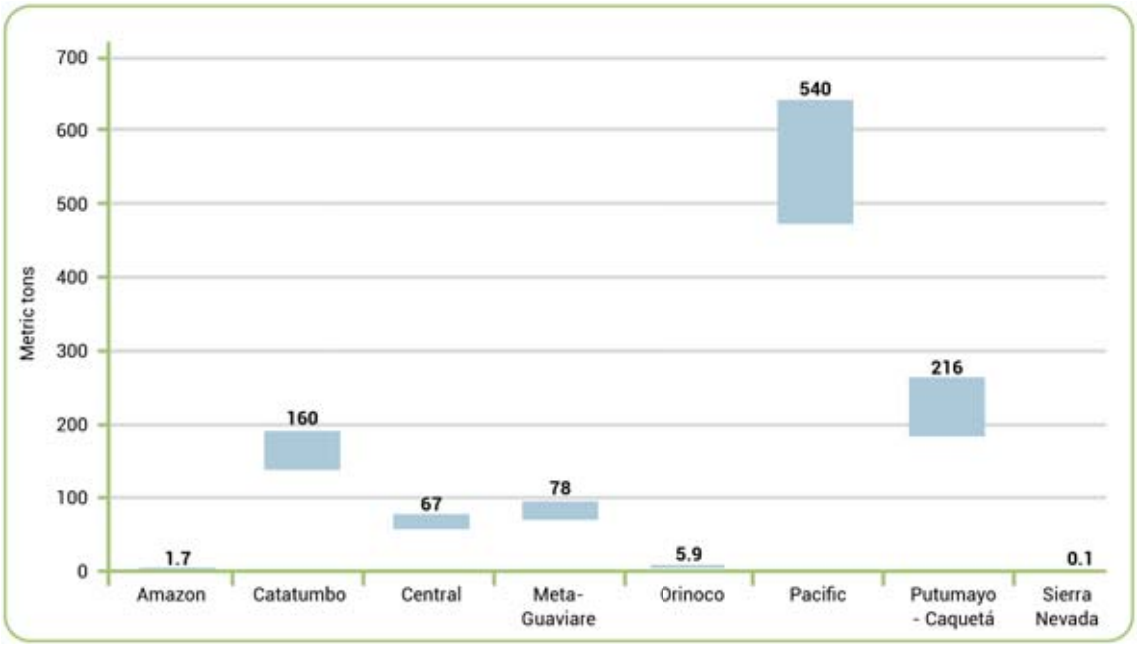
In contrast to the above, 39% of PACs processed the leaf on site to produce cocaine paste. For this process, they required 208,180 mt ca. of coca leaf, thereby obtaining 345 mt of cocaine paste[46].

In the results of the *Study of socioeconomic characterization of the territories with coca crops, Putumayo-Caqueta, Catatumbo and Magdalena Medio PACs,* who carry out the extraction processes on the farm, mostly reach the cocaine paste stage. No agricultural producer reported the use of potassium permanganate – a key chemical in the alkaloid refinement process to obtain cocaine base. This could be due to: i) a monopoly composed of an oligopoly, i.e. a single seller and buyer, around the potassium permanganate; this is a strategy that can be combined with the generation of incentives towards the purchase / sale of coca leaf, along with restrictions on extraction and refining at the local level; and (ii) controls

45 Taking 1.8 kg of cocaine base per MT of fresh coca leaf as a reference value, in the scenario of increase in the sale of coca leaf by the producer and the collection by other agents. The above, under the assumption of an efficiency in the processes of extraction above the efficiency recorded by the agricultural producer with coca, as a result of scale productions and the better use of supplies. This conversion factor was estimated based on the results obtained from 33 cocaine base processes, under controlled conditions, in the framework of the Efficiency Study on conversion of Cocaine Hydrochloride by UNODC and the Government of Colombia, which only would be updated upon the receipt of new information. It should be noted that sub-registration can occur, since it has been detected that large-scale production processes can optimize the use of solvents, which directly influences less chemical substances and more control of possible losses. It is estimated that the production of cocaine base processed by agents other than farmers is between 6 05 mt and 831 mt.

46 An equivalence of 1: 1 is estimated between processed quantities of cocaine paste and cocaine base; the calculations of basic cocaine paste production in situ by farmers can vary between 297 mt and 409 mt of cocaine paste.

to potassium permanganate in coca growing areas of influence, established by illegal stakeholders present in the territory, through restricted access to the product or an increase in price.



Graph 7. Estimated Potential Production of Cocaine Base, 2016.

Note:
[1] Productivity studies do not survey information in the Amazon region; therefore, production estimates are made taking into account the results of the Putumayo-Caquetá region.
[2] Calculations of base cocaine production are based on the estimated annual productive area (determined by the permanence factor), distribution of labor in the coca leaf processing and sale process, and crop yields and processes of extraction of each one of the regions under study and under controlled conditions. The percentage of purity is not determined in the estimates.
[3] For the determination of potential production and intervals, refer to Chapter 4. Methodology.

In conclusion, it is estimated that the potential production of cocaine base increased from 797 mt in 2015 to 1,069 mt in 2016[47]. It should be noted that this cocaine base production level does not necessarily become cocaine hydrochloride in the country. According to the results of the study *Characterization of cocaine hydrochloride production complexes*, two trends were identified: the first is the export of cocaine base with a high level of purity, processed by a "specialized" agent, which is shaped into 1 kg bricks with the same packaging characteristics as those with which cocaine hydrochloride is traditionally exported.

The cocaine base is exported as raw material in order to be crystallized in countries of Central America or Europe; The purpose of this strategy is to minimize the risk of loss by interdiction actions. In order to carry out this modality, the "chemist"[48] travels to the country in which he is going

47 Potential production of global cocaine base in 2015 was between 623 mt - 971 mt and it is between 922 mt - 1,269 mt in 2016.
48 This is the individual with the necessary knowledge to carry out the process of crystallization, efficiency, pressing and packaging.

to carry out the crystallization process; the place of destination is equipped with the infrastructure and technical equipment necessary to develop the conversion to cocaine hydrochloride. The second trend is the production of cocaine base for internal consumption. According to sources consulted[49], any cocaine base that does not meet certain quality standards is marketed at the nodes of consumption, under different names associated with cocaine and even as *basuco* (crack cocaine). Previously, basuco was generated as a by-product of the conversion of cocaine hydrochloride, from the collection of waste from in-situ processing. This situation does not occur currently in production complexes.

It should be noted that the dynamics associated with cocaine hydrochloride complexes have responded to the increase in the supply of coca and derivatives. According to the study *Characterization of cocaine hydrochloride production complexes the existence and specialization of cocaine hydrochloride production complexes* in the country is reconfirmed. These complexes have been classified into three broad categories: small complexes where on average 4 people work to produce between 5 and 100 kg of the alkaloid in a daily workday; Medium complexes, with the participation of approximately 10 workers and a production close to 200 kg of alkaloid per day; and large laboratories, which have the capacity to produce around 400 kg per day, with the intervention of approximately 40 workers. Finally there are mega laboratories, which seemingly reappear in the cocaine production landscape, with the capacity to produce up to one ton of cocaine hydrochloride per day, with a workload of about 100 workers.

Based on the results obtained in the productivity studies, the estimates of cocaine paste production and cocaine base and conversion rates used (81% average purity of cocaine base and conversion of cocaine base to cocaine hydrochloride in a 1:1 ratio), production of cocaine base in 2016 is equivalent to 866 mt of pure cocaine hydrochloride[50]. These estimates constitute a benchmark for comparability purposes, insofar as in practice there are no markets for pure cocaine hydrochloride.

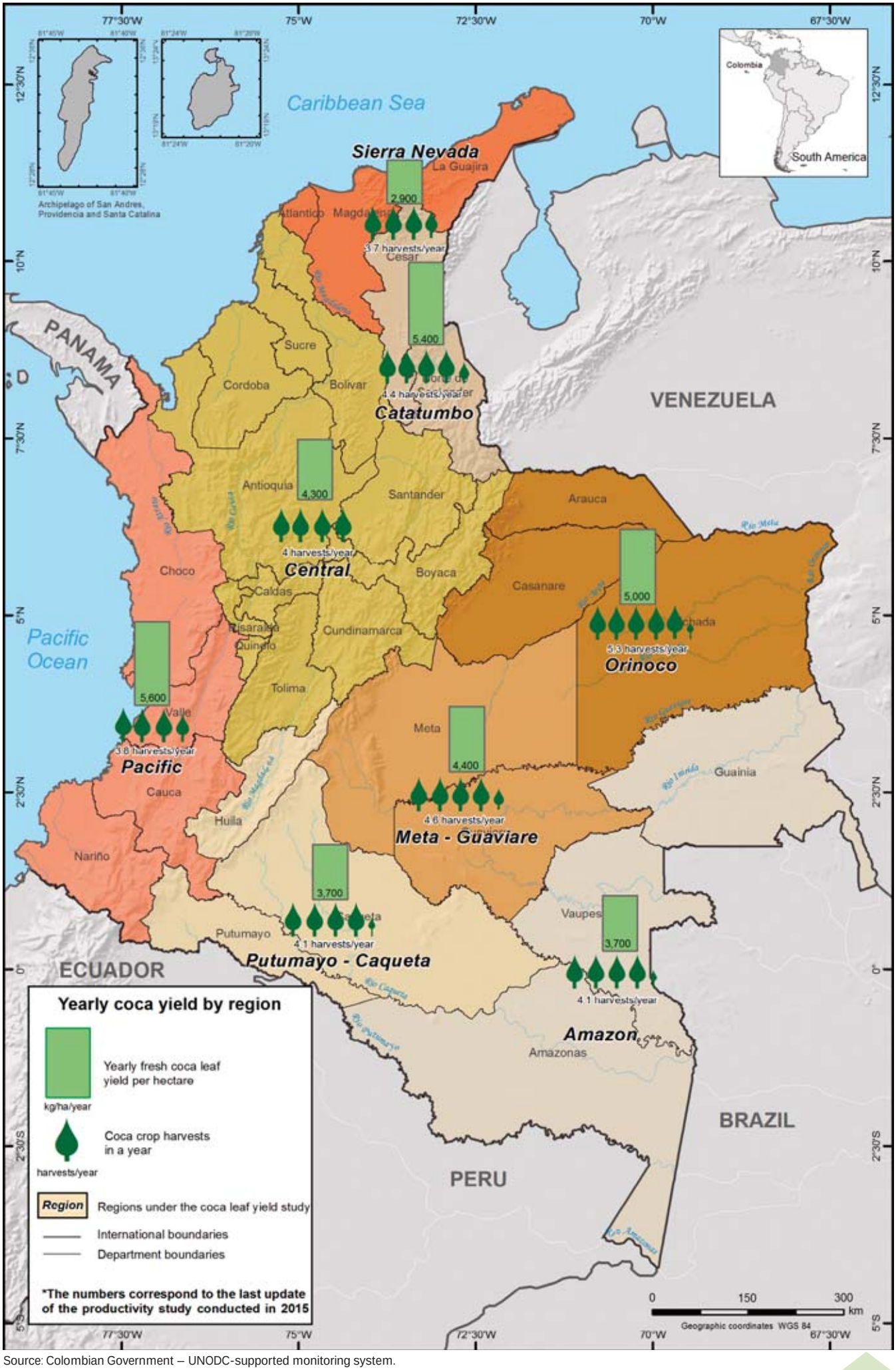
Were one to compare the results obtained in the processes of cultivation, extraction and refining of the alkaloid as previously exposed with the primary production unit, it is estimated that one hectare of coca would have a potential production of 8.6 kg of cocaine base/ha when harvested, and 6.9 kg of cocaine hydrochloride/ha when harvested[51].

49 In the framework of the study *Characterization of cocaine hydrochloride production complexes*, focus groups were carried out with people who have worked as chemists and / or administrators in these infrastructures in different areas of the country.

50 For the purposes of estimation of cocaine production, data obtained from production and yield studies in primary processing (cocaine sheet) and data obtained by the United States Government on secondary processing efficiency (Base to cocaine hydrochloride being 1:1) and the purity of the base (81%). Potential production of pure cocaine hydrochloride in 2015 was between 505 mt - 787 mt and between 747 mt - 1,028 mt in 2016.

51 These estimates correspond to the national scenario in which everything that is grown is extracted into cocaine base and refined into cocaine hydrochloride.

Map 13. Coca crop yield per region in Colombia, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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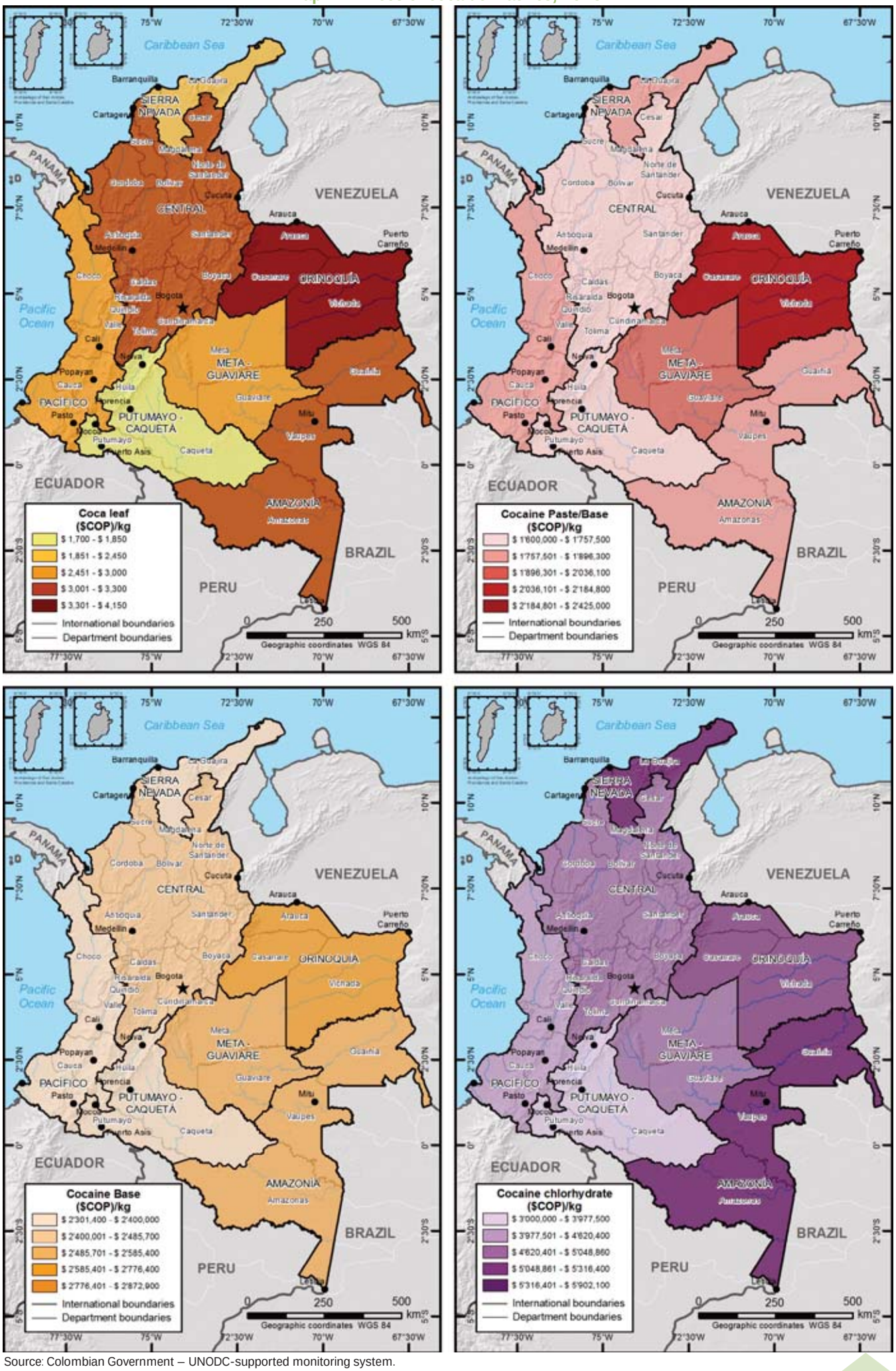
Map 14. Prices of coca derivatives, 2016.



Source: Colombian Government – UNODC-supported monitoring system.

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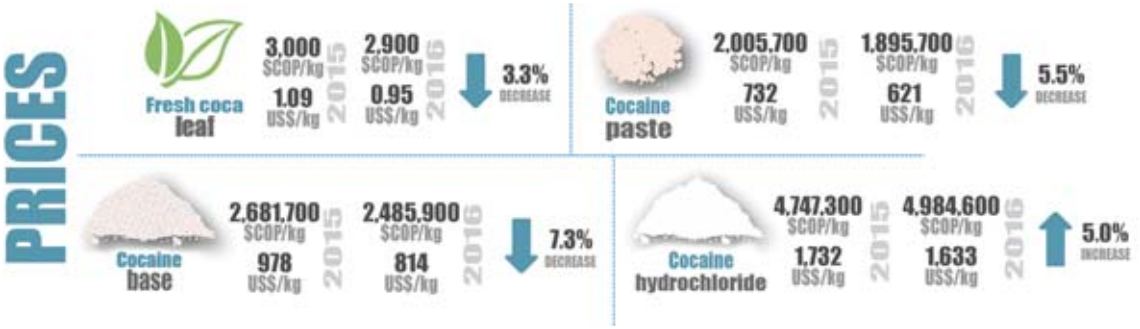
MARKET AND PRICES OF COCA DERIVATIVES

2015-2016 Price dynamics of coca leaf and its derivatives

The sharp increase in coca leaf production, associated with both an increase in area sown and an increase in leaf yields, should have an impact on illegal markets. In this section, we analyze the price dynamics and expose argumentative hypotheses of the variations. In any market, price is the mechanism through which the exchange takes place. The market for drugs and chemical inputs for its manufacture is no exception; it exists not only because there is someone who offers, it but also someone willing to buy it, and price is configured as the mechanism of mediation of negotiation between the parties. In this sense, monitoring prices contributes to a better understanding of the dynamics of the drug market.

In 2016, prices of coca leaf, base paste and cocaine base fell, whilst the price of cocaine hydrochloride tended to rise. Despite the reduction, the price of coca leaf remains at the high levels of the last two years.



Source: UNODC-SIMCI, Colombian National Police-DIRAN. Calculations: UNODC-SIMCI.
Notes:
1) The percentage changes correspond to the relationship between current prices in Colombian pesos (COP $) between 2015 and 2016.
2) The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741 / $ USD 1 in 2015, and COP $ 3,052 / $ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.

At the national level, coca leaf prices fell from COP $ 3,000 / kg in 2015 to COP 2,900 / kg in 2016, equivalent to a 3.3% decrease. The price of a kilogram of cocaine paste fell from COP $ 2,005,700 / kg in 2015 to COP $ 1,895,700 / kg in 2016, i.e. a 5.5% decrease. Likewise, a reduction of cocaine base prices is estimated, from COP 2.681.700 / kg in 2015 to COP 2.485.900 / kg in 2016, which is a 7.3% decrease as compared to the previous year. Contrary to these trends, the prices of a kilogram of cocaine hydrochloride at the national level during the year 2016 increased by 5%, from COP 4,747,300 / kg in 2015 to COP 4,984,600 / kg in 2016.

Trends in coca leaf prices and derivatives

The analysis of trends in the prices of coca derivatives presents different behaviors according to the type of product[52]. Although the price of the coca leaf registered a decrease in 2016; its current level is above the historical average recorded in the last six years (June 2011).

Graph 8. Index of the behavior of prices of coca derivatives in Colombia, 2011 to 2016 (fixed base: June 2011).

Source: UNODC-SIMCI, National Police-DIRAN. Calculations: UNODC-SIMCI.
Notes.
1. In order to facilitate the comparative analysis of the growth of the aforementioned variables, fixed base indices were estimated in June 2011. A fixed base index goes beyond the comparison of two moments in time, and seeks to analyze the variations in relation to a fixed period of reference.
2. The prices of coca leaf, cocaine paste, cocaine base and cocaine hydrochloride used in the construction of the fixed base index of the monthly series 2011 to 2016 were estimated upon the basis of the simple average of regional average prices provided by each source of information.

With respect to the cocaine base, there was a fall in 2016, continuing a downward trend in relation to its historical behavior, since its prices fluctuate in the lowest point of the last six years. As for cocaine paste, there is a historical trend toward stability. Finally, cocaine hydrochloride continues to show an upward trend since mid-2015 and shows signs of growth in the short term. However, it is possible that the behaviors of the Exchange Market Rate (EMR) may influence pricingof this product.

52 Taking into account time-series theories, coca-derivative prices tend to exhibit self-regressive behavior, which means that current levels of prices depend on their historical behavior, leaving other variables that may directly or indirectly affect them.

Possible reasons for the changes in the average prices of coca leaf and its derivatives

In Colombia, prices of coca products do not behave according to competitive market structures[53] to the extent that, as an illegal market, pricing follows regulated scenarios whose rules are defined by buyers present in the territory[54]. In fact, areas affected by coca cultivation are characterized by the presence of illegal groups who, through coercion and violence, regulate the participation of the supply and demand of these products and favor the interests of the buyers.

Some factors have been identified in 2016 which have tended to mobilize local markets in territories affected by coca cultivation. The latter may affect, to a greater or lesser extent, the decrease / increase in marketing flows and the behavior of prices in the regions.

Factors related to the marketing of coca leaf

One of the recent features in the market trend is the reactivation of the coca leaf markets. In the national context, it is important to emphasize that the Agricultural Production Units with Coca (UPAC), for the most part, tend to sell fresh coca leaf. According to information from the productivity studies, to date it is estimated that 60% of growers sell their crops while in 2005, 35% of agricultural producers did. One of the mechanisms of negotiation used by agricultural producers refers to the sale of the crop under the condition that the buyer assumes the labor costs of collecting the coca leaf; in fact, the sale of the crop allows the producer to transfer 77% of labor costs for harvesting[55].

Once the crop is sold, concerns arise about its destination. However, the following scenarios related to the collection can be deduced in which:

i. A proportion of leaf can be bought by wholesale buyer, then sold to an actor who performs the process of extraction and refining to cocaine base. In this scenario, it is an intermediary actor in the purchase and sale of coca leaf, without any level of transformation i.e. dedicated exclusively to the commercialization of this product. It should be noted that the leaf is marketed in a fresh state, which implies that it is a perishable good because the leaf tends to rot about two days after harvest. In this scenario, the production negotiations are carried out in advance in order to guarantee the optimal state of the raw material.

53 In the structure of competitive markets, the interaction of many buyers and many bidders allows price construction to be determined by the inverse relationship between available quantities and their price level.
54 These types of market structures can have two denominations: Monopsony, in the case where there is only one buyer in a market, and oligopsony, when a market is made up of many sellers and few buyers.
55 According to the results of the socioeconomic characterization of the territories affected by coca crops, Putumayo-Caqueta, Catatumbo and Magdalena Medio.

ii. A proportion of leaf could be obtained directly from the agricultural producer by a "specialized" actor who collects the coca leaf for processing it into cocaine base later.

iii. A proportion of the coca leaf could be collected by an Agricultural Producer with Coca (PAC) who has an infrastructure destined to the extraction of the alkaloid in his Agricultural Production Unit. It has been shown that the larger UPACs concentrate on average more than 50 hectares, and they carry out the primary extraction processes[56] specifically to produce cocaine base paste and would be able to absorb coca leaf production from their neighbors.

Supply-related factors

In relation to supply, in 2016, some behaviors were identified that were associated with the dynamics of the quantities offered in the market, especially in relation to the increase in available quantities, possible institutional aspects related to agricultural producers with coca, decrease in the costs of agrochemicals used in the cultivation of coca, the expansion of the installed capacity of cocaine hydrochloride production complexes, and new strategies for the acquisition of coca derivatives for the crystallization of cocaine.

Increase in available quantities of coca derivatives

The increase in the availability of coca, not only associated to the increase in production potential but also to the increase in availability in the market, has had a direct impact on the decrease in the sales prices of coca derivatives. This could be related to: (i) reducing state pressure on illicit production; (ii) reducing the level of risk perceived by the suspension of aerial spraying; and (iii) generating incentives for the establishment of Crops as a mechanism for future negotiations with the State in replacement programs[57].

A generalized increase in productive hectares translates into an increase in production that is potentially generated in the Units of Agricultural Production with Coca (UPAC), even more if the containment strategies have slowed its growth rate as compared to other periods. In fact, actions for supply reduction, especially in relation to the containment of cultivated hectares, presented a drop in 2016 as compared to what was reported in previous years[58], and forced manual eradication of coca in Colombia increased by 31 % from 13,473 hectares in 2015 to 17,642 hectares in 2016, and no aerial spraying was carried out since it was canceled in the last quarter of 2015. In the course of the year 2016, interdiction actions focused on the destruction of primary production

56 According to the results of the study Socioeconomic characterization of the territories affected by coca crops, Putumayo-Caqueta, Catatumbo and Magdalena Medio, 2016 showed that the UPACs with more than 50 hectares carry out the first level of processing (Extraction process).

57 VILLEGAS, Luis Carlos. The last battle: beyond crops. Time. March 5, 2017. Retrieved From: VILLEGAS, Luis Carlos. La última batalla: más allá de los cultivos. El Tiempo. 05 de marzo 2017. Consultado en: http://www.eltiempo.com/justicia/conflicto-y-narcotrafico/columna-del-ministro-de-defensa-sobre-aumento-de-cultivos-ilicitos-64250.

58 For more details, please do kindly refer to Chapter 3 - Government Actions, which analyzes official statistics on seizures by type of drug as well as related information on the dismantling of laboratories.

infrastructures[59] reported an increase of 29% compared to the previous year, according to information provided by the Colombian Drug Observatory. However, these actions slowed down as compared to 2015 (65% compared to 2014). In this regard, 2016 was a year with greater potential for cocaine production

Decreased spending on agrochemicals used in coca cultivation

In 2016, there was a decrease in the costs of sustaining coca cultivation reported by the agricultural producers[60]. In the case of the Putumayo-Caquetá region, the costs per hectare in the use of agrochemicals went from an average of COP $ 656,000 in 2009 to COP $ 494,600 in 2016, while in the Catatumbo region, the costs associated with the use of agrochemicals went from COP $ 2,577,500 in 2007 to COP $ 944,800 in 2016. This reduction is due to the lower utilization of the amounts of agrochemicals used by the agricultural producer, and this behavior possibly associated with the increase of agrochemical prices between 2008 and 2015.

Although the use of agrochemicals in coca cultivation in the UPAC has tended to decrease, it should be noted that they tend to be higher in areas affected by coca crops than with other crops. This situation implies that (for the maintenance of coca crops) more intense labor is required – about 77% of total production costs.

It is important to mention that the quality of the leaf depends directly on the management of the crop and the type of cultivar. However, the alkaloid content in the leaf tends to be standard according to taxonomic variety, so the yield of leaf alkaloid extraction tends to increase / decrease depending on the processing techniques used in the alkaloid extraction process.

Expansion of the installed capacity of cocaine hydrochloride production complexes

The increase in the quantities produced of coca derivatives in the territories has meant that the installed capacity of the sites destined to the production of cocaine hydrochloride is adjusted to these dynamics. Changes were identified in the characteristics of these infrastructures, mainly related to production capacity, negotiation schemes of the final product and the formation of capital[61]. In their results, the existence of interconnected facilities that function as a structural whole (called production complexes) is confirmed. In its structure, the crystallizer is one of these interconnected facilities, followed

59 The primary production infrastructure corresponds to the extraction laboratories, where the narcotic substance is obtained by processing the raw material (vegetable matter) with the use of organic solvents. In this case, a physical process is performed in which the chemical structure of the substance is not altered or modified – it is limited to its extraction. These are called Cocinas - "Kitchens", "chagras", "chongos", "saladeros", "picaderos" or can be reported as a makeshift construction. (Source: Colombian Drug Observatory).
60 The results of the study *Socioeconomic characterization of the territories affected by coca crops*, Putumayo-Caqueta, Catatumbo and Magdalena Medio.
61 As evidenced in the results of the study Characterization of cocaine hydrochloride production complexes *(Caracterización de los complejos de producción de clorhidrato de cocaína)*, which was carried out in 2016 by the Ministry of Justice and Law, the Colombian National Police, the Colombian National Navy, the Colombian National Army and the SIMCI-UNODC Project.

by the hideouts (for chemical substances, coca derivatives and final product). It was identified that, in some areas of the country, the facilities that are part of production complexes are fragmented, i.e. they do not have strict geographical proximity, and are not necessarily established in the areas of influence of the crop.

Similarly, it was identified that the production complexes that are currently being built in Colombia tend to be larger as compared to what was evidenced in the years 2010 and 2014[62], according to the information consolidated in this study. Although its order of magnitude is unknown, it is necessary to mention that the sources of information consulted in the study socialized a tendency to install production infrastructures with the necessary equipment to process Between 500 and 1,000 kg / day of cocaine paste / base. This trend is seemingly due to the increase in coca leaf production, inasmuch as a greater capacity is required in the transformation of coca derivatives and more efficiency, both in time and in resources, for the development of processes. It is important to mention that the quality of the final product does not depend on the production capacity of the production complex, but it corresponds to the agreements established between the owner of the drug and the owner of the production complex, since quality is a function of the purity and hence the magnitude of cutting substances added in the transformation from cocaine base into cocaine hydrochloride.

Given the clandestine nature of cocaine hydrochloride production sites, they are required to comply with basic strategies for availability of processing resources, such as coca derivatives, chemical and personnel inputs, invisibility to authorities, routes with controlled access and security. Expansive processes in these facilities have involved changes in their operating dynamics in:

i. The generation of strategic alliances with investors, especially foreign investors, in order to capitalize on the expansion of illegal cocaine production sites. It should be noted that, although production complexes may operate under the maquila modality[63], the generation of societies for the production and trafficking of drugs between the drug owners and the owners of the complexes is now evident. The incentive of this scenario is to participate in the distribution of a portion of the proceeds from the sale of cocaine hydrochloride placed in transit or consumption sites.

   It is noteworthy that, according to the information collected in the study, the maquila modality is maintained, because it is cheaper for some drug traffickers to buy the cocaine paste / base than the finished product.

ii. The expansionary phenomenon of production complexes has meant that they no longer tend to be invisible to the

62 The results of characterization studies of the transformation process of the coca leaf into cocaine hydrochloride, conducted by the PRELAC- Prevention of the diversion of drugs precursors in the Latin American and Caribbean Region, with Contribution of the European Union under the Instrument for Stability, IFS / 2012 / 286-049, and the SIMCI-UNODC project.

63 In the maquila, the owner of the drug delivers it to the owner of the complex, who receives in payment the payment for the transformation service.

surrounding population. For this reason, the owners of these infrastructures have implemented "good neighbor" strategies, which are characterized by supporting communities with financing, access to food, medical services, recreational activities and infrastructure improvement, inter alia. Likewise, owners of production complexes have strengthened their connections with agricultural producers with nearby coca, through the purchase of coca derivatives at higher prices as compared to other buyers. In case the agricultural producers or the local inhabitants do not want to cooperate, they are coerced by illegal armed groups to leave the zone.

These neighborhood strategies at the local level have led to the generation of strong networks of cooperation between the community, the owners of the production complexes and their workers, both in coexistence and in intertwining with the economy of the zones. In this scenario, the increase in economic dependence on coca has been identified to the extent that, in the case where the production complex is intervened, it harms the income and benefits that the community receives before its establishment. Indeed, in 2016, community demonstrations and protests have been reported in response to interventions against cocaine hydrochloride production complexes. This situation had not arisen in previous years, since the relations between agricultural producers and production infrastructures tended to be associated exclusively with extraction processes.

As reported by the sources interviewed, cocaine trafficking tends to be controlled by foreigners and it is they who coordinate (whether directly or through their emissaries) the processes of cocaine negotiation in production sites, as well as the mechanisms for their shipment abroad to countries of transit and consumption. With regard to products traded abroad, the sale of cocaine hydrochloride persists, with a level of purity that is defined by the buyer, as well as the addition of cutting substances. Likewise, there is a relevant tendency to export "re-oxidized" cocaine base, ready to be crystallized in other countries, which would be taking greater force in the current dynamics of trafficking[64].

Factors associated with demand

In relation to the demand in 2016, below are some of the following facts that directly and indirectly had an impact on the purchase and, therefore on the configuration of the marketing prices of the leaf derivatives: an increase in the international demand of the cocaine hydrochloride, new strategies for the acquisition of coca derivatives and new strategies in territorial control in areas affected by coca crops.

64 A study by the DEA and PONAL (2017) indicates that approximately 40% of cargoes seized in high seas corresponded to highly pure cocaine base.

Increased international demand for cocaine hydrochloride

According to the State Department, the use of cocaine and its availability on the streets of the United States is growing for the first time in almost a decade[65]. According to the data consolidated in the survey[66], there was a 23% increase in the population over 12 years of age who reported cocaine use, as compared to the 2009 and 2014 reports[67]; The report also warns of the increase in the number of people who reported having tried this drug for the first time[68].

If we include information on trends in the detection of cocaine use in the US population in this analysis, it is evident that from 2012 to January 2017 there has been a 75% increase in the number of individuals detected with cocaine in their system. Before that year (2012), this figure was in decline[69]. Based on the fact that about 90% of the total production of cocaine produced in Colombia is destined for the United States market, and it is visualized that the high growth of crops in the last two years can have a direct impact on internal consumption in the Country in the next two years[70].

In addition, the European Monitoring Center for Drugs[71] reports that the demand indicators point to generally stable or even somewhat decreasing levels of consumption, as compared to seizure data, which are generally stable. However, the latest information on the market suggests a possible increase in drug availability, retail prices with stability or slight downward trend, and purity of retail cocaine that has regained levels of 10 years ago, although generally still below 50%[72].

New strategies for the acquisition of coca derivatives

During 2016, new strategies have been identified in the acquisition of coca derivatives. One of them refers to the consolidation of the purchase of the coca leaf, under the modality of collection, to be processed outside the Units of Agricultural Production. This strategy would have the advantage of a possible homogenization of the coca derivatives, thus increasing the certainty of its quality to the point where, in case of being optimal, the phase of "re-oxidation" would be suppressed.

65 Data provided by the National Institute on Drugs Abuse (NIDA). National Survey on Drug Use and Health: Trends in the prevalence of various drugs for people 12 years of age or older, ages 12 to 17, 18 to 25, and Age 26 years or older; 2013 - 2015. Accessed at: https://www.drugabuse.gov/national-survey-drug-use-health.

66 According to the information consulted in the National Survey on Drug Use and Health (NSDUH). National Institute on Drugs Abuse (NIDA). "Cocaine." National Institute on Drug Abuse, May 6. 2016, accessed at: https://www.drugabuse.gov/publications/research-reports/cocaine.

67 According to information reported in the National Survey on Drug Use, between 2009 and 2014 reported cocaine use among those over 12 years ranged between 1.4 and 1.7 million people. But in 2015, that number skyrocketed to 1.9 million people (0.7 percent of this population), a 23% increase when compared to the figure of 2014 (1.5 million people) and the highest figure since 2008.

68 In 2015 there was a 26% increase between this group of people as compared to 2014, and 61% as when compared to the year 2013.

69 Quest Diagnostics. Annual Drug Testing Index (2016).

70 Quest Diagnostics. 2016 Quest Diagnostics ™ Drug Testing Index. Consulted at: http://www.employer-solutions-resources.com/whitepaper/2016-drug-testing-index.

71 European Monitoring Center for Drugs and Drug Addiction. EUROPOL. Report on drug markets in the EU. Strategic overview. 2016. Consulted in: http://www.emcdda.europa.eu/system/files/publications/2374/TD0416161ESN_1.PDF.

72 For more details, refer to Chapter 3. Actions of the Colombian Government.

In the scenario where the agricultural producers extract the alkaloid in-house, strategies have been established on the part of the buyer around the application of different quality tests on the derivatives of the coca, since it is frequent for farmers to cut the alkaloid with different types of substances added at the time of drying. In this sense, the price is agreed based on the quality of the product to be negotiated. In some regions, such adulteration strategies have caused victims, so vendors tend not to carry out these practices in order to avoid retaliations.

In some regions of the country, there was a temporary paralysis of the purchase of coca derivatives, both leaf and cocaine paste, due to oversupply in the producing areas and minimal presence of buyers. However, the market was reactivated through the appearance of new buyers, who are responsible for the collection process in specific places. These actors may operate independently, but with the authorization of the illegal armed group present in the area, or with representatives of some of these organizations in the territory.

Under this modality, the purchase of coca derivatives is made in advance, i.e. the drug traffickers negotiate through the delivery of cash ("advance") to intermediaries. Subsequently, the intermediaries take the cash to the producing areas for the acquisition of the cocaine paste / cocaine base, either through direct purchase to producers / intermediaries, or obtaining coca leaf for further processing in situ. Similarly, recruitment modalities have been identified in which illegal armed groups present in the producing areas buy the coca derivatives through "vouchers". These so-called vouchers are recognized in the local environment as a means of payment, so that their use allows purchase and sale transactions of other goods and services.

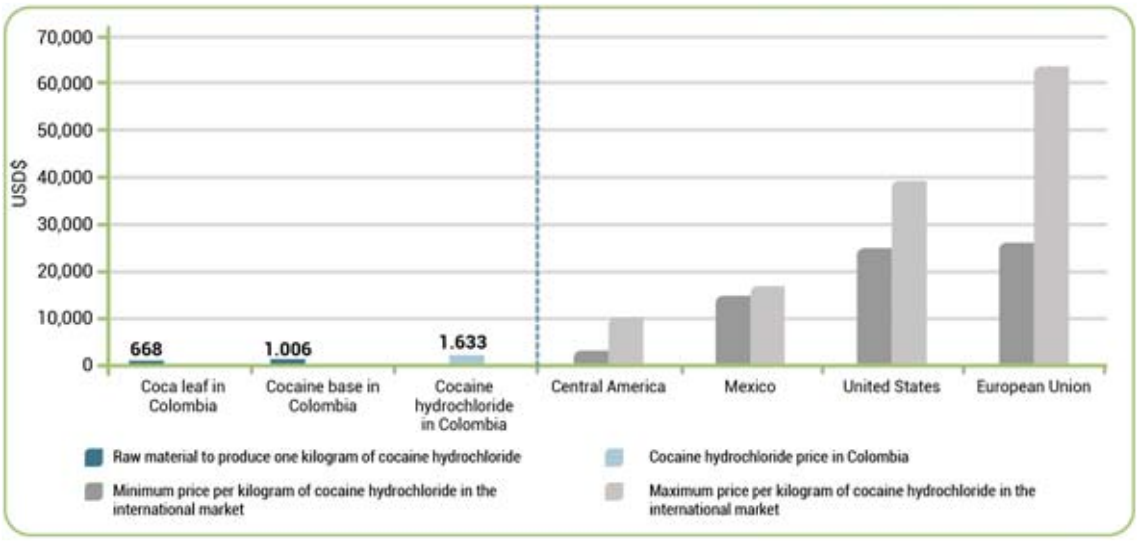
External factors associated with the market

Exchange market rate favorable to the illicit market

One of the key variables in the flows derived from export-type cocaine trafficking is the Exchange Market Rate (EMR). Cocaine hydrochloride is mainly destined for the international market, and the EMR sets the terms of trade. In the first months of 2016, the EMR fluctuated upward, but tended to stabilize during the year. In particular, the monthly average of the EMR fluctuated from a maximum of $ 3,354 to the USD in February 2016 to a minimum of $ 2,925 to the USD in September 2016. This scenario could possibly discourage the entry of foreign exchange, since a high EMR implies receiving more pesos for every dollar traded, which in the case of the coca market would allow a greater margin of negotiation of the prices of the coca derivatives. Due to the above, the stability of the EMR possibly encouraged the reduction of the price of coca derivatives. However, its high level compared to what was reported two years ago will allow the generation of a margin of negotiation.

On the other hand, two different scenarios are observed if we analyze the economic flows associated with the return of the purchase and sale of cocaine hydrochloride, from the primary products to the final product placed in nodes of transit and consumption. In the primary phase of production, agricultural producers (60% of whom sell the coca leaf), have no influence on the market or price determination. It should be noted that only 40% of the agricultural producers with coca carry out the extraction process on the farm, and it is estimated that only 1% of them would reach the cocaine base stage. This scenario implies that agricultural producers increasingly tend to participate less in the transformation processes, so the added value that is generated is distributed amongst other agents in the market.

However, the return of flows associated with the cocaine base and even cocaine hydrochloride in Colombia is lower when compared to wholesale prices at traffic and consumption nodes. It is estimated that when cocaine hydrochloride is wholesaled to consuming countries, its value can increase between 16 and 39 times as compared to the price marketed in Colombia – not counting the differentials that can be generated from dosing and addition of cutting substances.



Graph 9. Relationship between the price paid for one kilogram of cocaine hydrochloride at production sites in Colombia vs. The negotiation prices agreed in different nodes of traffic and consumption.

Sources: Update of the scheme proposed by the Colombian Drug Observatory, based on information from:

[1] The Drug Price System, SIMCI-UNODC, The Colombian National Police (DIRAN): in coca leaf prices, cocaine base and cocaine hydrochloride, by 2016.
[2] PRELAC-UNODC and SIMCI-UNODC, in relation to the prices reported in transit zones in Central America and Mexico reported in 2014.
[3] The Colombian National Police (DIRAN), Interpol, DEA and the UNODC World Drug Report, as consolidated by the Colombian Drug Observatory as of 2015.

Notes:
[1] The prices of coca leaf, cocaine base and cocaine hydrochloride listed correspond to the information consolidated by the Drug Price System collected in production zones, in the case of coca derivatives in the main traffic and consumption nodes in the country.
[2] In Colombia, it is estimated that the purity of the cocaine hydrochloride exported in 2016 is around 77%, according to the purity analyses carried out by the United States Government from the seizures arriving in that country from Colombia.
[3] The levels of purity in countries that are related as nodes of transit and consumption are unknown. However, prices correspond to wholesalers.
[4] The comparison proposed presupposes a relative stability in the construction of wholesale prices in the short and medium term. In this scenario, prices do not change even though they are reported between 2014 and 2016.

Some of the abovementioned elements have had repercussions on international markets. According to information from the Government of the United States, a period of about two years[73], usually elapses between the time the crop is harvested until it appears on the consumer market. Therefore, the increase in consumption currently reflected in the National Drug Use Surveys (2015) in the United States would be tied to the growth in supply that began to take place in producing countries in 2013.

Political and institutional aspects related to agricultural producers with coca

Ante las expectativas generadas en el Given the expectations generated in the peace process, the low levels of information provided by the rural population facilitated the dispersion of a message that was contrary to the intention of the National Government, in that there would only be state support for families who had coca crops, and that the economic incentives for replacement programs would reach only these family units. This had the effect of an increase in the number of families interested in planting illicit coca crops, assuming that this activity would give them state support in the future.

A second aspect to emphasize is the increase of organized social protest for the containment of the actions of forced manual eradication. Peasant families have increased the level of organized mobilization when eradication actions are about to be initiated, which has led to blockages on the roads and direct confrontations with the police. This has had a significant impact on the interdictive operation of the authorities in some areas affected by coca cultivation, which has been limited.

Thirdly, producers of illicit crops perceive an overall reduction in the risk of economic loss due to supply control actions. On the one hand, as mentioned in the previous paragraph, farmer mobilizations reduce the effectiveness of forced eradication actions and, on the other hand, the suspension of aerial spraying eliminates the risk of damage to the crop by the herbicide. An additional factor is the expectations regarding the incentives that the implementation of the peace agreement will bring[74] for growers.

Finally, the recent emergence of community-based organizations representing producers of illicit crops, which have hosted coca growers in order to ensure their inclusion in the local implementation of the peace agreements. These organizations seek to play a role of intermediation between the agricultural producers with coca and the regional and national authorities that represent the institutions that are going to implement the strategies of the peace agreement in the territory, for the impulse of the programs of substitution of illicit crops in their territories. The role played by these organizations can be positive or negative,

73 United States Department of State. Bureau for International Narcotics and Law. Enforcement Affairs International Narcotics Control Strategy Report. Volume I. Drug and Chemical Control. March 2017. Accessed at: https://www.state.gov/documents/organization/268025.pdf.

74 The official signing of the Peace Agreement was held on November 24, 2016. Since that date, the protocols agreed for the implementation of the agreement have been activated.

according to the strategies they implement to press favorable agreements with the National Government. Attention to these farmer associations should be integrated into the management of the Colombian authorities, in order to take advantage of the great potential they have for the drive towards satisfactory solutions for both parties, within the framework of the Agreement established with the FARC - EP, and in particular in relation to point 4 of their Agreement.

Regional variations in coca leaf prices and their derivatives

In Colombia, prices of products derived from the production and processing of illicit crops, especially coca products, do not always reflect behavior related to the laws of supply and demand. Due to the above, there is no clarity as to the determination of price in terms of the quantities offered and demanded, since previously socialized factors in the coca market have influenced to a greater or lesser extent the decrease / increase in marketing flows, and thus on the behavior of prices in the regions.

Regional variations in fresh coca leaf prices

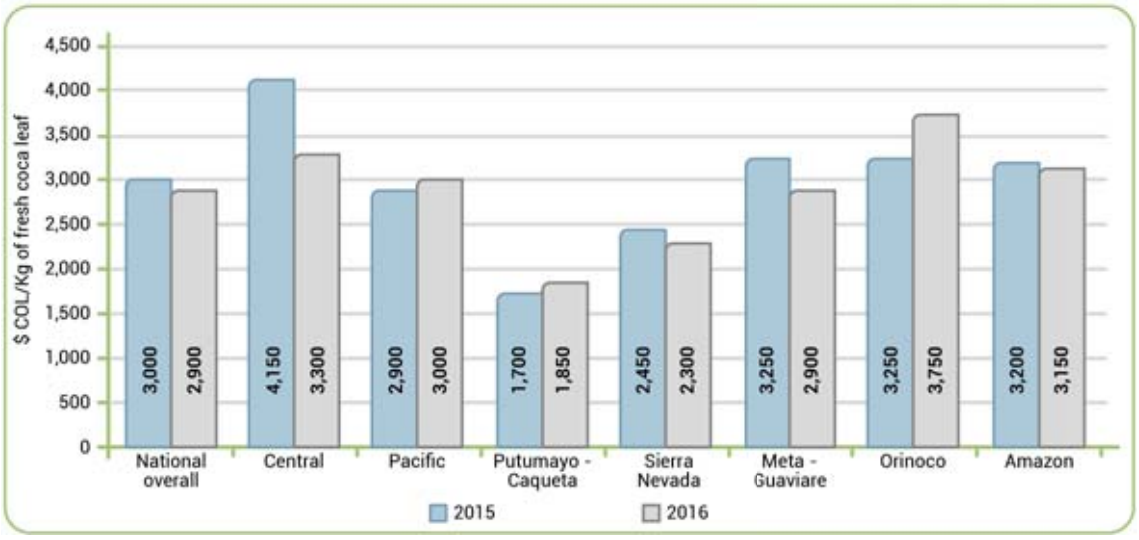
According to information reported by the productivity studies, it was estimated that only 33% of coca farmers sold coca leaf in 2005 without any kind of transformation, whereas it was estimated that 64 % of the producers reported this modality in 2015. The regions with the highest proportion of coca leaf sales are Sierra Nevada (91%), the Amazon Region (64%) and Putumayo-Caqueta (64%). The regions with the lowest proportion were Catatumbo (27%), Central (24%), Meta-Guaviare (14%) and Orinoco (5%).

Source: UNODC-SIMCI, National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes.
[1] The percentage changes correspond to the relationship between current prices in Colombian pesos (COP $) between 2015 and 2016.
[2] The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741 / $ USD 1 in 2015 and COP $ 3,052 / / $ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.

As was previously pointed out, coca leaf prices decreased at the national level from COP $ 3,000 / kg in 2015 to COP 2,900 / kg in 2016, equivalent to a 3.3% decrease. However, it is still significantly high with respect to its historical behavior. In the interior of the country, it is found that the regions with decreases in coca leaf prices are: The Central Region - from COP 4,150 / kg in 2015 to COP 3,300 / kg in 2016

(20.5%), followed by Meta-Guaviare - COP $ 3,250 / kg in 2015 to COP 2,900 / kg in 2016 (-10.8%), Sierra Nevada presented a 6.1% reduction in its coca leaf price levels, while prices in the Amazon region dropped from COP 3,200 / kg in 2015 to COP 3,150 / kg in 2016 (-1.6%).



Graph 10. Average prices of kilograms of coca leaf (fresh) 2015 and 2016, per region.

Source: UNODC-SIMCI, Colombian National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information reported by the sources.
[2] The values were rounded to the nearest multiple of 50.
[3] The values presented in the Central region include the behavior of coca leaf prices recorded in the department of Norte de Santander.

On the other hand, the regions that had a tendency contrary to the national aggregate, i.e. those that increased the price of the coca leaf were Orinoco, the Pacific and Putumayo-Caqueta, by 15.4%, 3.4% and 8, 8%, respectively. In the Orinoco, Central, Amazon and Pacific regions, price levels were higher than the national average, whilst prices in the Putumayo-Caquetá and Sierra Nevada regions were lower than the national average.

According to the studies of *Economic Structure of the Agricultural Production Units* in areas of influence of coca crops in the regions of Catatumbo, Magdalena Medio and Putumayo-Caquetá[75], it was found that agricultural producers tend to sell the leaf or to specialize in the extraction process. In the case of sale of the coca leaf, price levels may not fully cover the costs associated with the payment of agricultural inputs and labor for labor, so that, given a scenario of low prices, the buyer would bear the costs of the harvest wages. In this context, the agricultural producer with coca can receive a twofold income[76]: one from their investment in the crop, through the payment of the kilos harvested, and

75 Study conducted by the Ministry of Justice and Law and the SIMCI-UNODC Project. Economic Structure of Agricultural Production Units in areas of influence of coca crops. 2017.
76 However, the price received by the agricultural producer with coca does not cover labor costs, i.e. there is a mechanism of correction of the price by the buyer.

the other by its labor, from the per day payment of harvesting work.

Regional variations in the prices of Basic Pasta of Cocaine and Cocaine Base

Both cocaine paste and cocaine base can be obtained from fresh coca leaves. However, the identification of each of these products in situ is not easy, as both buyers and sellers use the terms cocaine paste and cocaine base indistinctly in the market. This section will refer to cocaine base as the product with the addition of potassium permanganate in its production process, which implies a level of purification (oxidation of alkaloid impurities). In terms of the market, the price of the cocaine base tends to be, on average, 25% higher as compared to the price of cocaine paste; because the latter product is the result of the first level of extraction, its quality in terms of alkaloid concentration is lower.

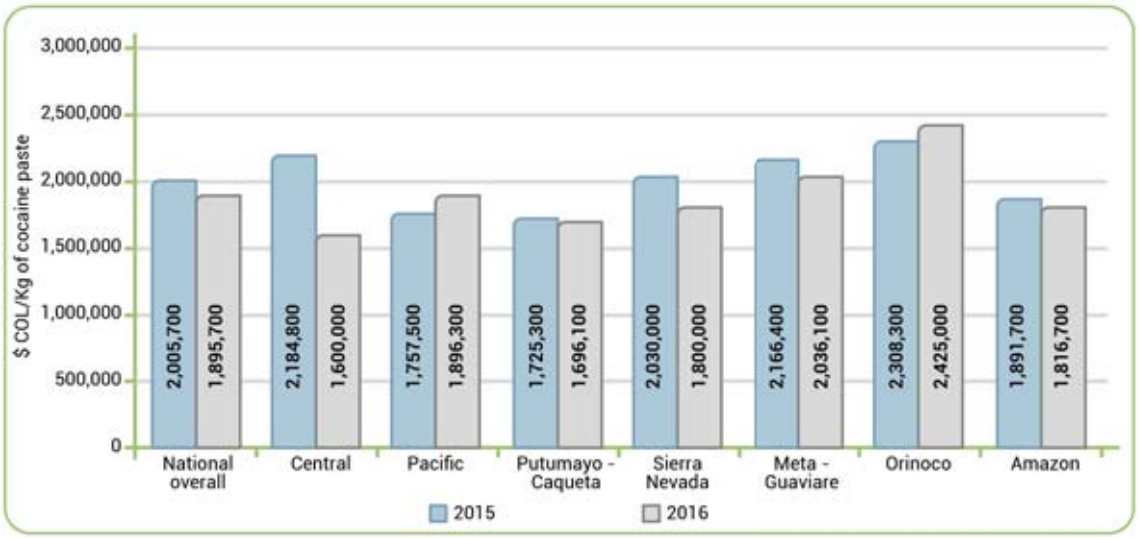
Cocaine paste prices

Prices per kilogram of cocaine paste during the year 2016 have had a trajectory similar to that of coca leaf, i.e. there is evidence of a sustained price reduction. In particular, the price of cocaine paste decreased from COP $ 2,005,700 / kg in 2015 to COP $ 1,895,700 / kg in 2016 (-5.5%).

Source: UNODC-SIMCI, National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes.
[1] The percentage changes correspond to the relationship between current prices in Colombian pesos (COP $) between 2015 and 2016.
[2] The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741 / $ USD 1 in 2015 and COP $ 3,052 / / $ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.

There was a 26.8% drop in the price in the Central region - from COP $ 2,184,800 / kg in 2015 to COP $ 1,600,000 / kg in 2016. There was also a downward trend in other regions: Sierra Nevada (-11.3%), Meta-Guaviare (-6.0%), the Amazon Region (-4.0%) and Putumayo-Caquetá , 7%). Contrary to this behavior, the Pacific and Orinoco regions increased their prices (7.9% and 5.1%, respectively).



Graph 11. Average prices of kilograms of cocaine paste in 2015 and 2016, per region.

Source: UNODC-SIMCI, Colombian National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information reported by the sources.
[2] The values were rounded to the nearest multiple of 50.
[3] The values presented in the Central region include the behavior of coca leaf prices recorded in the department of Norte de Santander.

Prices above the national average were recorded in 2016 in the regions of: Orinoco ($ COP 2,425,500 / kg), Meta Guaviare ($ COP 2,036,100 / kg) and the Pacific region (COP $ 1,896,300 / kg). The latter had a level close to the national average price. In contrast, the regions that obtained prices below the national average were: the Central Region ($ COP 1,600,000 / kg), Putumayo-Caqueta ($ COP 1,696,100 / kg), Sierra Nevada ($ COP 1,800,000 / kg), and the Amazon Region (COP $ 1,816,700 / kg).

As mentioned above, approximately 35% of coca farmers (PAC) transformed coca leaves into cocaine paste. However, this productive process is not homogeneous in all regions, as 95% of the PACs in the Orinoco region do so, 86% in Meta-Guaviare, 73% in Catatumbo and 76% in the Central region does so in a smaller proportion. 36% of the producers in the Putumayo-Caquetá region processed basic cocaine paste, while 5% and 4% thereof do so in the Pacific and Sierra Nevada, respectively.

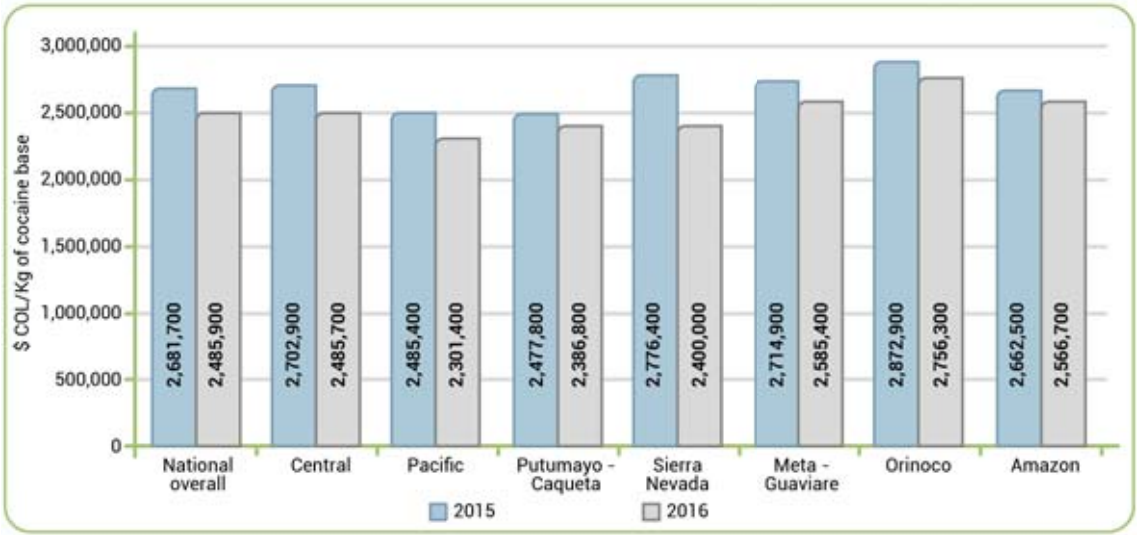
Cocaine base prices

The prices of the cocaine base registered during 2016 were reduced nationally from COP $ 2,681,700 / kg in 2015 to COP $ 2,485,900 / kg in 2016, representing a decrease of 7.3% as compared to the behavior of the year 2015. At the regional level, there is a general fall in the current price of cocaine base. Sierra Nevada was the region that showed the largest decline (-13.6%). Other regions that also had a decrease were the Central Region (-8.0%), the Pacific (-7.4%), and Meta-Guaviare (-4.8%). The regions of Orinoco, Putumayo-Caquetá and the Amazon Region decreased -4.1%, -3.7% and -3.6%, respectively.

Source: UNODC-SIMCI, National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes.
[1] The percentage changes correspond to the relationship between current prices in Colombian pesos (COP $) between 2015 and 2016.
[2] The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741 / $ USD 1 in 2015 and COP $ 3,052 / / $ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.

Regional prices that were above the national average corresponded to: Orinoco ($ COP 2,756,300 / kg), Meta-Guaviare ($ COP 2,585,400 / kg), and the Amazon ($ COP 2,566,700 / kg). On the other hand, the regions with prices below the national average were: Pacific ($ COP 2,301,400 / kg), Putumayo-Caquetá ($ COP 2,386,800 / kg) and Sierra Nevada (COP $ 2,400,000 / kg). In the case of the Central region, their prices (COP $ 2,485,700 / kg) were very close to the national price.



Graph 12. Average prices of kilograms of cocaine base in 2015 and 2016, per region.

Source: UNODC-SIMCI, Colombian National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information reported by the sources.
[2] The values were rounded to the nearest multiple of 50.
[3] The values presented in the Central region include the behavior of coca leaf prices recorded in the department of Norte de Santander.

As noted above, conversion of cocaine base paste is only performed by about 1% of Agricultural Producers with Coca. However, 5% and 3% of them do so in regions like Sierra Nevada and the Pacific, respectively. In the other regions there is no evidence of this transformation at the production site (farm).

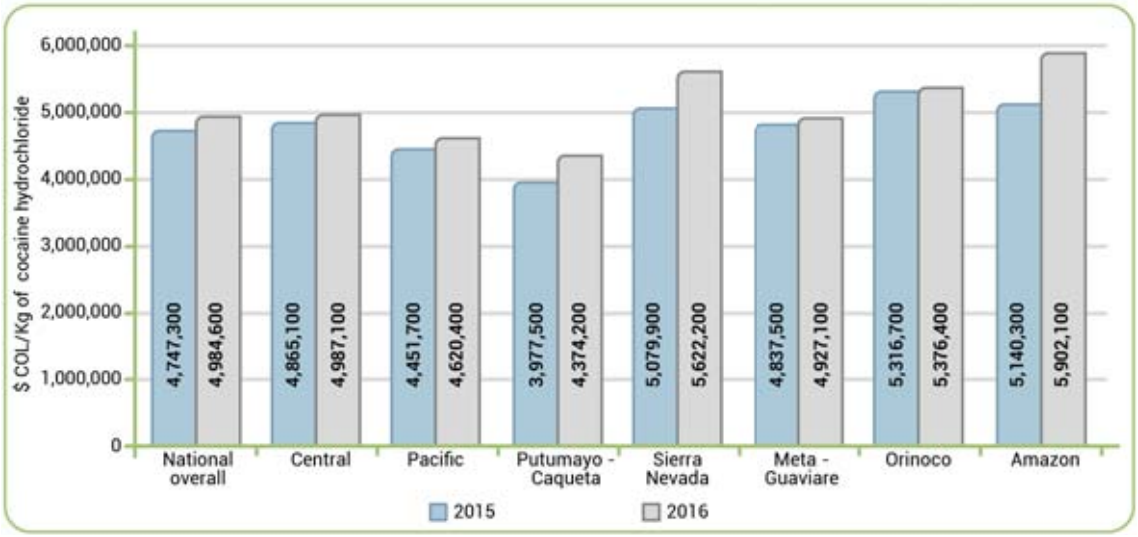
Regional variations in prices of Cocaine Hydrochloride

Domestic prices of the kilogram of cocaine hydrochloride showed an upward trend during the year 2016, contrary to all its productive predecessors, i.e. its increase contrasts with decreases in leaf, cocaine paste and cocaine base prices. Cocaine hydrochloride increased from COP $ 4,747,300 / kg in 2015 to COP 4,984,600 / kg in 2016, equivalent to a 5.0% increase.

Source: UNODC-SIMCI, National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes.
[1] The percentage changes correspond to the relationship between current prices in Colombian pesos (COP $) between 2015 and 2016.
[2] The Exchange Market Rate (EMR) used for estimates of Colombian pesos in US dollars was COP $ 2,741 / $ USD 1 in 2015 and COP $ 3,052 / / $ USD 1 in 2016. This rate corresponds to the monthly average reported by the Central Bank.

When compared to 2015, the Amazon Region had the highest price increase (14.8%), as did regions like Sierra Nevada (10.7%), Putumayo-Caqueta (10%), the Pacific (3.8%), Meta Guaviare (1.9%) and Orinoco (1.1%).



Graph 13. Average prices of kilograms of cocaine hydrochloride in 2015 and 2016, per region.

Source: UNODC-SIMCI, Colombian National Police-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information reported by the sources.
[2] The values were rounded to the nearest multiple of 50.
[3] The values presented in the Central region include the behavior of coca leaf prices recorded in the department of Norte de Santander.

Regional prices that were above the national average were reported in: Amazon (COP 5,902,100 / kg), Sierra Nevada (COP 5,622,200 / kg) and Orinoco (COP 5,376,400 / kg). The price in the Central region was close to the national price (COP $ 4,987,100 / kg), whilst the Putumayo-Caquetá (COP $ 4,374,200 / kg), Pacific (COP $ 4,620,400 / kg) - Guaviare (COP 4,927,100 / kg) were lower than the national price.

Annual income per hectare cultivated in 2016

The UPAC could receive revenues from the sale of products derived from the following processes: i) cultivation, through the sale of fresh coca leaf; ii) extraction of the alkaloid through the sale of cocaine paste and iii) refining the alkaloid, using potassium permanganate to obtain cocaine base for subsequent sale.

It is estimated that PACs would perceive USD $ 559 million in the 2016 as potential income – a 17% increase compared to 2015[77], This is explained by the increase in quantities produced despite the decrease in the price level[78]. On average, the UPAC could receive per year around COP $ 13,657,000 (US $ 4,475) per hectare in 2016[79], without discounting the costs associated with its production. It is worth noting that 60% of the PACs sell the leaf without any level of transformation, as compared to 1% of the PACs that carry out the extraction and refining processes on the farm to obtain a cocaine base. The latter productive units concentrate the higher percentage of value added.

It is estimated that in 2016, the costs of support oscillate around COP $ 714,000 (US $ 234) per hectare per year, which are characterized by less use of agrochemicals in relation to the findings of the 2007-2009 period[80]. The use of agrochemicals continues to be lower than in previous years, because the PAC seeks to compensate for the difference between the increase in the price of the inputs vs. the behavior of the sales prices of the sheet and derivatives, which tend to grow at a lower rate[81].

In addition, it was found that agricultural producers in areas affected by coca crops face an inflationary effect on the costs of agrochemical inputs and labor. This situation raises concerns about the high cost of living in the affected areas, insofar as the greater perception of the income received stimulates a generalized increase in the prices of the products, including basic goods. It is possible to associate a high cost of living scenario

77 In 2015, the gross revenue of the PAC is estimated at USD $ 478 million.
78 It is noteworthy that the effect of growth in income reported in dollars is mitigated by the increase in the Exchange Market Rate, which increased by 11% between 2015 and 2016, from COP $ 2.741 / USD $ 1 for 2015 and COP $ 3,052 / USD $ 1 for 2016.
79 The average estimate is made considering a weighting of the number of producers producing each of the by-products (leaf, pulp, or base) and their respective prices.
80 The Productivity Studies (2005-2015) as well as the Economic Structure of the Agricultural Production Units in areas of influence of coca crops (carried out in 2007 and 2009) generated benchmarks regarding the quantities of agrochemicals used by the PAC, as well as the prices paid.
81 According to the results in the socioeconomic characterization studies of the territories affected by coca crops, Putumayo-Caqueta, Catatumbo and Magdalena Medio.

with increasing economic dependence on coca. It is noteworthy that the low use of agrochemicals does not respond to better agro-cultural practices that allow them to increase their productivity or the quality of the final product. Indeed, the yield per hectare in the last 10 years has fallen from 6.6 mt / ha / year in 2006 to 4.8 mt / ha / year in 2015[82].

On average, the size of the lots in the UPAC is 0.96 ha nationally. In the case of small lots, the PAC family is responsible for carrying out maintenance and harvesting[83], whilst lots of more than 1 ha in area may demand labor ("raspachines"), which means that there are families that receive income both inside the UPAC and outside. It is estimated that about 106,900 households in 2016 – with an average of 5 persons per household – received income from these activities. Each household member could receive about USD $ 960 a year.

In 2016, 60% of growers marketed around 288,500 mt of coca leaf, valued at COP $ 787,795 million pesos (USD $ 287 million). 35% of the PACs obtained revenues from the sale of 261 mt of cocaine paste, worth COP $ 482,138 million pesos (USD $ 176 million), whilst 1% of the growers generated COP $ 42,412 million (USD $ 15 million) for the sale of 17 tons of cocaine base.

Product	2016 Production	Prices	Gross income		Net income	
	kg	US$/kg	´000 US$	´000.000 COP $	´000 US$	´000.000 COP $
Fresh coca leaf	389,193,138	0.95	355,928	1,086,340	315,453	962,805
Cocaine paste	345,180	621	185,607	566,498	83,403	254,556
Cocaine base*	23,669	814	17,822	54,395	10,790	32,931
On-site production value			**559,358**	**1,707,233**	**409,646**	**1,250,292**

Table 15. Total potential and net annual income of Agricultural Producers with Coca-PAC derived from the cultivation and process of extraction of the alkaloid in 2016.

We used the volume of total coca leaf production, cocaine paste and cocaine base made directly by the primary (farmer) producer, as well as the sales prices of coca leaf, cocaine paste and cocaine base, estimated in previous sections, in order to determine the total value of on-farm production. Based on the above, net income from primary production (on the farm) was estimated at US $ 410 million (deducting production costs).

From the macroeconomic point of view, the DANE (National Statistics Bureau) estimates that by 2015(p) the value added of illicit crop production and transformation represents 0.4% of the National GDP, in which illicit crop economic

82 Satellite image-based detection allows the identification of higher biomass in coca crops mainly in Nariño and Catatumbo. Due to the periodicity of production and performance studies, there is no up-to-date information for these departments. Better overall productivity of coca lots in Colombia is expected.

83 In this case, in the economic activity of coca crops carried out in the Agricultural Units with Coca (UPAC), the value added is equal to the mixed income since no worker payment obligation exists (compensation to employees).

activity represents 3% of the agricultural sector[84]; The above corresponds to the results of the *Enclave* research: *illicit crops in agricultural and industrial phases – 2005 Baseline*[85], which aims to identify the economic flows derived from the production and transformation of illicit crops in the Colombian economy.

84 According to DANE, Colombia's GDP at current prices in 2015(pr) was estimated to be around COP $862,675 billion (USD $ 283 billion) whilst the GDP in the agricultural sector, forestry, hunting and fishing is estimated at CIO $ 56,228 billion pesos (USD $ 18 billion).

85 According to the document Enclave research: *illicit crops in agricultural and industrial phases – 2005 Baseline 2000-2010pr,* the *Enclave* is a "virtual" space belonging to the economic territory, artificially created to record (separately from the national economy) activities related with the production and transformation of illicit crops (except trade).The enclave of illicit crops has two phases: an agricultural phase, where coca cultivation is carried out until processing cocaine base at the UPAC, whilst the industrial phase refers to establishments that are engaged in processing cocaine hydrochloride and heroin. For more detail please refer to http://www.dane.gov.co/index.php/cuentas-economicas/investigaciones-especiales.

Chapter 2

TERRITORIES AFFECTED BY ILLICIT CROPS

Illicit crop monitoring activities have made it possible to identify very strong links between territories and illegal activities. These links are a consequence not only of the presence of the illegal phenomenon in the territory, but of the conditions of vulnerability that allow the phenomenon to take root therein. In particular, territories affected by coca crops in Colombia are characterized by conditions of poverty, marginality, weak institutional presence and presence of armed groups outside the law, as recognized in the Peace Agreements.

Coca crop production in Colombia is dynamic in time and space, and – unlike other crops – does not have seasonal conditions marked by rainfall. In fact, there are increases and decreases in the production of coca crops in a heterogeneous manner throughout the territory, and this behavior does not show regularity. For instance, the increase in the area with coca nationally in recent years has been accompanied by a reduction in the number of municipalities affected, with a strong concentration of the phenomenon. Such concentration is much more intense than it has been in previous years.

The study of coca production in the different regions of Colombia carried out by SIMCI has allowed to identify the particular spatial dynamics of the phenomenon. The consolidation process for areas with coca crops can be synthesized in the following stages:

Phase	Description
Establishment of primary production foci	Some coca crops are established in a geographical area which do not have important grouping levels vis-à-vis a single core. They form low density foci.
Increase in density of production around primary foci	There is an increase in seed planting density around primary foci in an imperfectly radial fashion. Increase in density is not homogeneous in all initial foci; on the contrary, spatial arrangement tends to form clusters.
Consolidation of production cores	After the increase in density, and along with the uneven development of primary foci, there is a zone of high planting density which gradually increases its relative importance until it becomes a core. A spatial connection is established around the area between the different foci that have developed over time. When a core has been consolidated, ramifications and new expansion lines begin to appear in the area in coca cultivations along terrestrial or fluvial routes.
Expansion of crops to cover the available usable area	A significant increase in crop density is consolidated throughout the area at the end of the process. In several cases, coca cultivation has displaced traditional crops (in the case of previously intervened areas), or has generated a continuous area corresponding to fragmentation or disappearance of the primary forest system (in jungle areas).

Table 16. Consolidation process for areas with coca crops.

An inverse process has taken place in some areas of the country. Such regression has consisted of a reduction of coca planting until its disappearance, thereby generating illicit crop-free zones. In general terms, the process consists of a regressive tendency that starts at the consolidation level of areas with coca, as described above.

This conceptual model evinces the need to simultaneously consider the location of the phenomenon, its expansion dynamics within the territory, and the effects of its permanence in a determined space unit. In fact, the location comes from an opportunity analysis carried out by the producer, wherein the latter combines the distance for location of the crop to hide from the action of the authorities, but also caters to the need to have routes or alternative flows for illicit production.

Expansion of the phenomenon is a product of the success achieved in the different foci. Because producers are unaware of both the authorities' response and the conditions of productivity and crop yields in the area in which they are established, these foci of affectation serve as test scenarios in which further crops will be developed, to the extent that the evaluation carried out by producers yields a positive outcome.

The consolidation of illicit production focuses not only on the increase of the area with cultivations, but also on the consolidation of hardly observable key variables, related mainly to two aspects:

- The expansion of knowledge of illicit production techniques amongst the population.

- The consolidation of market and traffic networks in the territory, in relation to the regularization of flows of supplies and products, as well as normalization of the commercialization conditions for the illicit product.

The final expansion stage for the consolidated core results in an increase in density of illicit production within the territory, to the extent of favorable production and marketing possibilities.

Marginality

Coca farmers have been located in areas remote from populated centers, in order to dissuade the authorities and reduce risks for their coca crops from interdiction activities, such as forced manual eradication and aerial spraying. However, these farmers locate themselves close enough as to be able to obtain the supplies to be used in drug processing. With this generalized dynamic, coca crops reached an occupation of 140,000 hectares at the beginning of the historical series in areas of difficult access in a high percentage; this characteristic of marginality is associated to the very dynamics of the phenomenon.

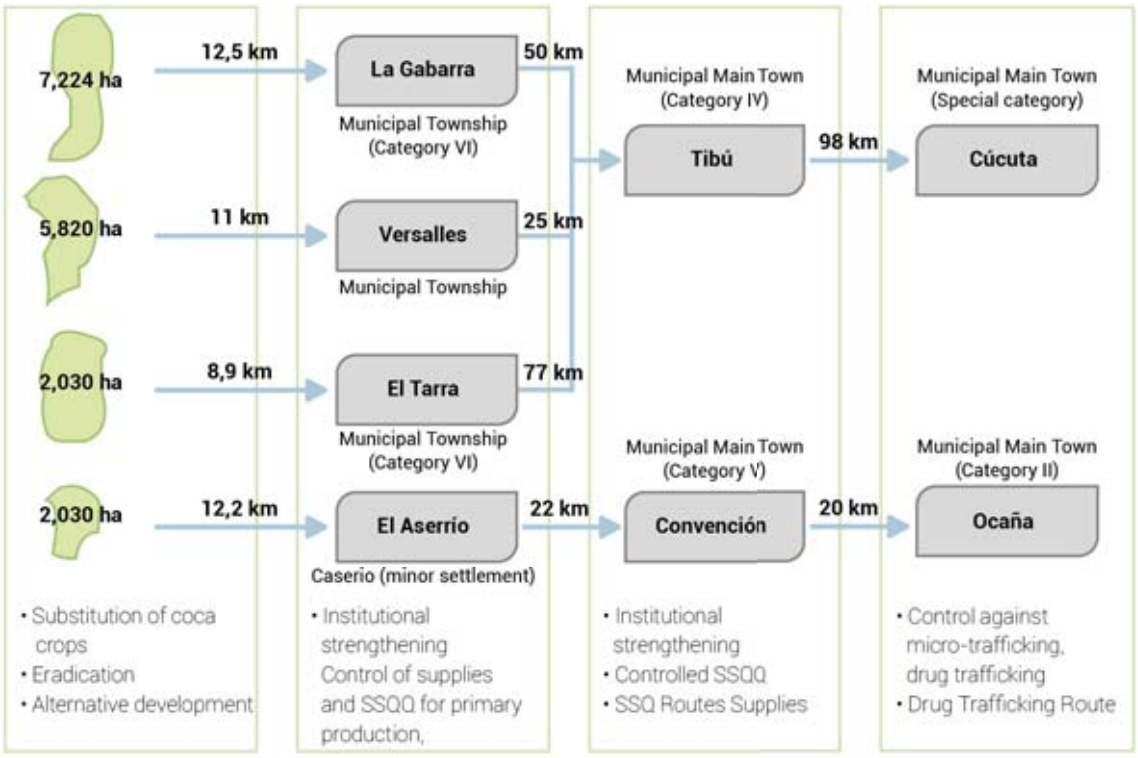
After 17 years of constant monitoring of the territories affected by coca cultivation, it can be said that conditions of isolation continue to be a difficulty in relation to options of legality. For example, transport costs are a differentiating factor with respect to legal crops in a marginalized area that has coca crops. In addition, the amount of population settled in these areas (and therefore somewhat related to illegal activities associated with drug trafficking) has grown, thus creating complex scenarios for intervention, as well as for State investment.

80% of the area currently with cultivations in Colombia is in municipalities with categories VI or unclassified[86]. In addition, 50% of the national total is associated with municipal settlements and townships. These characteristics can be used to define efficient mechanisms in the consolidation of illicit crop-free territories.

The diagram below represents the situation of Norte de Santander. In this department, coca crops are associated with 29 populated centers; however, four of these municipalities – e.g. La Gabarra, Versalles, El Tarra and El Aserrío concentrate 66% of the area with cultivations. Only one of these municipalities is a main

86 In Colombia, municipalities are classified into categories ranging from one to six, special category and unclassified, according to their number of inhabitants and their Current Free Destination Income (ICLD). The sixth and unclassified categories represent the lowest level of ICLD and the number of inhabitants; Which implies a lower capacity of investment and entrance of resources to the municipality for rural economic development and infrastructure.

municipality, though with category VI. Other two municipalities are departmental townships and the last one is a minor settlement (caserío). These settlements are located at an average distance of 60 kilometers from the market center (defined as a municipality with a greater category), and 133 km away from a city with over 34,000 inhabitants[87]. These conditions of access should be factored in when planning out any kind of intervention seeking a sustained reduction of illicit crops. On the other hand, investment in road infrastructure in these areas will shorten distances between rural areas affected by illegal activities and market centers, which shall in turn result in integrated territories to legal economies with a culture of legality.



Scheme 2. Populated centers and coca crops.

This chapter places emphasis on the relationships of illegal activities with the territories; a characterization is made for the level of threat, and there are vulnerability variables which constitute key factors for the persistence of the phenomenon and low sustainability of the actions implemented to combat it. Finally, information is presented on other crimes and conditions affecting territories, such as other illicit crops and mineral exploitation.

87 Calculations are made by Euclidean distance and do not take into account the conditions of the road, which can increase transport costs considerably.

2016 MUNICIPAL ILLICIT COCA CROP THREAT INDEX

In 2012, pursuant to an agreement with the Ministry of Justice and Law, SIMCI developed a first version of the Municipal Threat Index for the presence of coca crops. In this first approach, the index presented only the current situation of the municipalities affected by coca cultivation. Although this report took into account the historical series of the last five years, the methodology designed did not allow to make projections or compare data with the immediately preceding year. During 2017, we have worked on a second approach, where a new conceptual focus has been defined. Its statistical analysis method has been debugged, including a contrast of the consistency of the index with respect to illicit production field records in the territory.

This new model presents the current threat condition, but given its design can be comparable with previous years. In addition, this model allows a future perspective of what will happen in terms of cultivated hectares, affected geographical area, and permanence of the crop for the next year. Thus, this model is an index with predictive capabilities. The exercises carried out for the 2010-2015 period reached a 95% reliability level. In this case, the model covers the municipalities that have had presence of coca crops during the 2001 - 2016 period.

Determination of the threat index for the production of coca crops is part of the studies of prediction of criminal activity. This index also seeks to produce a tool that determines the territorial scenarios wherein an increase in the intensity of the impact is expected to be caused by the phenomenon; this aids in targeting state intervention.

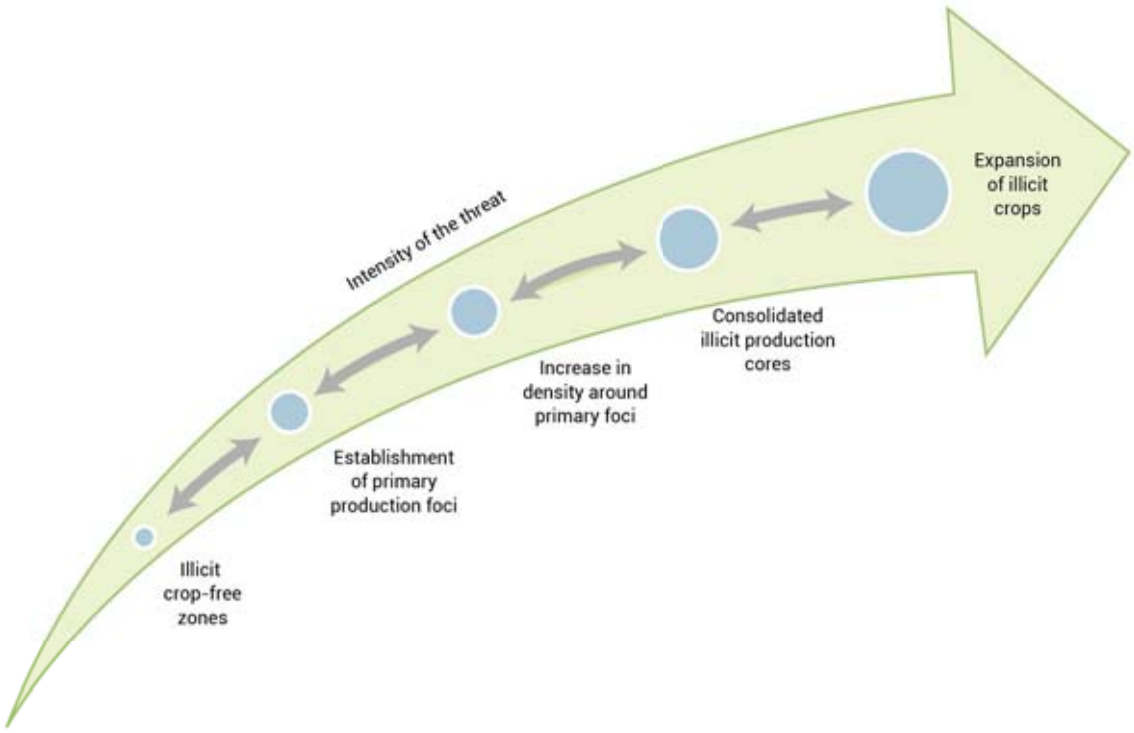
Most studies on the location of criminal behaviors starts with the identification of ***"hot spots"***, i.e. those where it is determined that there is a higher frequency of crimes. The literature also provides analysis of the predictive efficacy of hot spots, with generally positive but variable results in terms of accuracy according to the techniques used. For this study, coca crop hot spots can be assimilated through 1 km2 units in which the occurrence of the phenomenon is recorded, varying in density and permanence over time.

However, the literature reports the need to consider the temporal dynamics of criminal activity. In fact, there are changes of location in criminal activities, due both to the action of the authorities as a response to this concentration and to changes in criminal opportunities in the territory.

In this case, the variables are related to the production of illicit coca crops. For this reason, the universe of analysis is restricted to municipalities that have has illicit crops at some point during the 2001 - 2016 period.

We begin with the concept of "threat", as proposed by Lavell[88]: "The possibility of occurrence of an event that may cause some kind of harm to society" within the framework of the risk management approach. In relation to the above, the threat index does not cover the conditions of vulnerability likely to exist in the territories, but is particularly circumscribed to the constituent elements of the illicit crops problem.

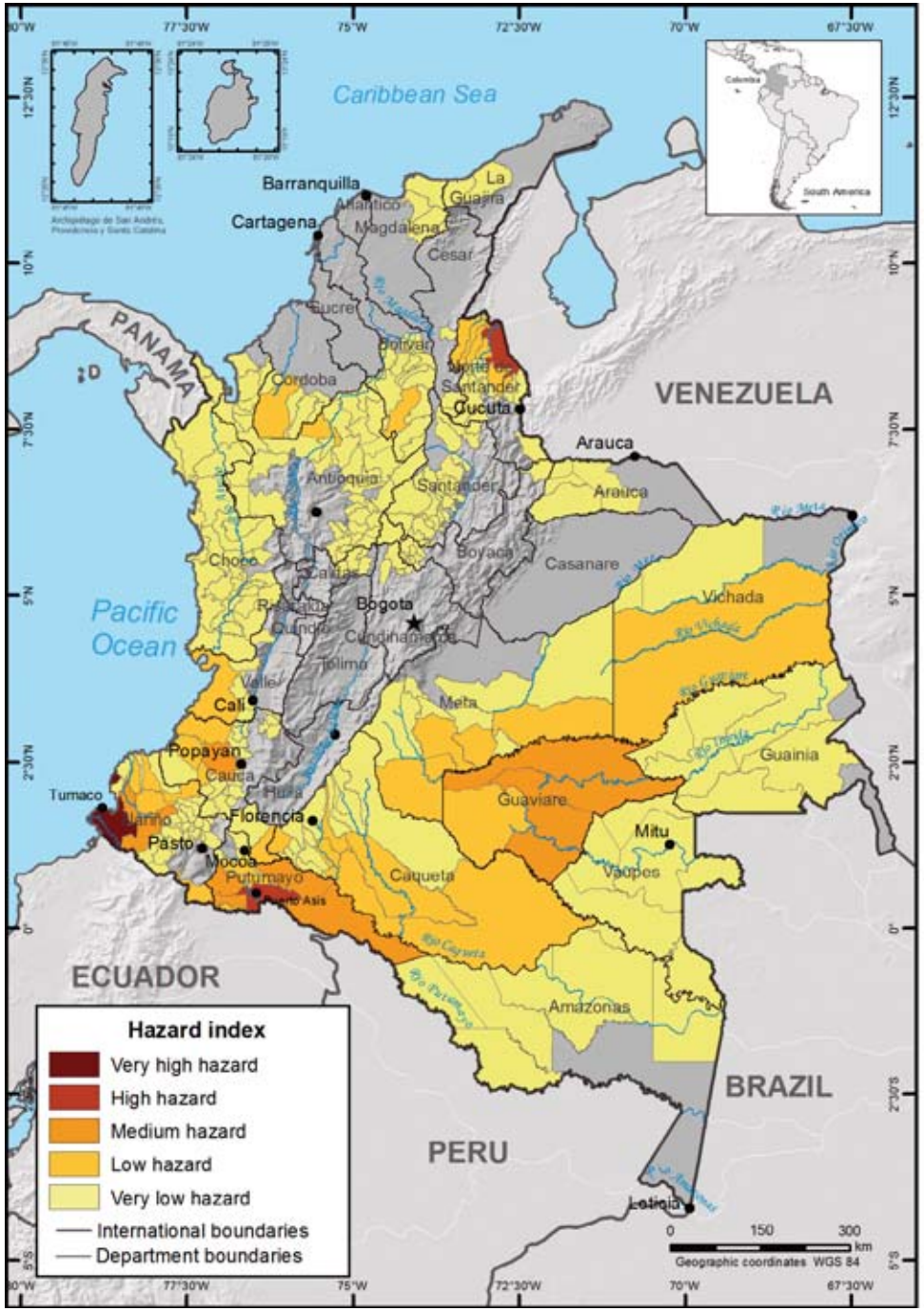
The condition of threat is very closely related to the initial condition of affectation by coca crops of the municipality. Indeed, a municipality with a high record of illicit coca crops in the initial year of the evaluation should be regarded as being in a higher threat condition than one in which there are a few hectares planted. Similarly, a municipality with a greater territorial impact (i.e. greater number of square kilometers with coca crops) will be more threatening than one with a low territorial impact, and a municipality with greater persistence of coca crops will be more threatening than one which has only recently been affected.



Scheme 3. Basis for assessing intensity of the threat from presence of coca crops.

88 Lavell, Allan.(1996) *Degradación ambiental, riesgo y desastre urbano: problemas y conceptos.* (Environmental degradation, risk and urban disaster: problems and concepts). In Fernández, María Augusta. Ciudades en Riesgo. LA RED. USAID. Lima Peru.

Map 15- Threat index from coca crops, 2015.



Coca crop density in Colombia, 2015.

Source: Colombian Government – UNODC-supported monitoring system.
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In general terms, it is considered that the threat of illicit coca crops in a municipality will increase from illicit crop-free areas to those in which illicit crops have expanded to cover the available area. This process will progress, to the extent that one or several of the following situations take place:

1. Increase in the area with illicit coca crops.

2. Increase the number of square kilometers of the territory with illicit coca crops.

3. Increase the number of years illicit coca crops have been present in the territory.

The Municipal Illicit Coca Crop Threat Index (IA)[89] consists of the articulation of these three dimensions of the presence of illicit crops (cultivated hectares, geographical area affected, and permanence of the crop), which express the relative level of strengthening or weakening of the coca crop phenomenon in a municipality, in a short-term perspective.

Applicability of the index

The Municipal Illicit Coca Crop Threat Index for each year expresses the projection of the situation that will occur in the following year regarding the quantity of coca crops, the expansion of areas affected by coca crops, and the Producing municipalities with the highest levels of illicit market consolidation in the national territory.

The index has an ordinal reading, and a cardinal reading. The ordinal reading presents the set of municipalities affected by the presence of coca crops, starting with the municipality that has the highest intensity of affectation in the last three years, and ending with the one that has the least affectation. The cardinal reading allows to establish the relative intensity of affectation between the municipalities historically affected. Thus, the index value for a municipality is established in relation to the intensity of affectation of the municipality that has been most affected by illicit coca crops in the national territory.

In addition, the components of the index also provide key information for the design of supply containment policies. The ***Crops*** component is a tool for targeting actions aiming to reduce the supply of coca crops; this component defines the municipalities in which the current amount and the trend of increase are greater, so that voluntary and forced eradication actions will have stronger effects on the national supply of coca. The ***Territory*** component provides information on the municipalities in which there is more territory affected, and where the expansion trend is stronger; it serves as a privileged tool for expansion containment programs. Crop eradication actions in these municipalities will help reduce the establishment of new production foci. The ***Permanence*** component provides information on the municipalities where

89 For further methodological details, please refer to Chapter 4. Methodology.

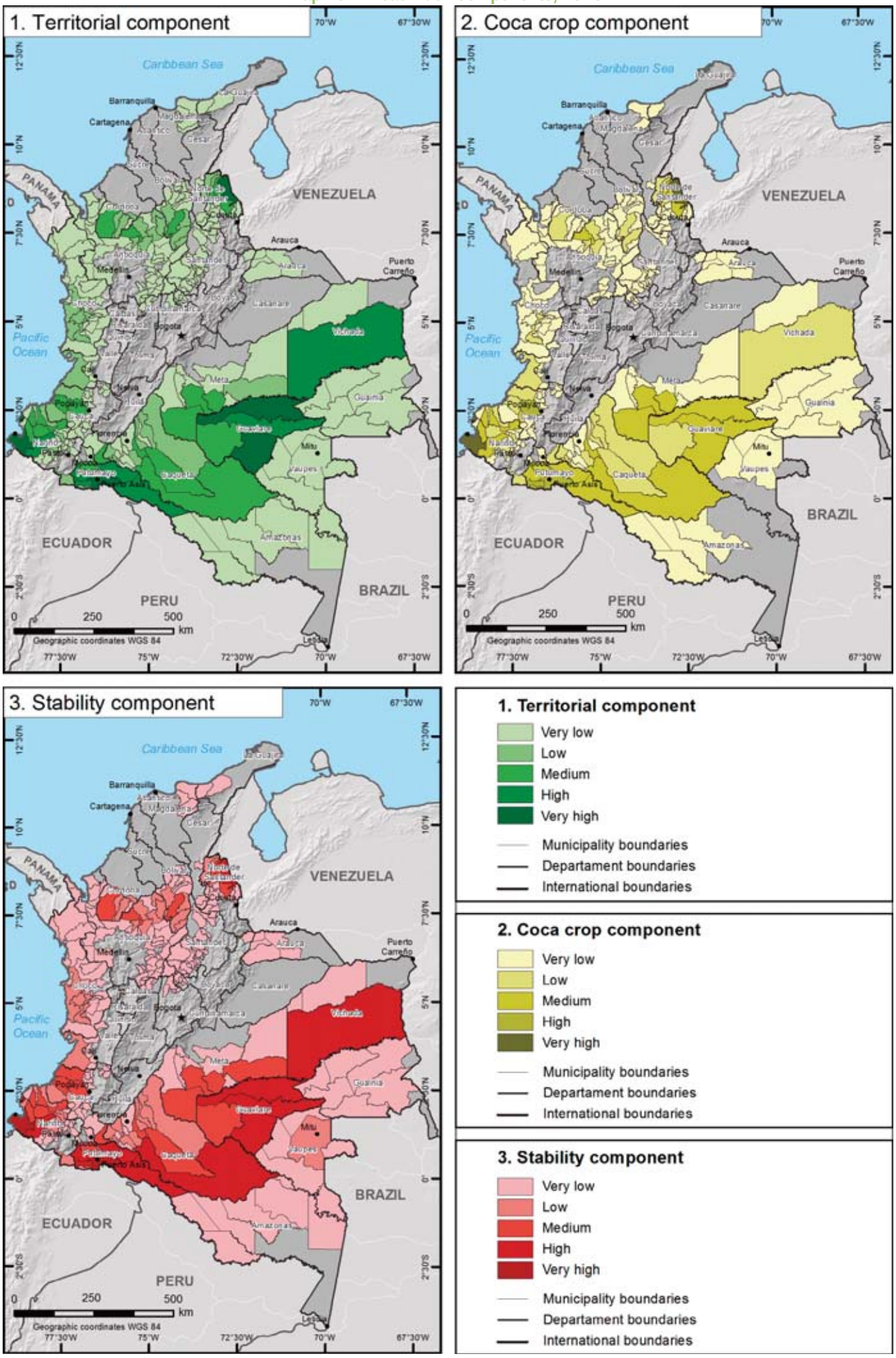
drug trafficking networks are most likely to be more strongly consolidated, so that municipalities with the highest index values will be those where greater intensity of efforts will be required in the area of intelligence and criminal investigation.

The threat index includes the municipalities wherein the highest values for the three components coincide. Thus, the index shows the municipalities with the greatest number of crops, with a stronger expansion tendency, and with a greater permanence of the phenomenon in the territory, simultaneously. Assessment of the index presents a standard scale from 0 to 1, according to the behavior of the index for each year, meaning that the municipality with the highest level of threat will have a value of one (1) and the lowest threat level will be zero (0). In this sense, values close to one (1) indicate a higher level of threat, whilst those nearing zero (0) indicate a lower level of threat.

Results

The main results of the 2016 Municipal Coca Crop Threat Index are presented below. The trends of each of its components (Crops, Territory and Permanence) are also discussed.

Map 16. Threat Index Components, 2016.



Source: Colombian Government – UNODC-supported monitoring system.
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In 2016, 285 municipalities have some level of threat against coca crops. This figure corresponds to 2.4% less of the municipalities registered in 2015. This means that the threat at the municipal level is being concentrated in increasingly consolidated geographical clusters. This behavior is consistent with the concentration trends and geographical recidivism of coca crops in recent years. The average threat rate was 0.028, whilst in 2015 it was 0.025, indicating that a greater degree of threat is materializing in fewer municipalities.

The map shows the threat situation due to the presence of coca crops at the municipal level for 2016. It is observed that the 10 municipalities where the problem has been exacerbated by the coincidence of important areas of cultivation, great affectation of the territory, and permanence of the phenomenon, are as follows: Tumaco (Nariño), Tibú (Norte de Santander), Puerto Asís (Putumayo), San José del Guaviare (Guaviare), Valle del Guamuez (Putumayo), Barbacoas (Nariño), El Tambo (Cauca), Miraflores (Guaviare), Orito (Putumayo) and El Retorno (Guaviare).

These municipalities had a threat index between 0.18 and 1, which is indicative of the high degree of dispersion among the most affected municipalities. In fact, the Gini coefficient[90] for the 2016 threat index was 0.764 - higher than the previous year's index (0.717). This means that the threat tends to be concentrated spatially, to the point that an estimated 85% of municipalities concentrate only 13% of the national threat. More importantly, 3 municipalities (Tumaco, Tibú and Puerto Asis) concentrated 24% of the total threat. This indicates that not only is the threat level in 2016 higher at the national level, but it also has a higher concentration.

The problem in these municipalities requires intensive intervention both in consolidated production areas and in expanding areas, so as to avoid rapid growth of areas with coca. Intervention strategies also require actions to control supply, accompanied by active strategies to weaken traffic networks and the circulation of chemical substances for the production and processing of coca byproducts.

Geographical distribution of the threat indicates very defined spatial cores. In the national domain, there is evidence of establishment of the threat in three specific geographic clusters: the most important cluster is located in the southwest of the territory, specifically in the border area between Nariño and Ecuador, delimited by the municipalities of Tumaco, and Barbacoas, and to a lesser extent by Roberto Payan, Olaya Herrera and El Charco. The second core is defined in the Catatumbo area with Tibú – the second municipality with the greatest threat at the national level – along with El Carmen, Convención, El Tarra and Sardinata, which have had an important growth in coca cultivation over the last years.

90 The Gini coefficient is a measure of the relative distribution of a variable of interest - in this case the threat of illicit coca crops in Colombia. The measure ranges between zero (0) and one (1), where 0 corresponds to perfect equality and where the value 1 corresponds to the perfect inequality, i.e. indicates a maximum concentration of illicit coca crops.

The third core is consolidated in the border region between Ecuador and Putumayo. The most relevant municipalities are Puerto Asís, Puerto Leguízamo, Puerto Guzmán, Orito and La Hormiga. A national nucleus that is not yet very defined, but which is currently being consolidated, is located in the Orinoco region, specifically between Meta and Guaviare, including San José del Guaviare, El Retorno, Miraflores (Guaviare) and Vistahermosa, La Macarena and Calamar in Meta. Nevertheless, this core tends to expand geographically towards the northeast in municipalities such as Cumaribo (Vichada) and towards the southwest in municipalities of Caquetá (Solano, Cartagena del Chairá, etc).

As for the dynamics of the threat index, the municipalities with the greatest increases in the threat index compared to 2015 were: Tarazá in Antioquia (56.81%), Tibú (55.2%), Sardinata (41.6%), El Tarra (29.4%) in Norte de Santander and Tierralta in Cordoba (19%). In contrast, the municipalities with the greatest decrease in the threat index were Cartagena del Chairá in Caquetá (-13%), Roberto Payán in Nariño (-5.4%), and Puerto Rico in Meta (-3%).

CROPS COMPONENT: Elements for the intensive reduction of supply

The map above shows Tumaco in an intense color, standing out among all the municipalities as it presents the greatest quantity of illicit crops and a growing tendency of planting in the last three years. This situation is so critical that it is the only municipality classified in the highest threat category. In addition, it is presumed that there will be more coca in the following year. Besides this municipality – albeit to a lesser extent – there are critical production areas in Tibú (Norte de Santander), Puerto Asís (Putumayo), El Tambo (Cauca), Guamuez Valley (Putumayo) and Barbacoas in Nariño. Voluntary and forced eradication programs will be more effective in these municipalities, provided they act on the areas with the highest recent concentration of coca cultivation.

It is worth noting that the Catatumbo region is the one that has had the greatest setback in this matter. In other words, it is the region wherein the crop component has increased most intensively. In particular, Tibú (Norte de Santander) increased by 63% in this indicator under the threat index, as compared to 2015. Other municipalities such as Sardinata and El Tarra (Norte de Santander) also show increases in this component under the index (by 46% and 24% respectively). Tarazá in Antioquia also has a significant increase of the crop component, which has been calculated at 51%. In contrast, Miraflores and San José del Guaviare in Guaviare show reductions of 27.7% and 25.2%, respectively. The department of Meta also shows progress advances in this subject, since Puerto Rico and Vista Hermosa had reductions of 27% and 22% in this component under the index between 2015 and 2016.

TERRITORY COMPONENT: Control of the expansion of the phenomenon

Programs to contain territorial expansion of the phenomenon should find a targeting

tool in this map. In fact, the map includes municipalities where there are more km2 with coca crops, including a weighting of the recent trend of increase or decrease in terms of territories affected by coca crops.

It is observed that the municipalities with the greatest amount of affected territory and with stronger tendencies of territorial increase were, in their order: Tumaco (Nariño), Puerto Asís (Putumayo), Tibú (Norte de Santander), San José del Guaviare and Miraflores, Guaviare). This component (compared to the previous one) has a new important geographic cluster located in the Orinoco region. In particular, there is a wide corridor which includes the municipalities of Vichada, Meta, Guaviare Caquetá and even Putumayo. Specifically, the municipalities which hve suffered the most impact are Cumaribo, San José del Guaviare, Vistahermosa, Calamar, El Retorno, Miraflores, Solano, on the way to Puerto Asís, and Puerto Leguízamo in Putumayo. In relation to these municipalities, early action to eradicate and replace crops is relevant in order to avoid the consolidation of production centers that give rise to new consolidated illicit production cores.

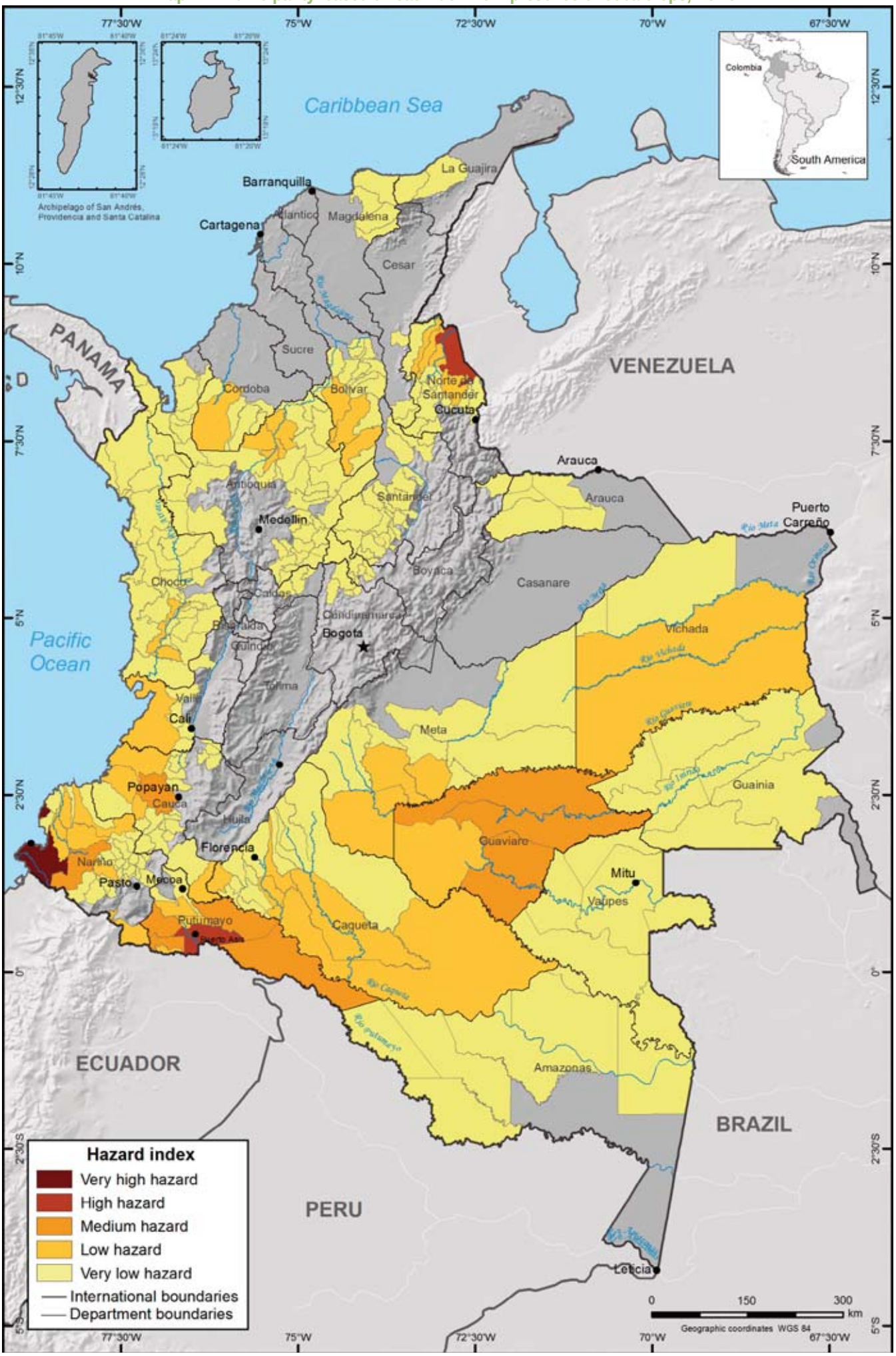
The municipalities that had a significant increase in the Territory component in 2016 were La Macarena (Meta), 51%; Tarazá (Antioquia), 40%; and Miraflores (Guaviare), 35%. In contrast, Tumaco (Nariño), Cartagena del Chairá (Caquetá) and Roberto Payan in Nariño have had reductions in this component, as compared to the 2015 results - 23.2%, 18% and 16.5%, respectively.

PERMANENCE COMPONENT: Action on consolidated markets

The map shows that the municipalities of Tumaco (Nariño), Puerto Asís (Putumayo), San José del Guaviare (Guaviare), Tibú (Norte de Santander), Barbacoas (Nariño) and Miraflores (Guaviare), in their order, have the highest levels of permanence and consolidation of illicit crop production. These municipalities vave a good degree of correspondence with the municipalities that show the highest level of joint threat, i.e. municipalities with a greater permanence component tend to have high levels of affectation in terms of crops and territories, hence the threat level.

This means that chemical substance trafficking and commercialization networks are strongly consolidated; therefore, this requires greater intensity of actions in the area of intelligence and criminal investigation, aimed at dismantling established traffic networks.

Map 17. Municipality-based threat index from presence of coca crops, 2016.



Source: Colombian Government – UNODC-supported monitoring system.
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TERRITORIAL VULNERABILITY AND LOCATION OF ILLICIT COCA CROPS IN COLOMBIA

One of the challenges the Colombian agricultural sector must face during the post-agreement period is drug trafficking associated with the production of illicit coca crops. Why are coca crops only established in a small part of the territory, even though their profitability conditions are extraordinary? In the words of Francisco Thoumi: *"None of the prevalent paradigms can explain why the great majority of countries that can grow coca and poppy and produce cocaine and heroin do not do so, i.e. why illegal production of these drugs is so concentrated if it is so profitable; or why large drug-trafficking organizations did not emerge in countries where traditional coca crops were common"*[91]. This question is also pertinent for the analysis of the problem in the interior of the country, since there are a large number of areas that meet the technical requirements to successfully produce coca crops, even though coca has a strong concentration and persistence tendency only in some places.

The concept of territorial vulnerability serves as a framework to answer the following question: Are there political, social and economic conditions in the municipalities that are relevant for the placement of illicit coca crops in Colombia?

The approach to territorial vulnerability is supplementary to the threat analysis for illicit crop risk assessment developed in an earlier section. Whilst the threat constitutes a latent danger that represents the potential manifestation of a natural, socio-natural or anthropogenic phenomenon (which can produce adverse effects on people, production, goods and services or the environment), vulnerability is an internal risk factor of an element or group of elements exposed to a threat, which corresponds to its intrinsic predisposition to being affected, being susceptible to harm, and finding it difficult to recover at a later stage. Vulnerability has three areas of existence:

- Susceptibility: It refers to the conditions inherent to the that enable them to resist or tolerate a certain degree of threat.

- Exposure: It relates to the (individual or social) subject's situation regarding the threat.

- Resilience: It means the ability of a subject to recover once they have been affected.

How do the concepts of threat and vulnerability interact with the problem of illicit crop production? Previous studies conducted by SIMCI suggest that there are effects of drug trafficking on the institutional and social systems. In addition, the literature reports the effects that this illegal economy causes on the transaction costs associated

91 Thoumi, F. (2009). *Políticas antidrogas y la necesidad de enfrentar las vulnerabilidades de Colombia* (Anti-drug policies and the need to address Colombia's vulnerabilities). Análisis Político, vol.22 no.67 Bogotá Sept./ Dec. 2009, available online: http://www.scielo.org.co/scielo.php?pid=S0121-47052009000300004&script=sci_arttext.

with conflict and violence, effects on income, effects on the educational and health services systems, and finally on the consolidation of democracy and the actions of local governments.

The abovementioned studies conducted by Thoumi provide important tools for analyzing the location of drug traffickers at the country level, but does not address the study at the regional level in the case of Colombia. The Rocha study[92] examines population vulnerability to coca production through a comparative standard of living analysis, using surveys of coca producers and contrasting them with the 2005 Quality of Life survey as a control group. This study proposes a delimitation of the municipalities where the occurrence of coca crops is considered probable. Rocha's work is an important advance in the study of the social and economic conditions that generate vulnerability, but does not incorporate institutional and political variables which are relevant to the analysis.

This section is a first approach to the analysis of vulnerability, as examined based the association between several territorial variables and the establishment of illicit coca cultivations at the municipal level. This approach points out the municipalities wherein there are more favorable socioeconomic conditions for the potential establishment of illicit crops. For the purposes of this analysis, vulnerability to the establishment of coca crops is understood as the degree of association between the levels of achievement of the in a municipality, and the probability of occurrence of coca crops in said municipality. The approach adopted uses the classification of freedoms as proposed by Sen[93], grouped into four categories:

- Political liberties and protective security
- Economic services
- Social Opportunities
- Guarantees of Transparency

An Occupation of the Territory variable was added, which is described by population density. For each type of freedom, indicators have been formulated that reflect at least one relevant aspect of that freedom and that can be operationalized in the territory. Subsequently, a test threshold has been defined for each variable, so that it is possible to have a delimitation criterion. Said threshold was established according to the variable and availability of information. In the case of continuous variables, the median value was used as the cut-off value in the majority of cases, in order to establish a frequency criterion that would not punish the figures at the national level. The mean value was not used as it is treated in all cases of strongly asymmetric distributions[94].

The specific indicators, along with the thresholds considered for differentiation, are listed in the next table.

92 Rocha, R. (1997) *Aspectos económicos de las drogas ilegales. En: Drogas Ilícitas en Colombia – Su impacto económico, social y político* (Economic aspects of illegal drugs. In: Illegal Drugs in Colombia - Its economic, social and political impact). F. Thoumi (editor). Ariel - UNDP, pp. 137-277.
93 Sen, Amartya (2000) Development as freedom. Bogotá, Planeta, 430 pp.
94 The distributions were leptokurtic asymmetrical; the use of the interquartile ranges - which eliminates the ends of the distribution - did not result in an adjustment higher than the medians.

Variable	Indicator	Threshold	Source
Occupation of territory	Population density	0.441 (median)	Dane and SIMCI
Political Freedoms / Protective Security	Presence of illegal armed groups	Presence	Police and Ministry of Defense
Economic services	Relative profitability between legal and illegal production: (UPA Profitability) / (UPAC Profitability)	0.5	SIMCI - UNODC Production and Yield Surveys
	Economic services	3,959,000 (median)	UNDP, Colombia 2012 Human Development Report (HDR), Annex B, p. 407
Social Opportunities	Health level: Infant mortality rate	31.4% (median)	Dane
	Social Opportunities	16% (median)	Dane, Ministry of Education
	Level of equity in land distribution: land GINI	0.69 (median)	UNDP, 2012 Human Development Report (HDR)
	Transfers: Municipal investment per capita	558,681 (median)	UNDP, 2012 Human Development Report (HDR)
Guarantees of Transparency	Presence of agencies of the justice administration system in the municipality	Presence of 4 agencies of the justice administration system	SIMCI - UNODC, Index of the presence of justice agencies
	Level of clarification of property rights: Cadastral update status	Updated	SIMCI - IGAC

Table 17. Variables of territorial vulnerability operationalization.

The information corresponds to different years because there is no updated information for the variables selected, so it has been necessary to use the last available value in each of them.

A threshold value of 0, 5 was considered for UPA / UPAC relative profitability, examining cases in which the profitability of the coca producing units (UPAC) doubles the profitability of the legal production units.

In the case of legalization of property, the criterion is the municipality being updated in the cadastral registry by IGAC. Regarding the capacity for administration of justice, the criterion applied was of the presence of agencies from the justice administration system in the municipality, following the guideline of the study on identification of criteria for the evaluation of zones free of illicit crops. As a control, a correlation analysis was performed between the

presence of entities of the justice system with respect to density, which presented a high and significant level of correlation.

An indirect relative risk analysis was performed[95], which is frequently used in clinical analysis. This method makes it possible to determine whether there is any association between the exposure to the factor of interest and the subsequent risk of presenting an undesirable outcome[96], which is defined in this case by the presence of illicit coca crops. A coefficient with a value equal to 1.0 indicates that there are no differences in the probability of occurrence of the response event with respect to variations in the behavior of the variable, as it would indicate that the upper and lower values in the quotient are identical. Thus, it can be said that there are no differences in probability. The values farthest from 1 express a higher impulse level of that variable; it may be greater than 1.0 (to infinity), or it may be smaller than one and approach strongly to zero. The further the quotient is from 1.0 (both towards infinity and toward zero), the greater the indication of a difference between the quotient, which in turn indicates that there is a greater difference between the probabilities.

The analysis was carried out at the municipal level, with the exception of the data corresponding to the UPA / UPAC relative yield, based on the information from the production surveys carried out in coca producing areas, which is only available at the regional level. In this case, the regional data applies to all the municipalities in the region.

The following table shows the results of the application of indirect relative risk analysis for the case of illicit crop production.

Variable	Probability Ratio	% of Municipalities presenting the factor	Quotient Value - Coca Producers: NO	Quotient Value - Coca Producers: YES
Population density	4.6340	26.73	1.575	0.340
Presence of illegal armed groups	5.1000	12.72	4.407	0.864
UPA / UPAC Performance	0.3368	61.4	0.120	0.356
Per capita income (municipality level)	1.9710	30.82	1.233	0.626
Infant mortality rate	2.7928	29.91	1.301	0.466
Illiteracy rate	2.7401	28.45	1.419	0.518
Land GINI	0.5601	38.18	0.803	1.432
Municipal investment per capita	1.3695	32.73	1.103	0.805
Presence of agencies from the justice administration system	0.4982	62.36	0.103	0.208
Cadastral update status	0.1567	67.91	0.013	0.085

Table 18. Results of the application of odds ratios for the selected realizations.

95 Also known as “Odds Ratio”.
96 Ruiz, et. al. (2001). *Investigación Clínica: Epidemiología clínica aplicada (Clinical Research: Applied Clinical Epidemiology),* Bogotá, Centro editorial javeriano. 540 pp..

The above results suggest that there are some factors of territorial vulnerability that increase the likelihood for territories to be affected by the presence of illicit coca crops. In particular, it can be observed that the factors with a greater degree of association with the production of illicit crops are the presence of illegal armed actors and the cadastral update status, followed by population density. Illiteracy rate and infant mortality rate also have a significant degree of association.

It is important to emphasize that none of the indicators considered is associated with the biophysical and climatological determinants of location. In other words, location of coca crops is due to a range of social characteristics that define conditions of possibility for the establishment of crops, besides a range of biophysical and climatological conditions, and some determinants of the threat.

It is striking that the degree of association with the cadastral update status is superior to that of the relative profitability of illegal production. This shows the importance of the definition of property rights within the framework of alternatives for action to reduce illegal production, as cadastral updates lead to an increased cost of being caught in illegal behaviors, which translates into a higher level of equity risk. It should also be noted that the low coverage of the cadastral update (as well as the low degree of presence of agencies from the justice administration system) in a very significant part of the national territory – over 60% of municipalities – constitutes a major risk factor.

Upon analyzing the regional peculiarities, it is observed that the pacific coast is the region with the highest degree of vulnerability. In addition, this region has comparative advantages for the drugs exportation and weapon trafficking. The Colombian Orinoco and Amazon regions also have a high degree of vulnerability, and therefore are likely scenarios for the expansion of coca crops.

The agreement for the end of the conflict signed by the Government of Colombia with the FARC – EP paves the road for tackling the territorial vulnerabilities that facilitate the establishment of coca crops. In fact, points 1 and 4 of the agreement revolve around the agrarian problem – in particular, the search for mechanisms to bridge the gap between urban and rural areas, with a view to finding a solution to the problem of drugs. The elements presented here, which constitute a first contribution in this regard, indicate the relevance of development programs with a territorial approach as a mechanism to overcome the factors that facilitate and promote the establishment of illicit crops, and open the space for rural development approach programs that will have – among other positive impacts – the reduction of the balloon effect associated to the migration of illicit crops to other municipalities with like conditions of vulnerability.

The relationship between illegal activities and poverty, marginality, institutional weakness and the presence of armed groups is not exclusive to coca crops. Illicit poppy and marihuana crops, illicit alluvial gold exploitation and the

presence of antipersonnel mines occur in territories similar to those affected by coca crops. In this regard, it is necessary to understand the territorial dynamics; UNODC and the Government of Colombia conduct continuous research in order to better understand the geography of illegal activities.

Poppy crops

Poppy in Colombia is planted in small plots, in mountainous areas, and generally in temperate to cold thermal floors and provinces of high humidity. Cultivars have been found at altitudes varying between 1,100 and 3,600 meters above sea level, and they are planted under a crop rotation system, sometimes associated with maize, pea, fava bean, quinoa, onion, potato and forest species[97].

Estimations of the area with poppy are made by the National Police by means of overflights. As of December 2016, the Government reported a total of 462 ha, of which 65% is located in Nariño (300 ha) and 35% in Cauca (162 ha).

The 2016 value reported represents 22% less than in 2015. However, it is important to clarify that there is no report of overflights in departments such as Huila, Tolima and César, which were affected by this type of crop in 2015.

Department	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Nariño	475	316	204	24	238	234	229	205	73	159	320	300
Cauca	538	448	280	126	100	92	102	102	220	208	256	162
Huila	320	114	45	45	11	12	5	4	4	10	10	n.d
Tolima	265	90	170	170	3	3	2	2	2	5	5	n.d
Cesar	152	3	7	18	2,5	-				5	5	n.d
Valle del Cauca	-	-	-	-	1,5	-						
La Guajira	68	-	2	4	-	-						
Caqueta	132	52	7	7	-	-						
Putumayo										0		
Total	**1,950**	**1,023**	**715**	**394**	**356**	**341**	**338**	**313**	**298**	**387**	**595**	**462**

Table 19. Poppy crops in Colombia, by department, in hectares, 2005 – 2016.

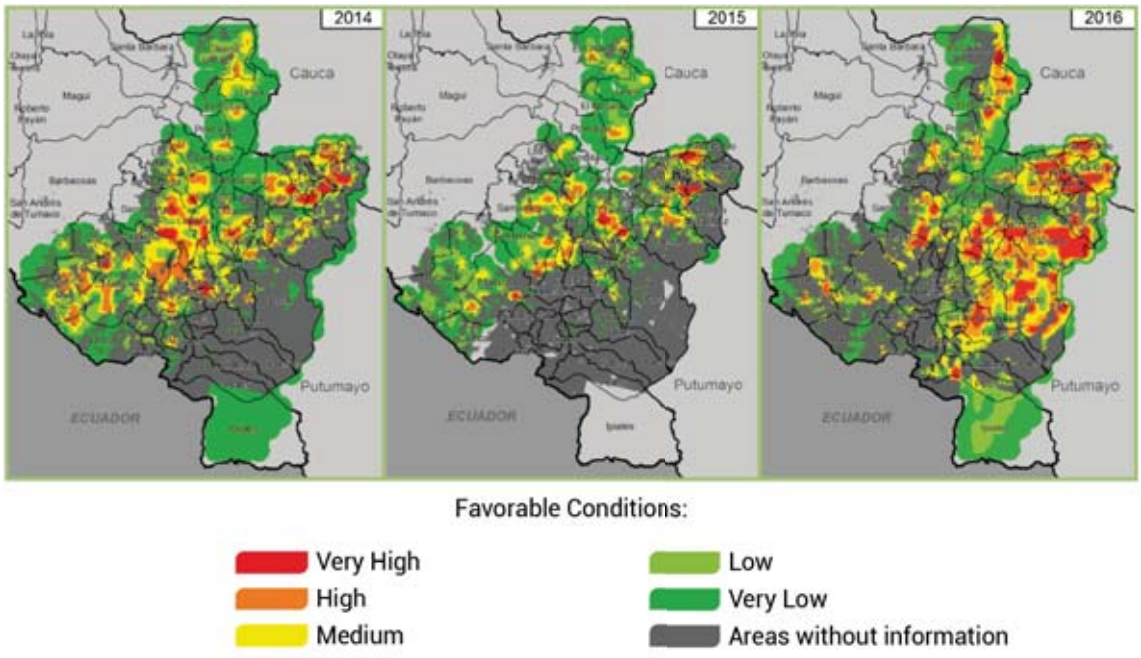
No survey has been conducted in Colombia which allows to know the area with poppy. UNODC – in agreement with the Ministry of Justice and Law – has proposed an objective model to qualify the probability of presence of poppy crops in the territories, by means of a methodology based on remote sensing, GIS, statistical design and field verification, which can be replicated and integrated into the illicit crop monitoring system of the Government of Colombia and UNODC. The model uses

97 Methodology and pilot study detection and measurement of the area planted with poppy and marihuana (Sierra Nevada and Cauca), 2016.UNODC.

biophysical variables, historical information and spectral information[98] integrated in the master area framework (25 km^2 grids), in order to identify territories with favorable conditions for the establishment of poppy cultivations.

Biophysical criteria are related to the identification of areas where optimal biophysical characteristics are presented for poppy crops – for example altitude, thermal floor and landscape. As for historical criteria, the detection data collected by the Colombian National Police since 2008 were incorporated in the area framework, as was UNODC's manual eradication information. Finally, object-oriented classification techniques were used in the spectral criteria in order to determine areas where the spectral response is very similar to that of poppy cultivations. This model was adjusted with the previous two years.

A pilot area was established in the department of Nariño in order to evaluate the poppy crop model. In 2016, the territories with favorable conditions for poppy crops are located in greater proportions in the municipalities of San Bernardo, San Pedro de Cartago, Buesaco, Colón, Mallama, Santacruz and El Tambo. The results were validated in an expert workshop on the poppy crop problem in Nariño[99], where the geographical coincidence of the areas defined by the model and the territories marked as affected by poppy crops by the participants was confirmed.



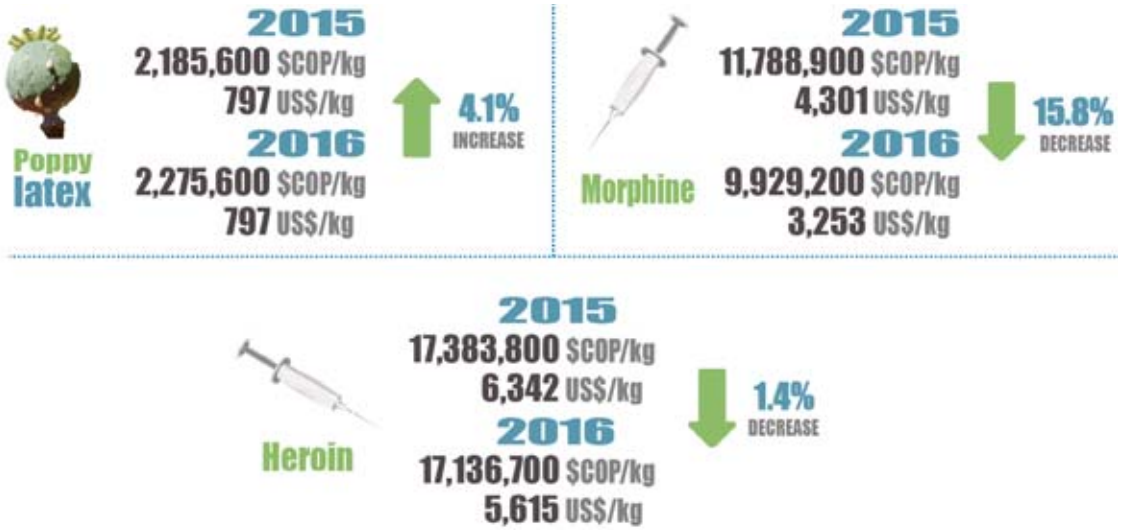
Scheme 4. Results of the Nariño 2014-2016 poppy crop identification pilot study.

98 To calculate the magnitude of the spectral variable, a reference frame was constructed based on the characteristic altitudinal range of the crop, secondary information from the military and police forces and the mobile eradication groups. These data were used to design the baseline of the spectral characteristics of poppy crops; subsequently, segmentation procedures (object creation) and application of spectral indices (CI, IPVI, EVI, EVI-SWIR, DVI, ANDVI, NDVI, PVI, RED/GREEN, RVI, SAVI, SUM/NIR y SWIR-RATIO) were used to polygons with spectral characteristics similar to those of poppy crops.

99 Workshop "Dynamics of Illicit Crops in the Territory (Institutional Perception)" held in the city of Pasto on November 23 and 24, 2016, with the participation of Alternative Development, the Colombian National Police and Local Government officials.

Prices of poppy byproducts

Since 2005, the Government of Colombia and UNODC have been consolidating a drug price information system. This is done through the collection and systematization of the records obtained through direct interviews with farmers in the production phase, as well as the information obtained by intelligence services in different cities of the country. Price data have been compiled in cultivation areas and in marketing influence sites through the work of people linked to UNODC programs, the Colombian National Police – Drug Enforcement Directorate (DIRAN) and the Special Administrative Unit for Territorial Consolidation (UAECT)[100].

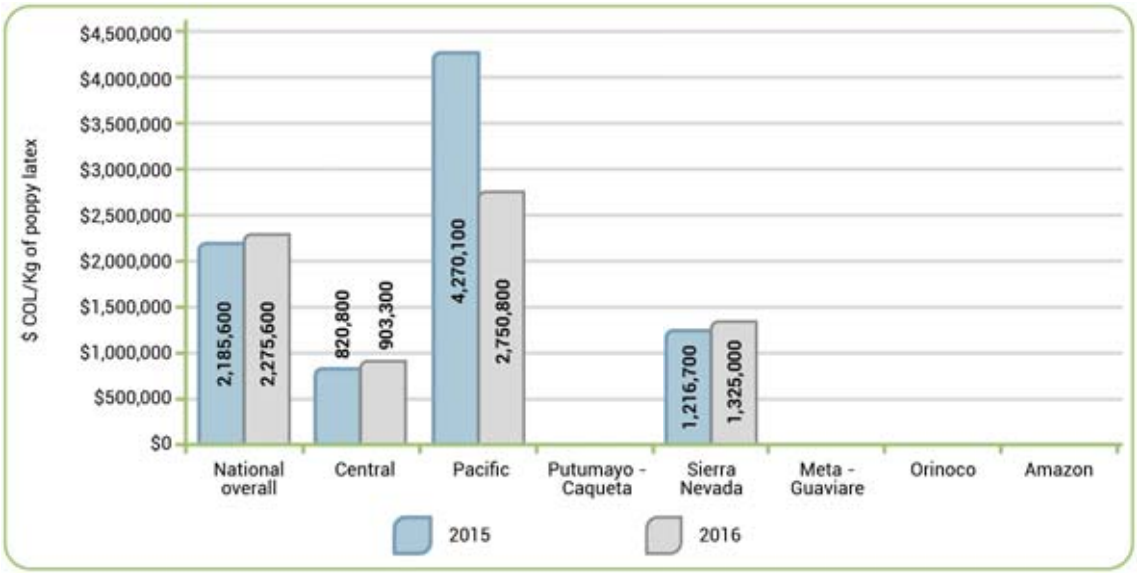


Notes:
[1] Percentage changes correspond to the ratio of current prices to Colombian pesos (COP$) between 2015 and 2016.
[2] The Market Exchange Rate (MER) used for conversions to US dollars is COP$ 2,741/US$ 1 for 2015 and COP$3,052/US$ 1 for 2016. This MER was estimated from the monthly average reported by the Central Bank.

In 2016, there is a 4.1% increase in poppy latex (raw material). Conversely, there is a decrease of 15.8% and 1.4% in products associated with extraction (morphine) and synthesis (heroin), respectively. Upon analyzing the historical trends, it is observed that poppy latex currently has higher growth as compared to 2011 (164% higher), whilst prices of morphine and heroin are below those established in 2011 (8.8% on average).

Poppy latex prices increased from COP$ 2,185,600/kg in 2015 to COP$2,275,600/kg in 2016. This behavior is due to a relative stability, considering that poppy byproducts are characterized by being volatile, i.e. they have strong price level fluctuations. The national consolidate change is mainly driven by the increase in the Central and Sierra Nevada regions by 10.1% and 8.9% respectively. As for the Pacific region, there was a 35.6% decrease from COP$ 4,270,100/kg in 2015 to COP$ 2,750,800/kg in 2016.

100 The UAECT provides price information that complements records captured in growing areas, through its liaison staff and residents in different regions. Since 2012, the price information system does not have the records provided by UAECT.



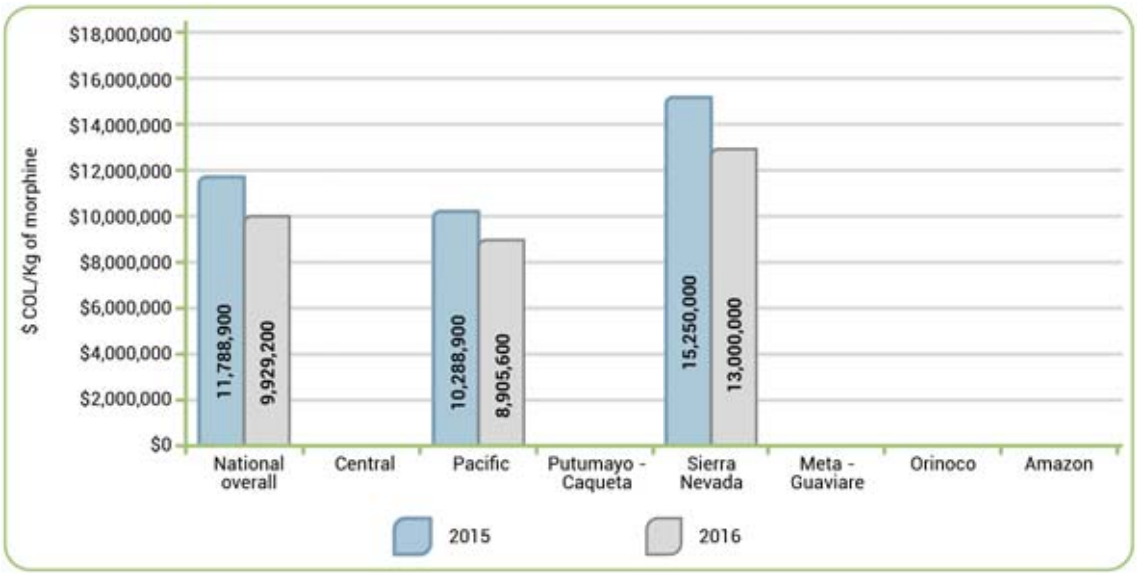
Graph 14. Average prices for a kilogram of poppy latex in 2015 and 2016, per region.

Source: UNODC-SIMCI, CNP-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information as reported by the sources.
[2] The values were rounded to the nearest multiple of 50.
[3] The Central region values presented include the behavior of prices in the department of Norte de Santander.
[4] The prices recorded in 2015 and 2016 for poppy latex were reported only in liters, whereas they had been reported in kilograms and liters in previous years. In order to guarantee the continuity of the series, it became necessary to convert measurement units (from liters to kilograms), assuming that the density of the latex is 1gr / cm3, being higher than the density of opium (0.95 gr/cm3, source: MSDH-Opium Mallinckrodt).

As for the historical evolution of the price of poppy latex at current prices, it is evident that the 2016 growth was lower than the previous year. In 2015, the price grew by 56%, whilst it only grew 4.1% in 2016. However, the prices currently recorded are at one of the highest points of its historical series. According to the monthly analysis, a relative stability was observed in 2016, which was only altered by slight upward spikes in the months of June and December.

Morphine prices in 2016 decreased by 15.8%, from COP$ 11,788,900/kg in 2015 to COP$ 9,929.200/kg in 2016. At the regional level, there was a 14.8% decrease in Sierra Nevada from COP$ 15,250,000/kg to COP$ 13,000,000/kg; the decrease in the Pacific region was 13.4%, from COP$ 10,288,900/kg to COP$ 8,905,600/kg.



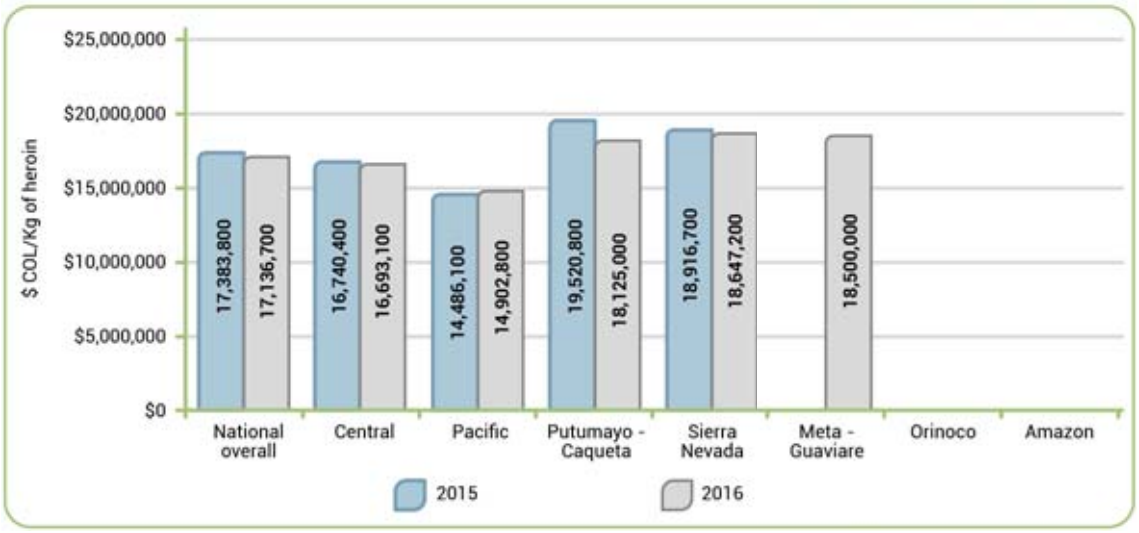
Graph 15. Average prices for a kilogram of morphine in 2015 and 2016, per region.

Source: UNODC-SIMCI, CNP-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information as reported by the sources.
[2] The values were rounded to the nearest multiple of 100.

In regard to data for heroin, there has been a tendency to decrease since 2012, with a trend change in 2015. However, the levels reported in 2016 are lower than those recorded in 2011.There is evidence of a fluctuation in the price since January 2016, starting with a decrease that reaches its lowest point in April 2016. Subsequently, prices reach their highest point in July 2016; a steady fall is observed from this period until November 2016.

The price of heroin fell from COP$ 17,383,800/kg in 2015 to COP$ 17,136,700/kg in 2016, i.e. it fell by 1.4% .The regions that contributed to this trend were Putumayo-Caqueta, Sierra Nevada and the Central region, with a decrease of 7.2%, 1.4% and 0.3%, respectively. On the contrary, the Pacific region increased by 2.9%, from COP$ 14,486,100/kg in 2015 to COP$ 14,902,800/kg in 2016. In addition, heroin prices were reported in Meta-Guaviare – a situation which had not occurred since 2006 – valued at COP$ 18,500,000/kg.



Graph 16. Average prices for a kilogram of heroin in 2015 and 2016, per region.

Source: UNODC-SIMCI, CNP-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information as reported by the sources.
[2] The values were rounded to the nearest multiple of 100.

Finally, information available from the Heroin Chemical Characterization Study conducted within the framework of the Colombian Drug Observatory (ODC)[101]. Based on the analysis of 113 samples, this study estimated that the average price of heroin sold on the street is COP$ 65,100 / gram, with an average 62.71% purity level. Taking into account the price of each dose, its weight and purity level, it was estimated that one 100% pure gram could cost COP$ 112,800, i.e. one kilogram of pure heroin in the consumer markets could cost COP$ 112,800,000/kg on average.

Marihuana Crops

No survey methodology has been developed in Colombia to determine the area with marihuana crops. The Colombian National Police reports a total of 95 ha as of December 2016. This area was detected by means of overflights; 69 ha were identified in Cauca and 11 ha in Magdalena; these are the departments with greater affectation by these crops. The other departments with presence of marihuana crops are Meta and Nariño.

Based on the manual eradication reports provided by the Mobile Eradication Groups (GME), the Colombian National Police and the Armed Forces that have been published in the ODC, it is possible to have an idea as to the location of crops in the territory. According to the 2005-2016 overall consolidate, 18 departments have implemented manual eradication operations. 74% of the total eradicated area is concentrated in four departments (Magdalena 42%, Cauca 12%, La Guajira 9% and Meta 11%).

101 This study was led by the Ministry of Justice and Law, in strategic partnership with the CNP-DIRAN and the Chemical Laboratory of the Technical Investigation Unit - CTI of the Attorney General's Office. UNODC technically supported the methodological development and the analytical results generated. Report submitted in 2016. The study was developed based on the analysis of samples obtained from the seizures carried out by the Colombian National Police in the cities of Armenia, Bogotá DC, Cali, Cucuta, Medellin, Sabaneta, Pereira and Santander de Quilichao.

The history of marihuana eradication has two periods: The first period comprises the years 2008 and 2013, and had a tendency to increase – reaching its maximum value in 2013 (326 ha). The second period goes from 2014 to 2016, and is characterized by decreases in eradicated areas until reaching a total of 134 ha in 2016[102], 35% less than in 2015. Crops were concentrated in Magdalena (37%), Tolima (13%), Huila (9%), La Guajira (9%), Cesar (6%) and Norte de Santander (4%).

Similarly, information is available on drug seizures. The historical behavior of seizures of pressed marihuana has two periods; the first between 2006 and 2013, with a tendency to increase, reaching its maximum value in 2013 (410 mt). The second period goes from 2014 to 2016, with a downward trend. 188 tons of pressed marihuana were seized in 2016 – 27% less than in 2015. 52% of these seizures were concentrated in four departments (Valle del Cauca 18%, Magdalena 15%, Antioquia 10% and Cauca 9%).

Albeit drug eradication and seizure data allow a first approximation of the territories affected by this problem, it is evident that comparable and verifiable data are necessary so as to define the territories where marihuana crops are planted. In addition, these data need not rely solely on interdiction operations. This information will be included in the monitoring system, and it will facilitate the fight against drug trafficking.

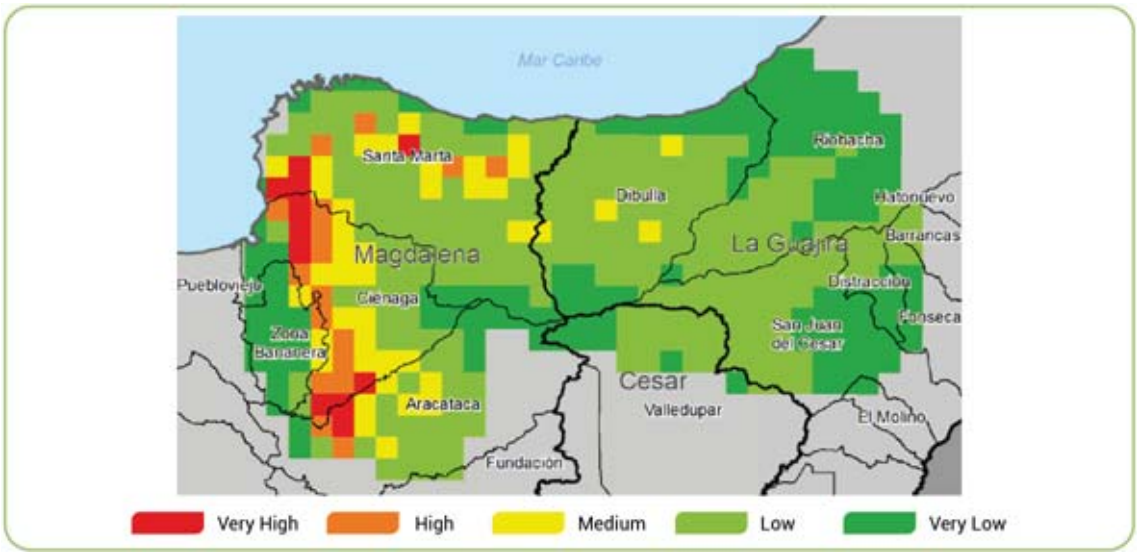
Department	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Antioquia	1	-	17	8	23	6	7	3	22	17	16	15
Arauca	-	-	-	-	-	-	-	-	3	7	1	1
Boyaca	-	-	-	-	-	-	-	-	-	-	-	-
Caldas	-	-	-	-	-	-	2	-	3	-	-	-
Caqueta	-	-	-	-	-	-	-	-	-	-	-	-
Cauca	215	1	-	-	-	12	2	-	12	1	9	5
Cesar	-	-	1	-	-	7	1	2	17	27	52	8
Cundinamarca	-	-	-	-	-	-	-	-	2	-	-	-
Guaviare	-	-	-	-	-	-	-	-	-	1	-	-
Huila	-	-	-	7	1	-	-	-	-	2	-	13
La Guajira	-	-	3	1	1	6	38	35	25	49	7	12
Magdalena	-	8	16	4	140	151	157	102	57	113	65	49
Meta	-	-	3	-	-	6	2	55	148	7	11	3
Nariño	-	-	-	-	-	-	-	1	-	-	3	2
Norte de Santander	-	-	5	-	-	-	-	1	11	15	21	5
Risaralda	-	-	-	-	-	1	1	-	-	1	-	3
Santander	1	-	-	-	-	-	-	2	3	12	2	-
Tolima	10	-	1	1	1	21	18	9	25	12	20	18
Valle del Cauca	2	-	-	2	-	8	-	1	-	-	1	-
Vichada	-	-	-	-	-	1	-	-	-	2	-	-
National Overall	**229**	**8**	**46**	**23**	**166**	**219**	**228**	**211**	**326**	**266**	**208**	**134**

Table 20. Manual eradication of marihuana crops, 2005 – 2016.

102 UNODC does not partake in the total validation of the area reported as eradicated in the Colombian Drug Observatory; UNODC only partakes in the validation it accompanies with Mobile Groups of Manual Eradication.

UNODC – in agreement with the Ministry of Justice and Law – have proposed an objective model to issue warnings about areas potentially affected by marihuana crops, with a methodology based on remote sensing, GIS, statistical design and field verification, that can be replicated and integrated in the Monitoring system of the Government of Colombia and UNODC. The model integrates variables of biophysical conditions, historical information and spectral information in a master area framework (25 km^2 grids) through which territories with favorable conditions for the establishment of marihuana crops at full exposure can be identified[103]. In addition, regarding marihuana crops in greenhouses, a model was designed that marks areas of interest determined by luminous alerts. Marihuana crops under greenhouse are characterized by the use of artificial light at night to accelerate growth and increase production and yield. These alerts would optimize the use of crop detection aircraft.

In order to evaluate the model of marihuana crops at full exposure, a pilot area was established at the Sierra Nevada de Santa Marta National Natural Park (PNN), plus a 25-kilometer buffer[104]. It was found that 7% of the grids (25 km2) presented the most favorable conditions for planting marihuana; these territories were located in four municipalities of Magdalena, bordering the lower part of the Sierra Nevada de Santa Marta: Ciénaga (57%), Santa Marta (29%), Aracataca (11%) and the Banana Zone (4%). On the other hand, 84% of the study area presented low conditions for these crops and included mainly the higher parts of the Sierra.

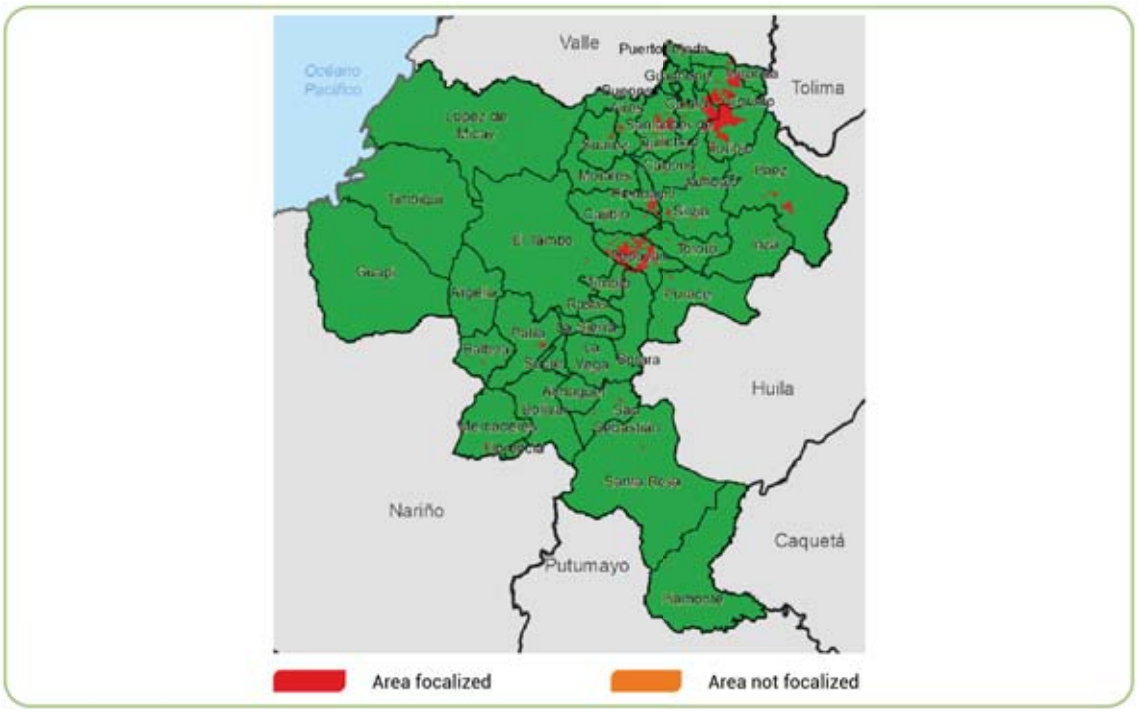


Scheme 5. Results of the pilot study for the identification of territories with favorable conditions for the establishment of marihuana crops at full exposure, Sierra Nevada de Santa Marta PNN.

103 Biophysical criteria refer to the identification of territories where optimal biophysical characteristics are found for the crop such as height, thermal floor, landscape, soil use and slope. As for historical criteria, detection and manual eradication data were incorporated in the database, and pixel attributes were used in the spectrum in order to determine the polygons with the same characteristics and digital levels as batches of marihuana eradicated and verified by UNODC.

104 The resulting area covers all the historical detections of the region (municipalities of Aracataca, Ciénaga, Santa Marta and the Banana Area, in Magdalena, Barrancas, Dibulla, Distracción, Fonseca, Riohacha and San Juan del Cesar in La Guajira, and Valledupar in Cesar). The total area of study was 11,105 km^2. The results obtained correspond to the year 2014.

As regards crops under greenhouse, a pilot area was defined in the department of Cauca. 507 km² were found under luminous alert by possible presence of greenhouses for production of marihuana located in 36 of the 42 municipalities of the department. The alerts were concentrated in the north and center of Cauca. In the northern area, there areas were concentrated in Toribio (21%), Corinto (14%), Caloto (9%) and Miranda (3%) where there is evidence of the presence of greenhouses for marihuana production, Santander de Quilichao (8%) and mountain areas in Jambaló (1%), Buenos Aires (1%) and Suárez (1%). In the central zone, these alerts were concentrated in Popayán (22%), Piendamó (4%), Timbío (3%), Silvia (2%) and Cajibío (1%). Finally, there are other dispersed territories with a lower concentration of luminous alerts, such as Páez (4%), Patía (1%), Puracé (1%), Sotará (1%) and Totoró (1%).



Scheme 6. Results of the pilot study for the identification of marihuana greenhouses –areas focalized by luminous alerts in Cauca.

In addition to interdiction records, since 2005 the Government of Colombia and UNODC have been consolidating a drug price information system. This is done through the collection and systematization of the records obtained through direct interviews with farmers in the production phase, as well as the information obtained by intelligence services in different cities of the country. Price data have been compiled in cultivation areas and in marketing influence sites through the work of people linked to UNODC programs, the Colombian National Police – Drug Enforcement Directorate (DIRAN) and the Special Administrative Unit for Territorial Consolidation (UAECT)[105].

105 La UAECT proporciona información de precios que complementan los registros capturados en zonas de cultivo, mediante su personal de enlace y residentes en las diferentes regiones. Desde el 2012, el sistema de información de precios no cuenta con los registros suministrados por la UAECT.

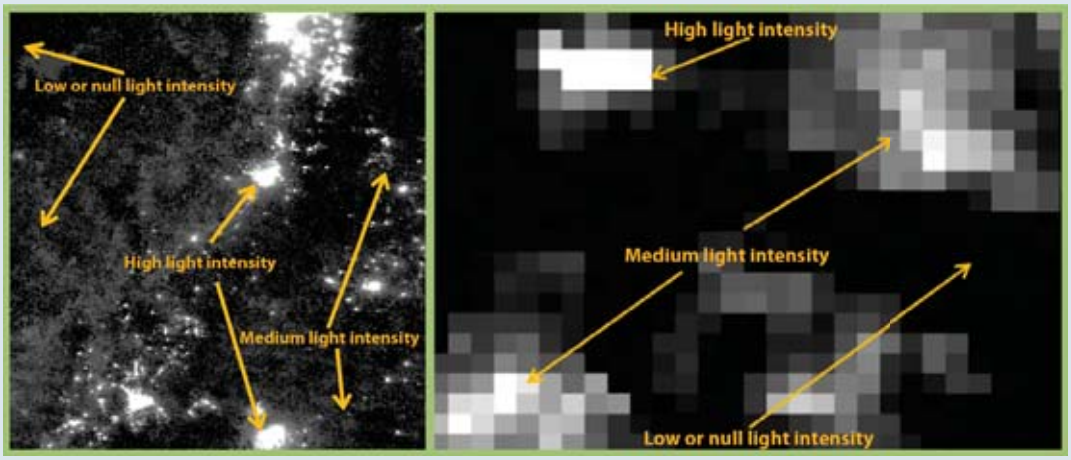
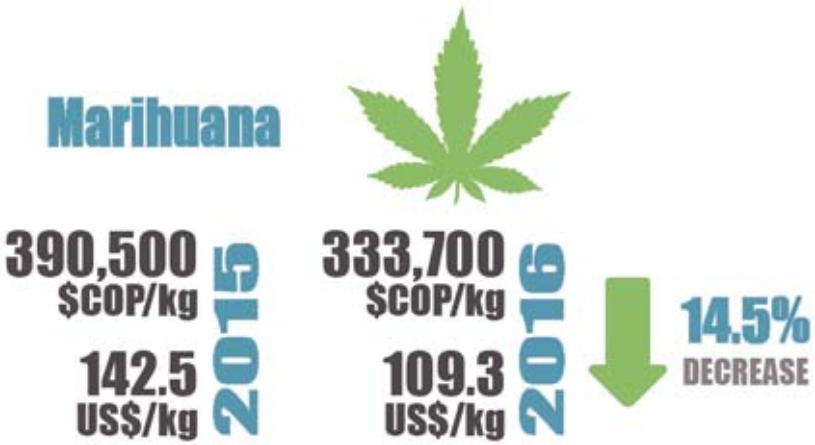
Luminous alert
Any and all areas in the Colombian territory where artificial lighting is kept on during the night, and which are not located in areas designated as populated centers, roads, areas of agroindustrial crops or petroleum production complexes, are considered a luminous alert. NOOA images (VIIRS-DNB Band) were used to define these zones. These images record monthly average values of emission of natural and artificial light energy, both on the earth's surface and in the environment. It was possible to classify the "Light" zones (Pixel value > 0,7 $Wcm^{-2}sr^{-1}$) and "No light" (Pixel value < 0,7 $Wcm^{-2}sr^{-1}$).      All the areas defined as populated centers, roads, agro-industrial crop areas or oil production complexes are subsequently eliminated by means of an overlap with secondary information (basic mapping databases and information obtained by visual interpretation of the Landsat 8 medium resolution images). Finally, the minimum and maximum emission ranges of the NOAA image pixels are identified and extrapolated to the entire department. The methodology described has the following scope: • Areas with a light emission response different from light emission response coming from population concentrations and large productive cores are identified. • The exact location, quantity and size of the greenhouses are not determined. • It does not identify areas with greenhouses that do not include the use of night electric power in their production. • It allows to identify greenhouse cores that concentrate greater light emission; isolated greenhouses cannot be detectable. • It is based on a territorial approach of alerts, as the areas identified by this methodology must be corroborated by field work or overflights. • Alerts for potential marihuana crops under greenhouse conditions do not include a relationship to production of marihuana. • Alerts of possible greenhouses are identified, without characterizing the legal or illegal nature of the crop that may be produced therein.

Table 21. Description of luminous alerts for marihuana detection.

The 2016 price dynamics for marihuana is described below.

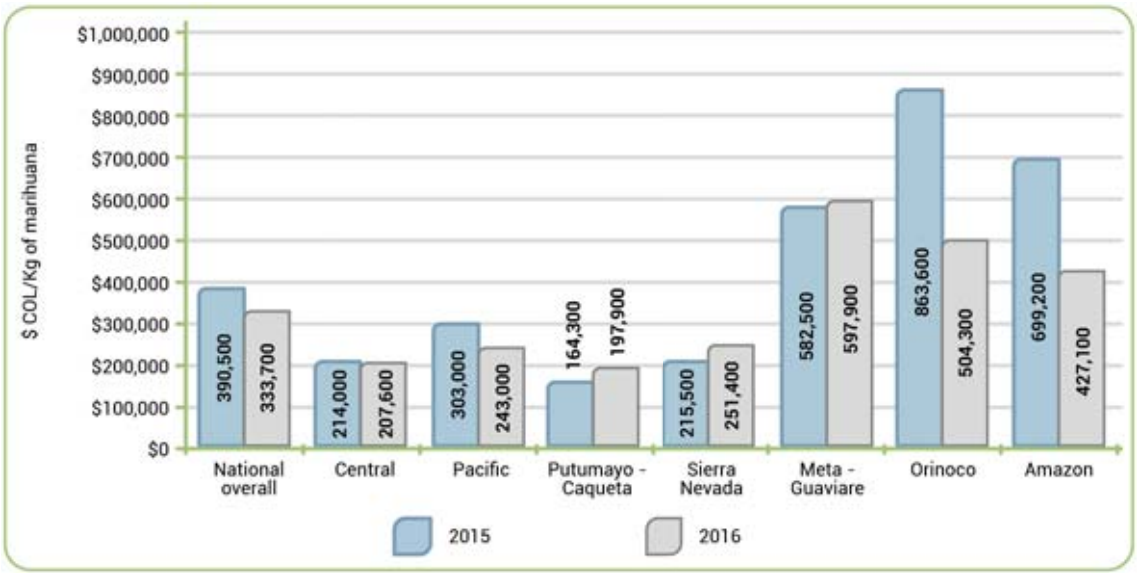
Marihuana prices



The national prices of the kilogram of (common) marihuana have decreased considerably, plummeting from COP$ 390,500/kg[106] during 2015, to a value of COP$ 333,700/kg in 2016. This means a 14.5% decrease, which could be associated with alternatives of negotiation of the producers and the change in the Colombian legislation regarding the viability of productive projects for planting of marihuana for medicinal purposes.

However, this reduction has not been generalized at the regional level. Whilst some regions such as the Pacific, Amazon and Orinoco had negative changes in the per-kilo price marihuana, amounting to -19.8%, -38.9%; and -41.6%, respectively – the latter was the most significant change, from COP$ 863,600/kg in 2015 to COP$ 504,300/kg in 2016; there were significant increases in other regions such as Putumayo-Caqueta (21%) and Sierra Nevada (16.7%), especially in Sierra Nevada, where the price increased from COP$ 215,500/kg to COP$ 251,400/kg in 2016, as compared to the previous year.

106 As a result of a review of the marihuana price information, an adjustment was required in the price level of the kilogram of Cripy marihuana in 2015, specifically in the Orinoco region, which was modified by 53.9% and COP$ 863,600/kg). This adjustment implied an update of the national average price of marihuana in 2015 from COP$ 558,800/kg to COP$ 390,500/kg.



Graph 17. Average per-kilo prices of marihuana in 2015 and 2016, per region.

Source: UNODC-SIMCI, CNP-DIRAN. Calculations: UNODC-SIMCI.

Notes:
[1] The prices listed in the report correspond to the arithmetic average of the monthly information reported by the sources.
[2] The values were rounded to the nearest multiple of 100.
[3] The values presented in the Central region include the behavior of the prices of the department of Norte de Santander.

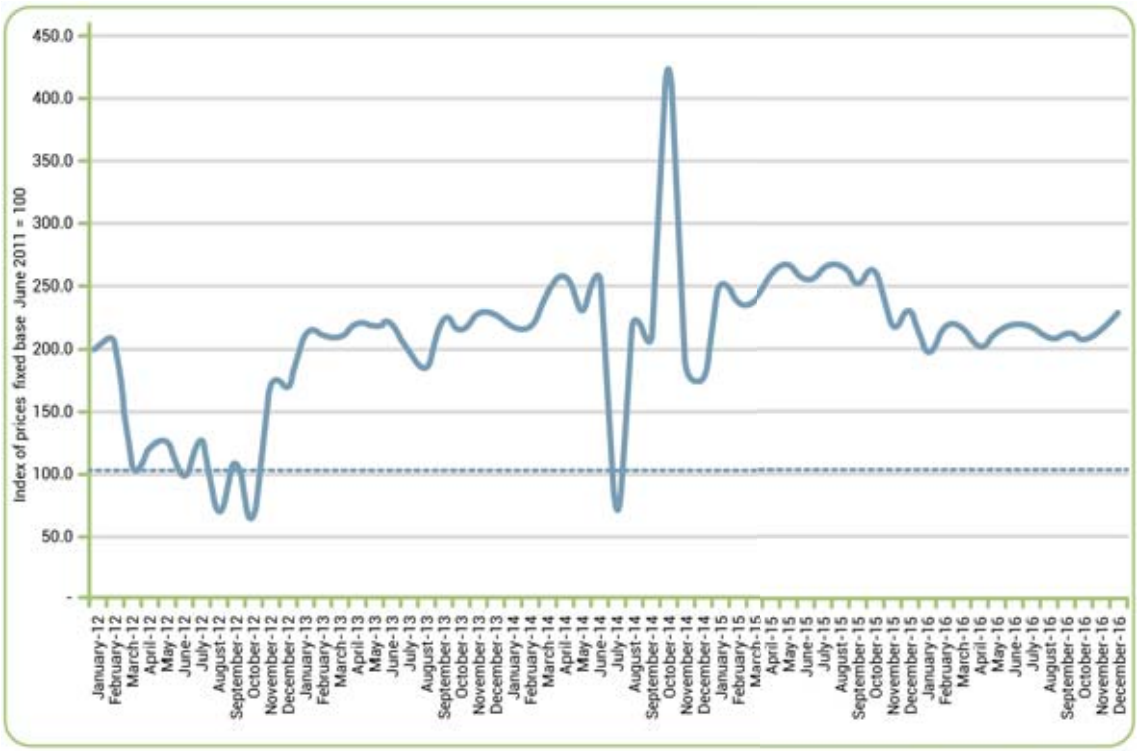
Upon analyzing the historical series of marihuana prices between 2006 and 2016, it is found that the highest recorded value was presented in 2015 (COP$ 390,500/kg) and the minimum value in 2007 (COP$ 47,300/kg). At the regional level, the price in the Amazon region in 2014 (COP$ 1,694,800/kg) and the region of Orinoco in 2015 (COP$ 863,600/kg) are the most outstanding. In addition, the high value of variance makes it possible to identify that there are large disparities between the prices of different regions. These differences can be associated to a differentiated market between the by-products marketed under marihuanas, with different commercial names that have brought with them a differentiation in the consumer and which are reflected in the level of prices, especially in the Pacific, Central, Meta-Guaviare and Orinoco regions.

Let us take for instance the so-called Cripy strain of marihuana. Prices were differentiated at the regional level, while in the Pacific there was an average price of COP$ 280,600/kg, in Orinoco there was a price of COP$ 456,700/kg, Sierra Nevada COP$ 574,200/kg, Central region with COP$ 676,100/kg, Putumayo-Caqueta with COP$ 792,900/kg and Meta-Guaviare with COP$ 910,400/kg - the country's highest price. These values were significantly higher than those of common marihuana; however, there is no evidence of taxonomic differences between species, and this phenomenon responds to differences in the form of commercialization and the name with which it is marketed.

With regard to the other trade names, the Pacific region recorded average values in 2016 for Púrpura Marihuana (COP$

360,417/kg) and Blueberry Marihuana ($ 230,833/kg). Again, there is no evidence of taxonomic differences of species, but rather the commercial terminology of the product. Evidence of this is the marketing of the so-called marihuana "Wraps" in the Central region, whose price was COP$18,300/Unit, with a minimum of COP$ 10,000/Unit and a maximum of COP$ 35,000/Unit, marketed under different flavors, and even revolt with basuco (cocaine paste).

As for the aggregate evolution of real marihuana prices by means of the Price Index calculated on a 100 base in June 2011, it is observed that between the beginning of 2012 and the end of the same year there was a tendency to reduce the price. Since then, there is a vertiginous increase in early 2013, followed by a period of relative stability until the first half of 2014. The second half of 2014 is characterized by being highly fluctuating, and reaches the highest real levels of the series (in August 2014 and October 2014). Subsequently, there is an increase in price until the beginning of 2015, followed by a period of relative stability, until it falls sharply in November 2015. In 2016, a tendency to price reduction is strengthened, much more marked in the first half, since the second half of the year shows a relative stability of the series.



Graph 18. Index of the behavior of prices of marihuana in Colombia, 2012 to 2016 (fixed base: June 2011).

Source: UNODC-SIMCI, CNP-DIRAN. Calculations: UNODC-SIMCI.

Note: In order to facilitate the comparative analysis of the growth of the aforementioned variables, fixed base indices were estimated in June 2011. A fixed base index goes beyond the comparison of two moments in time and seeks to analyze the variations in relation to a fixed period of reference.

Other illegal activities in the territories: Alluvial Gold Exploitation

The results of the monitoring on vegetation cover changes conducted by SIMCI have identified Evidence of Alluvial Gold Exploitation (EVOA - by its Spanish acronym) in territories where the activity is carried out exhaustively, in areas of the country that do not have mining grants or environmental permits, and where the presence of coca crops has been detected historically. This unfortunate coincidence poses a great risk and threat to the population, given the unlawful nature of these activities, as it becomes attractive for illegal armed actors who seek not only territorial control but new sources of income.

The Pacific region of Colombia is the region of the country which is most heavily affected by EVOA. It is also the area where the most hectares have been detected with coca crops in the last eight years.

The first baseline of alluvial gold evidence was developed in 2014, with the use of ground machinery for the Colombian territory. It was found that – although the area with coca crops has been reduced in some regions – these territories still fail to free themselves from phenomena of illegality. The alluvial gold mining phenomenon has been expressed with increasing force, and overflight and verification surveys have revealed a spatial relationship between these two activities. 38% of the territory affected by EVOA in 2014 matches areas where coca crops are present.

The aforesaid study found that the territories affected by both phenomena were located mainly in the municipalities of Barbacoas, Magüi and El Charco, in the department of Nariño, and Puerto Guzmán and Puerto Asís in Putumayo.

Of the municipalities affected with EVOA in the Pacific region, three are included in the list of the 10 municipalities with the highest area with coca crops: Tumaco (Nariño) ranks first, Puerto Asís (Putumayo) third, and Orito Putumayo) tenth. In Cauca, 70% of EVOA occurs in territories affected by coca crops, concentrated in Timbiquí and López, where the two phenomena are found. In the departments of Chocó and Valle del Cauca, 30% to 35% of EVOA is found in territories affected by coca crops.

Based on the first approach reached with the alluvial gold evidence baseline – especially in territories with coincidence of two illegal activities, UNODC and the Ministry of Justice and Law have developed a comprehensive research model aimed at characterizing the socioeconomic situation of rural communities areas with gold mining and coca crops in the Colombian Pacific. This project is a contribution to understanding the problems in the territory and an input for strengthening the actions in the fight against drugs and illegal exploitation of minerals. The research provides information on the living conditions of the rural household in the mineral producing regions, in the social and economic dimensions.

The sample was based on the Agricultural Area Sampling methodology, and was

composed of 624 Units of Agricultural and/or Minerals Production (UPAM). The surveys are distributed in three typologies, technically called sub-strata, according to the level of formalization of the extractive activity:

- Formalized Exploitation Activity: grids with Mining permits or grants, including or not EVOA or hectares with coca.

- Request (Future Formal Exploitation Potential): grids with no coca crops, EVOA and mining grants. However, there may be grids with application for certification; because no EVOA is found, it is assumed that the operating activity with the use of ground machinery is not active.

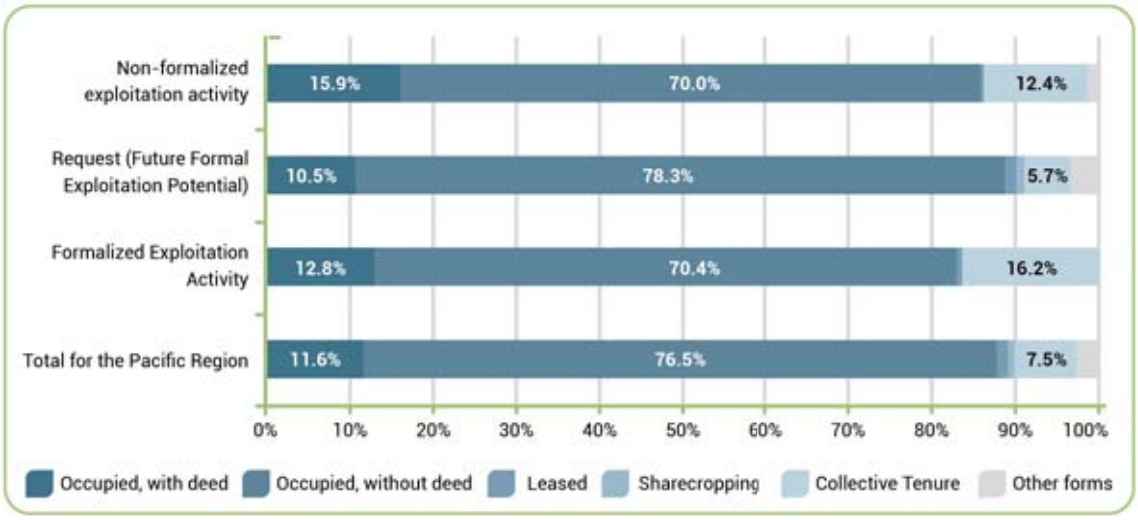
- Non-Formalized Exploitation Activity: grids with no mining grant or permit, but which have coca crops and/or EVOA.

These three sub-strata coexist in the territory, and were included in the study in order to examine their similarities and differences. The main results found in the study area are briefly presented below, and the particularities found in each of the sub-strata are later reported.

The study was carried out in the Pacific region. Its main cities are Buenaventura, Tumaco and Quibdó, inhabited mostly by Afro-Colombian population, and in a smaller proportion by indigenous peoples. Historically, it has been a region with a high level of poverty, Chocó being the department with the highest index of poverty in the country. Since the colony, exploitation of gold and platinum have been a source of employment in the region; there have periods of boom and decay of the activity. In the last decade, mining has become relevant once more due to increases in the price of precious metals, and this region has become the area that has suffered the most impact by this type of exploitation, coupled with high incidence of illicit crops.

Collective land tenure predominates in this region, in Indigenous Reserves and Afro-Colombian community territories

It was found that more than 70% of the UPAMs present in the region are occupied without a grant; only a little more than 10% thereof have deeds of property, and the remainder is held under other tenure modalities. In this sense, it must be considered that the high percentage of occupation of land without property deeds in the Pacific region can be explained because land tenure in this region of the country is mainly due to collective tenancy schemes provided in Act 70/1993; 84.6% of the study sample belongs to Afro-Colombian community lands (Community Boards). The sample did not coincide with indigenous communities.



Graph 19. Form of land tenure in the Pacific region, 2016.

The results showed that in territories with a Request (Future Formal Exploitation Potential), the main form of land tenure is the untitled occupation, regardless of the size of the UPAM, followed by collective tenure. On the other hand, territories with non-formalized exploitation activity have UPAMs with areas of less than five hectares and show another (unspecified) form of land tenure, and medium and large areas are occupied without deeds.

As for use of the soil, it was found in the three substrata studied that 46.5% of the territory corresponds to weeds and stubble. Forests amount to 26.5%; non-agricultural areas together represent over 73% of land use. There is a marked increase in the intensity of land use and tenure as the land area is reduced – specifically in UPAMs with small areas (under three hectares), which dedicate a considerable proportion of their land to permanent crops (around 40%).

7.5% of the population has no schooling level...

It can be observed that secondary school is the highest educational level achieved by 53.1% of the population in the region, with a remarkably greater participation of women. Elementary school follows with 37.3%, with greater participation of men, and 7.5% of the people have no schooling level. It was found that 2% of the population has higher education studies.

There is a high rate of children aged 6 to 9 who cannot read or write – over 30% of boys and over 40% of girls – followed by the elderly population (older than 60). In the latter population, more than 20% of men and more than 35% of women cannot read or write. As to the reasons why the population older than 5 years is not currently studying, the need to work (43.1%) was identified as the first motive, followed by home chores (17.3%).

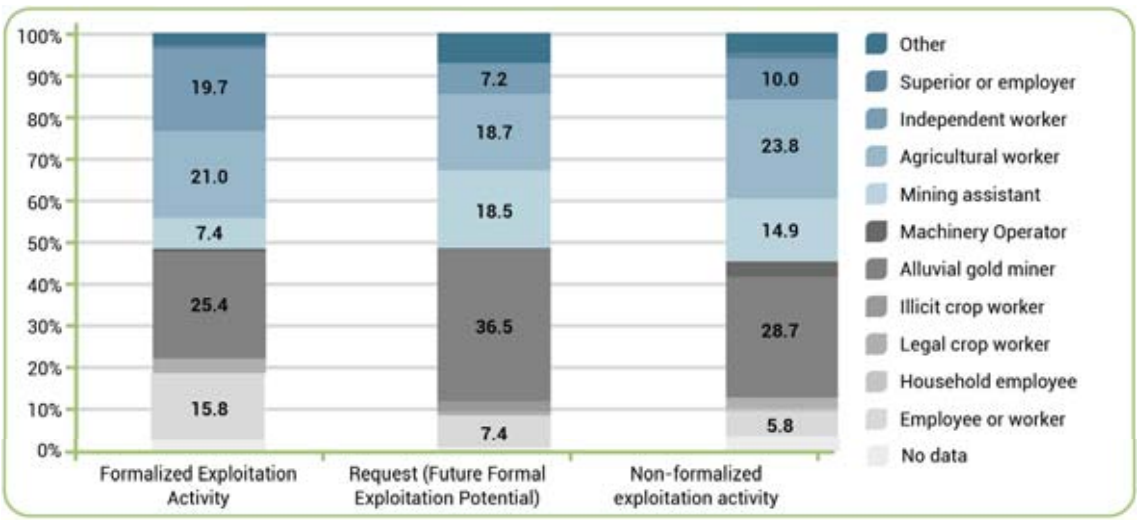
Electricity was the public utility with the greatest coverage; there is no domestic gas or sewage service, and the most frequent source of water for human consumption is rainwater (68%).

Alluvial gold mining, licit agricultural production, and assistance in mineral exploitation activities were the most frequent job in the target population. Independent workers and employees also had a significant share in the Occupied Population (OP).

It should be noted that the predominance of these jobs corresponds to the high level of informality that exists in the labor market of the region. In this sense, it is observed that (regardless of the substratum where it is found) only 4.08% of the population had effective guarantees through a written labor contract, and 19.1% had a verbal contract of employment. In both cases, the contracts are mostly established with men.

The highest source of income comes from mining economic activities (42% of the overall income), followed by agricultural activities (38%), which is the second largest component of income in the region. This scenario corroborates the fact that exploitation of minerals – and specifically of gold – is currently the main economic activity in the Pacific region.

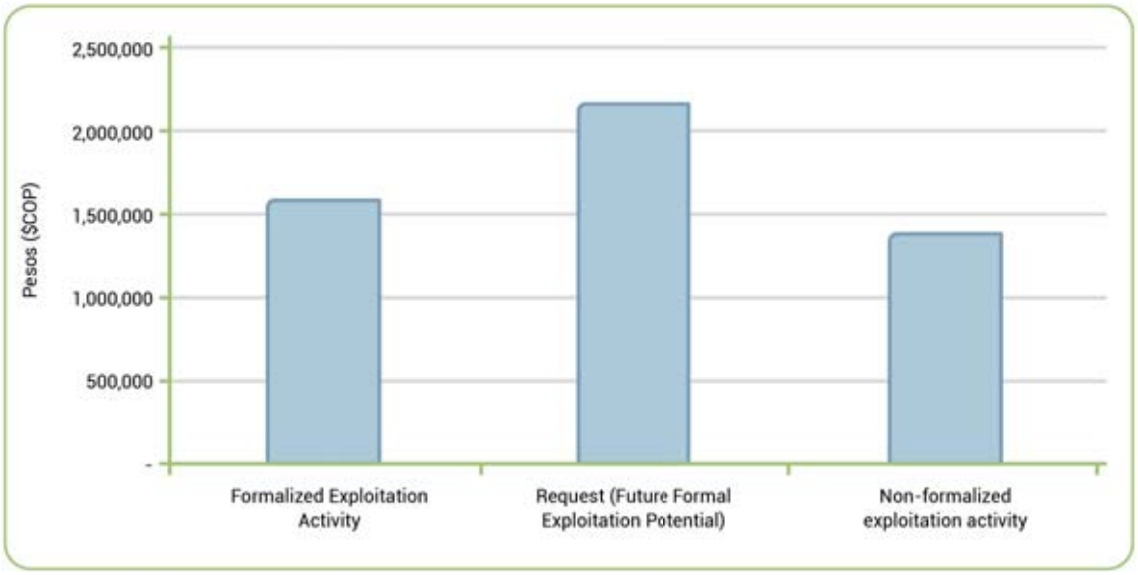
The labor market dynamics of the region reflect a concentration of the Economically Active Population (EAP) in the age ranges from 25 to 34 years, and from 35 to 44 years, because of coincident national demographic statistics that include a higher proportion of the Working-Age Population (WAP). When analyzing unemployment levels in the region for each of the sub-strata, the highest estimated unemployment rate occurred in territories where the activity was not formalized (6%), followed by a 3.8% unemployment rate where the activity is formally carried out. An opposite scenario was found in territories with Request (Future Formal Exploitation Potential) - 1.9%.



Graph 20. Work dynamics according to occupation status of the UPAM in each substrate, 2016.

In territories with formalized exploitation, 46.6% of revenues are associated with mineral exploitation, followed by 31.0% of agricultural production. The average monthly income for this substratum is estimated at COP $ 1,566,700. In territories with Request (Future Formal Exploitation Potential), 43.6% of revenues are associated with mineral exploitation activities, followed by 40.8% of agricultural production; the average monthly income is COP$ 2,144,927 for this substrate. Finally, in territories with no formalized exploitation activity, 51.7% of revenue is associated with mineral exploitation activities, followed by 37.0% for agricultural production; in this substratum, 67.8% of the income corresponds to income received by wages of legal crops; the average monthly income for this substratum is COP$ 1,369,316, although it includes income from illicit activities.

When analyzing the distribution of the monthly average income according to the size of the UPAM, it is observed that the increase in the areas of the properties is not related to higher levels of income; the intermediate properties (between 3 and 10 hectares) are those that perceive a higher income in the region, with some variations when analyzing the substrata.



Graph 21. Average monthly income per substratum in the Pacific region.

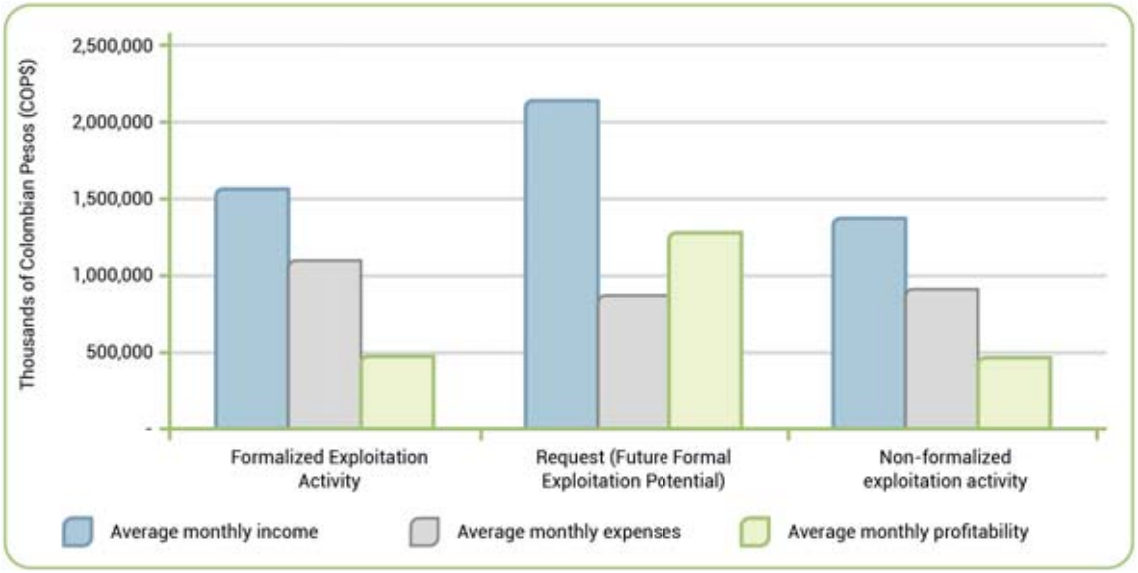
An idea has been frequently created about illicit activities generating higher profit margins than legal activities. However, the results obtained in the study indicate that areas with the highest levels of informality had the lowest levels of profitability of the productive unit.

It was evidenced that this result can be associated with several factors, such as: (i) this substratum had the highest levels of unemployment, (ii) the development of illicit activities in this substratum cause income to be fluctuating for individuals involved in this type of activities; (iii) the population

surveyed in this substratum probably did not accurately report the income received in the reference period.

When performing an economic balance, i.e. a comparison between family income and total monthly expenses, it appears that a family in the Pacific region perceives an estimated profitability of COP $ 1,140,255. When analyzing profitability at the level of the alluvial gold mining influence zone, corresponding to the substrata of the survey, it is found that the UPAM with Request (Future Formal Exploitation Potential) were the ones that obtained the highest levels of profitability, valued at COP$ 1,272,120. This amount is the product of receiving the highest revenues (COP$ 2,144,930), but simultaneously the lowest levels of expenses (COP$ 872,810), which means a 59.3 % gross profitability ratio.

A 33.7% gross profitability of was obtained in UPAMs with Non-Formalized Exploitation Activity, from a monthly income of COP$ 1,369,320, expenses of COP$ 907,230 and a gross profit of COP$ 462,090. The most unfavorable economic scenario (as opposed to what is usually recorded) corresponded to UPAMs with Formalized Exploitation Activity, in which the gross profitability rate was 29.8%, as a result of revenues in the amount of COP $ 1,566,700, expenses of COP $ 1,099,410, and a gross profitability of COP$ 467,290. This behavior ratifies the hypothesis that higher levels of formality in the territory are not necessarily associated with a less favorable economic balance.



Graph 22. Profitability analysis per substratum in the Pacific region.

As for perception of security in the region, 40% of respondents said they had a generalized perception of insecurity in their villages and towns.

The substratum with Request (Future Formal Exploitation Potential) has the highest level of perception (44%), followed by the substratum of non-formalized exploitation activity (22%). The lowest levels

of perception of insecurity are found in zones with formalized exploitation activity (15%).

The main cause of insecurity is the presence of groups outside the law. The areas of the substratum Request (Future Formal Exploitation Potential) have a more acute concern, reflected in 76% of the respondents. The area with non-formalized exploitation has percentages of 54% and 46% in areas with formalized exploitation. This is particularly important since illegal armed actors have historically positioned themselves in the region, using it as a rearguard against operations of Law Enforcement Agencies, as well as for the development of illegal economic activities such as cocaine production and illegal mining. In turn, this means a high risk of making recourse to illegality in areas with potential for future formal exploitation.

It should be noted that despite the process of implementing the agreements reached in Havana with the Farc - Ep, the ELN guerrilla now operates with several of its fronts and mobile columns in the departments of Chocó, Cauca and Nariño. Similarly, post-demobilization groups such as Clan del Golfo, Los Rastrojos, Las Águilas Negras, Los Policarpa and Los del Ejido have presence in these areas; this phenomenon stirs up the concerns of the communities in the region.

This section includes considerations on several aspects such as the recognition of social organizations in the territory and the perception of local governments. It should be noted that this component had a high percentage of abstention when responding (exceeding 50%) in the different forms of citizen participation (with the exception of community councils that were the main form of participation recognized by the population). For this reason, data below should be considered only as an indication.

The first thing to be mentioned is that there is a high level of self-recognition as an Afro-Colombian population (97%). Accordingly, the most widely recognized organizations in the Pacific region are Community Councils (with 97.5%), although the substratum with formalized exploitation activity has a slightly lower recognition (78.6%).

In addition to the above, a survey was conducted regarding the main problems faced by communities. Health issues were reported at 16.3%, followed by employment/ income generation capability, with 15.3%, and attention to the countryside (15.0%), displacement (12.1%), corruption (11.9%), insecurity/crime with (10.5%), political participation (6.0%) and others (1.5%).

Regarding the level of confidence of the communities in the region vis-a-vis representative state agencies in the territory, it was observed that there is a majority of confidence in the National Government, with 61.3%, and in the Military Forces, with 52.23%. This may respond, among other factors, to the development of public policies in the area by the central government as well as to the recovery of security by the Public Force. In contrast, the agencies with less confidence levels were the Mayor's Offices where the study was conducted, with 74.87%.

90% of the population believes that water and river pollution is the main environmental problem in the region

The main environmental problems according to the perception of the Agricultural and / or Minerals Producer (PAM), regardless of their substratum, are water and river pollution (over 90%). Given the existence of evidence on the use of mercury and cyanide during gold processing activities, these perceptions could facilitate/hinder the implementation of health prevention programs, as the second main source of water in the region is rivers, streams and springs.

According to the UPAM's perception in the region, it was evident that despite the fact that the population recognizes some adverse effects of gold mining, 72.9% of the population in the region believe that the activity should continue to operate in the territory. In addition, only 4.2% believe that gold mining should not continue to operate[107]. This apparent inconsistency can mainly be attributed to two factors: (i) mining activities have become the main source of income, ergo a representative line in the region's economy, since respondents indicated that it improves the quality of life and access to goods; (ii) when comparing the above with the damages produced, people's preferences lean in favor of the gold exploitation activity.

Understanding that the location of the formal or informal mining activity generates changes in the characteristics and dynamics of the women in the territory, the results of the survey provide an analytical view with a gender approach to the territories under study. In terms of demographic characteristics, it was observed in the first part that there is a greater population of men in the region; however, there is a larger population of women in the age ranges between 10 and 18, 25 and 34 and 45 and 59 years, in addition to the fact that there are more women in areas with formalized and non-formalized exploitation activity.

In terms of the labor force associated with mining activities, 17.7% of women work mainly as barequeras (gold panners). This economic activity has developed historically and is associated with the cultural traditions of the region.

Upon enquiring about some type of labor contract, it was observed that there is not a high index of contractual relation (neither in writing nor verbally) in the region. Nevertheless, the little contracting that exists is more frequent in men; 4.7% of men have a written contract of employment, as opposed to 2.8% of women. 26.1% of men reported having a verbal contract of employment, as compared to 5.2% of women.

With regard to the educational levels reached, women have an advantage over men since they have a higher percentage of studies in primary, secondary, technical and college education. In addition to the above, it was found that the reasons presented by

107 Of the total population surveyed in the Pacific region, 0.9% do not know / do not respond and the remaining 21.9% is not applicable.

the respondents to not further their studies were mainly related to household chores; something that confirms and deepens the gender roles imposed in the territories.

When questioning the reasons for migration, women mentioned that the first cause is associated with job opportunities or business in the territory, something that could be related to mining activities. The second cause mentioned by them was associated with threats or risks to their life or physical integrity, caused by the armed conflict and common crime; this sign sharpens gender violence in the region.

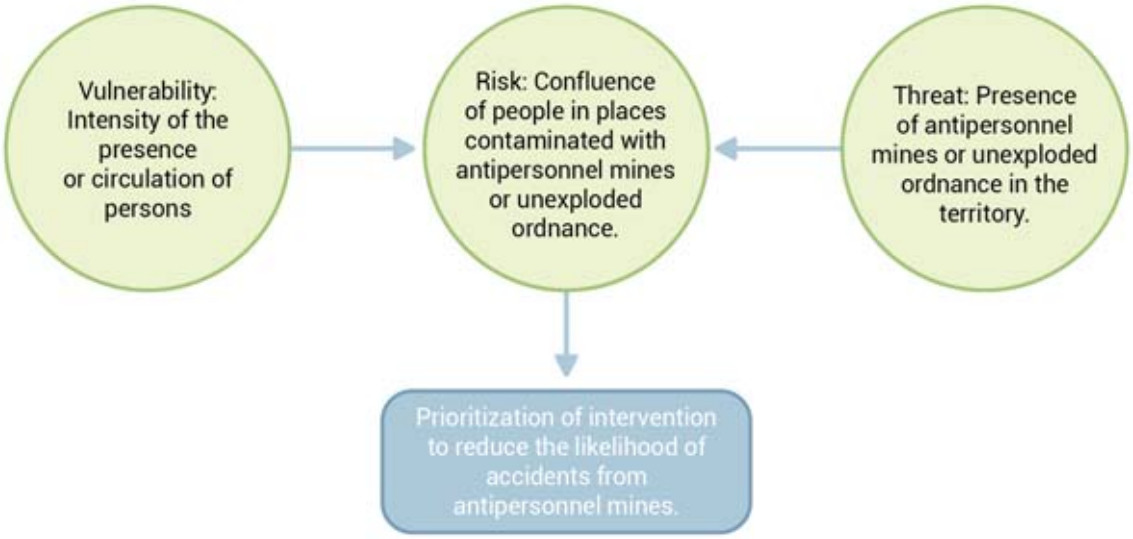
Finally, it was observed that the perception about the health status of women is good. Women's main reasons for using medical services are associated with respiratory difficulties (cough, bronchitis, sinusitis, rhinitis, asthma) followed by allergies (skin rashes, skin flakes, wounds), diseases that may be related With the work they perform in the formal or informal exploitation of gold, where chemicals such as mercury and cyanide are used in the development of this activity that may be affecting them. As for the condition of disability, the general population reported that it is not in that state; however, the small percentage of people who claimed to have some type of disability were mainly women. In the region, 4.0% of women reported having some form of disability compared to 2.5% of men. Areas with Request (Future Formal Exploitation Potential) is where this situation is worse for women, with 4.2% in contrast to 2.5% of men.

Threat and vulnerability integration case study

As a result of the alliance between UNODC's SIMCI project of and Directorate for Comprehensive Action against Landmines (DAICMA), responsible for targeting comprehensive action against antipersonnel mines in Colombia, the experience developed in SIMCI was used in the analysis of Illegality to develop an instrument to refine the targeting of the attention of the territories and population affected by anti-personnel mines.

The primary objective of the action against anti-personnel mines is to prevent the occurrence of new accidents; therefore, a determination is necessary as to the areas in which the population and anti-personnel mines are most likely to coincide. Therefore, a methodology was designed to address the prioritization based on the comprehensive risk management approach, which consists in reducing threat and vulnerability. There are no studies on this phenomenon that apply the comprehensive risk management approach from a spatial perspective.

The classical definition of risk proposes it as a function of the threat (likelihood of a disturbance) in its interaction with vulnerability (susceptibility, exposure to threat and capability of recovery from the impact, or damage caused by the threat). In the case of contamination by anti-personnel mines and unexploded ordnance, the corresponding definitions for addressing the problem from the comprehensive risk management approach are as follows:



Scheme 7. The prioritization of actions against antipersonnel mines from the comprehensive risk management approach.

Based on the definitions above, some factors were established to assess vulnerability and threat.

Vulnerability

The following variables associated with the location and concentration of the population were taken into account for the vulnerability assessment:

Variable	Weight*	Source and observations
Density of housing constructions[108]	30	It is obtained from the IGAC cartography at scale 1:100,000 of 2012. 1 mm in the plane is equal to 100m in the ground. Isolated constructions less than 100m are not reflected in the map. There is evidence of some areas with information gaps from the source.
Density of educational establishments[109]	40	It is obtained from the IGAC cartography at scale 1:100,000 of 2012. Some areas are evidenced with information gaps by the source.
Presence of roads	20	It is obtained from the IGAC cartography at scale 1:100,000 of 2012. Only land routes are taken.
Stratification based on vegetation cover	10	Stratification is based on the interpretation of SIMCI 2014 coverage (1:50,000 and 1:25,000 scales) and the 2008 IGAC land cover (1:100,000 scale).
TOTAL	**100**	

Table 22. Evaluation of Vulnerability Variables.

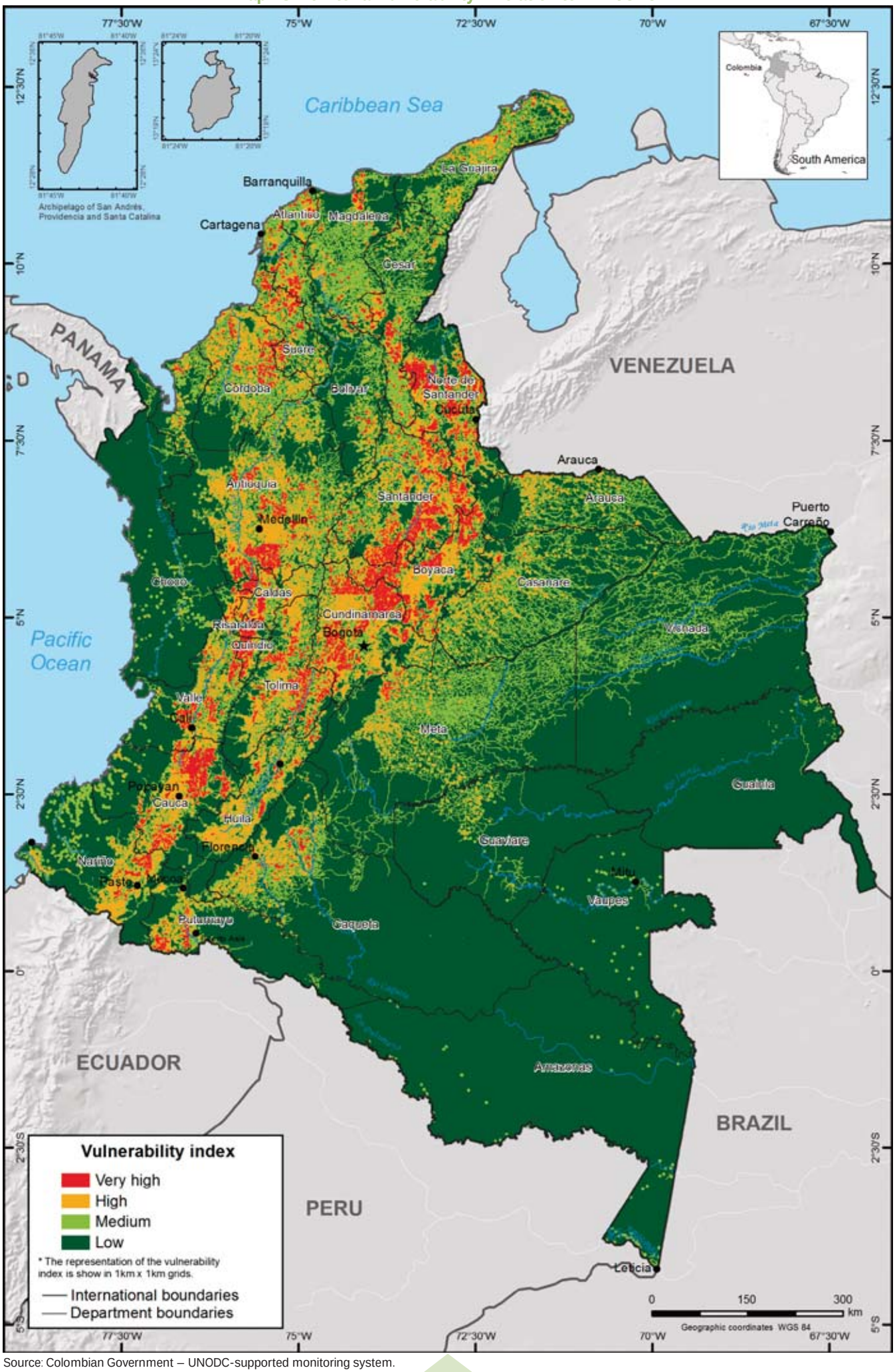
*The criterion for the allocation of weights was defined in a qualitative fashion, following the principle of probability of permanence or circulation of people.

108 The density of housing constructions is an indirect indicator of the location of people in rural areas. It was established that 71% of APM events (accidents and incidents) occurred in distances under 1 km from residential constructions.
109 Schools serve as a common meeting place for rural communities. It was established that 37% of events (accidents and incidents) occurred at distances equal or less than 1 km from educational establishments.

Allocation of the weight of each variable in the total vulnerability assessment was done based on the criterion of concentration of the population[110], giving greater importance to the density of educational establishments because it is a place where large numbers of people converge, and density of housing constructions because these are people's dwelling places. To a lesser extent, the assessment included the presence of roads, because the presence of people is temporary. Finally, stratification based on plant cover, based on the assumption that higher levels of use (agricultural crops) have a greater potential for movement of people than those with lower levels of use (forest or stubble). At the end, the index is normalized from 0 to 1, where values close to 1 have more vulnerability.

110 The criterion for the allocation of weights was defined qualitatively, following the principle of probability of movement of people.

Map 18. Territorial vulnerability in relation to APM/UXO.



Source: Colombian Government – UNODC-supported monitoring system.
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Threat with evidence of APM/UXO

In order to evaluate the threat of contamination of APM/UXO in the territory, we evaluated coincidence in territories of 1 km^2 of coca crops, Mobile Eradication Groups (GME) and evidence of alluvial gold exploitation (EVOA) with grids affected by APM/UXO events[112]. There are no studies that have addressed this interaction in a spatial way.

Variable	Weight*	Source and observations
2010 - 2015 APM/UXO Events[111]	80	Accidents and incidents between 2010 and 2015 from the Daicma database are integrated into the 1 km^2 area framework.
APM/UXO events prior to 2010	50 (valor alterno)	Accidents and incidents prior to 2010 from the Daicma database are integrated into the 1 km^2 area framework.
Coca crops	12	The presence of coca crops in 1 km^2 grids is taken into account. Area is not taken into account. 2002 - 2015 historical series.
Mobile eradication groups (GMEs)	6	Eradication verified by UNODC from 2007 to 2015. Eradication by third modality is not taken into account.
Evidence of alluvial gold exploitation (EVOA)	2	2014 EVOA Interpretation.
TOTAL	**100**	

Table 23. Assessment of threat.

* The criterion for the allocation of weights was defined qualitatively following the following principles:
[1] Because the location of antipersonnel mines constitutes the most consistent evidence of contamination of the territory, it was decided to assign the highest weight (80%) to this variable, so that the probable associated contamination factors could not, under any circumstances, surpass the value given to the evidence.
[2] The DAICMA has established that 24% of events after 2010, generate a Hazardous Area (HA), while only 15% of the events prior to 2010 do. From the above, it is derived that there is a 1.6 times greater probability of determining a hazardous area in recent events (between 2010-2015) than in previous events. Due to the fact that events weigh a maximum of 80% within the methodology of risk assessment by APM/UXO, recent events (2010 - 2015) will have a maximum weight of 80%, and the previous ones will have a maximum weight of 50%.
[3] The missing weight (20%) was distributed according to the percentage of association of coca, GME and EVOA crops with APM/UXO events (% occurring in grids that present the condition), maintaining the proportionality relation between them.

The variable that determines the threat by contamination of APM/UXO is the occurrence of accidents and incidents in the territory. A weight of 80% was assigned to the contamination level associated with evidence for recent APM/UXO events (period 2010-2015). For previous events, the maximum weight is 50%. The other weights were assigned from the global association level of the variable with the presence of events in the country. At the end, the index normalizes from 0 to 1 where values close to 1 present a greater threat.

Regarding coca cultivation, in order to know if the territories with coca cultivation during 2010-2015 coincided with territories affected by APM/UXO, the coincidence of these two phenomena was evaluated in the same period of time in 1 km^2 grids. At

111 There are threat factors that are not possible to map with the data available, such as the area of influence of organized armed groups outside the law. For this reason, the threat index proposed is evaluated only with the variables described.
112 The location of antipersonnel mines constitutes the most consistent evidence of contamination of the territory, it was decided to assign the largest weight (80%) to this variable, so that the probable associated contamination factors could not, in any case, exceed the value given to the evidence.

the national level, of the total of grids with APM/UXO events, 25.56% had coca crops. At municipal level, it was evidenced that the level of association between APM/UXO events and the presence of coca crops was not homogeneous. In some municipalities there was a high level of association, whilst this was not the case in other municipalities. Data on antipersonnel mines events are distributed not only in coca production areas but have also been a territorial control mechanism to block the armed and police forces, to protect hideouts with drugs, weapons and money, and to prevent passage of people by strategic corridors in the country. However, in the municipalities that are most affected by coca crops, correlations are higher and therefore the presence of coca crops is defined as a driver of the threat.

A municipal gradient was assigned to the grids in order to consider the level of heterogeneity typical of each territory, with the municipal relation between amount of grids with coca crops vs grids with events. The municipalities with the highest number of grids with coca crops vs. grids with APM/UXO events are located in Nariño, Putumayo and Norte de Santander.

The same exercise was carried out with GME and EVOA. Of the total grids with historical intervention of GME, 7.04% presented APM/UXO events. Although this percentage is not significant at the national level, greater coincidences are observed when performing the exercise at the municipal level. A municipal gradient was assigned to the grids for the integration of the level of municipal association between the amount of grids with GME vs grids with APM/UXO events. The municipalities with the highest number of grids of events vs grids that share GME and events were: Linares (Nariño), San Miguel (Putumayo), Tumaco (Nariño), Policarpa (Nariño) and Puerto Asís (Putumayo).

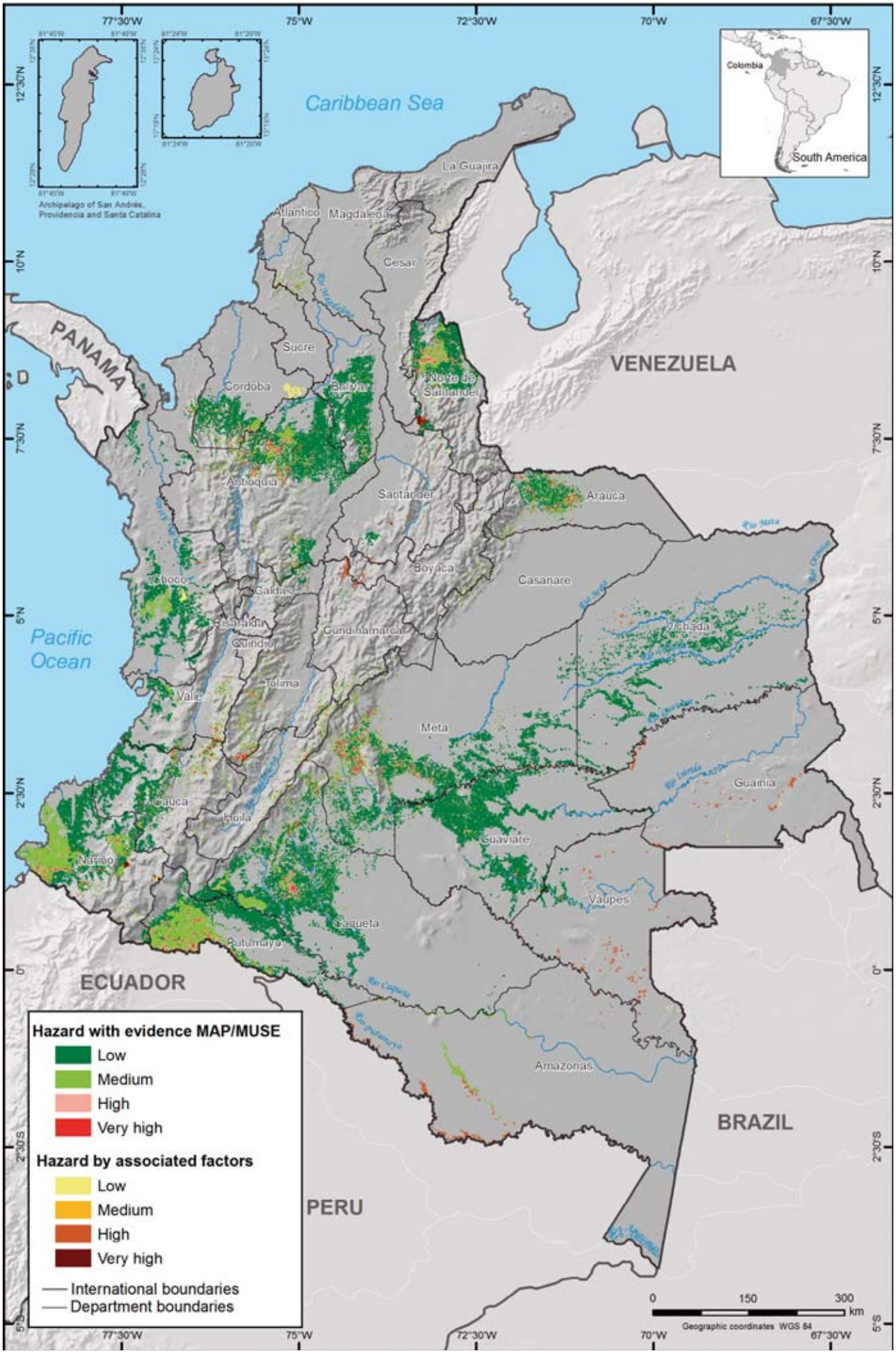
As for EVOA, of the total of the grids with APM/UXO events from 2010 - 2015, 1.82% presented EVOA in 2014. The municipalities with the highest number of APM/UXO event grids that share grids with EVOA were in Antioquia and Chocó.

Threat from associated factors

Threat by associated factors means any factors associated to the result of the threat-driving variables different from APM/UXO events, in territories where there is no evidence that these events have occurred. As an example, it is possible that some of the APMs have been installed in some of the territories affected by coca crops, but that no incidents or accidents have occurred so far; the presence of GME or EVOA can be inferred from this phenomenon.

Therefore, in addition to the calculation of the threat in territories with evidence of APM/UXO events, the threat posed by factors associated with the installation of APMs (coca, GME, EVOA) was evaluated. To this effect, we took the municipalities without APM/UXO affectation, and their level of affectation was evaluated by some of the associated elements. The assessment of variables remained the same as in the threat analysis with APM/UXO evidence.

Map 19. Accident / incident threat by APM/UXO.



Source: Colombian Government – UNODC-supported monitoring system, DAICMA: Events data base APM/UXO 1990-2015.
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Risk analysis with evidence of APM/UXO and risk by associated factors[113]

The risk is given by the product of threat and vulnerability in 1 km^2 areas. Thus, whenever a territory is vulnerable but not threatened, or whenever there is a threat but no vulnerability is registered, the resulting risk level is zero.

The presence of APM/UXO in the territory can be evaluated with three levels of reliability. Firstly, territories in which there is evidence of the presence of these artefacts, either due to the historical existence of accidents, or through military demining processes in operations. A second level consists of the presumption of contamination by APM/UXO, derived from statements by communities of the suspicion of the presence of APM/UXO. A third level is the presence of phenomena frequently associated with the installation of APM/UXO in the territory, such as the presence of illicit crops or unregulated mining.

From the above, it is necessary to determine two types of risk: Risk based on evidence of presence of APM/UXO, and risk derived from the presence of the driving factors, even if there is no evidence of APM/UXO. In the first case, the risk level is obtained from factorizing the value found in the threat by the value found in the vulnerability. In the second case, the threat level is established without evidence of antipersonnel mines (APMs), but with the presence one or more of the factors driving the installation of these devices (coca, GME, EVOA). As in the previous case, this risk level is obtained by factorizing the threat by factors associated by vulnerability.

Ranges	Risk Level
0.000001 - 0.024884	Low
0.024885 - 0.098937	Medium
0.098938 - 0.265176	High
0.265177 - 0.804517	Very High

Table 24. Ranges of risk levels determined using the Natural Breaks (Jenks) tool of the ArcGis software.

Ranges	Risk Level from Associated Factors
0.01 - 0.04	Low
0.05 - 0.12	Medium
0.13 - 0.30	High
0.31 - 0.63	Very high

Table 25. Ranges of risk levels from associated factors determined using the Natural Breaks (Jenks) tool of the ArcGis software.

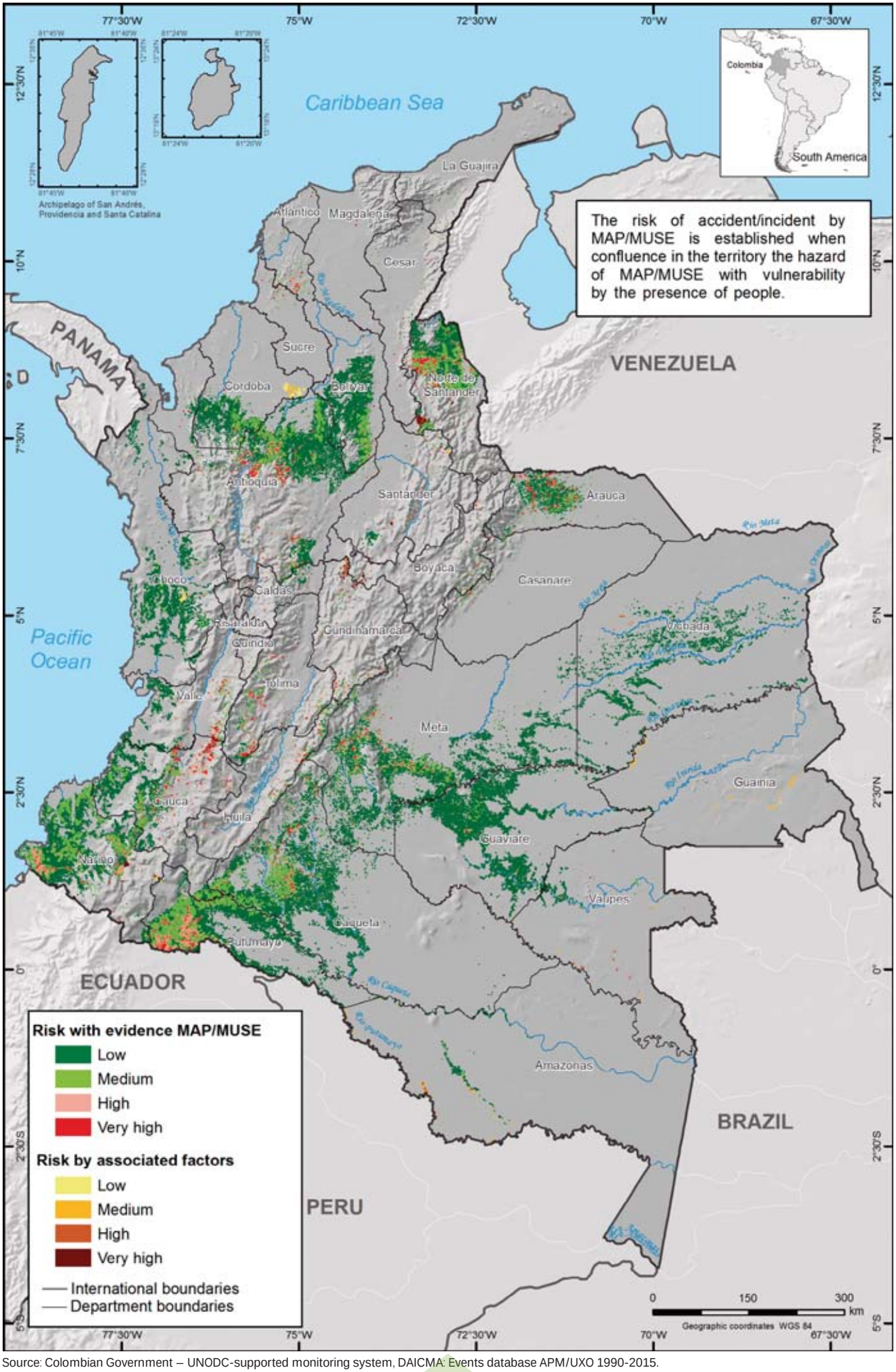
113 Vulnerability, threat and risk calculations were performed in 1km2 areas for the entire Colombian territory.

As a result, in the national territory there is a total of 106,734 km 2 in some level of risk by contamination of APM/UXO. Of these, 73% are at low risk, 21% are at medium risk, 5% are at high risk and 1% are at very high risk.

The departments with the highest amount of area in some degree of risk are Caquetá, Meta, Nariño, Putumayo, Guaviare and Antioquia, with over 10,000 km2 at risk each, and concentrating more than 60% of the national territory at risk. The highest concentration of very high risk is found in Antioquia and Cauca with 15% each, Norte de Santander with 11%, Putumayo with 10% and Arauca with 9%. As for high risk, it is found mainly in Putumayo (22%), Antioquia (11%), Nariño (10%), Cauca (9%) and Meta, Norte de Santander and Caquetá (7% each).

The departments with the highest presence in medium risk are Putumayo with 18%, Nariño with 16%, Norte de Santander with 12%, Caquetá with 12% and Antioquia with 10%. Guaviare, Caqueta and Meta concentrate much of their territory at low risk.

Map 20. Risk of accident / incident by APM/UXO.



Source: Colombian Government – UNODC-supported monitoring system, DAICMA: Events database APM/UXO 1990-2015.
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Chapter 3

ACTIONS OF THE COLOMBIAN GOVERNMENT

The Government of Colombia has been developing different strategies to address the problem of illegality in the territories, and in particular the problem of drug production. A number of these actions have focused on the illicit crops tackled, and have included tools ranging from alternative development to aerial spraying of crops[114].

Transformation of the territories constitutes one of the most important challenges that Colombia faces in this period of implementation of the Peace agreement. This is recognized by the agreements that contain two chapters *(point 1, Comprehensive Rural Reform and 4, Solution to the Problem of Illicit Drugs)* with strategies and commitments specifically designed to design programs and mechanisms that lead to that transformation of the territories.

This chapter provides an overview of the actions that have been developed, and aims to address the problem of illicit crops on the basis of the acknowledgement that public policy is in a situation of transition towards an intervention model focused on the transformation of vulnerabilities to build on the opportunities arising from the peace agreement.

THE NEW DRUG POLICY APPROACH AND CHALLENGES FOR IMPLEMENTATION

In response to the country's new dynamics, trends and needs in the field of drugs and the commitments made at the 2016 UN General Assembly Special Session on Drugs (UNGASS), the Colombian Government has set out to focus its efforts on the fight against the intermediate and higher links of the drug trafficking chain, as

114 The historical series of aerial spraying by department 2001 - 2015 can be found in Annex 5.

they are the main beneficiaries of the drug market's profits and generators of violence, corruption and social vulnerability.

This new vision of drug policy recognizes the relevance of human rights, public health and human development approaches to the development of policies, plans and programs to address the drug problem in the country. In this sense, the objectives of the drug policy that have been proposed in the country are as follows:

General objective

To reduce the impact of drugs on the Colombian population, by modifying the social and economic conditions of the territories and their population, which explain their vulnerability to the dynamics of the drug problem.

Specific objectives

- Reduce the crime associated with drug trafficking, by directing the efforts of the State as a priority towards the fight against the intermediate and higher links of this chain, which are the main beneficiaries of the profits of the drug market and generators of violence, corruption and social vulnerability.

- To strengthen the transformation and comprehensive development of territories and populations affected by illicit crops, production and drug trafficking.

- To fully address the use of psychoactive substances from the human rights, public health and human development approaches.

Colombia has a historic opportunity to implement new policy approaches in line with post-conflict challenges, geared primarily to fostering territorial and social transformations that reduce illicit drug use. These transformations must be accompanied by the dismantling of organized crime structures and effective control over the economic incentives of drug trafficking and related crimes. In addition, the use of psychoactive substances will be fully addressed through the application of human rights, public health and human development approaches.

On the occasion of the signing of the Final Agreement for the ending of the conflict and the construction of a stable and lasting peace with the Farc - Ep, the national government began a process of institutional transformation to comprehensively respond to the challenges posed by the post - conflict[115]. In this sense, the territorial approach is recognized as an opportunity for the design and implementation of measures that take into account the needs of each territory, and ensure the active participation of different sectors of society in its construction.

Considering that the Final Agreement envisages the structural transformation of the countryside as a central axis for the solution of the historical causes of the conflict, it was established in Point

115 Legislative Act 01 of 2016 conferred upon the President of the Republic the extraordinary and exceptional legislative power to issue Decrees with material force of Law oriented to the implementation of the Final Agreement. In May 2017, Decree of Law 893 was issued, which created the Territorial Approach Development Programs (PDET - Programas de Desarrollo con Enfoque Territorial) and Decree of Law 896, which created the National Comprehensive Crop Substitution Program (PNIS - Programa Nacional Integral de Sustitución de Cultivos de ilícitos – PNIS).

1 - "Towards a New Countryside in Colombia: Comprehensive Rural Reform" to implement Development Programs with a Territorial Approach (PDET - Programas de Desarrollo con Enfoque Territorial) as management tools for the implementation of national plans and resources, in areas with illicit crops, amongst other characteristics[116].

The strategy that the Colombian government has undertaken to promote the substitution of illicit crops aims to use the Comprehensive Rural Reform and the instruments that derive from it as an opportunity to overcome the conditions of inequity and marginalization experienced by the populations affected by the Presence of these crops.

The Peace Agreement - Point 4: *Solution to the problem of illicit drugs*, establishes the need to look for alternatives that lead to improve the welfare and good living conditions of communities in the territories affected by illicit crops. Under this framework (without ignoring the debate generated by the increase of hectares planted in illicit crops) the national government recognizes the need to work in a more strategic and intelligent way against the whole chain of drug trafficking.

There is awareness as to the fact that, in the face of the complexity of the problem of illicit crops, no single strategy can be used to reduce them. In this sense, since the aerial spraying program was suspended[117], the national government formulated an intervention strategy from a comprehensive approach, reviewing the various factors that influence the presence and persistence of the phenomenon in some territories. The purpose of this new approach is for the actions of the programs to be oriented to the recovery and creation of opportunities of territorial and social development, to overcome the impact caused by the presence of illicit crops, and in accordance with the characteristics of each territory.

Emphasis is given to the process of transforming the countryside into a stable and lasting peace, with the aim of ensuring that the conditions that have allowed illicit crops to remain in the territories be modified.

During 2016, there began the formulation and implementation of a strategy with the recognition that some small growers of illicit crops are associated with such illicit activity because of the lack of economic opportunities in legal markets. For this reason, the Directorate of Comprehensive Care to Fight Illegal Drugs of the Post-Conflict Counseling Board began a series of rapprochements and dialogues with some communities of small coca producers, in order to explore the willingness of these sectors to participate in a Strategy of voluntary and concerted substitution of illicit crops. This would rely on the implementation of the application of the methodology and objectives contained

116 The Final Agreement establishes four prioritization criteria for choosing the areas where the PDET will begin its operation: a) Poverty levels, in particular, extreme poverty and unmet needs; b) Degree of affectation derived from the conflict, c) Weakness of administrative institutions and management capacity; and d) Presence of illicit crops and other illegitimate economies.

117 In a session of the CNE on May 14, 2015, after analyzing the statements made by the High Courts, the World Health Organization through the IARC, the Ministry of Health and Social Protection and the considerations of the Members and interveners, the use of the herbicide glyphosate was suspended in the "Program for the Eradication of Illicit Crops by Aerial spraying with the Glyphosate Herbicide (Pecig)". On May 29, 2015, the National Drug Enforcement Board issued Resolution 0006/2015, basing its arguments on the test of constitutional proportionality.

in point 4 of the Final Peace Agreement. This exploratory activity led to the signing of some collective agreements (Vichada and the Department of Cordoba) and to initiate contacts and dialogues around the purpose of implementing a strategy of voluntary substitution of illicit crops. These processes culminated in 2017 with the signing of 34 collective agreements, some of which have a regional scope (Córdoba and Nariño municipalities). Others have a departmental outreach (Putumayo) and others have municipal coverage. In principle, the coverage of these agreements is 76,991 families that control 76,065 hectares of coca.

Since the end of the final agreement, and in application of item 4, *the National Comprehensive Program on Illegal Crops – PNIS*[118] was created, in pursuance of Decree 896 of 2017. This decree provides the legal basis for the control of illicit crops, facilitates inter-institutional coordination in interventions and provides financial and technical support to small farmers so that they can progress towards legality in the context of overcoming vulnerabilities of the territories Affected.

Also in 2016, and in anticipation of the new illicit crop control policy that would derive from Point 4 of the Final Agreement, a special agreement was signed between the Farc - Ep and the national government to *"launch a **joint effort** of voluntary substitution of illicit crops in the municipality of Briceño (Antioquia)".* This initiative began on June 10, 2016 (joint communiqué No. 74 FARC - Ep / National Government) and reinforced the effort of the pilot project of humanitarian demining that was carried out in the El Orejón township, in the same municipality. This process involves an accompaniment group composed of the National Government, the Farc - Ep , the United Nations Office on Drugs and Crime (UNODC), the International Organization for Migration (IOM) and the UN Organization for Food and Agriculture (FAO). The communities of the 11 villages affected by illicit crops have been highly involved in the process. The national government has made a comprehensive intervention that has benefited 1,137 townships, and aims to eliminate all of the coca identified in the intervention area, amounting to 954 hectares. With this effort, the Government seeks to identify lessons learned that will serve to refine the formulation and implementation of the new illicit crop control policy.

With the new drug policy approach, actions are carried out where public health and human rights are prioritized. In this context, alternatives to imprisonment for drug-related offenses constitute a proportional response with a greater impact on crime prevention. In order to generate alternative approaches and prioritize the adolescent population, work is currently being done in terms of the formulation and implementation of the Judicial Follow-up Program for Drug Treatment in the Criminal Responsibility System for Adolescents *(SRPA - Programa de Seguimiento Judicial al Tratamiento de*

118 The National Comprehensive Program for the Substitution of Illicit Crops - PNIS was created with the following components: Safety conditions for communities and territories affected by illicit crops; Agreements with communities; Prioritization of territories; differential penal treatment; pparticipatory construction and development of comprehensive community and municipal plans for substitution and alternative development (PISDA); implementation of PNIS in National Natural Parks; Communication strategy. Complement PDET and RRI.

Drogas en el Sistema de Responsabilidad Penal para Adolescentes)[119], which proposes an alternative to prosecution or excessive use of deprivation of liberty for young people who, as a consequence of drug use, committed minor crimes, who voluntarily enter the treatment program for their addiction as a complementary measure to the sentence. To date (June 2017), the pilot model is being implemented.

To implement an effective policy, the national government focuses on the search, prosecution and effective punishment of the strong links of the drug trafficking and money laundering chain, through policies on investigation and prosecution of criminal organizations in order to dismantle them. The motivation of criminal organizations is related to with the high profitability of illicit drug trafficking and other forms of organized crime, which promotes bribery and corruption, finances insurgency and destabilizes licit economies and businesses. Due to the above, the investigation and prosecution efforts are being doubled through efficient use of legal tools in dealing with drug-related offenses, and specialized groups focusing on organized crime.

Clearly, another challenge the country faces is the increase in drug consumption. In this regard, the Ministries of Justice and Law and the Ministry of Health and Social Protection have, since 2015, led the process of formulating the "National Plan for the Promotion of Health, Prevention and Care of Drug Use", through consultations involving different sectors such as academics, experts, authorities of territorial entities and the society in general. The Plan was approved by the National Council on Narcotic Drugs, as per Resolution No. 007 of 2015, and – most importantly – it adopts the approaches of public health and human rights and aligns with the temporary projection of the Ten Year Plan of Public Health and Justice.

The Plan seeks to reduce the magnitude of drug use and its adverse consequences through a coherent, systematic and sustained effort; aimed at the promotion of healthy conditions and lifestyles, the prevention of consumption and the care of people and communities affected by drug use, and strengthening public health information and surveillance systems. To achieve the objective, the Plan proposes five strategic components: 1) Institutional strengthening, 2) Promotion of coexistence and mental health, 3) Prevention, 4) Reduction of risks and damages, and 5) Treatment.

The National Government's intention is to prioritize the perspective of human rights and public health. This implies leaving behind the punitive and criminal approach through which consumers have been thought of, and instead to offer information, facilitate access to various health and social services, to treatment when there are already problematic uses, and to recognize the rights of drug users and to take measures to reduce the associated risks and harms, as well as the exclusion and stigmatization typical of the punitive approach.

On the other hand, following the enactment of Law 1787 of July 6, 2016, Colombia establishes the regulatory framework that allows safe and informed

119 The Judicial Follow-up to Drug Treatment Program is led by the Ministry of Justice and Law, in partnership with the Ministry of Health and Social Protection, the Colombian Institute of Family Welfare (ICBF), and the Attorney General's Office.

access to cannabis and its derivatives for exclusively medical and scientific purposes throughout the national territory. In this context, the Ministries of Health and Justice have the responsibility to exercise sanitary, administrative and operational control over activities related to the production and marketing of cannabis and the issuance of licenses for this purpose.

In addition, in order to contribute to the effective fulfillment of these objectives, the National Drug Enforcement Board has entrusted the Colombian Drug Observatory with monitoring and evaluation the drug policy through the design of results and impact indicators. This should lead (in the long term) to a drug policy evaluation system, which facilitates the generation of knowledge and technical and scientific evidence, thereby resulting in updated newly designed policies that respond effectively and efficiently to the new realities and dynamics of the drug problem in Colombia.

Within the actions and strategies of the defense sector, and in accordance with the government strategy, the Security and Defense Sector has been implementing the Strategy to Combat Drug Trafficking, which has five strategic objectives: (i) Comprehensive eradication of illicit crops; (ii) strengthening maritime comprehensive interdiction, (iii) Strengthening the investigation, judicialization, asset forfeiture and asset laundering, and (iv) comprehensive prevention in the production, traffic, consumption of psychoactive substances and provocation of violent environments, and (v) International cooperation.

The interdiction strategy has prioritized the middle and upper links of the drug trafficking chain, with actions against the industrial complexes of production and a more effective control of the fluvial, marine and aerial spaces. Among the efforts being made by the Public Force, the following are worth mentioning:

- Intelligence operations will be directed towards the disarticulation of the production networks, thereby impacting Organized Crime structures.
- Special emphasis shall be put on the control and interdiction of irreplaceable chemical supplies for production.
- Strengthening of the Border Military Bases.
- Strengthening of the Colombian Air Force's surveillance and early warning system.

MANUAL ERADICATION AND VOLUNTARY SUBSTITUTION

The manual eradication strategy in Colombia is divided into two modalities: (i) forced manual eradication with Mobile Eradication Groups (GMEs)[120] and (ii) forced manual eradication carried out by the National Police and the Military Forces on patrols throughout the country.

Voluntary substitution is carried out in concert with communities. They eradicate

120 The 2001 - 2016 historical series of manual eradication of coca per GME and Department can be found in Annex 5.

and abandon their illicit crops, and are included in crop substitution and Alternative Development programs. This modality did not have a monitoring that allowed to accurately know the location and totality of the area eradicated voluntarily by the communities[121]. The process requires that a *collective agreement* be signed that expresses the political will at the regional, municipal or departmental level to be committed to the process of voluntary substitution of crops. Subsequently, the families of small producers are linked to the program and the transition of these families to legality begins.

Forced manual eradication was assigned to the DPCI of the Department for Social Prosperity, and was carried out through the GMEs, with accompaniment of the Law Enforcement Agencies, to guarantee the integrity of the members of the group, who in the execution of their work are exposed to risks by Antipersonnel Mines (PMAs), Improvised Explosive Artifacts (AEI) and unexploded ordnance (UXO), as well as civil security in general. This modality of eradication has been certified by UNODC since 2007.

The second mode of eradication is conducted by the public force, when in the exercise of their work and surveillance operations, they identify illicit crops. However, the data reported in this modality does not comply with parameters of traceability, objectivity and reliability to be validated and included in the UNODC monitoring system[122].

According to the Colombian Drug Observatory, a total of 18,227 hectares of illicit crops were eradicated in 2016, distributed as follows: 450 ha of poppy (concentrated in Nariño with 83%), 17,642 ha of coca (concentrated in Nariño With 17% and Meta with 16%) and 135 ha of marihuana (concentrated in Magdalena with 37%)[123]. Of the total eradication, 20% was made by GMEs (3,692 ha); of which 134 ha were poppy, 3,556 ha of coca and 2 ha of marihuana.

In 2016, manual eradication activities in the three modalities increased by 28% as compared to 2015 and concentrated mainly in Nariño (18%), Meta (16%), Caquetá (12%) and Antioquia (10%). Despite the high costs of the strategy, the territory intervened with manual eradication corresponds to only 5% of the whole territory affected by coca crops.

121 Starting in 2017, UNODC and the Territory Renewal Agency - ART, will implement a registration system that will provide this information.
122 In 2014, the Ministry of Justice and Law and UNODC designed a data collection instrument to improve the records of operations carried out in the third modality. During the first half of 2017, the National Police and UNODC signed an agreement to adjust the third modality data collection tool to include eradication information in the monitoring system.
123 Data consulted on the website of the Colombian Drug Observatory www.odc.gov.co, May 23, 2017, corresponding to manual eradication data provided by Mobile Eradication Groups, the Colombian National Police and Military Forces.

Map 21. Forced manual eradication and coca crops in Colombia, 2016.

Source: to coca crops: Colombian Government – UNODC-supported monitoring system; to manual eradication: Social Prosperity.
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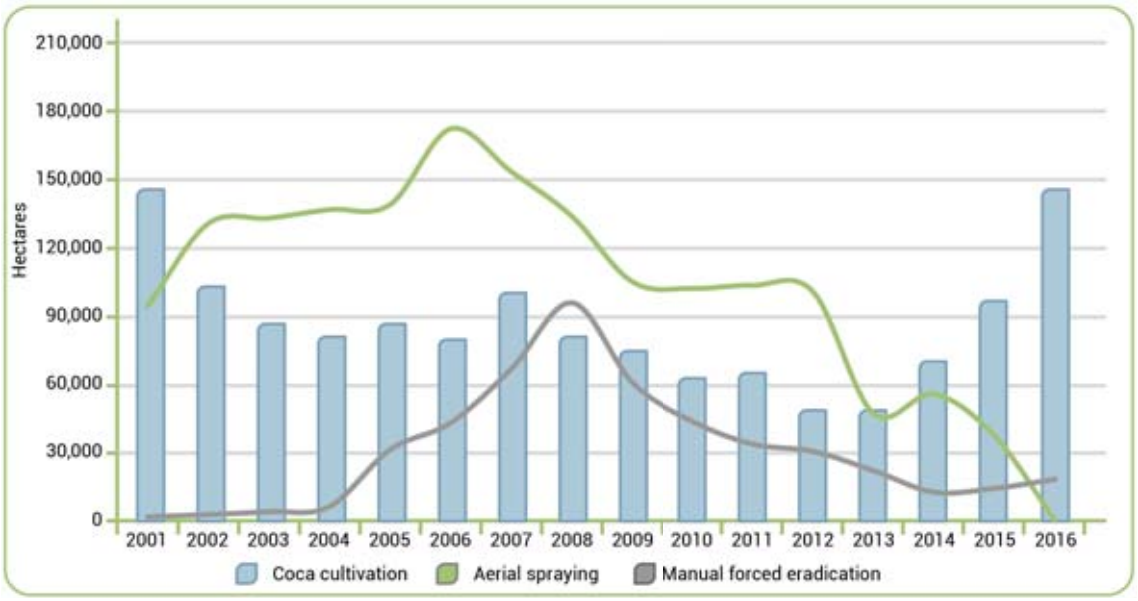
Department	Poppy		Coca		Marihuana		Total	
	Area eradicated (ha)	%	Area eradicated (ha)	%	Area eradicated (ha)	%	Area eradicated (ha)	%
Antioquia	0	0	326,212	9.17	0	0	326,212	8.83
Bolivar	0	0	338,022	9.51	0	0	338,022	9.15
Boyaca	0	0	14,249	0.40	0	0	14,249	0.39
Caqueta	0	0	530,417	14.92	0	0	530,417	14.37
Cauca	0.679	0.50	39.11	1.10	0	0	39,789	1.08
Cesar	0	0	16,232	0.46	0	0	16,232	0.44
Choco	0	0	562,077	15.81	0	0	562,077	15.22
Guaviare	0	0	497.36	13.99	0	0	497.36	13.47
Magdalena	0	0	0.968	0.03	2,255	99.08	3,223	0.09
Meta	0	0	651,129	18.31	0	0	651,129	17.63
Nariño	133,786	99.50	457,863	12.88	0,021	0.92	591.67	16.02
Norte de Santander	0	0	3,088	0.09	0	0	3,088	0.08
Putumayo	0	0	24,687	0.69	0	0	24,687	0.67
Santander	0	0	16,896	0.48	0	0	16,896	0.46
Valle del Cauca	0	0	53.29	1.50	0	0	53.29	1.44
Vichada	0	0	24,078	0.68	0	0	24,078	0.65
Overall	**134,465**	**100**	**3,555.68**	**100**	**2,276**	**100**	**3,692.42**	**100**

Table 26. Manual eradication of illicit crops by GMEs as validated by UNODC, per department, in 2016*.

* This report brings together the overall results of the monitoring and the UNODC certification for forced manual eradication in 2016. The total area eradicated and reported by the Department for Social Prosperity was 3,720.028 ha, of which 3,692.42 ha (99%), distributed in 6,405 lots, were validated by UNODC in 2016.
Resolution 139 of March the 27, 2014 of UACT requires that a neutral body validate the Manual Forced Eradication procedures carried out by GMEs. This is reflected in the project document (PRODOC) signed by UNODC and UACT, which states that UNODC will produce a "Report measuring the number of hectares eradicated from illicit crops in areas where the Mobile Eradication Groups are present) and whose management indicator is a "Report of hectares eradicated by eradication phases by the Mobile Eradication Groups, and the proportion of the number of hectares verified / Number of hectares eradicated".

Manual eradication during the 2001-2016 series has had three behaviors. The first from 2001 to 2004, where eradication of coca crops was below 6,500 ha and represented only 4% of the detected area. The second behavior ranges between 2005 and 2008, where there was a tendency to increase and reach the highest number of manual eradication of the historical series (96,003 ha in 2008). Starting this year, a downward trend will continue until 2016.

On the other hand, the Government of Colombia approved the suspension of aerial spraying operations with glyphosate. Since October 2015, there are no aerial spraying operations, so the series is terminated. The historical data shows a downward trend from 2006 to 2009, followed by stability from 2009 to 2012, a year in which the downward trend continues and is maintained until its completion in 2015.



Graph 23. Comparison between the dynamics of coca crops detected, aerial spraying and forced manual eradication, 2001 – 2016.

Source: Colombian Drug Observatory, 2017 for forced manual eradication and aerial spraying.

Replanting

Manual eradication consists of the elimination of the crop by hand, as the plants are totally uprooted and their loose roots have an impact on the production of coca leaf. Replanting implies additional costs for the farmer, since approximately eight months' time is required between planting and the first harvest, thus presenting low productivity in the initial stage.

In order to have an approximation of the replanted area, UNODC evaluated the behavior of coca crops in areas with forced manual eradication. To this effect, a superposition exercise was conducted for the coordinates reported by GME and the data on coca crops detected on December 31, 2016. The following table shows the area of lots that were manually eradicated in 2016 and which were re-planted with coca at the time of the survey. The analysis includes only UNODC-certified forced eradication data.

Region	Eradication GME		Coca replanting		No replanting	
	Studied area	% of the total area	Hectares	%	Hectares	%
Catatumbo	12.58	65	1.45	11	11.14	89
Central	626.18	89	178.24	28	447.93	72
Meta-Guaviare	1,143.55	99	397.30	35	746.25	65
Orinoco	24.32	100		0	24.32	100
Pacific	897.97	80	204.31	23	693.66	77
Putumayo-Caqueta	555.76	100	139.02	25	416.73	75
Sierra Nevada	0.85	88	0.69	81	0.16	19
Overall	**3,261.21**	**91**	**921.02**	**28**	**2,340.20**	**72**

Table 27. Reseeding in areas of forced manual eradication of coca crops, 2016.

91% of the total area eradicated by GMEs had information to evaluate replanting. The remaining 9% was covered by clouds. In the national consolidate, 28% of the eradicated area had evidence of replanting, i.e. 3% more than in 2015. The regions that contribute the most in the national consolidated are Meta-Guaviare, Central and Pacific, and the three regions amount to 85% of the total.

COMPLEMENTARY ACTIONS TOWARDS THE REDUCTION OF VULNERABILITIES

Formalization of land to promote territorial transformation

The areas where the phenomenon of illicit crops is present have also been characterized by the conflict over land, resulting from the marked incidence of informality in the property rights and diverse interests thereon. Limitations to formalize land in a planned, massive manner and upon the basis of a bid, among other factors, have aggravated the situation. If we were to add the armed conflict to the equation, as well as theft and abandonment of land, and the change of agricultural vocation of the peasant families, this combination has gradually inserted these families into the circuit of illicit crops, which forms an even more complex scenario.

Under this tenet, the National Government proposed that the harmonization of land formalization with the current territorial development approach should positively impact the rural settings where vulnerabilities persist. It is clear that the solution to the problem of socio-economic backwardness in these vulnerable areas is not only having the right to land ownership. However, progress in this area will allow the creation of conditions to encourage (among other things) legal productive activity without detriment to its social and ecological function.

In this sense, the pilot exercise developed by the Ministry of Justice and Law in alliance with UNODC supported the formalization of land in the municipalities of Los Andes-Sotomayor and Linares in the department of Nariño, having facilitated over 2,500 formalization processes and obtaining over 800 titles of property. As a result of the monitoring of illicit crops, it was observed that the majority of coca farms did not present coca crops, despite the fact that in some of the townships intervened the phenomenon persisted or was intermittently present. From the final results, it was possible to establish that 5,796 hectares were inserted in legality under a territorial approach. It was possible to identify that the methodology was effective when analyzing the territory-level picture, agreements and previous consensuses with the communities, as well as the need to complement intervention with the establishment of productive projects with technical and commercial accompaniment. It was also found that investment on properties incorporates families into legality in the immediate term, but complementary efforts are necessary to

avoid expansion of the illicit crops in barren lot areas.

An intervention of this nature is currently being carried out by the National Land Agency since August 2016, through the *"Formalizar para Sustituir" (Formalize to Substitute)* program, as a mechanism that seeks to strengthen the national policy of formalization and access to land in areas vulnerable to the presence of illicit crops. This program was initially developed in 9 municipalities of Antioquia (Caucasia, Nechí and Tarazá), Cauca (Balboa, Rosas and Mercaderes) and Putumayo (Orito, Valle del Guamuez and Villagarzón) where the persistence of the phenomenon has been consistent. The program seeks to favor more over 5,000 vulnerable families. During the first half of 2017, more than 3,000 families have been characterized.

OPERATIONAL RESULTS AND FIGHT AGAINST THE STRONG LINKS IN THE DRUG TRAFFICKING CHAIN

In Colombia, the seizure of illicit drugs (as well as the detection and dismantling of infrastructure for their production) is carried out by the government through operational actions carried out by interdictive control agencies such as the military forces, the Attorney General's Office of the Nation and the Colombian National Police (CNP). The Colombian Drug Observatory (CDO), managed by the Ministry of Justice and Law[124], is responsible for consolidating information from all sectors responsible for carrying out these actions, and reporting official information on drugs.

UNODC does not partake in the processes of capture, consolidation and validation of information in relation to the interdiction processes in which the dismantling of the production infrastructure and the seizure of drugs and chemical substances is carried out. However, given the relevance for the analysis of the business dynamics of illicit drugs, this report includes the results reported in 2016.

Dismantling the drug production infrastructure

En 2016, la destrucción de la infraestIn 2016, the destruction of infrastructure for the extraction and production of illicit drugs and chemicals increased by 26% over the previous year. This increase was concentrated in the destruction of primary production infrastructures (extraction of basic pulp and cocaine base), which increased by 29% as compared to 2015.

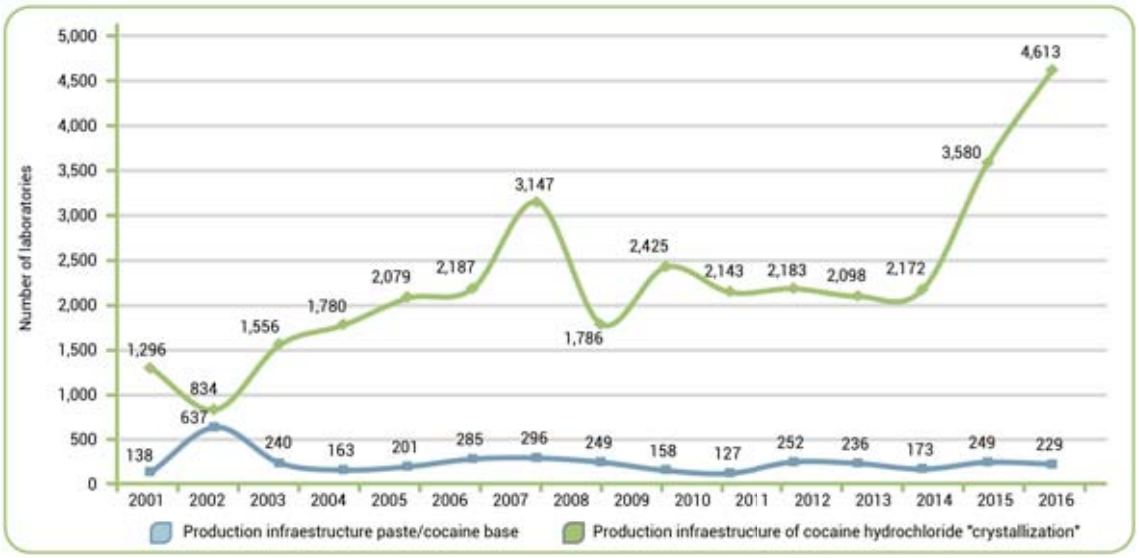
124 Statistical information on seizures and dismantled infrastructure can be found in further detail on the website of the Colombia Drug Observatory www.odc.gov.co. The information presented in this chapter was updated as of April 19, 2017 and corresponds to the variables available to date, subject to verification and adjustment by the source.

In general, the destruction of illicit drug production infrastructure during the year 2016 by the Public Force was 4,843 units, i.e. 24% more than in 2015, this figure being the highest of the last 14 years.

Authorities in Colombia carried out operations in which a total of 4,843 infrastructures were destroyed, distributed as follows: 4,613 laboratories for extraction of cocaine paste and cocaine base (highest value reported in the entire historical series), 229 production laboratories for cocaine hydrochloride production, and a heroin production laboratory. There were no reports of destruction of laboratories for the production of potassium permanganate or marihuana collection centers.

The dismantling of cocaine paste and cocaine laboratories (primary production) was concentrated in coca-leaf producing departments. 54% of the dismantled laboratories were located in the departments of Nariño (16%), Putumayo (14%), Norte de Santander (12%) and Caquetá (12%), continuing the historical trend of locating primary production laboratories in areas of cultivation and production of coca leaf. This proximity in its location allows minimizing risks associated with transportation and the mobilization of the coca leaf for processing. By 2016, significant increases were recorded in the primary production infrastructure dismantled in the departments near the border with Ecuador (Nariño, Putumayo, Caquetá).

In relation to cocaine hydrochloride production laboratories, most of the "crystallization facilities" dismantled were located in the border or offshore departments, such as Nariño (29%), Norte de Santander (16%), Cauca (11%) and Putumayo (10%), which concentrated 67% of the "crystallization facilities" disintegrated.



Graph 24. Infrastructure for the production of cocaine dismantled, 2002 - 2016(p).

Source: Colombian Drug Observatory, Ministry of Justice and Law.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

It should be noted, that throughout the historical series, the number of dismantled infrastructures dedicated to primary production (extraction of cocaine paste and cocaine base) is higher than that of infrastructures dedicated to the crystallization of cocaine hydrochloride or other substances, to the extent that the latter are quite difficult to detect. The implementation of a crystallization facility involves the investment of considerable financial costs, coordination with armed groups that approve their operation and guarantee security, and recruitment of workers who perform specific functions in the process, among other reasons[125].

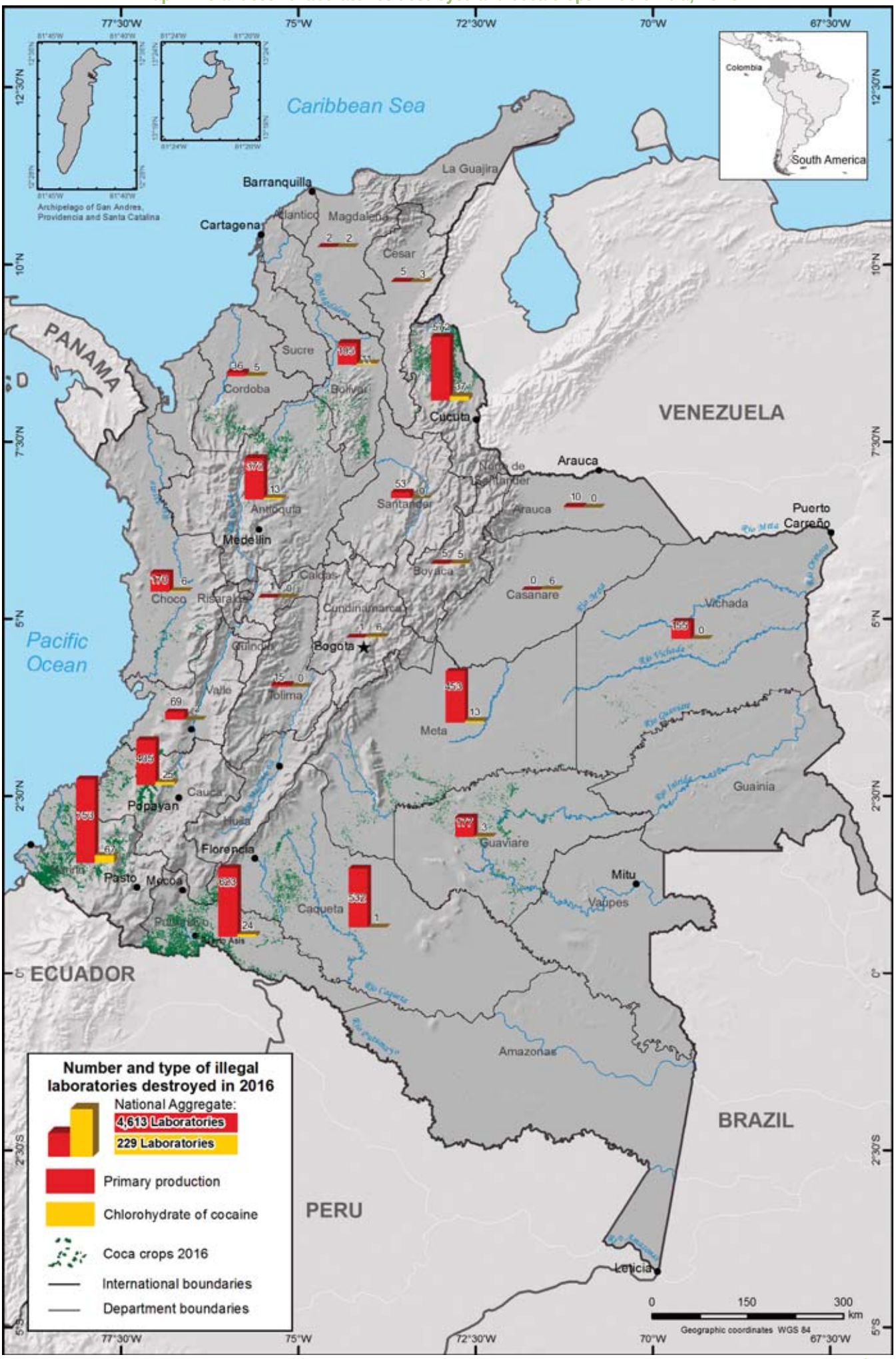
Studies conducted by the Government of Colombia in coordination with UNODC[126] allow to reconfirm that Cocaine Hydrochloride Production Complexes (CPCC) have been implemented in the country, consisting of a series of interconnected infrastructures, functioning as a structural and functional whole, for the illicit production of the alkaloid. CPCCs are generally distributed in a spatial area directly related to the central or "crystallization" facility, where "industrial chemical" activities are carried out to clandestinely produce cocaine hydrochloride. In addition, small laboratories have been found implemented in farms and recreational houses, in order to obtain small amounts of cocaine hydrochloride. Both personnel interviewed by the Anti-Narcotics Directorate (DIRAN) of the Colombian National Police, and the human sources contacted, agree that cocaine hydrochloride production complexes are currently more efficient in terms of lead time and in rationalization of supplies. It can be stated that they are more dynamic in their implementation.

It should be noted that large production complexes (characterized by large volumes of cocaine paste or cocaine base) have begun to appear again. There were reports of large laboratories with capacity to produce up to one ton of cocaine hydrochloride per day, which supply the alkaloid to investors with foreign criminal capital, where activities are carried out 24 hours a day.

125 According to information obtained by PRELAC / UE and SIMCI, with the support of the Government of Colombia, small-scale crystallization facilities hire between one and three operators; medium scale crystallization facilities use 13 to 20 operators and large scale crystallization facilities hire from 22 to 35 operators.

126 Ministry of Justice and Law, Office of the United Nations against Drugs and Crime - SIMCI / UNODC, Characterization of cocaine hydrochloride production complexes, 2016.

Map 22. Clandestine laboratories destroyed and coca crops in Colombia, 2016.



Source: to coca crops: Colombian Government – UNODC-supported monitoring system; to laboratories destroyed: Colombian Drug Observatory, ODC.
Boundaries, names and titles used herein do not construe acknowledgement or acceptance by the United Nations.

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Seizures[127]

Drug seizures constitute an effort by Colombian Government agencies to reduce supply in the market. According to figures provided by the Colombian Drug Observatory, the number of coca leaf, cocaine paste/cocaine base and cocaine hydrochloride seizures carried out by law enforcement agencies in 2016 increased by 6%, from 55,634 cases in 2015 to 58,743 in 2016. In these operations, 1,041 mt of coca leaf, 43 mt of cocaine paste / cocaine base and 378 mt of cocaine hydrochloride were seized[128].

Said increase in interdiction actions was reflected in the increase in the volume of illicit drug seizures as compared to 2015. The volume of seizures of coca leaf increased by 34%, 1% for cocaine paste / cocaine base, and 49% for cocaine hydrochloride.

Similarly, 4,557,248 gallons of liquid inputs were seized – 48% more than the year immediately before. It is important to note that the liquid supplies seizure strategy was developed with a special emphasis on irreplaceable substances for drug production.

There was a reduction in the volume of seizures of marihuana, and especially of synthetic drugs[129] and latex.

Drug	Unit	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016 (p)
Coca leaves	kg	688,691	562,264	665,251	844,031	1,095,841	644,353	852,779	839,887	1,023,579	481,674	446,290	532,989	777,640	1,040,878
Cocaine paste / Cocaine base[1]	kg	29,471	38,402	54,399	50,411	63,867	54,664	53,430	220,821	57,101	56,054	46,622	40,890	42,658	43,075
Cocaine hydrochloride	kg	113,142	149,297	168,465	130,916	131,432	200,983	200,018	157,148	155,558	183,245	166,682	148,077	253,591	378,260
Opium latex	kg	27	57	1,623	155	133	172	49	22	17	10	15	1	1,724	1
Heroin	kg	629	767	762	515	527	678	735	339	555	470	403	349	393	521
Marihuana	kg	134,939	152,318	128,957	109,629	183,204	254,685	208,875	272,388	354,283	362,367	410,511	305,464	258,221	193,069
Synthetic drugs[2]	comp.	5,042	20,158	148,724	17,888	1,968,929	5,597	126,573	9,475	26,749	57,122	121,151	20,553	132,667	10,233

Table 28. Volume of illicit drug seizures*, 2003-2016.

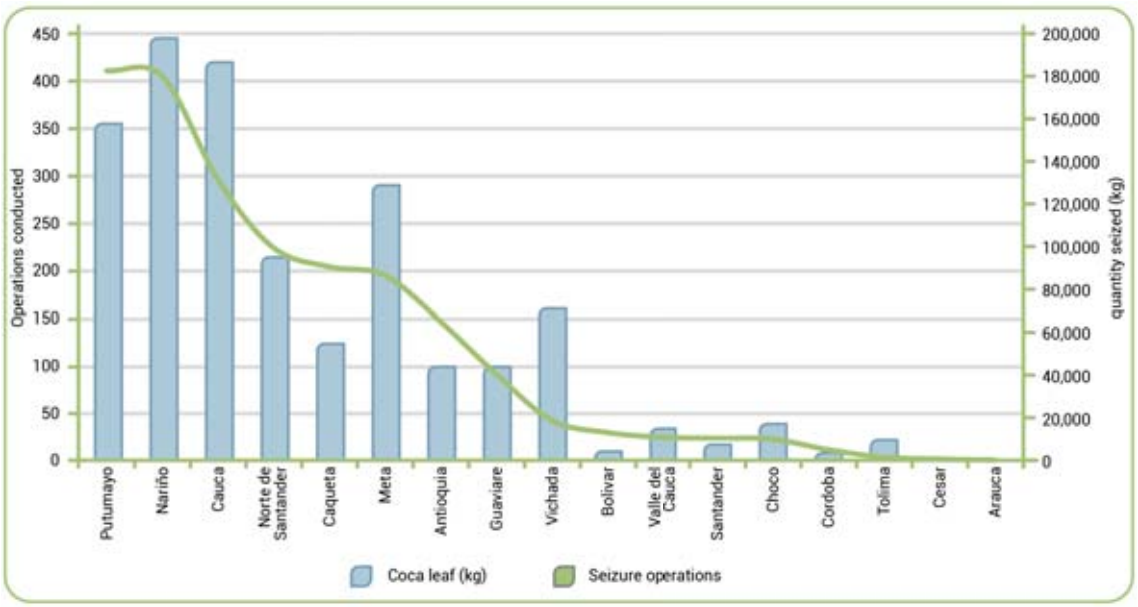
Source: Colombian Drug Observatory - Ministry of Justice and Law.

1 Coca paste and cocaine base are intermediate products in the production of cocaine hydrochloride, and their differentiation in the field is subject to uncertainty, as there is no validated evidence to characterize them separately. There may even be intermediate products subject to partial oxidation. For this reason, they are added as a single drug called cocaine paste / cocaine base.
2 Ecstasy and LSD stimulants are reported in synthetic drugs. However, it is noteworthy that the information is captured from administrative records based on preliminary field tests, and laboratory results are not available to identify their true composition and purity.
Technical Notes:
(P) Preliminary figures and subject to verification and adjustment by the data source, and can be modified during the year. Validation processes can alter trends and figures in the data.
* Operational results include those that resulting from actions by the control authorities within the national territory, as well as results of international operations or existing Maritime Agreements, in which the law enforcement agencies participate with intelligence information.

127 Information on seizures is compiled and updated by the Information and Statistics Group of the Department of Sectoral Studies of the Ministry of National Defense. The data reported periodically are provisional, subject to verification and adjustment at any time.
128 It is noteworthy that the purity and chemical characteristics of the seized drugs reported are unknown.
129 Ecstasy-type stimulants and LSD are reported in synthetic drugs. It is emphasized that the information is captured from administrative records based on preliminary field tests, and the results of laboratory analyses are not available to identify their true composition and purity.

In 2016, cocaine seizures were concentrated in the departments of Nariño (19%), Cauca (18%), Putumayo (15%) and Meta (12%). In these regions, the grower usually sells coca leaf to intermediaries. To a lesser extent, seizures were reported in Norte de Santander (9%), Vichada (7%), Caquetá (5%), Guaviare (4%) and Antioquia (4%).

The increase in cases of coca leaf seizure operations was 37%. When comparing the number of operations and the amount of coca leaf seized, it was observed that in Putumayo, Nariño and Cauca, where more than 50% of operations are concentrated, the amount seized is 52% of the total. In the departments of Tolima, Vichada, Chocó and Meta, the percentage of operations was 12%, and the volume of seizures represented 22% of the total coca leaf.



Graph 25. Seizures of coca leaf by number of operations carried out[1] 2016(p).

Source: Colombian Drug Observatory, Ministry of Justice and Law.

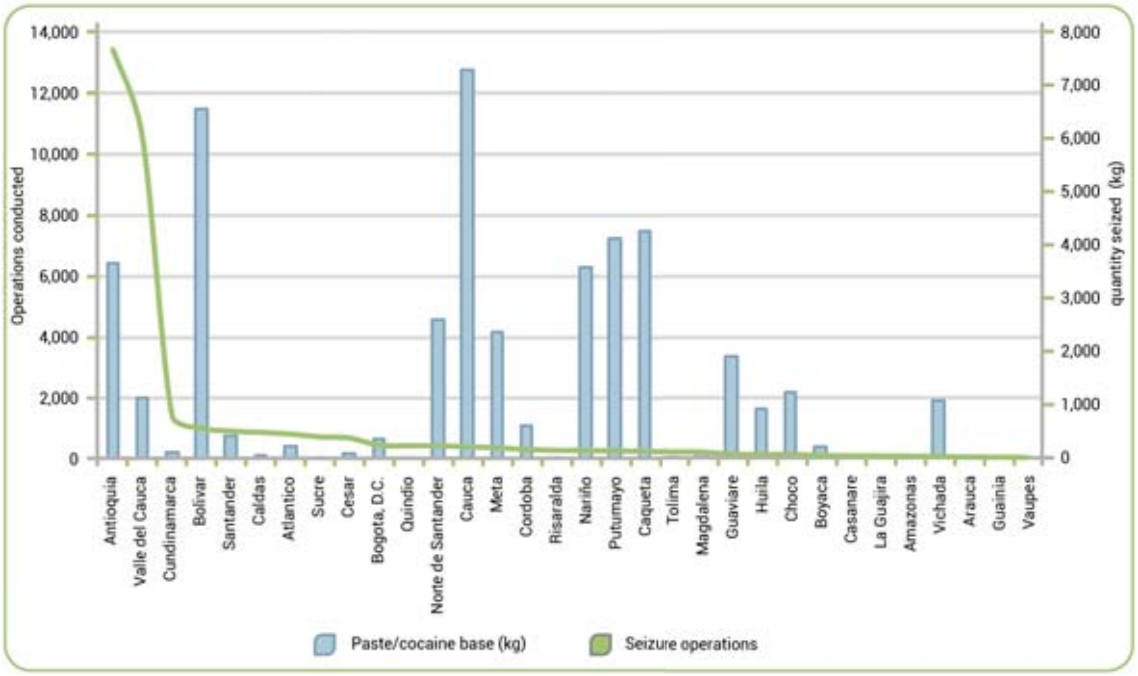
1 Information on records reported by The Information and Statistics Group of the Department of Sectoral Studies at the Ministry of National Defense to the Colombian Drug Observatory.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

While the potential production of cocaine is high, the seizure effort is equally high; This year cocaine seizures increased by 49% over 2015.

In 2016, cocaine paste / cocaine base seizures increased by 5% and the volume seized remained stable as compared to 2015 (43mt). These seizures were mainly carried out in the departments of Cauca (17%), Bolívar (15%) and Putumayo (10%). In smaller proportion, seizures were made in the departments of Antioquia and Nariño with 8% each, and Norte de Santander and Meta with 6% each.

When comparing the number of operations carried out by the Armed Forces with the quantities of cocaine paste / cocaine base seized, the seizures carried out in Vichada, Cauca, Caquetá and Putumayo are the most relevant. The percentage of operations represented 3% and the seizures constituted 39% of the total cocaine paste / cocaine base seized in 2016. 70% of the operations were generated in the departments of Antioquia and Valle del Cauca, generating 11% of the total cocaine paste / cocaine base seized.



Graph 26. Seizures of cocaine paste / cocaine base by number of operations carried out[1] in 2016[(p)].

Source: Colombian Drug Observatory, Ministry of Justice and Law.

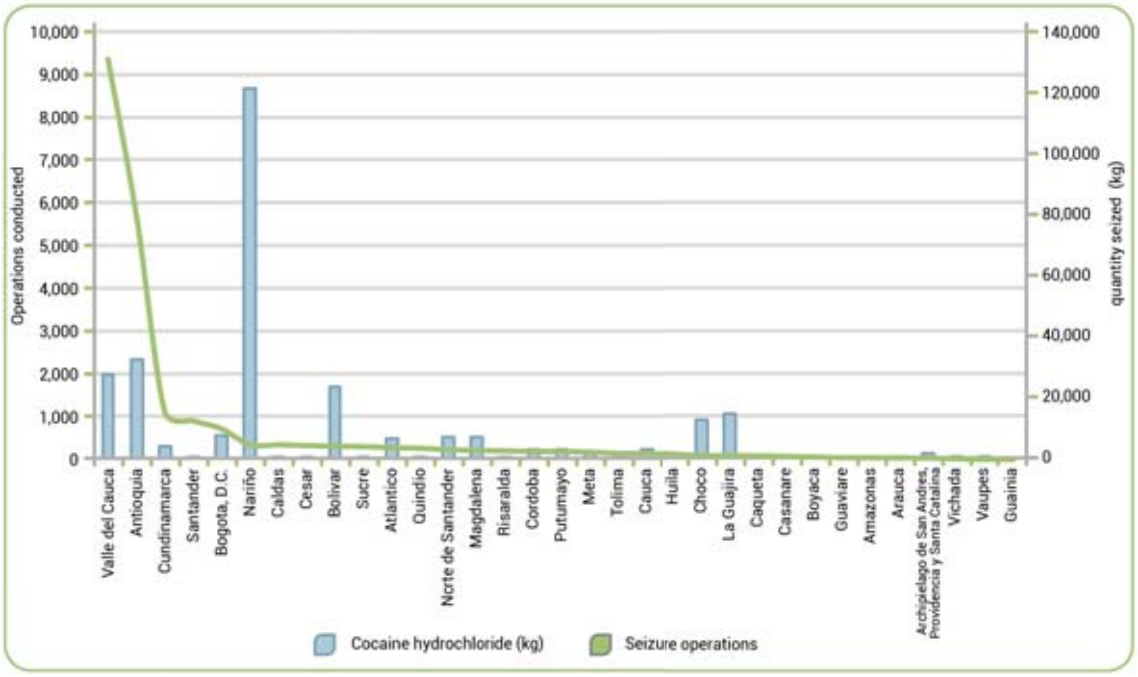
[1] Information on records reported by The Information and Statistics Group of the Department of Sectoral Studies at the Ministry of National Defense to the Colombian Drug Observatory.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

In terms of seizures of cocaine hydrochloride, there was a 5% increase in interdiction operations, and 49% in the volume of hydrochloride seized – from 254 mt in 2015 to 378 mt in 2016. Seizures of cocaine hydrochloride were concentrated in areas with oulets to the sea – mainly in Nariño, with 43% of the total seized and in a smaller proportion in Antioquia (12%), Valle del Cauca (10%) and Bolivar (8%). Proximity to the sea could indicate the exit of the product for the international traffic. The purity of the seizures made in Colombia is not known, as the national regulations do not consider it for the assessment of the sentence. For this reason, forensic laboratories do not report this variable. However, studies conducted in the United States indicate that the average purity of cocaine produced in Colombia exported to that country is 77.1%[130].

130 United States Department of Justice. Drug Control, Special Testing Laboratories and Research Control Administration. Report of Chemical Traceability of Cocaine, January 2017.

When comparing the number of operations and quantities of cocaine hydrochloride seized, the behavior of the departments of Nariño, La Guajira and Chocó is relevant, as 2% of the total operations were carried out and 53% of the total volume of hydrochloride was seized in 2016. Other important seizures were reported in Antioquia and Valle del Cauca, where 68% of the total operations were concentrated, with 21% of the hydrochloride seized.



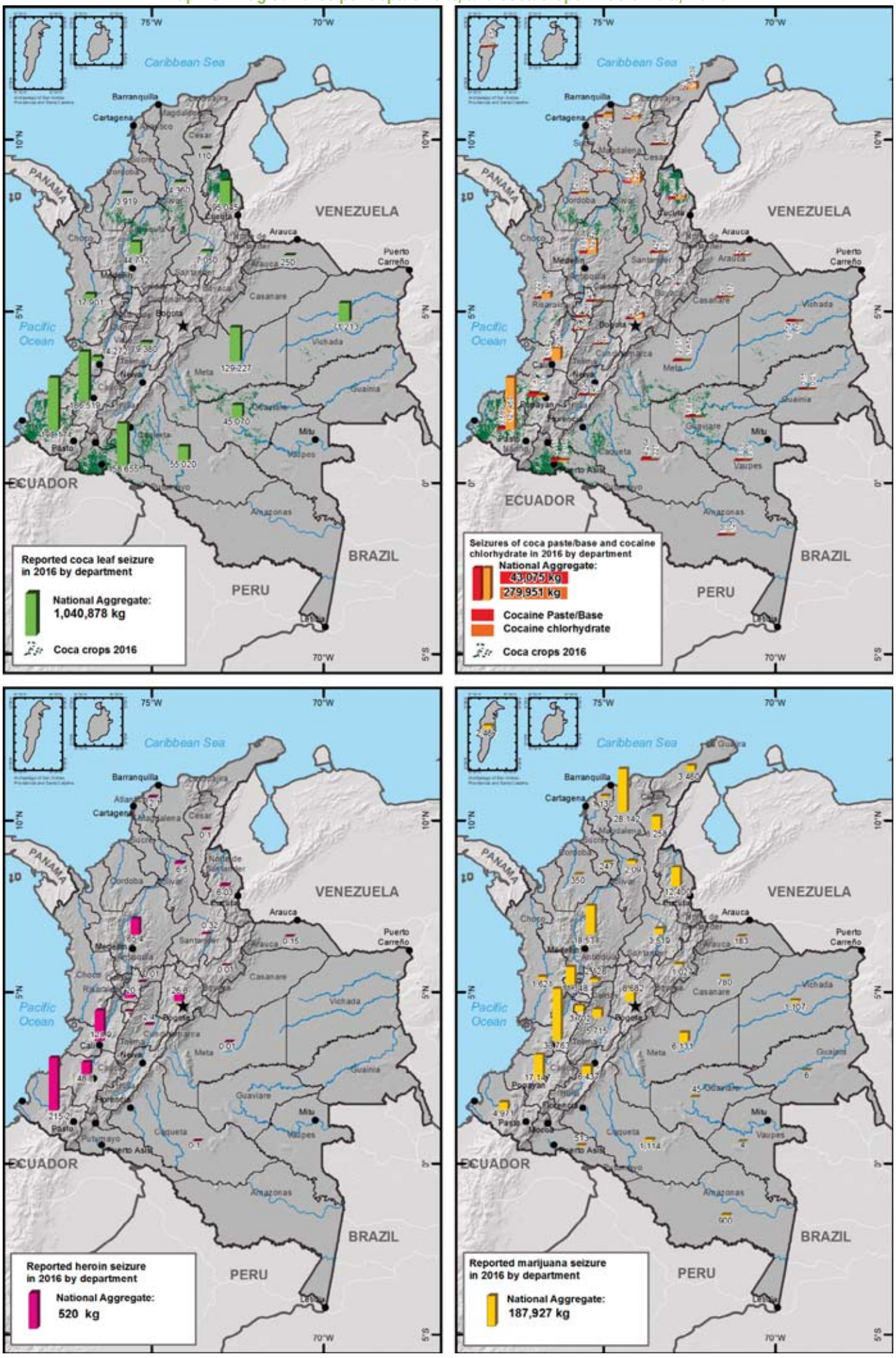
Graph 27. Seizures of cocaine hydrochloride per number of operations conducted[1], 2016(p).

Source: Colombian Drug Observatory, Ministry of Justice and Law.

[1] Information on records reported by The Information and Statistics Group of the Department of Sectoral Studies at the Ministry of National Defense to the Colombian Drug Observatory.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

Map 23. Drug seizures per department, and coca crops in Colombia, 2016.



Source: to coca crobs: Colombian Government – UNODC-supported monitoring system; to drug seizures: Colombian Drug Observatory, ODC.
Boundaries, names and titles used herein do not construe acknowledgement or acceptance by the United Nations.

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Department	Coca leaf (kg)	Cocaine Paste / cocaine base (kg)	Basuco (kg)	Cocaine hydrochloride (kg)
Amazonas		56	1	125
Antioquia	44,712	3,658	314	32,420
Arauca	250	2	3	3
San Andrés, Providencia and Santa Catalina Archipelago			0	1,674
Atlántico		223	85	6,812
Bogotá, D.C.		368	439	7,418
Bolívar	4,360	6,555	83	23,525
Boyacá		204	6	219
Caldas		47	73	18
Caquetá	55,020	4,264	18	227
Casanare		20	3	613
Cauca	186,519	7,290	120	3,333
Cesar	110	98	30	486
Chocó	17,902	1,223	10	12,659
Córdoba	3,919	620	56	2,929
Cundinamarca		111	157	4,065
Guainía		0	0	0
Guaviare	45,070	1,894	2	1
Huila		924	23	45
La Guajira		21	18	14,539
Magdalena		90	9	6,931
Meta	129,227	2,371	35	1,482
Nariño	198,174	3,589	124	121,450
Norte de Santander	95,045	2,606	30	7,030
Putumayo	158,655	4,117	27	3,065
Quindío		24	23	305
Risaralda		18	34	285
Santander	7,050	425	85	127
Sucre		21	8	325
Tolima	9,380	20	37	15
Valle del Cauca	14,272	1,142	321	27,707
Vaupés		0	0	0
Vichada	71,214	1,074	2	118
National Overall	**1,040,878**	**43,075**	**2,178**	**279,951**
Others[1]		0		98,309
Total	**1,040,878**	**43,075**	**2,178**	**378,260**

Table 29. Volume of seizures of illicit drugs, per type and department, in 2016(p).

Source: Colombian Drug Observatory, Ministry of Justice and Law.

1 Corresponds to seizures made in international operations in collaboration with the Colombian Law Enforcement Agencies.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

Department	Heroin (kg)	Pressed Marihuana (kg)	Latex (kg)	LSD[1] (Unit)	Ecstasy-type stimulants[2] (unit)	2cb (unit)	Popper (milliliters)
Amazonas		900					
Antioquia	65	18,538	0	319	1,306		14,519
Arauca	0	183			28		
San Andres, Providencia y Santa Catalina Archipelago		2,467			4		20
Atlantico	2	1,130			3,503		
Bogota, D.C.	27	7,131		11	417	999	398
Bolivar	7	2,091			501		645
Boyaca	0	1,027			204		
Caldas	0	2,128		10	174	35	105
Caqueta	0	1,114					
Casanare		780					
Cauca	49	17,147			31		
Cesar	0	8,258			184		
Choco		1,621					
Cordoba		350			31		1
Cundinamarca	0	1,551	0		1		
Guainia		6					
Guaviare		45					
Huila	0	6,437			10		
La Guajira	0	3,460					
Magdalena	0	28,142			79		
Meta	0	6,131		22	389		50
Nariño	215	4,971	1	300	120		
Norte de Santander	6	12,400		7	64		200
Putumayo		513		6			
Quindío	1	3,702		3	230		255
Risaralda	20	11,348		67	670		480
Santander	0	3,519		441	45		263
Sucre		247					
Tolima	2	5,715					225
Valle del Cauca	125	33,763		36	1,020	91	17
Vaupes		4					
Vichada		1,107					
National Overall	**520**	**187,927**	**1**	**1,222**	**9,011**	**1,125**	**17,178**
Others[3]	1	5,142					
Total	**521**	**193,069**	**1**	**1,222**	**9,011**	**1,125**	**17,178**

Table 30. Volume of seizures of illicit drugs, per type and department, in 2015(p).

Source: Colombian Drug Observatory, Ministry of Justice and Law.

[1] The data refer to the name under which the substance is marketed; there is no laboratory test to confirm its nature.
[2] Both ecstasy and amphetamine seizures have been reported separately in the reports submitted historically. Because the information is captured from administrative records based on preliminary field tests and the results of the laboratory, analyses are not available to identify their true composition and purity. Moving forward, the sum of the total seizures of these two drugs will be reported under the name: ecstasy-type stimulants.
[3] Corresponds to seizures made in international operations in collaboration with the Colombian Law Enforcement Agencies.

Technical Notes:
(p) Preliminary figures, subject to verification and adjustment by the data source – can be modified during the year. Validation processes can alter trends and figures in the data.

2016 EARLY WARNING SYSTEM FOR COLOMBIA

The latest World Drug Report published by UNODC reports on the emergence of 739 New Psychoactive Substances, which constitute an important risk to public health, as many of these substances have unknown potential damages for users.

Aware of the need to search and analyze reliable information related to trends in the use of New Psychoactive Substances (NPS) and Emerging Drugs (ED) in the country, the Government of Colombia's Colombian Drug Observatory has the Early Warning System – SAT *(Sistema de Alertas Tempranas)*, which is a structured tool for collecting, analyzing and disseminating information related to the supply and consumption of psychoactive substances, which bases its activities on the integration of different institutions whose competences contribute to the detection, characterization, risk assessment and communication of alerts related to this type of substances.

In Colombia, the synthetic drugs panorama is no different from the global trend reported by UNODC in 2016. Since the creation of the SAT in 2013, and until 2016, the number of NPS identified in the country amounts to 28. Information is available for consultation at the Colombian Drug Observatory (http://www.odc.gov.co/SAT).

Dynamics of synthetic drugs and NPS in Colombia

Colombia is significantly exposed to being affected by the new dynamics associated with synthetic drugs and New Psychoactive Substances (NPS). This is due to several factors, such as its geographic location, the existence of illegal armed groups involved in the production and trafficking of illicit drugs, over thirty years' accumulated experience in the production and national and international trafficking of natural drugs, as well as the increase in drug consumption verified in recent years.

It is important to clarify that, to date, no evidence has been found in Colombia to determine that synthetic drugs or their precursors are produced in the country. However, recent studies indicate that, although the synthetic processes are not performed in the country, it is evident that dosing processes are carried out consisting of mixing synthetic drugs from abroad with medicines or drugs of natural origin .

Whilst the most widely used illicit drug in Colombia is marihuana, followed by cocaine, synthetic drugs and NPS, are gradually gaining ground in the country. Synthetic drugs related to ecstasy have been used by about 1% of the population

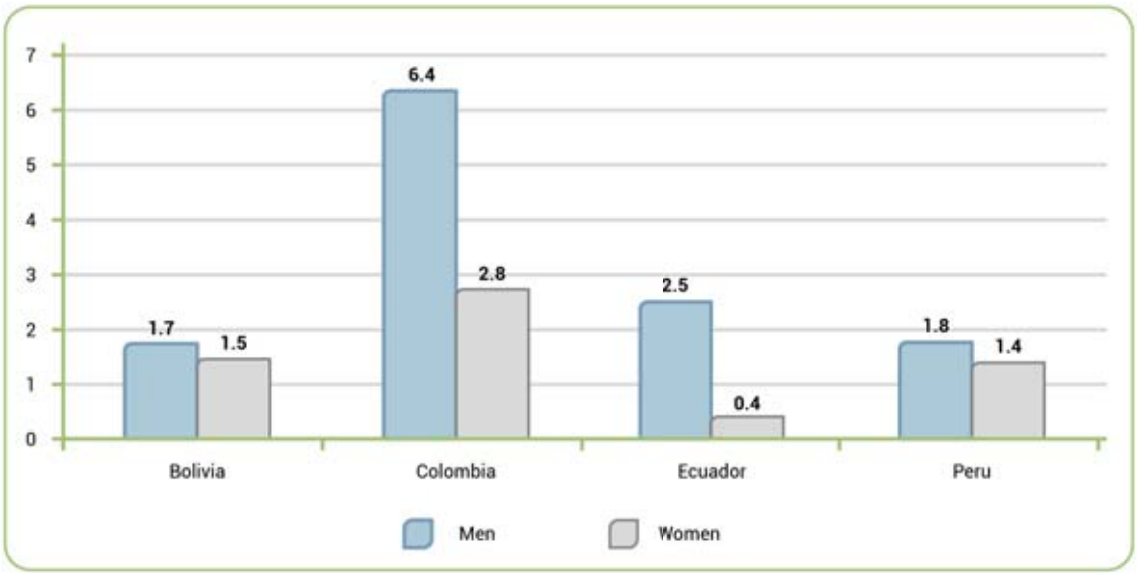
aged[131] 12 to 65 years, especially in high strata of the population[132].

Through different technical studies[133], it has been possible to confirm that the drug market in Colombia is very broad and diverse. In addition to the drugs of natural origin, commercialization and consumption of medicines of special control without prescription has been identified, as well as commercialization and consumption of a wide variety of Inhalable drugs (such as glues, solvents, Dick[134], Popper), vegetable products such as mushrooms, cacao sabanero, etc. and synthetic drugs such as the family of Ecstasy, GHB, LSD, Ketamine, 2CB, inter alia.

However, it is surprising that, in the two Andean Epidemiological Studies on Drug Use in University Population (conducted in 2009 and in 2012), it has been found that the consumption of ecstasy in Colombia has been higher than 3% in this population. It is also the highest level of use among the countries of the Andean region (Peru, Bolivia and Ecuador). In the last study, there was a significant increase in the consumption of LSD (lysergic acid diethylamide) in university students, which is about 5%. However, it is possible that this consumption is associated more with amphetamine derivatives of the 25-NBOMe family, than with LSD itself[135], [136].

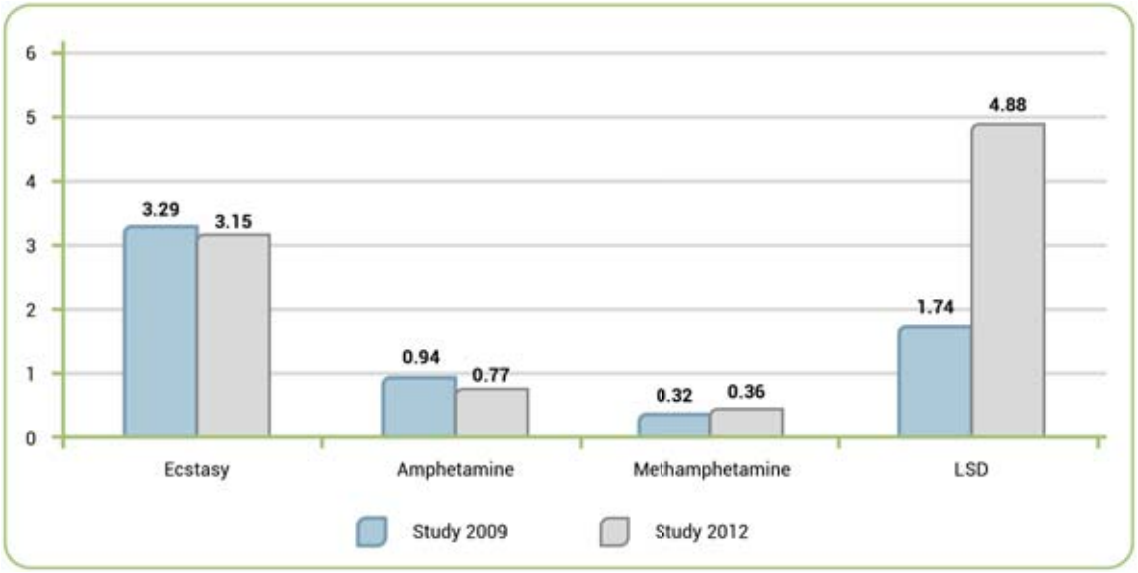
The Colombian Drug Observatory's Early Warning System (SAT) reports the accumulated finding of 28 new psychoactive substances of synthetic origin detected until 2016, indicating the increase in the variability of these drugs in the country.

131 The consumption statistics presented in this report correspond to prevalences of life.
132 National Study of Consumption of Psychoactive Substances in Colombia, 2013. Final Report, Ministry of Justice and Law, June 2014.
133 In Colombia, several studies of chemical characterization and of the market for synthetic drugs, NPS, have been carried out through the Ministry of Justice and Law, with the support of various government institutions with the support of UNODC.
134 Methylene Chloride (CH_2Cl_2) is a colorless liquid with a slight sweet aroma, also known as dichloromethane, used as an industrial solvent and to remove paint or cleaning electronic equipment. Inhalation of methylene dichloride (also known as DICK) Has a narcotic effect that easily enters the lungs, and can cause a state of unconsciousness, psychosis, and even cause death.
135 The latest studies of chemical characterization of synthetic drugs and NPS used in the main cities of the country indicate that amphetamine derivatives of the 25-NBOMe family, especially 25- I-NBOMe, 25-C-NBOMe and 25-B-NBOMe, are commercialized and consumed in the context of LSD.
136 Bulletin No. 1 of the Smart Program for Latin America highlighted this problem in Chile, where it appears that the increase in LSD consumption, reported in consumer surveys in the general population, was apparently more related to the increase in consumption of NPS of the N-BOMe series.



Graph 28. Drug use prevalence for some synthetic drug in university students.

Includes Ecstasy, Amphetamines, LSD, Methamphetamine, Ketamine, GHB.
Source: Andean epidemiological study of synthetic drugs. DROSICAN 2009



Graph 29. Evolution of the use of synthetic drugs in university students in Colombia, prevalence of life.

Source: Andean epidemiological study of synthetic drugs in university students. DROSICAN 2009.
Andean epidemiological study of SPA in university students. PRADICAN 2012.

In the case of Colombia, one of the reasons synthetic drugs are extremely dangerous is the fact that users are unaware of what they are using, since the substances that are marketed as synthetic drugs may contain a wide and diverse nature of psychoactive substances, of which there is no knowledge as to their effects and the risks associated with their use[137]. There is lack of knowledge in addition to the amount of drug generated by the stimulant, depressant or hallucinogenic effects on the

137 In a study conducted in 2010, within the framework of the DROSICAN / UE Project implemented by the National Drug Enforcement Directorate (DNE) to determine the chemical characterization of synthetic drugs consumed in Bogota, it was found that most tablets marketed as ecstasy actually corresponded to drugs, natural drugs and countless substances that did not correspond to the family of ecstasy.

Central Nervous System; for this reason, in many cases the amount consumed can cause toxic effects on consumers.

Regarding technical studies, Colombia has already developed several investigations with the objective of knowing the composition of the synthetic drugs and NPS that are commercialized and consumed in the main cities of the country. These studies have also contributed to the strengthening of the SAT, which has issued different alerts related to the synthetic drugs and NPS used in the country, based on the qualitative and quantitative chemical characterization performed in forensic laboratories. In 2015, the study coordinated by the Government of Colombia and UNODC, conducted in 13 cities in the country, indicated that 25-I-NBOMe was the NPS found in greater proportion[138], followed by ecstasy and clonazepam. In total, the study identified 44 different molecules, including drugs of natural origin (cocaine, opiates, salvinorin), amphetamine-type substances (methamphetamine), cathinones (ethylone), phencyclidine-like substances (ketamine), special control drugs, (clonazepam, escitalopram, etc.) as well as industrial chemicals and synthesis residues.

The technical studies on synthetic drugs and NPS have allowed to identify the sale of different classes of NPS in the country, which have been reported through the SAT. Relevant findings in these NPS include different N-BOMe substances marketed in the context of LSD; some are even more dangerous, such as alpha-pvp (better known as flakka), which has also been detected in Europe and the United States. In 2013 and 2014, PMMA (a drug which is said to have caused several deaths in Europe) was marketed in the context of Ecstasy in Medellín, Bogotá and Bucaramanga. A substance was found in the city of Cali which, when analyzed, indicated that it is the molecule known as AM-2201, which is part of the group of synthetic cannabinoids.

Strategies for its control

For nearly four decades, Colombia has focused all its efforts on containing the problem related to the production, trafficking and, in recent years, consumption of natural drugs, especially cocaine – a field in which a high Degree of specialization has been achieved to deal with it; however, in contrast to synthetic drugs and NPS, the need to design institutional strengthening strategies has been verified.

In the previous sense, different technical studies have been carried out that have allowed us to approach the true dimension of the problem, from which we have been working on the adaptation of strategies that allow us to approach it from different perspectives, generally including institutional strengthening vis-à-vis supply/demand, the adequacy of standards and the capacity of forensic institutions, among other fields of interest. Taking into account the novelty of the synthetic drugs, the Colombian Government is currently

138 It should be borne in mind that in the development of such studies there are considerable difficulties in carrying out surveys that represent the universe widely; In this case, it was an opportunity sampling, consisting of the analysis of drugs obtained from seizures carried out without a sampling frame; for this reason, the results cannot be extrapolated to the entire national territory.

working to adapt and update the current regulations, seeking to turn them into efficient tools in the control of this new dynamics of drug trafficking, so as to enable effective prosecution of the production and trafficking of synthetic drugs, NPS and its precursors.

With regard to forensic capabilities, work is being conducted on the acquisition of state-of-the-art technology that allows the identification and quantification of synthetic drugs and NPS, as well as the acquisition of reference material – especially chemical standards of the main substances on which there is information on its commercialization and use. In order to achieve the latter purpose, coordinated work has been conducted with the Scientific Research Laboratory over at UNODC.

Continuing efforts have been made in the development of training processes directed at interdiction control authorities, which address technical issues related to drugs, precursors, production processes, the characteristics of clandestine laboratories and appropriate mechanisms for their intervention, in case they are detected in the country. However, despite the efforts being made in this field, it is still important to deploy greater efforts, not only in terms of systematized training processes, but especially in the generation of strategies that appropriately approach the problem of synthetic drugs within the general context of the problem.

Considerable efforts have been made to raise the awareness amongst port authorities (sea and air ports) as to the need to increase controls on the entry of goods into the country. This has been done because efforts have focused for many years on avoiding the exit of natural drugs (especially cocaine) to international markets. However, when assessing the capacity to contain the eventual entry of synthetic drugs and NPS, there are institutional weaknesses, which can be evidenced in the poor knowledge of the problem, the need to acquire non-intrusive technology to detect cargoes and – in some cases – adaptation of customs regulations.

Finally, it is important to note that the Colombian Drug Observatory has been leading the Early Warning System, as a mechanism to respond to the emergence of new psychoactive substances, which generates alerts based on a process of analysis that begins before the detection of a new substance, to ensure the timely detection of NPS. The bulletin was published in January 2017, and it reports the appearance of 24 new psychoactive substances in the country.

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Chapter 4
METHODOLOGY

METHODOLOGY APPLIED IN THE COCA CROP SURVEY[139]

The monitoring of coca crops in Colombia is supported by mid-resolution satellite image interpretation, as well as validation of the data obtained from aerial reconnaissance.

The calculation of the total area with coca crops in Colombia as of December 31, 2016 is the result of the following processes:

Satellite Image Selection and Acquisition

274 Landsat 8 satellite images (LDCM) were downloaded and processed for the construction of the coca crop survey figure for the year 2016. In addition, 75 base images were used, and an additional 199 Landsat 8 images, 12 Sentinel images and 6 Worldview II images were taken for interpretation support processes – the latter covered the departments of Norte de Santander and Caquetá.

The images acquired cover the entirety of the national territory (1,142,000 km^2), except the islands of San Andrés and Providencia. 70% of the study area was covered with satellite images obtained within the optimum range (two months before or two months after the cut-off date), according to established quality control parameters.

Image Pre-processing

Image pre-processing uses a series of techniques in order to correct or to remove effects in images originated by sensor errors or by environmental factors, enhancing contrast to facilitate interpretation, and increasing space resolution to improve the delimitation and object detection. These techniques include pansharpening[140] and radiometric improvement.

139 A detailed description of the survey methodology is available on www.biesimci.org.
140 The pansharpening technique reaches a 15m spatial resolution for Landsat 8, while maintaining the spectral resolution.

Map 24. Satellite images utilized in the 2016 Colombia Coca Crop Survey.

Source: Colombian Government – UNODC-supported monitoring system.

Boundaries, names and titles used herein do not construe acknowledgement or acceptance by the United Nations.

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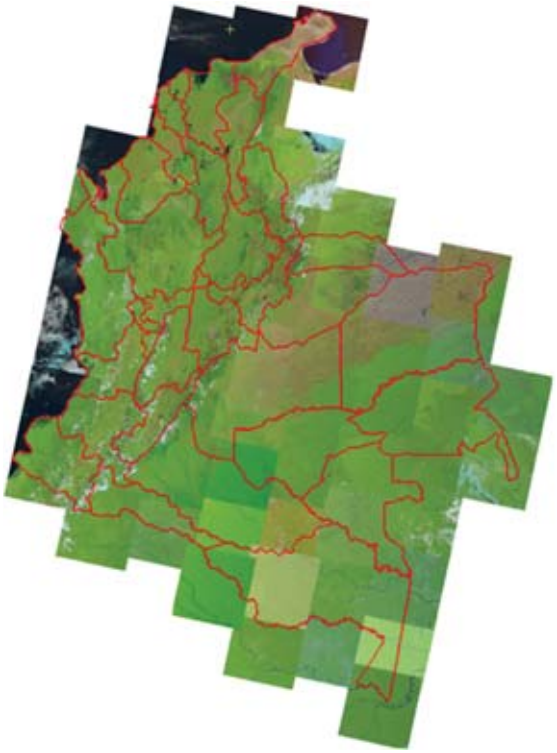
Georeferencing system used

Projection System: Universal Transverse Mercator (UTM) Zone 18N Datum: WGS84



The project has adopted the 1984 World Geodetic System (WGS 84) as a spatial reference framework. This system has the same ellipsoid as the one used by the Agustín Codazzi Geographic Institute for Colombia, which allows UNODC / SIMCI data to be linked to another type of geographic information officially produced in the country.

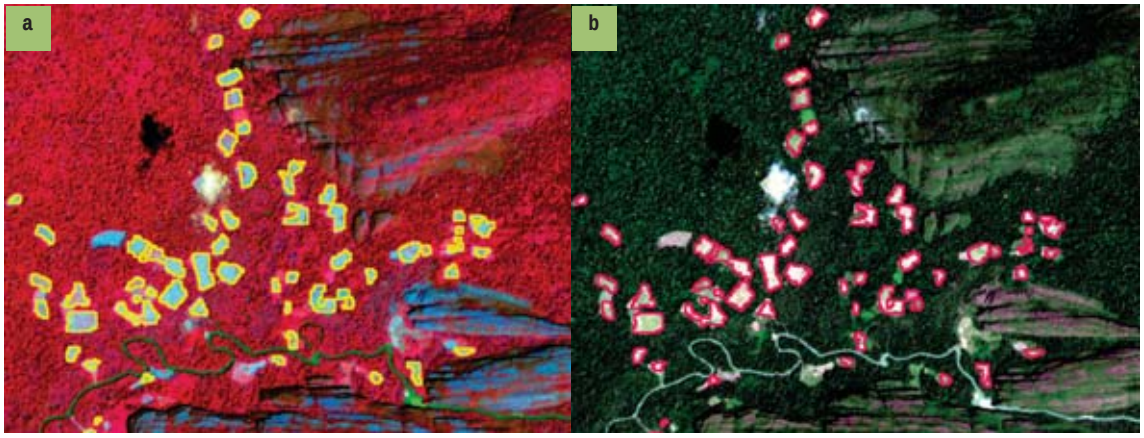
Tin order to facilitate the interpretation work, a mosaic was built for the whole country which is defined as the georeferencing base for each of the images. A co-registry operation helps ensure that each image being downloaded is adjusted – on a pixel-by-pixel basis – to the base image selected, thereby preventing any displacement, rotation or distortion.

Consequently, each image used as an input of the interpretation process is spatially referenced to this base matrix, which guarantees the temporal comparability for different surveys.

Visual interpretation of coca lots

Coca lot identification is based on the visual interpretation of satellite images supported by the following elements: pictomorphological elements (tone, shape, texture, pattern), spectral behavior dynamics (traceability)[141], geographic environment, specific characteristics of the area and the use of secondary information from various sources. These factors help qualify a lot as having coca or not, and to sort out any confusion with other coverages.

141 Traceability of the lots allows to follow the crop dynamics process through the use of satellite images in addition to those planned during the cutoff period, and guarantees reliability in interpretation.



Scheme 8. Visual interpretation. Lots with coca crops visually interpreted on Sentinel-2 images a. Yellow outline, false RGB color (4, 3,10) b. Red outline, Natural RGB color (3, 2,1).

The interpretation includes three stages:

Preliminary interpretation of coca crops

In addition to the elements in the image, the preliminary visual interpretation includes an analysis of the historical coca series and secondary information from various sources, such as georeferenced photographs taken in overflights by the National Police, manual eradication data and information provided by different Government agencies and the United Nations System.

It is worth mentioning that the interpretation of coca crops is based on the use of color compositions (as mentioned previously), highlighting objects of interest, and distinguishing them from other coverages. In this vein, crop identification is not limited to verification in a single color composition, but is corroborated with several others. The most widely used compositions on Landsat 8 are in RGB: 543, 547,654, 562 and 743, amongst others.

Similarly, the project has decision trees for interpretation support which have been developed with the support of the University of BOKU for the following regions: Meta-Guaviare, Putumayo-Caquetá and Cauca-Nariño. This allows to reduce subjectivity and to document the process conducted by the interpreter in order to classify a lot as a coca crop.

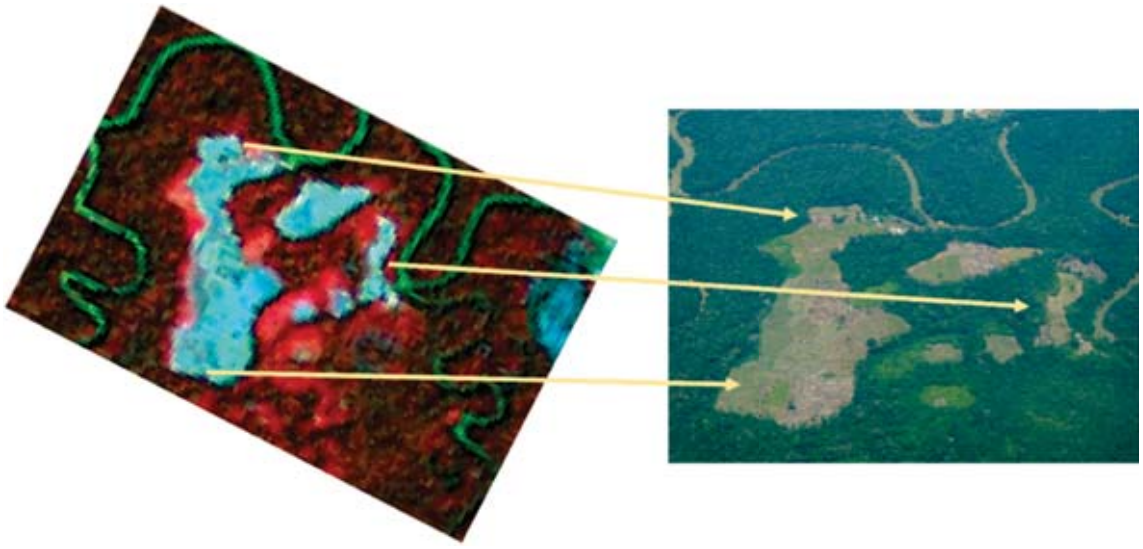
Verification Overflights

Verification overflights are necessary to adjust – and subsequently validate interpretation. This verification is based on visual inspection from an aircraft on the territories affected by coca crops. A direct data collection system has been in place since 2014 for information obtained in the field; it relies on satellite images by way of a tablet synchronized with a wireless GPS antenna. This device allows the creation of a shapefile-type vector file[142], built by the expert during the overflight. This shapefile-type vector file defines a lot, core or zone, based on a list of previously defined

142 Vector representation format developed by ESRI (Environmental Systems Research Institute). It consists of a variable number of files, in which the location of the geographical elements is stored digitally (shape*.shp file), along with its attributes or characteristics (dBase*.dbf table).

attributes (lot with coca, high or low density zone, lot which has been regrown, bare soil, other crops and others). The improvement provided by this process is a reduction in edition of the information obtained in the field, while facilitating the construction of a georeferenced historical file of the verification missions.

Pictures are taken with digital GPS-combined camera in addition to the vector file built during the overflight; a video camera is also used in order to collect further data and a GPS for recording areas with or without coca. All these resources are used for the processes of editing the preliminary lots interpreted in the office. Verification overflights are supported by DIRAN; the preparation of the 2016 Coca Survey included six missions with an approximate duration of 120 flight hours.



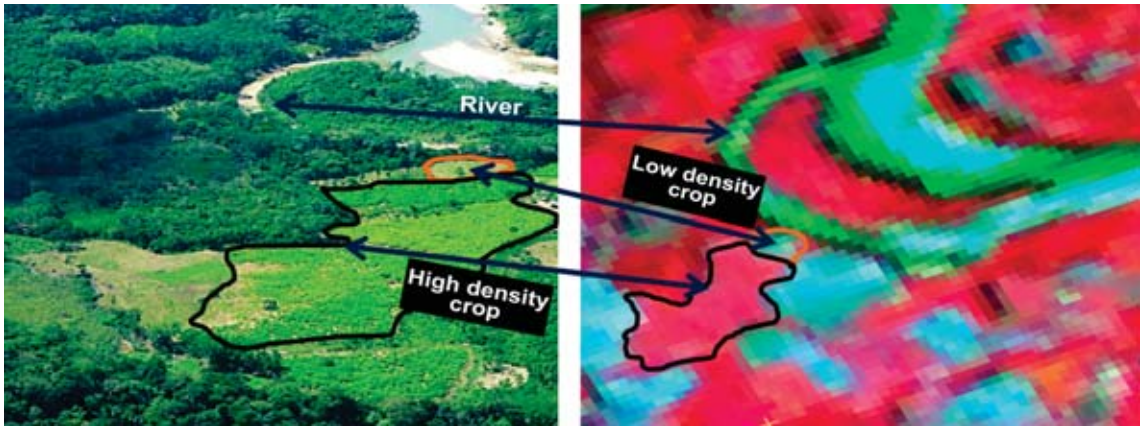
Scheme 9. Photographic record of a verification overflight, and its equivalent in a satellite image.

Edition

The information collected in the verification overflights is used to adjust the preliminary interpretation, taking into account the date of the images and the spraying and eradication operations carried out in the area covered by the image. Upon completion of the edition process, the coca crop interpretation file of is obtained.

Changes in spectral behavior

Until 2015, the spectral behavior of coca crop remained stable. Lots were characterized by high reflectance of the soil, due to low leaf density resulting from the physiological response of the plants to perturbation factors (mainly aerial spraying). Physiological responses also include alteration of the natural foliar development of the crop.

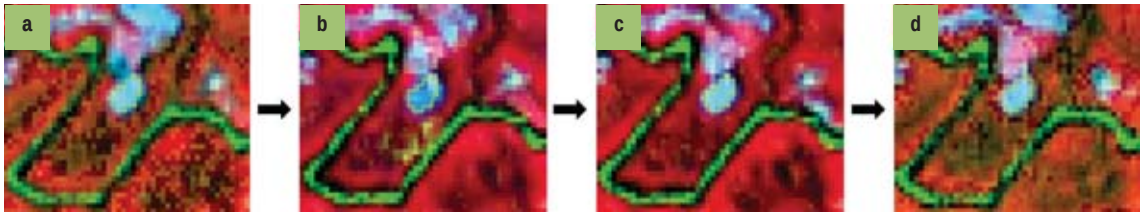


Scheme 10. Increase in crop leaf density. Left: photograph taken in overflight in the department of Putumayo. Right: Spectral matching. Landsat 8 Satellite Image - RGB 5, 4,7.

The suspension of aerial spraying operations in September 2015 led to changes in the traditional spectral response of crops. Biomass values were below the natural limit during the period in which aerial spraying operations were in force; spraying operations disrupted the phenological cycles of coca plants and generated either a harsh action or a weakening of their biomass production capacity. Currently, the crops present a natural phenological cycle, characterized by a spectral behavior in values of high reflectance of soil in the newly planted and harvested statuses (where the amount of biomass is minimal); this contrasts with a low or zero spectral response of soil reflectance in the status near to harvest, where the amount of biomass reaches its maximum values.

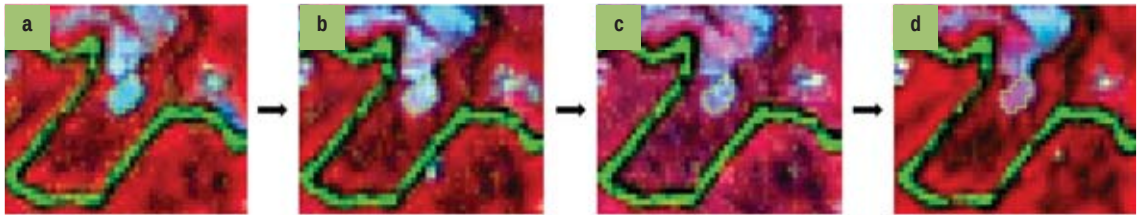
This change in the spectral dynamics of the crops is clearly seen with the use of color compositions, mainly with RGB 547, 543 and 743 compositions, which have greater sensitivity to biomass discrimination and detection of vegetation vigor. The system uses infrared range bands, a region of the electromagnetic spectrum where there is high reflectance of chlorophyll. With the support of pictomorphological elements (color, tone, texture), this condition allows to identify and distinguish vegetation types and changes in crop biomass. Within this framework, the following sequences made in RGB 547 color composition show (in light blue and white tones) areas with high soil reflectance and low or no biomass or plant presence, whilst high infrared reflectance for vegetation allows to distinguish these areas in shades ranging from violet (mix of blue and pink), where the increase in biomass minimizes high soil reflectance, to pink tones where soil reflectance is annulled by the increase of biomass (areas with dense pastures and crops), and finally in different shades of red (areas with advanced stages of vegetation such as stubble and forests).

This dynamic can be observed in the sequence below:



Scheme 11. RGB 547 color composition, dynamics of a coca crop before the suspension of aerial spraying operations.

The figure shows the following (from left to right): **a.** A coca crop with low leaf density and high soil reflectance (January 24, 2014). **b.** A coca crop, three months later, undergoing harvest processes; the lower part of the batch presents no leaf density (harvested) and the upper part shows low leaf density (April 14, 2014). **c.** Coca crop, 4 months later) again with low leaf density and high soil reflectance (August 4, 2014). **d.** Lastly, a coca crop three months later, with average leaf density (November 8, 2014). Note that the coca crop predominates in this sequence with light blue tones, which indicate low biomass from the visual standpoint.



Scheme 12. RGB 547 Color composition: dynamics of a coca crop after the suspension of aerial spraying operations.

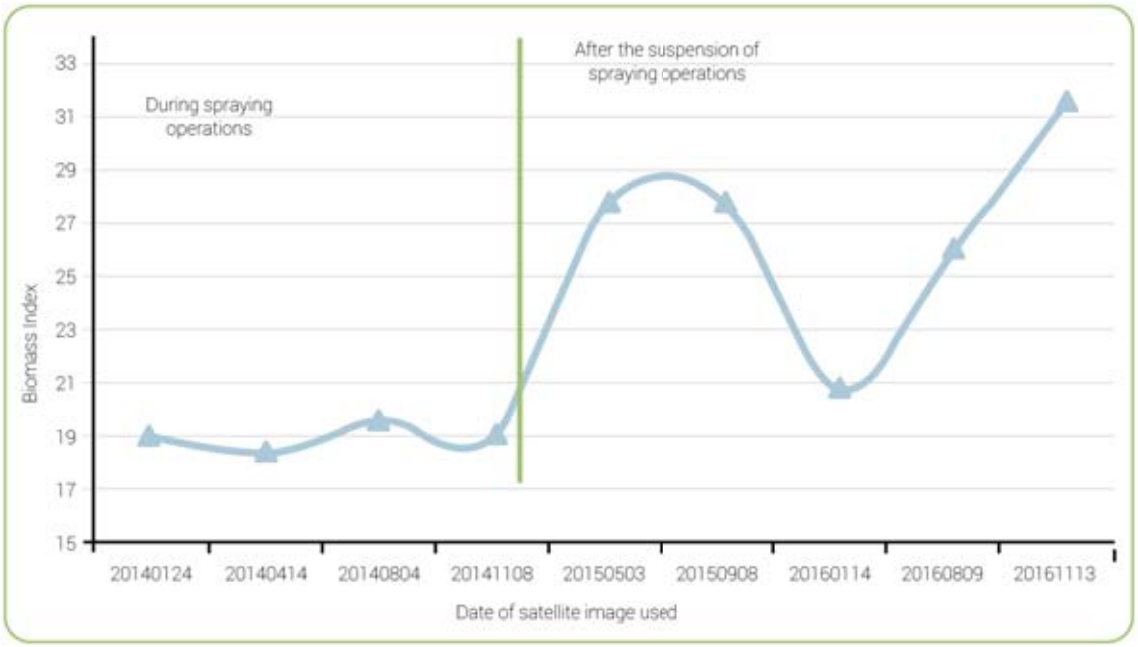
In the figure above shows (from left to right): **a.** A coca crop with low leaf density and high soil reflectance (January 14, 2016). **b.** Coca crop with medium leaf density. Note that this stage (in light pink) already has greater biomass than any of the stages in the previous sequence (August 9, 2016). **c.** Lot of coca in violet tone, with increased leaf density, where soil reflectance is minimized and biomass response predominates (October 27, 2016). **d.** Finally, a coca crop in a pink tone which is characteristic of high leaf density, where soil reflectance is zero and the biomass response of the crop predominates, as it reaches its natural phenological status approaching harvest (November 13, 2016).

The dynamics of change in spectral response found during the interpretation stage can also be viewed by way of the use of spectral biomass indices. The following graph shows the behavior of the *Difference Vegetation Index (DVI)* with respect to the variation of biomass contents in a stable batch of coca.

$$DVI = R_{NIR} - R_{RED}$$

(Tucker, 1980)

Scheme 13. Dynamic of the coca batch.



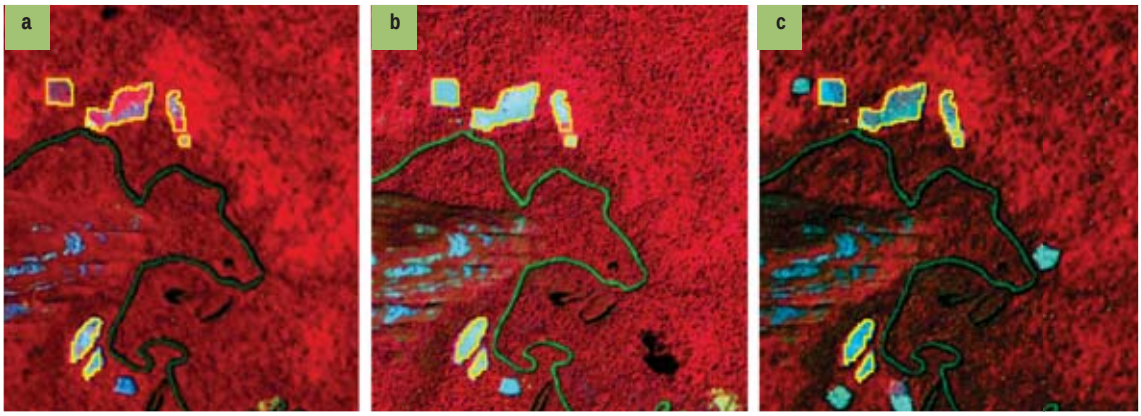
Gráfica 30. Dinámica del lote de coca.

The figure above identifies two periods. The first period is characterized by the aerial spraying operations in effect at the time, as a control measure against illicit crops. The second period is after the suspension of said measures. Index values in the first period reach a maximum score of 20, whilst the second period has a maximum value score of 31. This indicates higher development in biomass content and leaf maturation during the second period; this did not occur during the first period, where the abovementioned control operation limited crops' foliar development.

Traceability

Traceability, generally defined as "the possibility of identifying the origin and the different stages of a process" is applied to the interpretation of coca crops when the different growth stages of the crop are identified, taking advantage of the temporal resolution of the images used in the survey.

Having images of the area in different periods of time allows to observe changes in spectral response, based on traceability of the crop. In turn, this facilitates decision making when it comes to classifying lots as coca crops or not. Specifically, images close to the date of taking the image used in the survey are analyzed to identify (according to the changes in the spectral response) whether the lot has been subject to cultural management, whether the crop has been harvested or pruned, and whether it has increased its biomass, or if it is a non-intervened area, which has recently been cleared.



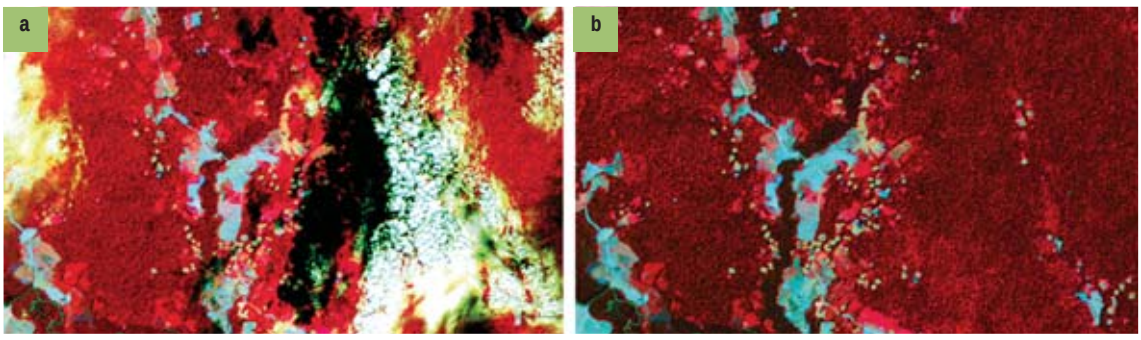
Scheme 14. Landsat RGB images (5,4,7). Traceability.

a. Image dated August 2016 - coca crop with high biomass content
b. Image dated November 2016, showing high reflectance of soil with coca, harvested or pruned.
c. Image dated February 2017, showing coca in foliar maturation status and response with average contents of biomass and lower soil reflectance.

Using Sentinel-2 images to support interpretation

Images of the Sentinel-2 program were used in order to improve traceability of coca crops with strong support by in- field verification, and to reduce the percentage of areas without information due to cloud covers.

Sentinel-2 is a ground observation mission developed by the European Space Agency within the Copernicus program[143]. The Sentinel-2 program offers free access medium resolution images and wide coverage in the national territory. The mission consists of two identical satellites (Sentinel-2A and Sentinel-2B) that follow polar orbits and have 13 spectral bands with different spatial resolution: four bands at 10 m, six bands at 20 m and three bands at 60 m respectively. Of these, the four bands at 10 meters (bands 2-3-4 and 8) are mainly used as support[144]. Sentinel 2 does not have a panchromatic band. The width of the orbital strip is 290 km. (European Space Agency, s.f.).



Scheme 15. Satellital images. Landsat - Sentinel.

a. Image Landsat affected by clouds in an area planted with coca
b. Free Cloud Sentinel-2 Image

143 The Copernicus program, formerly called "Global Monitoring for Environment and Security", is a joint project led by the European Space Agency (ESA) and the European Union through the European Environment Agency, which aims to provide information which is accurate, up-to-date and easily accessible to the scientific community, in order to improve environmental management, understand and mitigate the effects of climate change and ensure citizens' safety.
144 These bands are equivalent to bands 2,3,4,5 on Landsat 8.

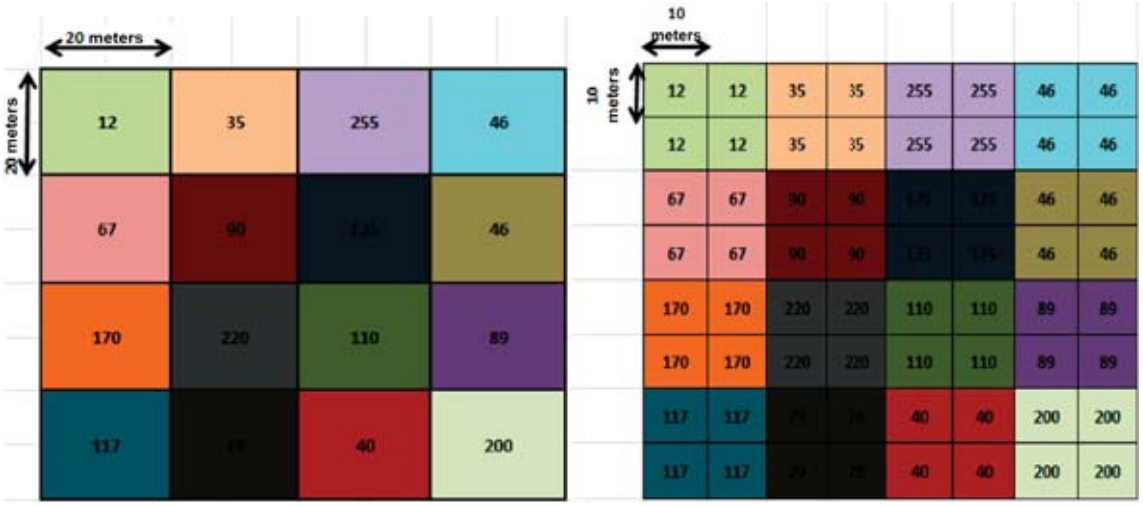
The Sentinel -2 images are used exclusively as support, and not as a basis for the interpretation of coca crops, due to the following limitations:

- While Sentinel 2 has four bands with better spatial resolution (10m, i. e. "A-bands") than those used for Landsat 8 (15m), three of these bands correspond to the visible spectrum and the remaining one the near infrared spectrum. With these characteristics, the potential of color compositions with a resolution of 10 m which distinguish vegetation types is reduced to the true RGB 432 color composition and the false RGB 843 color. These compositions have a specific scope in the discrimination of areas with or without vegetation, but do not allow to discriminate the type of vegetation – for example distinguishing between pastures and crops, or between crops with low leaf density and soils without vegetation.

  In this regard, it is necessary to mention that during 2007 and 2008 the *Department of Landscape, Spatial and Infrastructure Sciences de University of Natural Resources and Applied life Sciences, Department of Landscape, Spatial and Infrastructure Sciences (BOKU)* in Vienna conducted interpretation reliability studies and concluded that images' spectral resolution does indeed strongly influence thematic precision. Subsequent reliability studies have ratified this result. This leads to the conclusion that the use of "A-bands" is not sufficient for coverage discrimination.

- In addition, Sentinel-2 has 6 additional multi-spectrum "B-bands" (bands 5- 6- 7- 8 a-11 and 12)[145] with a 20 m spatial resolution – lower than the spatial resolution of Landsat 8 (15m). Since Sentinel 2 does not have a panchromatic band for spatial improvement, the combination of "B-bands" with "A-bands" for use in color-composition based discrimination of covers is performed by processing the "B-Bands" with the spatial homologation technique, which divides each pixel into the desired spatial resolution (10m). However, it is important to note that – although the image obtained has all its bands with a 10m spatial resolution, only the "A-bands" (i.e. 2, 3, 4, and 8) have spectral information captured in 10 m spatial resolution detail. Similarly, the "B-bands", have a 10 m spatial resolution but they maintain the 20 m spatial resolution detail. In this sense, the color compositions that can be obtained as support for cover discrimination provide spectral information with a spatial resolution of 20 m, i.e. lower than the spatial resolution reached by Landsat 8.

145 Bands 5, 6 and 7 are bands with short bandwidth and correspond to a range of the electromagnetic spectrum not covered by Landsat 8 and located between bands 4 and 5. Band 8a is in the range of band 5 and bands 11 and 12 correspond to bands 6 and 7 respectively.



Schema 16. Spatial homologation matrix. a. Pixel Matrix with 20 m spatial resolution - b. Matrix spatially homologated at 10 m resolution. However, it is worth noting that the level of detail expressed in the color of the pixels is unchanged.

METHODOLOGY FOR ESTIMATING THE PRODUCTION OF COCA LEAF, BASIC PASTE, COCAINE BASE AND COCAINE CHLORHYDRATE

In strategic partnership with national and international public and private institutions, the SIMCI project has carried out studies and methodologies leading to strengthen the estimation of cocaine production. This is done in order to contribute to the construction of an indicator that reflects the dynamics of the factors involved in its transformation[146]. As a result, adjustments were made to the traditional calculation methodology in the year 2013; these adjustments focused on strengthening two strategic variables: *Production area during the yearn (PA) and Cocaine base yield per ton of coca leaf outside the UPAC (RBe).*

The methodology for estimating the annual production of cocaine hydrochloride relies on existing information on hectares, yields per hectare, conversion factors of extraction and refining processes, purity, among others. The convergence of information related to the processes of transformation of the leaf to cocaine hydrochloride that contributes to the production calculations is synthesized in the following procedures:

146 These factors may be due to: (i) establishment of the coca production area; (Ii) obtaining fresh coca leaf per hectare; iii) extraction of the alkaloid to cocaine base paste; iv) oxidation of cocaine base paste; and v) crystallization to obtain cocaine hydrochloride.

1. Production of fresh coca leaf (PHC)	=	*Production area during year$_n$ (AP)* x Annual yield of coca leaf year n (RAH)
2. Production of cocaine base	=	$PB_1 + PB_2 + PB_3$
where,		
Production of basic paste made at the UPAC (PB1)	=	(PHC) x% farmers processing basic paste x Basic paste yield per ton of coca leaf in UPAC (RPB) x Ratio / base coefficient (RBC / RPB)[1]
Production of cocaine base at the UPAC (PB2)	=	(PHC) x% growers who process cocaine base x Cocaine base yield per ton of coca leaf at UPAC (RB_1)
Production of cocaine base outside the UPAC (PB3)	=	(PHC) x% growers selling coca leaf x *cocaine base yield per ton of coca leaf outside UPAC (RB_e)*
Production of pure cocaine hydrochloride	=	(PBC) x Purity of cocaine base (P) x Conversion factor Base kg / Hydrochloride kg (RHCL)

Table 31. Synthesis of procedures for the estimation of the production of cocaine hydrochloride.

[1] A coefficient is estimated based on the yields between cocaine base paste and cocaine base, obtained from productivity studies, in order to express the quantities of base paste in terms of cocaine base. However, in cases where cocaine base yields are not recorded, the coefficient is assumed to be equal to 1.

In 2013, two adjustments were incorporated in the methodological processes used in the calculation of production: the permanence factor, that improves estimates of production area, and the cocaine base conversion factor differentiating the processing in the UPAC and beyond. This last adjustment allows to incorporate the new trends in the process of extraction of the alkaloid. These adjustments affect the continuity of the historical series, so that in this section are the details of their impact and a comparison between these estimates and those made with the traditional methodology for the 2005 – 2016 period. The changes that influence the estimates used in the traditional methodology and in the adjusted methodology are summarized in the following table:

Indicator	Variable	Traditional Methodology	Adjusted methodology
Production of coca leaf year n (PH) Production of cocaine base obtained from the sale of the leaf: processed by agents other than the cultivator	Productive areas year n (AP) Coca leaf cocaine conversion factor	AP = average (area census year n and area census year$_{n-1}$) The same behavior of the conversion factors reported by the grower is assumed in the productivity studies	AP= ∑(area of the census batch year$_n$, year$_{n-1}$ x permanence factor) It assumes efficiency in the extraction processes superior to that registered by the agricultural producer with coca. Conversion factor of 1.8 obtained from studies of efficiency in transformation.

Table 32. Synthesis of methodological changes between the traditional methodology and the adjusted methodology.

Firstly, the *Productive area during the year$_n$ (AP)* seeks to estimate the hectares that have remained productive throughout the year (January to December). To make these estimates in the traditional methodology, the productive area is calculated from the average of the last two censuses under the assumption that the new and abandoned lots are only productive in the middle of the year. It should be noted that, although this indicator is a proxy for the establishment of productive hectares, it does not incorporate the dynamics that affect the permanence of the lots during the year, nor the incidence in the production of factors such as interdiction actions of the State, climate and plagues, inter alia. For this reason, a methodology of spatial analysis was developed that allows the estimation of the permanence of coca cultivation through the construction of a factor that allows to model, from plot to plot, the dynamics of the area cultivated in the year from the incorporation and systematization of available information on variables that directly affect stability, such as forced eradication, aerial spraying and plant coverages, inter alia.

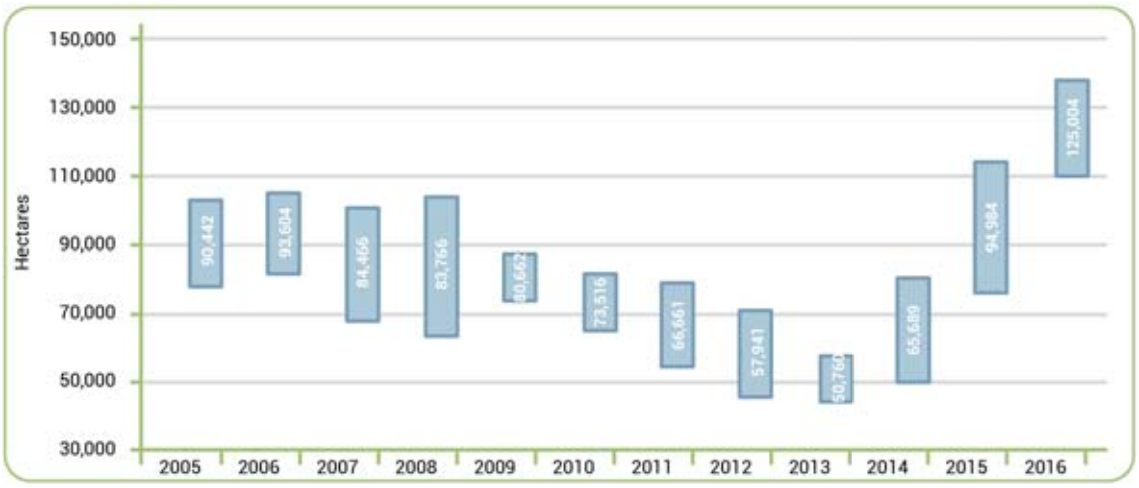
The methodology of the permanence factor included spatial information (georeferencing) such as: (i) polygons of areas eradicated manually by GME - Mobile Eradication Groups; (ii) polygons of areas sprayed by the National Government's glyphosate aspersion program; iii) Data on coca crop censuses for each cut-off date since 2001, iv) land coverage interpreted by satellite images since 2000, v) areas with no information because of clouds from the images used every year for each coca crop survey. However, new variables can be included for the strengthening of the model, to the extent that the information is available.

The permanence factor is calculated according to three categories of lots: stable, new and abandoned[147]; Also, and in order to include in the spatial analysis in the behavior of the variables mentioned above, each categorized batch may belong to a subcategory generated from the definition of possible scenarios of affectation[148]. The factor oscillates between zero (0) and one (1), and is applied directly to the area measured in hectares for each region. For example, a 1 permanence factor means that a batch was productive throughout the year, while 0.5 means it was productive only for 6 months; zero (0) shall be understood as (despite its detection in the monitoring of coca crops) a nonproductive lot, i.e. it could be subject to interdiction activities throughout the year[149]. As a result, we obtained the *Production area during the year$_n$* (PA) based on the implementation of the permanence factor methodology, as presented below:

147 The stable area corresponds to the lots identified in the last two surveys consecutively (t) and (t-1). The area detected in the current survey (t) and not in the previous surveys (t-1) was regarded as new lots. Abandoned are those identified in the previous survey (t-1) that were not present in the current survey (t).

148 For example, subcategories may include the following scenarios: (i) sprayed, (ii) sprayed and eradicated, (iii) sprayed, eradicated and historical, (iv) sprayed and historical, (v) eradicated,) Historical and vii) without intervention.

149 Under this scenario, a lot that was sprinkled has an unproductive period (three months) which is estimated from the percentage of survival; if the lot was eradicated manually, an unproductive period of eight months is assumed as the plant needs to regenerate for a new harvest.



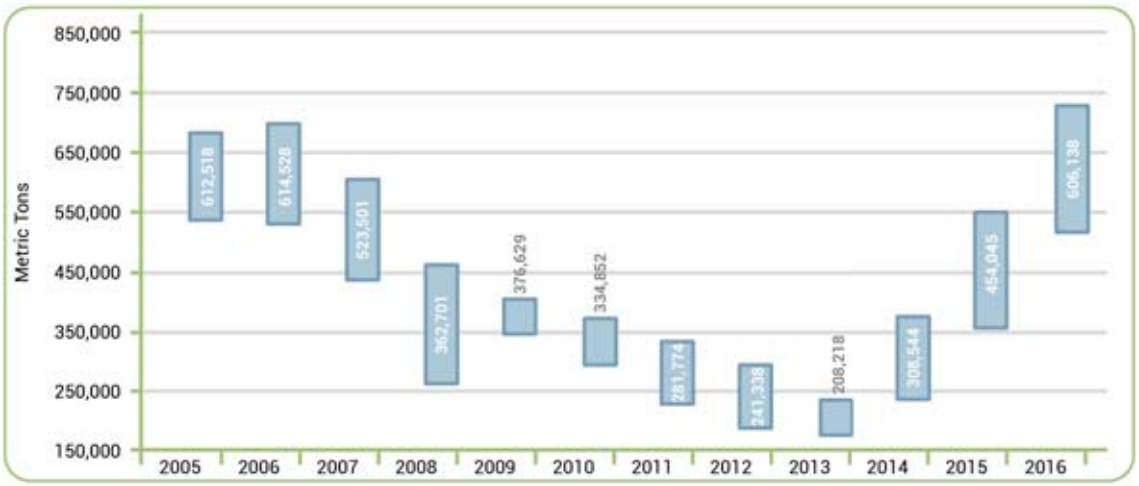
Graph 31. Production area during the year in hectares: adjusted methodology, 2005-2016.

Notes:

[1] The lower and upper limits of the productive area during the year of the 2005-2015 series were built based on the variance in the cultivated hectares as reported in the surveys.

[2] For the year 2016, based on new available information, the intervals were estimated based on the relative precision of the interpretation and the adjustment factors by areas without information.

Taking into account the adjustment of the estimated annual productive area, and keeping constant annual yields of fresh coca leaf obtained in the productivity studies, the fresh coca leaf production series is projected, going from 612,518 mt in 2005 to 606,138 mt in 2016.



Graph 32. Production of fresh coca leaf in metric tons: adjusted methodology, 2005-2016.

Note:

[1] Productivity studies do not carry out data collection in the Amazon region, therefore production estimates are made taking into account the results of the Putumayo-Caquetá region.

[2] Estimates of cocaine base production are based on the annual productive area, as estimated based on the permanence factor, the distribution of labor in the process of selling and processing coca leaves, and yields of the crop and the extraction process of each of the regions under study and under controlled conditions.

[3] In the 2005-2015 period, estimates of potential production are determined from the estimates of the 95% confidence intervals of the annual area of coca crops. From these intervals, and maintaining the leaf yield parameters as determined by the productivity studies, the production potentials were estimated from the upper and lower limits of the intervals. This results in the minimum and maximum estimates of potential leaf production.

[4] For the year 2016, production intervals were estimated based on the analysis of the accuracy level of the satellite interpretation, considering the factors of adjustment by zones without information. Additionally, intervals were included for annual yields of fresh coca leaf, as generated in productivity studies.

Secondly, considering that there are sales of coca leaf processed outside the Agricultural Production Unit-UPAC, it is assumed in the traditional methodology that (although the extraction process is performed by an external agent) the *Yields of cocaine base per ton of coca leaf external to the UPAC (RB_e)* associated with transformation from sale of the leaf are equal to those recorded by the cocaine farmer[150]. This is due to the fact that we only have the leaf-to-base conversion factors reported by the productivity studies[151].

Given the increase in the sale of coca leaf by the producer, and its collection by other agents, it became necessary to incorporate a differentiated conversion factor of the transformation with cocaine base in the traditional methodology, under an assumed efficiency in the extraction processes superior to the efficiency of agricultural producer with coca, as a result of productions at scale and better use of supplies. This conversion factor (of 1.80 kg of cocaine base per MT of fresh coca leaf) was estimated from the results obtained from 33 cocaine base processes, under controlled conditions, in the framework of the Efficiency Study of The transformation of Cocaine Hydrochloride conducted by UNODC and the Government of Colombia[152], which would only be updated upon the receipt of new information.

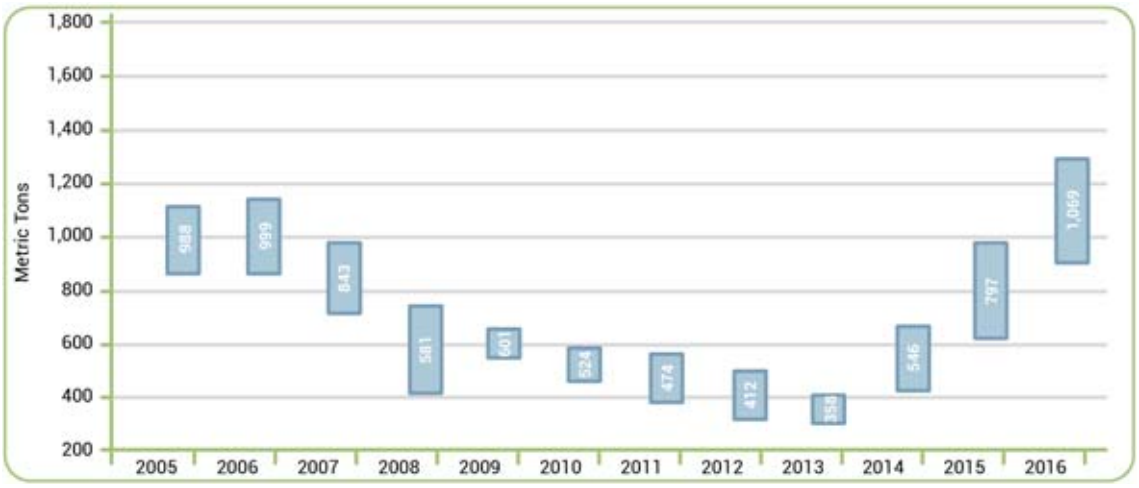
As a result of the inclusion of the adjustments above, and keeping a constant methodological processes as implemented in the other variables, a new series of cocaine base production is estimated going from 988 mt in 2005 to 1,069 mt in 2016, and cocaine hydrochloride From 801 mt in 2005 to 866 mt in 2016.

At present, the SIMCI project continues to carry out the methodological review of the scope in each of the variables and the construction of the minimum and maximum production levels. This is done in order to strengthen the estimates and improve accuracy of the results. Therefore, the methodological proposal herein is likely to be updated in the near future.

150 It should be clarified that, although the extraction processes would be carried out outside the UPAC by agents other than the cultivator, they continue to be carried out in the same region, due to the high risks of interdiction actions when transporting supplies. This implies imply that both marketing of the leaf and its transformation are directly associated with the areas of influence of the crop.

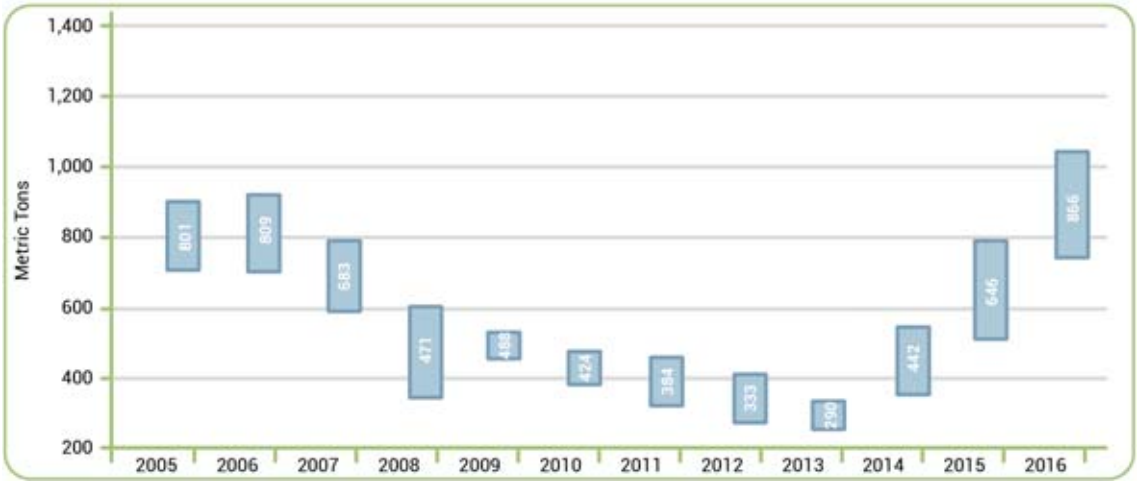
151 To the extent that the information corresponds to interviews conducted with agricultural producers with coca and to the characterization of the production processes inside the UPAC.

152 These experimental exercises allow to simulate, under controlled conditions, the processes of production, leaf extraction, its oxidation and crystallization to cocaine hydrochloride during the years 2010 to 2012. Additionally, it allows to characterize the supplies and chemical substances used for the transformation of the leaf. After the results obtained in the exercises carried out to date, a factor of 1.8 kg of cocaine base per mt of coca leaf was built, which would be associated with scale extraction processes. This is an approximation to the efficiency of the transformation carried out in a real laboratory. Currently, UNODC / SIMCI and the Government of Colombia are developing and strengthening experimental studies of coca leaf alkaloid content and laboratory efficiency.



Graph 33. Production of fresh cocaine base in metric tons: adjusted methodology, 2005-2016.

Note:
[1] For the year 2016, production intervals were estimated based on the analysis of the accuracy level of the satellite interpretation, considering the factors of adjustment by zones without information. Additionally, intervals were included for annual yields of fresh coca leaf, as generated in productivity studies.



Graph 34. Adjusted production of cocaine hydrochloride in metric tons: adjusted methodology, 2005-2016.

Note:
[1] For the year 2016, production intervals were estimated based on the analysis of the accuracy level of the satellite interpretation, considering the factors of adjustment by zones without information. Additionally, intervals were included for annual yields of fresh coca leaf, as generated in productivity studies. For the purpose of estimating cocaine production, the data obtained by the productivity and performance studies in the primary transformation process (coca leaf to cocaine base) and the data obtained by the US Government on the efficiency of the secondary transformation (cocaine base to cocaine hydrochloride, being 1:1) and the purity of cocaine base (81%) are used. No intervals have been calculated for the conversion factors.

Notes graphs 3 and 4:
[1] Productivity studies do not carry out data collection in the Amazon region, therefore production estimates are made taking into account the results of the Putumayo-Caquetá region.
[2] Estimates of cocaine base production are based on the annual productive area, as estimated based on the permanence factor, the distribution of labor in the process of selling and processing coca leaves, and yields of the crop and the extraction process of each of the regions under study and under controlled conditions.
[3] In the 2005-2015 period, estimates of potential production are determined from the estimates of the 95% confidence intervals of the annual area of coca crops. From these intervals, and maintaining the leaf yield parameters as determined by the productivity studies, the production potentials were estimated from the upper and lower limits of the intervals. This results in the minimum and maximum estimates of potential leaf production, in the different links of the chain.
[4] These estimates correspond to the national scenario wherein everything that is grown is extracted into cocaine base and refined into cocaine hydrochloride.

Region		Amazon	Catatumbo	Central	Meta-Guaviare	Orinoco	Pacific	Putumayo-Caquetá	Sierra Nevada	Total
2007	Average	1,853	1,055	10,394	22,702	9,004	19,684	19,351	422	**84,466**
	Lower limit	1,552	45	5,291	22,109	7,268	14,728	16,642	372	**68,007**
	Upper limit	2,154	2,065	15,497	23,294	10,740	24,641	22,061	472	**100,924**
2008	Average	1,840	2,006	12,731	17,988	6,438	25,394	16,933	435	**83,766**
	Lower limit	1,461	1,354	10,540	12,770	2,479	22,652	11,964	306	**63,527**
	Upper limit	2,219	2,657	14,923	23,207	10,397	28,136	21,902	563	**104,005**
2009	Average	1,810	3,290	17,491	14,173	3,898	25,624	13,893	484	**80,662**
	Lower limit	1,322	3,185	16,913	13,497	3,872	23,617	10,883	345	**73,635**
	Upper limit	2,299	3,394	18,069	14,848	3,924	27,630	16,902	622	**87,689**
2010	Average	1,503	3,213	15,785	12,534	3,932	25,979	10,218	351	**73,516**
	Lower limit	1,370	2,418	14,682	9,471	3,470	25,051	8,655	285	**65,401**
	Upper limit	1,636	4,009	16,889	15,597	4,395	26,908	11,780	418	**81,632**
2011	Average	1,396	2,945	10,237	10,628	3,201	26,407	11,661	185	**66,661**
	Lower limit	850	1,836	5,893	9,817	2,790	25,640	7,562	51	**54,440**
	Upper limit	1,942	4,055	14,580	11,439	3,613	27,174	15,760	319	**78,882**
2012	Average	759	3,959	6,643	9,360	2,089	20,661	14,410	61	**57,941**
	Lower limit	714	3,247	5,767	7,053	1,346	15,243	12,029	51	**45,451**
	Upper limit	803	4,670	7,518	11,666	2,833	26,079	16,790	72	**70,432**
2013	Average	617	5,604	4,543	8,072	1,278	16,818	13,783	45	**50,760**
	Lower limit	425	4,337	2,175	7,328	903	16,535	12,296	43	**44,041**
	Upper limit	809	6,871	6,912	8,815	1,653	17,101	15,270	48	**57,479**
2014	Average	372	7,658	4,615	11,272	860	21,758	19,122	32	**65,689**
	Lower limit	354	7,243	3,228	9,140	690	16,620	13,466	10	**50,751**
	Upper limit	390	8,074	6,001	13,404	1,031	26,896	24,778	54	**80,628**
2015	Average	327	10,779	5,418	12,637	798	37,450	27,563	12	**94,984**
	Lower limit	212	7,604	5,141	12,447	683	27,321	22,276	9	**75,693**
	Upper limit	443	13,955	5,695	12,827	912	47,580	32,849	14	**114,275**
2016	Average	260	17,456	9,431	12,170	839	51,945	32,885	20	**125,004**
	Lower limit	239	16,041	8,666	11,184	771	47,735	30,220	18	**114,873**
	Upper limit	291	19,565	10,570	13,641	940	58,221	36,858	22	**140,107**

Table 33. Production area during the year in hectares, as estimated based the permanence factor, 2007-2016.

Note:
[1] The lower and upper limits of the productive area during the year of the 2005-2015 series were built based on the variance in the cultivated hectares as reported in the surveys.
[2] For the year 2016, the intervals were estimated based on the analysis of the accuracy level of satellite interpretation, considering the adjustment factors for zones without information.

Region		Amazon	Catatumbo	Central	Meta-Guaviare	Orinoco	Pacific	Putumayo-Caquetá	Sierra Nevada	Total
2007	Average	12,692	3,584	91,606	281,928	69,339	51,787	100,780	2,812	**614,528**
	Lower limit	11,081	2,449	77,222	244,724	55,170	49,672	88,090	2,419	**530,827**
	Upper limit	14,302	4,719	105,990	319,131	83,509	53,902	113,470	3,205	**698,228**
2008	Average	7,544	8,424	72,569	91,741	45,712	66,025	69,425	1,260	**362,701**
	Lower limit	5,990	5,688	60,080	65,125	17,603	58,896	49,054	887	**263,323**
	Upper limit	9,098	11,160	85,059	118,356	73,820	73,155	89,796	1,634	**462,078**
2009	Average	7,423	13,817	99,701	72,280	27,677	97,369	56,960	1,403	**376,629**
	Lower limit	5,420	13,377	96,406	68,834	27,495	89,746	44,621	1,001	**346,900**
	Upper limit	9,426	14,256	102,995	75,726	27,859	104,993	69,299	1,805	**406,358**
2010	Average	6,161	13,496	89,977	63,924	19,662	98,722	41,892	1,019	**334,852**
	Lower limit	5,615	10,155	83,688	48,303	17,348	95,193	35,485	826	**296,614**
	Upper limit	6,706	16,838	96,265	79,544	21,977	102,251	48,299	1,212	**373,091**
2011	Average	5,725	16,200	40,946	54,203	16,007	100,347	47,809	537	**281,774**
	Lower limit	3,486	10,098	23,572	50,068	13,949	97,432	31,004	149	**229,758**
	Upper limit	7,964	22,302	58,320	58,338	18,065	103,262	64,614	924	**333,790**
2012	Average	2,808	21,772	26,571	47,734	10,447	78,511	53,316	178	**241,338**
	Lower limit	2,643	17,861	23,070	35,971	6,730	57,922	44,508	147	**188,851**
	Upper limit	2,973	25,684	30,072	59,498	14,164	99,101	62,124	209	**293,824**
2013	Average	2,283	30,823	18,173	35,515	6,388	63,909	50,997	131	**208,218**
	Lower limit	1,571	23,853	8,699	32,244	4,513	62,835	45,493	124	**179,332**
	Upper limit	2,995	37,792	27,647	38,785	8,264	64,983	56,500	139	**237,104**
2014	Average	1,377	42,122	18,459	49,597	4,301	121,847	70,750	92	**308,544**
	Lower limit	1,310	39,838	12,913	40,215	3,449	93,074	49,822	28	**240,649**
	Upper limit	1,444	44,405	24,005	58,979	5,153	150,619	91,678	156	**376,440**
2015	Average	1,211	58,209	23,297	55,602	3,988	209,722	101,982	34	**454,045**
	Lower limit	783	41,060	22,105	54,767	3,416	152,998	82,423	27	**357,578**
	Upper limit	1,639	75,358	24,489	56,438	4,559	266,447	121,542	40	**550,512**
2016	Average	960	94,261	40,551	53,550	4,193	290,891	121,675	57	**606,138**
	Lower limit	811	80,205	35,531	46,973	3,545	252,995	102,747	47	**522,854**
	Upper limit	1,164	111,519	47,565	62,748	5,075	343,503	147,433	68	**719,074**

Table 34. Fresh coca leaf production in metric tons, based on the inclusion of the permanence factor, 2007-2016.

Notes:

[1] Productivity studies do not carry out data collection in the Amazon region, therefore production estimates are made taking into account the results of the Putumayo-Caquetá region.

[2] Estimates of cocaine base production are based on the annual productive area, as estimated based on the permanence factor, the distribution of labor in the process of selling and processing coca leaves, and yields of the crop and the extraction process of each of the regions under study and under controlled conditions.

[3] In the 2005-2015 period, estimates of potential production are determined from the estimates of the 95% confidence intervals of the annual area of coca crops. From these intervals, and maintaining the leaf yield parameters as determined by the productivity studies, the production potentials were estimated from the upper and lower limits of the intervals. This results in the minimum and maximum estimates of potential leaf production.

[4] For the year 2016, production intervals were estimated based on the analysis of the accuracy level of the satellite interpretation, considering the factors of adjustment by zones without information. Additionally, intervals were included for annual yields of fresh coca leaf, as generated in productivity studies.

Region		Amazon	Catatumbo	Central	Meta-Guaviare	Orinoco	Pacific	Putumayo-Caquetá	Sierra Nevada	Total
2007	Average	22	6	145	436	121	88	177	5	**999**
	Lower limit	19	4	122	378	96	84	155	4	**863**
	Upper limit	25	8	167	493	145	91	200	5	**1,135**
2008	Average	13	14	98	144	80	112	119	2	**581**
	Lower limit	10	10	81	102	31	100	84	2	**419**
	Upper limit	16	19	114	185	128	124	154	3	**744**
2009	Average	13	23	134	113	48	171	98	2	**603**
	Lower limit	9	23	130	108	48	158	77	2	**553**
	Upper limit	16	24	138	119	48	184	119	3	**653**
2010	Average	11	23	121	100	22	173	72	2	**524**
	Lower limit	10	17	113	76	19	167	61	1	**464**
	Upper limit	12	28	129	125	25	180	83	2	**583**
2011	Average	10	30	71	85	18	176	82	1	**474**
	Lower limit	6	19	41	78	16	171	53	0	**385**
	Upper limit	14	42	102	91	20	181	111	2	**563**
2012	Average	5	41	46	75	12	138	95	0	**412**
	Lower limit	5	33	40	56	8	102	79	0	**323**
	Upper limit	5	48	52	93	16	174	110	0	**500**
2013	Average	4	58	32	52	9	112	91	0	**358**
	Lower limit	3	45	15	47	6	110	81	0	**308**
	Upper limit	5	71	48	57	12	114	100	0	**408**
2014	Average	2	79	32	73	6	228	126	0	**546**
	Lower limit	2	75	22	59	5	174	89	0	**426**
	Upper limit	3	83	42	86	7	282	163	0	**666**
2015	Average	2	99	38	81	6	389	181	0	**797**
	Lower limit	1	70	36	80	5	284	147	0	**623**
	Upper limit	3	128	40	83	6	495	216	0	**971**
2016	Average	2	160	67	78	6	540	216	0	**1,069**
	Lower limit	1	136	59	69	5	470	183	-	**922**
	Upper limit	2	189	78	92	7	638	262	0	**1,269**

Table 35. Production of cocaine base adjusted in metric tons, 2007-2016.

Notes:

[1] Productivity studies do not carry out data collection in the Amazon region, therefore production estimates are made taking into account the results of the Putumayo-Caquetá region.

[2] Estimates of cocaine base production are based on the annual productive area, as estimated based on the permanence factor, the distribution of labor in the process of selling and processing coca leaves, and yields of the crop and the extraction process of each of the regions under study and under controlled conditions.

[3] In the 2005-2015 period, estimates of potential production are determined from the estimates of the 95% confidence intervals of the annual area of coca crops. From these intervals, and maintaining the leaf yield parameters as determined by the productivity studies, the production potentials were estimated from the upper and lower limits of the intervals. This results in the minimum and maximum estimates of potential leaf production, in the different links of the chain.

[4] For the year 2016, production intervals were estimated based on the analysis of the accuracy level of the satellite interpretation, considering the factors of adjustment by zones without information. Additionally, intervals were included for annual yields of fresh coca leaf, as generated in productivity studies.

[5] These estimates correspond to the national scenario wherein everything that is grown is extracted into cocaine base and refined into cocaine hydrochloride.

Estimation of production area intervals during the year for the 2005-2015 series

For the 2005-2015 years, estimation of the variation intervals in the productive area during the yearn were made based on the statistical variance of the coca census as of December 31 reported in the last two years; that is to say:

Interval Size =

$$\sqrt{\frac{\sum_{i=n-1}^{n}(X_i-\mu)^2}{N}} * q_{95\%}$$

Where $q_{(95\%)}$ is the quantile of the t-student distribution that leaves a 95% cumulative probability.

n = year in which the interval is to be estimated

n-1 = year immediately prior to which the interval is to be estimated

X_i = Corresponds to the value of the area detected in the survey as of December 31

μ = Average of the area detected in the in the survey as of December 31 of the last two years (n and n-1)

N = 2: Number of years to be considered, ie two years: n and n-1

Range limit = productive area during the year n ± Size of the interval.

Estimation of the lower and upper limits of coca leaf production for the year 2016, based the intervals of the productive area during the year and fresh coca leaf yields

The estimation of coca leaf production intervals is made from the intervals of the productive area during the year and the intervals of fresh coca leaf yields, as follows:

$$PHC_{UPPERFOR2016} = AP_{UPPERFOR2016} * RHCF_{UPPERFOR2016}$$

$$PHC_{LOWERFOR2016} = AP_{LOWERFOR2016} * RHCF_{LOWERFOR2016}$$

PHC is the Production of Fresh Coca Leaf in the year, AP is the productive area during the year[153] (measured in hectares), RHCF is the Annual Yield of Fresh Coca Leaf (measured in kg/ha/year).

Firstly, the limits of the PA interval (productive area during the year) correspond to an estimation method that includes the estimated magnitude of uncertainty in the interpretation of the satellite images. There are two types of sources of uncertainty in interpretation:

1. Due to the detection of coca crops[154]: The percentage of area with coca is established as detected by each of the interpreters. By means of a detailed revision of the results against high resolution images, it was found that, on average, the interpreters fail to interpret 12% of the coca crops present in the ground, so under-registration of area

153 Estimates of the productive area during the year take into account adjustments for temporality and those related to the intervention.
154 The error in detection includes the error related to the thematic component (whether or not coca cultivation was interpreted) and the geographical component associated with the level of precision in delimiting the polygons identified with coca.

with coca is likely. This was estimated based on reliability studies and assessments[155].

2. Due to uninformed areas: Some areas cannot be interpreted due to presence of clouds in satellite images. For these areas, an estimated amount of coca crops is allocated from the density of coca crops in their surrounding areas, but uncertainty about the exact amount of coca crops present in those areas persists. Areas without information vary each year because of differences in cloudiness; this is the reason they are an annual variable factor.

Taking into account the two sources of uncertainty above, the value of the probable deviation in each region is calculated according to its specific uncertainty characteristics (by detection and by zones without information), and the national total[156] is also calculated in order to define the boundaries of the range. Thus, the limits are established as follows:

$$AP_{UPPERFOR2016} = [AP_{2016} + ED_{2013\text{-}2015}\ (12{,}1\%)]$$

$$AP_{LOWERFOR2016} = [AP_{2016} - \varepsilon_{ZONEWITHOUTINFORMATION(2016)}\ (8.1\%)]$$

PA is the productive area during the year[157], ED is the uncertainty by detection and ε_(ZONA SIN INFORMACIÓN) is the uncertainty associated with adjustment for zones without information. The upper limit of the interval represents the tendency to underestimate the productive area associated with the uncertainty in the detection. The lower limit does not consider this uncertainty, staying closer to the productive area. In the estimation of the lower limit, the adjustment by zones without information is deducted under the assumption of not having detected any hectare with coca under the clouds; this is due to the fact that the areas without information are one of the input variables in the model of spatial analysis of the permanence factor used in the calculation of the productive area during the year.

Secondly, annual yield of fresh coca leaf corresponds to an estimate that integrates coca leaf yields per harvest[158], the number of harvests per year and the area of the lot grown and harvested, provided by the Agricultural Producer with Coca (PAC) and estimated at the level of the Agricultural Production Unit with Coca (UPAC). Thus, the intervals are established in terms of the statistical confidence of the RHCF variable. These vary between regions, according to the agricultural and productive characteristics reported in the UPAC, and are collected in the framework of productivity studies. Productivity studies for a region are updated every three years, completing information at the national level over a five-year interval.

155 A more detailed description of reliability studies is available in the Methodology Chapter.
156
157 Estimates of the productive area during the year take into account temporary adjustments and those related to the intervention.
158 This information is obtained from the application of harvesting tests carried out on a batch of the UPAC, according to the sampling design criteria (given its three-year sampling condition) and with reference to the document "Guidelines for Measurement of the yield of opium poppy and coca leaf on short visits to the field" prepared by the United Nations International Drug Control Program. United Nations Office for Drug Control and Crime Prevention.

Region	Annual coca leaf yield	Lower limit of the 95% confidence interval (kg/ha/ year)	Upper limit of the 95% confidence interval (kg/ha/ year)
	kg/ha/year		
Amazon	3,700	3,400	4,000
Catatumbo	5,400	4,800	6,000
Central	4,300	3,700	4,900
Meta-Guaviare	4,400	4,200	4,600
Orinoco	5,000	4,600	5,400
Pacific	5,600	5,300	5,900
Putumayo-Caqueta	3,700	3,400	4,000
Sierra Nevada	2,900	2,600	3,200
Average national coca leaf yield	4,800	4,600	5,100

Table 36. Average annual yield of coca leaf by region in Colombia, 2015.

Note:
[1] An update was made on the upper limits of annual coca leaf yields for the Catatumbo, Central and Sierra Nevada regions.

Map 25. Study area distributed by regions and coca crops in Colombia, 2016.

Source: Colombian Government – UNODC-supported monitoring system.
Boundaries, names and titles used herein do not construe acknowledgement or acceptance by the United Nations.

Inicio

QUALITY PARAMETERS

Process quality control mandates that good quality in processes improves reliability in final data, as it allows to detect and to adjust any inconsistencies that may emerge during the data collection stage, thereby improving the final degree of reliability.

The 2016 survey quality control process consists of three basic lines. The first line refers to adjustments to the data that are not associated with the interpretation itself, but which reduce the error associated with lack of information (clouds and shadows), as well as temporality; acquisition of images with the least number of clouds and close to the cut date of the survey is a priority factor for the total coverage of the territory. The incidence of adjustment for lack of information was 6% nationwide, 2 percentage points more than the 2015 survey. In spite of the increase of the adjustment, several images were used this year in order to obtain the best coverage of the area, achieving an average of 6 images per zone for the national territory and 5 images for the Pacific region, which historically represented the highest percentage of cloud coverage; thereby maintaining an acceptable percentage according to agreed quality parameters.

The second line is based on the intensity and distribution of the field work for validation and adjustment of the thematic character of the data. In this regard, the

Quality Control Parameters	Process	Reference Value	2016 value
Non-intepretation related processes	Areas without information	20% Max.	9%
	Adjustments associated to areas without information (gross data)	15% Max.	6%
	Temporality of images	Optimal: Date under 60 days prior to cut-off date	73%
Fieldwork	Fieldwork coverage	Min. 30% of the affected area	60%
	Fieldwork per-image distribution	100% of images used must have fieldwork	85%
Survey Data	Geometric accuracy	Based on DTM Landsat	18 metros (promedio)
	Interpretation	Evaluation and validation amongst interpreters for at least 40% of the images	100%
		Validation for atypical errors – 100% of the images	100%
		Dynamic comparison and in-field trend for 100% of the images	80%

Table 37. Quality control parameters, 2016.

2016 survey included six overflight missions on the ground, totaling 120 flight hours with 12,000 kilometer coverage, i.e. 60% of the area affected by coca crops and 85% coverage in the number of images used in the survey. However, public order conditions (i.e. flight restrictions in zones for national security) and climate conditions prevented overflights in zones of the departments of Amazonas, Cauca, Nariño, Putumayo, Antioquia, Norte de Santander, Córdoba and Caquetá.

The last line was quality control on processes directly related to interpretation. This line is based on specific evaluations to the different activities involved in data collection from crop interpretation (georeferencing and interpretation).

With respect to georeferencing, as of 2015, the project adopted the 1984 World Geodetic System (WGS 84) as a spatial reference framework. This system has the same ellipsoid as the one used by the official system for Colombia, which allows UNODC / SIMCI data to be linked to other types of geographic information officially produced in the country. The data obtained in Landsat images through the adoption of this system averages 18.1 meters precision, which is acceptable for the survey's work scale.

Finally, control to the interpretation process included three basic filters, as follows: i) Evaluation and validation of data amongst experts. This allows to validate the interpretation of the zones by other interpreters. ii) Validation of spatial attributes for detection of atypical data, which consists of the use of technical tools and automatic mechanisms, which guarantee objectivity and standardize verification. This filter allows to validate information regarding atypical lots by shape and area, expansion of zones of historical influence and altitudinal validation. Finally, iii) A comparison of the dynamics from the historical trend with the information of the activities which generate dynamics in the region, and with the findings of the field verification process.

RELIABILITY

Coca crop identification through the use of satellite images is a fundamental input for the estimations of area planted with coca crops, territory affected by the phenomenon, potential production of cocaine and income derived from the cultivation of coca, among others.

Since 2002, the project has been committed to measuring and improving the reliability of interpretation; initial evaluations led by ICMP focused on the thematic reliability of data and user accuracy, obtaining reliability values greater than 95% (the regions evaluated were Putumayo-

Caquetá, Meta-Guaviare and Nariño). In 2008 and 2009, case-based case studies were conducted with the support of the *Department of Landscape, Spatial and Infrastructure Sciences of the University of Natural Resources and Applied Life Sciences, Department of Landscape, Spatial and Infrastructure Sciences (BOKU)* in Vienna. Said studies included aerial photographs and high resolution images in the municipalities of Vista-Hermosa (Meta) and Cáceres (Antioquia). The results obtained allowed us to conclude that: i) field surveys improve preliminary interpretation, ii) interpreters' expertise in a specific area translates positively into reliability of the final data, and iii) the spectral resolution of images has a strong impact on thematic precision.

Boku made two recommendations for its implementation in later case studies: i) the use of high-resolution spatial images with "at least" one band in the near infrared[159], as a basis for the construction of field truth, in order to obtain accuracies and inclusion of lots below 0.25 ha, and similarly, ii) obligatory field recognition to validate field truth .These recommendations have been adopted in later studies, and from 2010 the project has included an adjustment in the survey data for estimation of small lots (<0.25 ha).

A case study was carried out in the department of Caquetá (Unión-Peneya) in the year 2012, which was based on the comparison of the result obtained between the interpretation in average resolution images used for the construction of the survey data. Field truth was built using overflights with high spatial resolution image support (Pleiades constellation, 12-bit radiometric resolution, 2-meter spatial resolution and 4-band spectral including near-infrared). The results obtained reported high thematic accuracy and user accuracy above 89%. Differences in alignment accuracy were found due to the spatial resolution of the image used (30 meters) and omission errors related thereto.

The use of medium resolution images with improved spatial resolution (using the pansharpening technique) was implemented for the 2013 reliability evaluation (Miraflores-Guaviare case study) and for the processing of the 2014 survey, in accordance with the findings of the 2012 study, in order to improve accuracy in limits and to incorporate batches under 0.25 ha in the interpretation (which impact the global thematic precision and omission error by this factor).

Field truth was built in the same way as for the 2012 case study. The results obtained corroborated the previous findings and reported a strengthening in the general delimitation of the lots, as well as in the interpretation of batches between 0.1 and 0.25 ha. The survey data for the year 2014 does not include adjustment for estimation of small lots.

159 The infrared band corresponds to a range of the electromagnetic spectrum that provides information relevant to the study and discrimination of the vegetation.

A fifth case study was carried out in Norte de Santander (Tibú) in 2015, with an emphasis on thematic precision in coca crop and coverings with potential spectral confusion (bare soils and pastures).

High-resolution spatial image and medium spectral resolution imaging were scheduled, according to the results and recommendations of previous studies in regards to truth field construction. However, the climatic conditions in the area and the distributor's priority level costs[160] did not allow to take the image in a period similar to the date of the average resolution image used in obtaining the survey data. However, it was possible to acquire an earlier date (3 months) on which the field truth of this study was based. The image obtained corresponds to Worldview II sensor.

The results obtained showed a user and producer accuracy of over 70% for coca crop, indicating a high degree of certainty in the identification of the crop. The results corroborate the findings in previous studies, where expertise in the area is a positive factor in the reliability of the data.

A sixth case study was carried out in Cauca (Argelia) in 2016, following the approach developed during the year 2015 (emphasis on thematic precision in coca crop and coverings with potential spectral confusion (bare soils and pastures).

The process to obtain reliability included the following stages:

• Random sample collection for confrontation between field truth and the map classified by the interpreter.

In order to objectively obtain the classes or spectral groupings present in the scene, the average resolution image (Landsat 8) was taken as a base, with a mask of intervened areas (excluding forest vegetation) and an unsupervised classification was applied with the Isodata method (Iterative Self-Organizing Data Analysis Technique). According to the input parameters established, this type of classification creates clusters or classes with sufficient spectral separability between them, and with as much inner homogeneity as possible. A minimum and maximum of 6 clusters, 3.0 deviation and 30 iterations were established for this exercise.

The result of clusters previously obtained was used to obtain the comparison sample, and the "Accuracy assessment" algorithm of the PCI Geomatics software classification analysis module was applied. 100 random sample points and class stratification were specified as the input parameter.

• Map classified by the interpreter

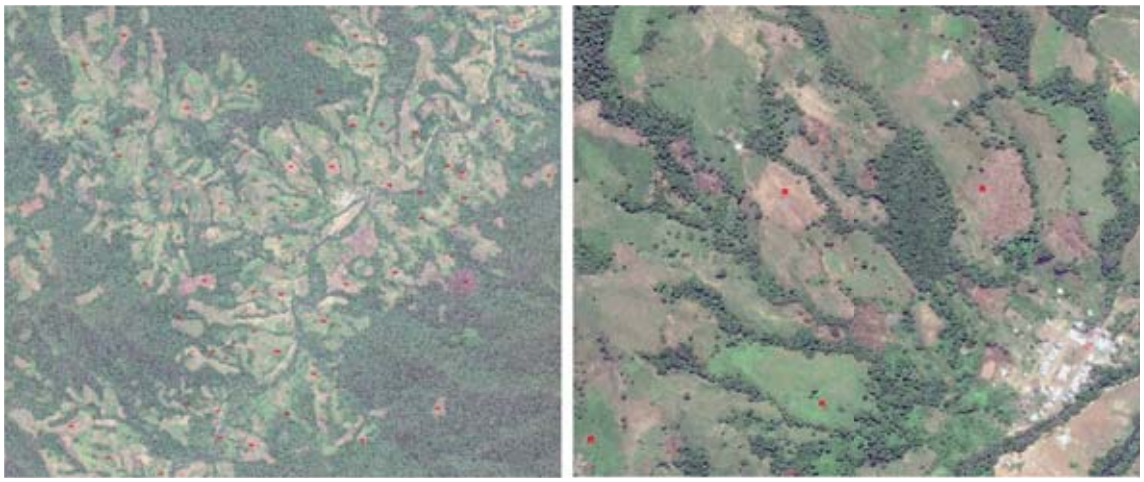
Each interpreter obtained a map of classes, through interpretation of coca crops and other coverages present in the scene, according to the legend adopted by the Project.

160 Value per Km^2 (for 9 multispectral bands and 8 SWIR bands) on Standard Programming: USD $ 202.49, priority programming: USD $ 256.15 and rouge Programming USD $ 324.03.

• *Field truth construction*

Field truth is the main challenge in the reliability monitoring process. This study had the support of the Office of International Narcotics and Law Enforcement **(INL)**; they aided in obtaining a Worldview II image which provides high, 2 mt spatial resolution and medium spectral resolution with 6 bands in the visible spectrum and two in the infrared spectrum. The combination of these 2 characteristics facilitates the identification of the coverings present in the scene. While the image, the temporality and the dynamics of the area do not allow for a 100% reliable identification, this set does represent a good approximation to field truth.

Based on this image and the objective interpretation of three experts, each of the sample points obtained was assigned to the corresponding class or coverage for their comparison with the map classified by each interpreter in the average resolution image.



Scheme 17. True color Worldview Image, with comparison points in red. Left: Total scene. Right: zoomed view.

• *Comparison of data.*

Reliability (user accuracy, producer accuracy and overall accuracy) was obtained automatically using the "Accuracy Assessment" algorithm. This task was based on the field truth sample and class map obtained by each interpreter in the medium resolution image scene (Landsat 8). The results obtained report user accuracy above 80% and relative accuracy greater than 85%.

The reliability studies and evaluations conducted have allowed to identify strengths and weaknesses of the interpretation process. They have also aided in improving techniques in the data collection process. Albeit the evaluations have focused on case studies for specific regions, the results obtained have been adopted for the whole territory, they strengthen data quality and provide robust, objective and technical information for the development of research and for the improvement of data characterization on the phenomenon of drugs in the Colombian territory.

Despite strong restrictions in relation to representativeness in the reliability studies conducted to date[161]; it is possible to define several traits on the interpretation carried out by SIMCI. Upon integrating case study results within the last three years (2014 – 2016), it can be found that coca crop interpretation could tend to underestimation. Although magnitude is strongly reliant on the interpreter and the zone, underestimation ranging between 10% and 14% could be estimated[162]. Said underestimation has a twofold component (thematic and geometrical items), which tend to be compensated for SIMCI interpreters. Thus, interpreters who tend to underestimate thematic items tend to overestimate geometrical items, and vice versa.

It is recommended that more reliability studies be conducted, so as to fine-tune ranges and eventually reach reliability measurements with national representativeness, thereby allowing for better interpretation of the data reported.

THREAT INDEX EVALUATION METHOD

The universe comprises the set of municipalities where coca production has been recorded in some year during the 2002-2015 period. The data was grouped at municipality level, since it is the most functional administrative political unit for targeting control actions.

Assessment of the coca crop cultivation component *(Crops)* takes two elements into consideration:

1. The average amount of hectares of coca grown in the last three years in the municipality (initial condition of affectation).

2. The trend of growth or decrease of cultivated area in the last three years in the municipality (trend).

The concept of area affected is used to evaluate of the land affectation component (Territory), which includes the area detected with coca crops in a year, plus the area sprayed and/or manually eradicated. Assessment of the land affectation component includes three elements:

1. The average number of square kilometers in which the presence of coca crops in the last three years in the municipality is recorded (initial condition of affectation).

2. The trend of increase or decrease of the affected area in the municipality (trend).

3. The level of municipal permanence (Permanence), weighting the number of years of involvement by coca crops in each 1 km^2 grid of the territory.

161 Reliability assessments are based on case studies with restrictions in representativeness, coverage and periodicity. Determination of field truth has had restrictions in matters of image quality and matching time with the contrasting image.
162 Estimation refers to relative accuracy, regardless of user or producer accuracy.

The data were subjected to several probability distribution tests, and regression analysis of the variables used in the study was carried out by means of several linear regression exercises with Ordinary Least Squares and panel data, in order to evaluate the degree of fit of the threat index.

The calculation of the Threat Index (I) was performed according to the following functional form:

$$\underbrace{I}_{\text{Threat Index}} = \underbrace{\widehat{\beta}_1 AP(1+E)}_{\text{Territory and permanence component}} + \underbrace{\widehat{\beta}_2 C(1+T)}_{\text{Crops Component}}$$

As for the variables, these indicate:

AP : Affected Area and Permanence Factor.

E: Territorial Expansion of the phenomenon.

C: Area with presence (affectation) of coca crops.

T: Expansive or contractive trend of coca crops.

Where $\widehat{\beta}_{1,2}$ are the relative weights of the components, being $\widehat{\beta}_1$=0.2 y $\widehat{\beta}_2$=0.8.[163]

Several regression exercises were carried out in order to contrast the threat index with the current problem of coca crops, under the assumption that the threat index and its components are adequate predictors of the amount of hectares detected with crops and the amount of territory affected by same. In general terms, a good degree of fit and statistical significance is found. In addition, regressions with panel data were performed in order to evaluate the stability of historical statistical estimators between 2010 and 2016.

These regression exercises determined that the threat level of the immediately preceding year has a positive and statistically significant relationship with the number of hectares of illicit crops detected. Similarly, it was found that the threat index has an optimal role as regressor of territorial affectation for illicit crops, i.e. of the amount of grids affected by coca crops. The specification was relatively stable and statistically significant throughout the study period.

163 These weighting elements were obtained by means of an evaluation of the combinations that would provide the best simultaneous fit with the amount of hectares with coca detected, as well as territorial affectation and permanence of the phenomenon. This is done seeking to minimize the difference of the determination quotient's absolute value, in order to guarantee balanced fit weighting amongst the components of the index.

VARIABLES	(1) coca_2016	(2) coca_2015	(3) coca_2014	(4) coca_2013	(5) coca_2012	(6) coca_2011
IA_2015	22,063*** (1,420)					
IA_2014		12,873*** (1,939)				
IA_2013			7,034*** (885.3)			
IA_2012				5,057*** (718.4)		
IA_2011					3,273*** (542.9)	
IA_2010						5,272*** (293.0)
Constant	-38.51** (16.45)	-86.81** (40.51)	-27.49 (19.42)	-18.34 (16.14)	6.483 (14.76)	-8.334 (6.578)
Observations	354	354	354	354	354	354
R-squared	0.898	0.872	0.840	0.845	0.772	0.907

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 38. Estimate of the area in coca crops (hectares grown) as a function of the Threat index of the previous year.

VARIABLES	(1) cond_ afec_2016	(1) cond_ afec_2015	(2) cond_ afec_2014	(3) cond_ afec_2013	(4) cond_ afec_2012	(5) cond_ afec_2011
IA_2015	3,239*** (821.0)					
IA_2014		3,010*** (510.4)				
IA_2013			2,759*** (374.9)			
IA_2012				2,637*** (346.7)		
IA_2011					2,313*** (192.0)	
IA_2010						3,044*** (281.3)
Constant	48.01*** (11.03)	30.49*** (11.03)	21.38** (9.002)	23.82*** (7.855)	26.49*** (5.756)	25.24*** (7.536)
Observations	354	354	354	354	354	354
R-squared	0.750	0.853	0.871	0.817	0.884	0.872

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 39. Estimation of the area affected (grids with presence of coca crops) as a function of the threat index of the previous year.

INFORMATION TECHNOLOGIES

The United Nations Office on Drugs and Crime (UNODC) - in particular the SIMCI project, aware of the increasing need to consume, consult and share information, have been constantly introducing improvements in terms of the communication mechanisms they commonly use with agencies, counterparts and the general public.

Amongst these improvements, SIMCI is progressing in the modernization of its main information disclosure channel and platform www.biesimci.org) in which innovative potentialities have been incorporated, mainly by hosting the typo3 platform as the CMS for its management. This process has been implemented by stages; its content and a new image have been consolidated in the year 2016.

The portal implements a powerful module that allows any content to be easily shared on social networks or email, thus expanding the opportunity for more people to access information.

As for user experience, the platform provides its navigation elements and contents in such a way as to enable users to access the different sections in a natural and intuitive way. In addition, the CMS incorporates responsive functionalities that adjust the content to the different screen sizes according to the device the user is navigating on.

Annually, the page www.biesimci.org receives an average of about 8000 visits, mainly for purposes of deepening on, and specific consultation of, key information for different national and international stakeholders.

Similarly, SIMCI continues to strengthen its links with the academic community and government agencies through cooperation agreements of various types. 17 interagency cooperation agreements or information exchange agreements mere maintained in force in the year 2016, and around 165 specific requests were answered.

Access to information

WMS Geographic Services[164] produced from the SIMCI provide support on the four[165] possible access scenarios.

i) For the general public.
ii) For developers of geographic applications.
iii) For specialized users.
iv) For information-producing agencies that provide and / or access geographic resources of joint interest.

164 Web Map Service, from its acronym in English.
165 Sosa, R., Integration of Geographic Services in Electronic Government Platforms. Montevideo, Uruguay: PEDECIBA Informática, Institute of Computing – School of Engineering at Universidad de la República, 2011.

There are currently two complementary alternatives in order to access info published by SIMCI; the Colombian Drug Observatory *(Observatorio de Drogas de Colombia)*[166] provides access to information on the presence of coca crops in the illicit crop consultation/supply section, both at the departmental and municipal level, in natural national parks, in black communities and in indigenous reserves.

In addition, the geographic viewer can be consulted from the geodata / geographic viewer section, to access the WMS services available from SIMCI.

"For specialized access or use of services, consult the digital version, which has the supporting links of each related component".

Secondly, the website www.biesimci.org has a section called "spatial information bank" where users can access details of source satellite information, the 16 maps of the illicit crop monitoring study, available geoservices, some specialized utilities and links to basic useful information, and even summary infographics on the main national statistics and some specific, theme-based information for the departments most heavily affected by illicit crops.

Interoperability as an organizational philosophy...

The fundamentals of the Online Government Strategy - GEL (from its original Spanish language initials – *Gobierno En Línea)* of the Colombian government, led by the ministry of information and communication technologies MinTic, include excellence in service to citizens, the opening and re-use of public data, standardization, technological neutrality, innovation and collaboration, as well as interoperability, an aspect which is not very well known.

Interoperability is defined as the strength to exchange information between agencies and sectors.

Several of the fundamental issued presented by Min - Tic are addressed by SIMCI in the development of the cooperation agreements that have been brought forward with the government counterparts. This has been done keeping a constant focus on the efforts to strengthen the mechanisms of interoperability according to the possibilities of each government agency.

Implementation of the GEL strategy is a process which poses great challenges for agencies that have to start this process, as well as those that have already started it. In the first case, the beginning requires a change in the paradigms of each organization, an important injection of resources and *(surely)* support in the implementation. In the second case, it is necessary to stay abreast, be constant and maintain the organizational focus towards continuous improvement, as this is a process that takes time and involves changes – two aspects that are partly

166 www.odc.gov.co.

contradictory to the early victories and the mission of government agencies. The latter elements above become entwined within the agencies' everyday activities, thereby considerably decelerating the attainment of its objectives.

However, the joint work of the Government of Colombia and UNODC, has achieved successful models. The Colombian Drug Observatory strengthened the process with UNODC, in particular with SIMCI, as a strategic ally for twofold support; as an information provider and aiding in the implementation of technological components with an emphasis on the scalability, usability and functionality of the platform – aspects that were particularly reinforced during this year. Additionally, it was decided to implement a gradual, iterative and incremental implementation process, as well as the incorporation of agile development methodologies, combining other elements of traditional models for channeling efforts to achieve immediate goals. This model is more product-orientated than in other orthodox Software Engineering processes, but it also provides the necessary elements to keep processes properly documented and organized.

Collaboration and neutrality are the most complex aspects of implementation with the ODC. On the one hand, the ODC is the official source of drug-related information in Colombia, and it requires a connection with several agencies that produce official information; this entails a link to a variety of different situations and conditions in order to compile such information that is not always available. On the other hand, technological neutrality is much more associated with the internal conditions of the agency, and this is where deceleration in the implementation of technological components is further evidenced, in a world where OpenSource platforms support companies, social networks, banking or communications processes, among others; some government agencies maintain institutional policies focused on the use of commercial platforms that greatly hamper the implementation of comprehensive solutions.

The approach to the territories through the strengthening of Local Drug Observatories is one of the challenges in which the Ministry of Justice and Law begins to structure and plan their action methodology hand in hand with SIMCI, in order to determine information needs for two pilot departments where technological implementations will be carried out, in interconnection with the ODC from the national level to the local level and vice versa.

The Observatory's continuous information management improvement process requires an increasingly complete conceptualization and structuring of the *Data Warehouse* as the model that best responds to the characteristics and needs detected for information analysis and decision making at ODC.

On the other hand, the experience with the Directorate of Comprehensive Action Against Ladmines – Daicma (from its original Spanish language initials -

Dirección de la Acción Integral Contra Minas Antipersonal), attached to the presidency of the Republic, evolved very differently from the ODC. It started as an observatory in 1997; it would alter become a program and finally a Directorate, and its information system focuses on IMSMA – a platform that has been implemented in several countries of the world which have been overwhelmed by the scourge of landmines.

Cooperation with DAICMA was much more oriented towards interoperability with SIMCI, incorporating a strong analytical component, which in principle combines information on illicit crops with events associated with landmines in order to support various processes: a. Information integration from various sources, b. The construction of specific geographic information services, c. The construction of consultation tools for both the general public and internal clients of the organization, d. Integration between existing technological components in order to maximize the platform's potential, e. The construction of strategic reporting modules; and f. Support on issues associated chiefly with prioritization of territories for comprehensive intervention therein.

Thus, Simci and DAICMA jointly built the first successful interoperability exercise for the generation of knowledge (but it was not limited to this task), and several technological components were integrated. Over 25 WMS geographic information services were created by UNODC, based on DAICMA information and official IGAC geographic information, which will serve as a basis for all the other services – including prioritization.

From the technological viewpoint, alternatives were implemented for the interconnection of IMSMA with the management subsystems, thereby enhancing the existing resources and generating elements of value for information management. This task benefits the institution, it is also an important milestone in information exchange between data-producing and data-consuming agencies, including the population located in the affected areas, specialized analysts, state agencies, NGOs and field operators perform the demining work. Together with these advances, the management team has managed to debottleneck the technical team, by means of the automation of processes for the creation of specific reports. In addition, access to information was achieved in a much faster and easier fashion, in addition to the inherent advantages of interoperability itself – having 100% updated geographic information services which are compatible with its technology platform.

The main challenges for the implementation of information technologies are focused on strengthening the following points:

- Strengthening the multi-channel and high availability infrastructure. Interoperability is a process that will most undoubtedly lead to an increase in information queries,

which must necessarily take topics such as high availability into consideration.

- Maintenance of applications and continuous improvement. All platforms and information systems require the inclusion of maintenance processes, as they evolve with the objectives and goals of each institution.

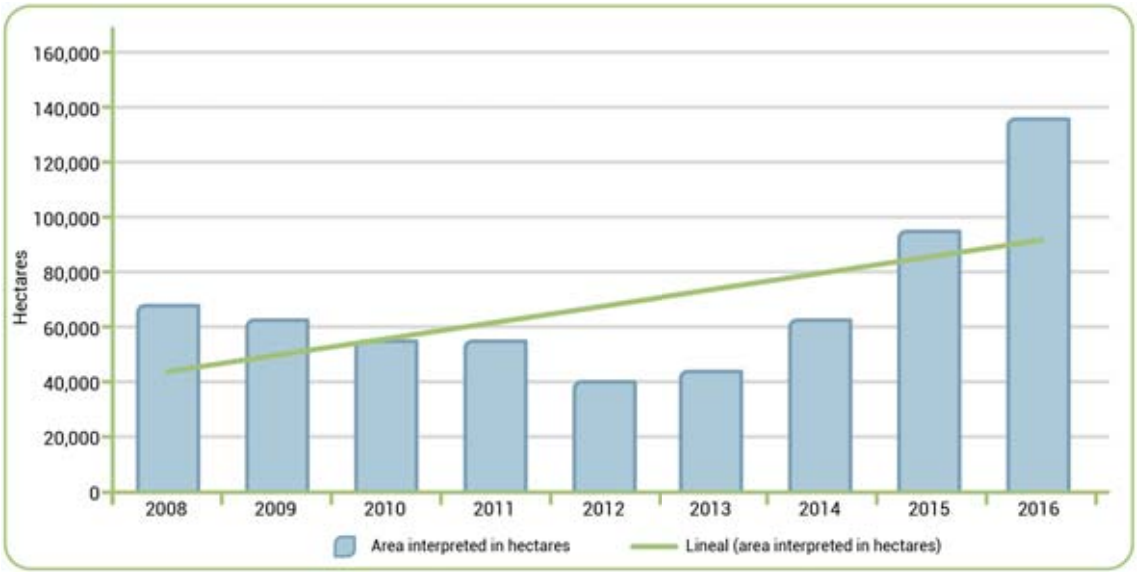
- Service orientation. Agencies that need to evolve towards the upper levels of interoperability, or intend to automate their possibilities to share information or consume it, should consider migrating their architecture to a service-oriented one.

- Launch and integration of modules along with its administration. Each development carried out and implemented at SIMCI requires appropriation by technical teams, in order to maintain their operation in adequate conditions. To this effect, it is clearly necessary to start using these developments on live mode well ahead of time.

Annexes

ANNEX 1.
ESTIMATION OF ZONES WITHOUT INFORMATION, AERIAL SPRAYING AND IMAGING TIME IN 2016

In 2016, several images were used to achieve the best coverage of the area, achieving an average of 6 images per zone for the national territory and 5 images for the Pacific region, which historically represented the highest percentage of cloud cover. This strategy allowed a greater area available for interpretation, which in turn was reflected in a greater coca area interpreted and in an overall decrease of the adjusted area.



Graph 35. Interpretation of coca crops without adjustments, 2008 -2016.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Estimation in areas without information	9,962	6,177	5,492	8,843	5,328	5,377	4,243	2,666	8,423
Adjustment for imaging time	391	371	-119	936	1834	-119	1,830	-1,432	3,178
Adjustment for aerial spraying	3,266	2,843	1,378	159	30	95	1,221	213	0
Total	13,619	9,391	6,752	9,938	7,192	5,353	7,294	1,447	11,601
Percentage / Survey	17	14	11	15	15	11	11	2	8
Area interpreted in hectares	67,334	63,634	55,061	53,826	40,597	42,836	61,838	94,637	134,538
Area reported in hectares	81,000	73,000	62,000	64,000	48,000	48,000	69,000	96,000	146,000

Table 40. Series - Historical Adjustment, 2008 - 2016.

Department	Interpretation (ha)	Adjustments (ha)			2016 Survey (ha)
		Aerial spraying	Zones without information	Temporality	
Amazon	171	0	0	-4	167
Antioquia	7,073	0	1,139	643	8,855
Arauca	8	0	1	0	9
Bolivar	3,210	0	564	320	4,094
Boyaca	15	0	0	0	15
Caqueta	9,282	0	237	-176	9,343
Cauca	12,568	0	438	-411	12,595
Cesar	22	0	4	0	26
Choco	1,614	0	246	-57	1,803
Cordoba	2,579	0	140	-51	2,668
Guainia	22	0	0	0	22
Guaviare	6,804	0	75	-41	6,838
Magdalena	29	0	4	2	35
Meta	5,439	0	16	9	5,464
Nariño	39,293	0	4,732	-1,398	42,627
Norte de Santander	20,753	0	533	3,545	24,831
Putumayo	24,148	0	208	806	25,162
Santander	28	0	2	7	37
Valle del Cauca	674	0	84	-6	752
Vaupes	106	0	0	-9	97
Vichada	700	0	0	-1	699
Total	**134,538**	**0**	**8,423**	**3,178**	**146,139**

Table 41. Estimation for areas without information, aerial spraying and imaging time, 2016.

The weight from the estimates applied in the different surveys along the historical series ranges around 17% in 2008, and subsequently decreases to 2% in 2015. For 2016, the weight of the adjustments is around 8%. While there has been an increase vis-à-vis 2015, it is maintained under the established parameters. The adjustments for areas without information were concentrated in Nariño, and those associated with temporality in Norte de Santander. Since the end of 2015, actions related to aerial spraying were suspended in the national territory; therefore, no aspersion adjustment is introduced.

ANNEX 2.
LIST OF SATELLITE IMAGES USED IN THE 2016 SURVEY

IMAGING TIME (YY/MM/DD)		
PATH	ROW	IMAGING TIME (YY/MM/DD)
4	56	28/12/2016
4	57	28/12/2016
4	58	2016/10/25 - 2017/02/14 - 2017/03/02
5	56	20/01/2017
5	57	2016/11/17 - 2016/12/19 - 2017/01/20
5	58	20/01/2017
5	59	20/01/2017
5	60	01/11/2016
5	61	20/01/2017
5	62	20/01/2017
6	55	28/02/2017
6	56	28/02/2017
6	57	16/03/2017
6	58	2017/02/12 - 2017/03/16
6	59	2016/08/20 - 2017/02/12
6	60	28/02/2017
6	61	12/02/2017
6	62	12/02/2017
7	54	2016/10/30 - 2017/01/02
7	55	02/01/2017
7	56	03/02/2017
7	57	02/01/2017
7	58	2016/10/30 - 2017/01/18
7	59	18/01/2017
7	60	18/01/2017
7	61	18/01/2017
8	52	08/12/2016
8	53	22/11/2016
8	54	2016/09/03 - 2017/01/25
8	55	2016/09/03 - 2017/01/25
8	56	2016/09/03 - 2017/01/25
8	56	25/01/2017
8	57	02/10/2017
8	58	10/02/2017
8	59	25/01/2017
8	60	2017/01/25 - 2017/02/10
9	52	29/11/2016
9	53	29/11/2016
9	54	2017/01/16 - 2017/02/17
9	55	2016/10/28 - 2016/11/13 - 2017/01/16 - 2017/02/17
9	56	28/10/2016
9	57	22/04/2017
9	58	06/04/2017
9	59	2016/08/25 - 2016/11/13
9	60	2016/07/24 - 2016/11/13
10	54	19/10/2016
10	55	19/10/2016
10	55	28/03/2017
10	56	2016/09/17 - 2017/01/23
10	57	23/01/2017
10	58	2017/01/23 - 2017/02/24
10	59	2017/01/23 - 2017/02/24
LANDSAT 7 TM		
PATH	ROW	IMAGING TIME (YY/MM/DD)
4	61	17/10/2016
4	62	14/08/2016
4	63	18/11/2016
Total	75	

ANNEX 3.
METHODOLOGY OF PRODUCTIVITY STUDIES

The estimation of potential cocaine production in Colombia takes into account three fundamental steps: i) the ability of the coca crop to harvest the leaf and its conversion into cocaine paste - processes commonly carried out by farmers; (Iii) conversion of cocaine paste into cocaine base; and (iii) the industrial process for obtaining cocaine hydrochloride. The calculations for the first two steps are based on the results of the productivity studies, while the third step is estimated based on data published by the United States Government.

Between 2004 and 2005, the SIMCI project and the National Drug Enforcement Directorate (DNE) developed a probabilistic sampling methodology to characterize and estimate the production and yield of coca leaf in Colombia. The general framework of the research includes three thematic cores: (i) Establishing the productive characteristics associated to the coca cultivation and to the Agricultural Production Units of Coca (UPAC); (ii) Socioeconomically characterizing the Coca Agricultural Producers (PAC); and (iii) Identifying the persistence of coca cultivation.

This study allowed to establish the baseline of the investigation and a structure for the execution of subsequent updates, obtaining a national consolidate every three years. The conceptual framework of the research comprises the identification of particularities and differentiated territorial dynamics around the cultivation of coca in its social, economic, institutional, cultural and environmental dimensions. In order to assess the problem at the regional level, the country was divided into eight study target regions:

SIMCI Region	Departments
Meta- Guaviare	Meta y Guaviare
Putumayo-Caqueta	Putumayo y Caquetá
Central	Bolívar, Antioquía, Córdoba, Santander, Cesar Boyacá, Cundinamarca, Caldas y Risaralda
Orinoco	Arauca y Vichada
Pacific	Nariño, Cauca, Chocó y Valle del Cauca.
Catatumbo	Norte de Santander
Sierra Nevada	Magdalena y La Guajira
Amazon	Amazonas, Guainía y Vaupés

Tabla 42. Division of the study target regions.

The data collection method includes field surveys to direct informant PACs, and harvest trials in the lots, in order to determine the per hectare coca leaf yield. Coverage of the research is regional, and refers to the incidence areas of coca crops in the last two annual surveys prior to field application. The research started with a

baseline in 2005 (Phase I) and the national update was implemented between 2007 and 2010, which is called Phase II. Phase III was applied between 2011-2014 and Phase IV began to be updated from the year 2015. The table below presents the years of research execution and the number of surveys applied in the territory for the four study phases.

Regions	Phase I Baseline	Phase II				Phase III				Phase IV	Total
	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Meta-Guaviare	309		300					300			909
Central[a]	165	165				180				165	675
Putumayo-Caquetá[c]	240		210[b]				240				690
Orinoco	150				135			150			435
Pacific	255			276					270		801
Catatumbo	135	135				120				135	525
Sierra Nevada	135	135				45[d]				30	345
National Overall	1389	435	510	276	135	345	240	450	270	330	4,380

Table 43. Number from Surveys applied according to the research stages[e].

Note:
(a) The Central region includes the departments of Bolívar, Antioquia, Córdoba, Santander, Cesar, Boyacá, Cundinamarca, Caldas and Risaralda. In previous studies, this region was designated with the name Sur de Bolivar, since the geographic configuration of the coca cores was established in this zone.
(b) Study conducted by the National Drug Enforcement Directorate (DNE). It only has the data of yield and production for this survey, therefore the information related to the characteristics of the crop, social, economic and market-related characteristics (among others) are not entered in this book because the microdata of the information collected is not available.
(c) No field operations are performed for the Amazon region for estimating yields. The same yield of Putumayo-Caqueta for this area is assumed by geographical continuity and association of agricultural practices.
(d) In the Sierra Nevada region, the dynamics of coca cultivation showed a strong reduction and no coca lots were found to perform harvest tests in the sample selected. Therefore, the figures captured in 2007 are used for the purpose of the production and yield estimates.
(e) In 2005, the information collected in the baseline corresponds to Phase I of the productivity study, while the regional update carried out between 2007-2010 refers to Phase II. Updates made in the regions of Sierra Nevada, Central and Catatumbo in 2011, Putumayo-Caqueta in 2012 and those published in this report regarding Meta-Guaviare and Orinoco correspond to Phase III, which ended its round in 2014 With the implementation of field operations in the Pacific region.

The methodology applied in the productivity studies is multistage sampling, based on the area master framework. The master area framework is a 1 km^2 x 1km^2 grid, with a unique and unrepeatable identification for the whole national territory. It is important to emphasize that the probabilistic methodology used allows to extrapolate the information of the sample to the population. Since the universe of producers is not known, reference is made to the location of the coca lots that comes from the annual surveys carried out by the SIMCI project, where the survey becomes the population universe. (ergo, the Area Framework).

The statistical units of observation are as follows: i) Primary Sampling Unit (UPM), related to the grids in the statistical framework, ii) Secondary Sampling Unit (USM) - the coca lots identified in each

One of the UPM; iii) Tertiary sampling unit (UTM) i.e. the plots selected in the coca lot. The observation unit coincides with the USM. The harvest test is conditioned only to productive lots. The sampling frame is built from the coca surveys, and a sample design which can be:

Probabilistic: Each UA (coca lot) has a known and non-zero probability of being included in the sample.

Stratified: The first level of stratification is given by the land use cover. Grids (UPMs) are classified in the following strata: Crops (1), Mixed Crops (2), Pastures (3), Natural Forests and Other Uses (4), based on the land cover map information from SIMCI / UNODC.

Tri-stage sampling: In the first stage, the Primary Sampling Units (PSUs) are systematically selected. These PSUs are formed by 1 km^2 x 1km^2 grids, which were chosen with probabilities proportional to size (PPS) of their surface with coca. The second stage includes a systematic selection of the Secondary Sampling Units (USMs), which include coca lots within the UPMs (grids) of the first stage which were designated with PPT of their area with coca. In the third stage, the Tertiary Sampling Units (UTMs) called plots are randomly selected within the USMs included in the second stage sample. Two plots are selected, which are 5 m^2 rectangles, or a trapezoid with a surface similar to that mentioned. Harvesting tests are carried out in each of these plots in order to measure and weigh green coca leaves.

The methodological process includes interviews with coca leaf growers and harvest trials based on the guidelines of the United Nations Manual. UNODC / SIMCI and the Government of Colombia are currently developing experimental studies of coca leaf alkaloid content and laboratory efficiency; however, the point of reference of this information to date continues to be the reports of the US Government.

Agricultural Production Unit (UPA from its Spanish initials – *Unidad de Producción Agropecuaria):*	It is an economic unit which is totally or partially dedicated to the development of agricultural activities. It may comprise one or more farms, located in one or more areas of the same municipality, provided that all are under a single management, and share the same set of means such as labor, machinery and working animals, regardless of their title deed, legal form or size. Single management may be exercised by a single person, by two or more persons, by a household or households jointly, by a community, or by a legal entity, such as a company, a cooperative or a public or private agency.
Coca Agricultural Production Unit (UPAC from its Spanish initials – *Unidad de Producción Agropecuaria de Coca):*	It is a UPA totally or partially dedicated to the cultivation of coca and other agricultural activities under a single management by an Agricultural Producer of Coca (PAC – from its Spanish original language - *Productor Agropecuario de Coca).*

Table 44. . Definitions of UPA / UPAC.

ANNEX 4.
COCA CROPS IN INDIGENOUS RESERVES 2014 - 2016 (HECTARES)

INDIGENOUS RESERVE	2014	2015	2016
Amazon			
MURCIÉLAGO ALTAMIRA	0.0	1.6	0.0
VAUPÉS	18.6	1.6	0.0
ARARA, BACATÍ, CARURU Y MIRAFLORES	27.8	17.9	55.9
ARRECIFAL	0.8	0.0	0.0
CARANACOA YURI-LAGUNA MOROCOTO	3.7	0.0	0.0
CARPINTERO PALOMAS	4.7	2.3	0.0
CUENCA MEDIA Y ALTA DEL RÍO INÍRIDA	13.5	15.1	15.8
CUMARAL-GUAMUCO	0.9	2.7	0.0
GUACO BAJO Y GUACO ALTO	3.2	0.0	0.0
LAGUNA NIÑAL,COCUY, LOMA BAJA Y LOMA ALTA DEL CAÑO GUARIBEN	3.0	0.0	0.0
MINITAS-MIRALINDO	2.5	0.0	0.0
PARTE ALTA DEL RÍO GUAINÍA	0.8	0.0	0.0
PREDIO PUTUMAYO	175.9	112.6	167.1
PUEBLO NUEVO-LAGUNA COLORADA	4.6	0.0	2.3
PUERTO ZÁBALO Y LOS MONOS	1.0	0.0	0.0
RÍOS CUIARI E ISANA	3.1	0.4	0.0
TONINA, SEJAL, SAN JOSÉ Y OTRAS	2.5	0.0	0.0
Central			
ALTO SINU, ESMERALDA CRUZ GRANDE E IWAGADO	123.6	262.5	322.5
CAIMÁN NUEVO	1.0	0.0	0.0
CHONTADURAL CAÑERO	0.0	0.7	0.0
GABARRA-CATALAURA	13.7	19.3	41.2
JAIDEZAVÍ	7.2	8.1	13.7
JAI-DUKAMA	3.7	1.7	3.5
MOTILÓN - BARÍ	53.4	91.1	167.8
PABLO MUERA	1.0	0.7	0.0
POLINES	0.0	0.0	0.6
QUEBRADA CAÑAVERAL	0.0	4.2	0.8
RÍO CHAJERADÓ	0.4	0.0	0.0
UNIDO UWA	0.9	0.0	0.0
YABERARADÓ	1.0	0.0	3.8
Meta-Guaviare			
LA ASUNCIÓN	4.9	2.7	3.7
ALTO UNUMA	1.2	0.0	0.0
ARARA, BACATÍ, CARURU Y MIRAFLORES	8.7	15.9	23.7
BARRANCO CEIBA y LAGUNA ARAGUATO	18.5	30.3	23.5
BARRANCO COLORADO	10.0	6.5	8.4
BARRANQUILLITA	33.7	9.9	25.8
CHARCO CAIMÁN	2.5	4.2	5.5
COROCORO	1.2	0.0	0.0
EL ITILLA	3.9	0.5	1.6

INDIGENOUS RESERVE	2014	2015	2016
LA FUGA	2.1	2.0	1.3
LA YUQUERA	104.9	92.3	134.9
LAGOS DEL DORADO, LAGOS DEL PASO Y EL REMANSO	251.9	295.9	275.2
LLANOS DEL YARÍ - YAGUARÁ II	0.0	0.0	0.9
MACUARE	9.7	11.8	10.4
MORICHAL VIEJO, SANTA ROSA, CERRO CUCUY, SANTA CRUZ, CAÑO DANTA- OTROS	141.9	118.1	188.9
NUKAK - MAKU	550.2	621.9	826.3
PUERTO NARE	34.3	54.0	49.9
PUERTO VIEJO Y PUERTO ESPERANZA	5.4	7.1	5.2
SIKUANI DE DOMO PLANAS	1.1	0.0	0.0
TUCÁN DE CAÑO GIRIZA Y PUERTO LA PALMA	33.5	31.1	30.4
VUELTA DEL ALIVIO	28.6	30.0	37.5
YAVILLA II	153.3	107.2	110.5
Orinoco			
ALTO UNUMA	45.3	70.0	67.1
CALI-BARRANQUILLA	0.5	2.4	2.5
CARPINTERO PALOMAS	0.8	0.0	5.0
CHOCON	0.3	0.0	0.0
CIBARIZA	0.5	0.8	0.0
CONCORDIA	1.7	0.0	2.7
COROCORO	0.0	0.0	1.1
EGUA-GUARIACANA	1.3	0.9	0.0
FLORES SOMBRERO	0.6	0.5	0.5
GUACO BAJO Y GUACO ALTO	4.8	2.3	1.9
LA LLANURA	1.5	0.0	0.0
LA PASCUA	0.4	0.0	0.0
LAGUNA TRANQUILA	0.2	0.0	0.0
LOS IGUANITOS	0.4	0.0	0.0
RÍO SIARE	3.0	1.8	0.3
RÍOS MUCO Y GUARROJO	2.8	0.0	5.7
RÍOS TOMO Y WEBERI	0.2	0.0	1.0
SAN JOSÉ DE LIPA O CAÑO COLORADO	0.7	0.3	0.0
SANTA TERESITA DEL TUPARRO	28.5	35.8	42.1
SARACURE-CADÁ	30.7	39.4	48.6
SELVA DE MATAVÉN	21.9	8.3	3.3
VALDIVIA	2.2	2.0	6.1
Pacific			
EL CEDRO, LAS PEÑAS, LA BRAVA, PILVÍ Y LA PINTADA	188.6	524.0	773.3
GUELNAMBI-CARAÑO	4.1	5.2	13.0
AGUA NEGRA	1.1	0.9	3.5
AGUACLARA Y BELLA LUZ DEL RÍO AMPORÁ	1.3	0.0	0.0
ALMORZADERO, SAN ISIDRO Y LA NUEVA UNIÓN	9.0	10.1	14.9
ALTO BONITO VIRA VIRA	0.4	0.0	0.0
BAJO GRANDE	3.7	4.2	3.0
BELLAVISTA-UNIÓN PITALITO	28.5	14.7	19.0
BOCHOROMA-BOCHOROMACITO	0.0	0.0	0.0
CALLE SANTA ROSA RÍO SAIJA	127.4	93.4	170.9
CAÑÓN DEL RÍO SANQUININI	0.9	3.1	3.9

INDIGENOUS RESERVE	2014	2015	2016
CHAGPIEN	28.2	2.5	23.0
CHAGUI CHIMBUZA VEGAS Y OTROS	31.3	32.8	68.8
CHIDIMA TOLO	0.0	0.1	0.1
CHINGUIRITO MIRA	106.6	286.9	338.6
CHONARA HUENA	0.7	0.0	1.0
CHONTADURAL CAÑERO	0.1	2.2	0.1
CORINTO LÓPEZ ADENTRO	0.0	2.7	4.4
CUAIQUER INTEGRADO LA MILAGROSA	40.8	44.3	125.3
CUASBIL-LA FALDADA	3.9	8.0	12.7
CUASCUABI-PALDUBI	0.7	0.6	0.9
CUAYQUER DEL ALTO ALBI	182.4	380.5	444.9
CUCHILLA-PALMAR	3.1	3.7	5.5
DOMINICO, LONDOÑO Y APARTADÓ	1.8	0.9	0.6
EL GRAN SABALO	226.4	435.4	610.3
EL SANDE	132.1	242.6	445.8
GRAN ROSARIO	715.0	1.200.5	1.302.8
GUADUAL, CUMBAS, MAGÜI, INVINA Y ARRAYÁN	0.0	0.3	2.5
GUALCALA	10.1	16.9	65.8
HONDA RÍO GUIZA	1.4	10.6	19.8
HUELLAS	0.0	0.4	0.7
INDA ZABALETA	943.6	2.047.9	2.520.1
INFI	41.2	77.1	118.8
INTEGRADO EL CHARCO	84.8	16.2	168.6
ISLA DEL MONO	1.8	2.2	6.5
JAGUAL RÍO CHINTADO	0.0	0.9	0.0
LA FLORESTA - LA ESPAÑOLA	11.7	11.1	14.7
LA FLORESTA, SANTA ROSA Y SAN FRANCISCO	467.8	660.4	660.9
LA IGUANA	7.0	63.2	77.3
LA RAYA	1.5	7.6	0.0
LA TURBIA	584.5	745.8	1.051.5
LA UNIÓN CHOCO - SAN CRISTOBAL	3.1	0.1	1.1
MAIZ BLANCO	0.7	1.4	0.7
NUNALBÍ ALTO ULBÍ	6.9	19.4	14.8
PATIO BONITO	0.1	0.0	0.0
PIALAPI-PUEBLO VIEJO-SAN MIGUEL-YARE	0.8	1.6	0.6
PIEDRA SELLADA-QUEBRADA TRONQUERIA	14.2	25.5	37.3
PIGUAMBI PALANGALA	29.0	40.0	101.1
PIPALTA-PALBI-YAGUAPI	4.8	17.9	36.3
PLANADAS TELEMBÍ	29.0	72.1	155.5
PLAYA BENDITA	8.3	14.2	17.6
PLAYITA SAN FRANCISCO	2.4	1.0	2.0
PUADÓ, LA LERMA, MATARÉ, Y TERDO	7.6	12.5	12.7
PUERTO ALEGRE Y LA DIVISA	1.6	0.0	0.0
PUERTO LIBIA TRIPICAY	1.6	0.0	0.0
PULGANDE CAMPOALEGRE	102.8	216.1	230.7
QUEBRADA GRANDE	3.9	3.6	7.9
QUEBRADA QUERA	1.9	0.0	1.3
RAMOS-MONGON-MANCHURIA	2.0	4.7	19.8
RÍO GARRAPATAS	1.8	1.4	30.3
RÍO GUANGÜI	41.0	162.3	225.3

INDIGENOUS RESERVE	2014	2015	2016
RÍO NAYA	5.6	9.5	7.4
RÍO ORPUA	0.0	0.5	0.0
RÍO PURRICHA	8.2	2.1	0.9
RÍO SATINGA	29.1	49.3	39.2
RÍO TAPARAL	1.6	0.0	0.2
RÍOS CATRU-DUBASA Y ANCOSO	14.1	8.1	1.6
RÍOS JURUBIDA-CHORI Y ALTO BAUDÓ	5.8	0.0	0.0
RÍOS TORREIDÓ Y CHIMANI	4.0	1.4	0.0
SAN ANTONIO DEL FRAGUA	2.8	7.0	4.8
SAN MIGUEL	17.8	24.4	32.9
SANANDOCITO	2.7	2.1	6.0
SANQUIANGUITA	8.4	8.5	10.4
SANTA CECILIA DE LA QUEBRADA ORO CHOCÓ	3.1	4.9	0.0
SANTA MARÍA DE PANGALA	2.3	0.0	0.2
SANTA ROSA DE IJUA	1.1	0.0	0.0
SANTA ROSA SUCUMBIOS EL DIVISO	22.3	30.2	40.8
SAUNDE GUIGUAY	142.8	256.4	303.6
SIRENA BERRECUY	2.3	1.4	0.0
TORTUGAÑA, TELEMBI, PUNDE, PITADERO, BRAVO, TRONQUERIA Y ZABALETA	44.3	76.8	193.5
TRONQUERIA, PULGANDE-PALICITO	9.0	12.4	89.7
URADÁ JIGUAMIANDÓ	0.1	1.9	1.5
WASIPANGA	0.6	3.7	6.2
YARUMAL Y EL BARRANCO	0.4	0.0	0.0
YU YIC KWE	0.9	0.0	1.3
Putumayo - Caqueta			
PUERTO NARANJO, PEÑAS ROJAS, CUERAZO Y EL DIAMANTE	6.7	9.0	9.5
AGUA NEGRA	14.0	16.2	18.2
AGUANEGRA	58.1	80.7	113.4
AGUAS NEGRAS	1.9	6.5	0.4
ALBANIA	0.0	1.1	1.6
ALTO LORENZO	52.7	69.7	90.8
ALTO ORITO	7.8	21.5	38.6
BELLA VISTA	17.6	16.4	14.2
BUENAVISTA	158.9	157.4	180.0
CAICEDONIA	40.0	37.0	52.4
CALARCA	55.5	83.3	83.9
CALENTURAS	10.4	17.8	12.5
CAMPO ALEGRE DEL AFILADOR	14.9	28.2	38.5
CAÑAVERAL	46.5	66.3	95.5
CECILIA COCHA	2.4	0.0	0.4
CHALUAYACO	1.9	4.7	5.3
CONSARA-MECAYA	6.1	8.1	9.3
COROPOYA	5.6	4.4	5.9
CUSUMBE-AGUA BLANCA	0.6	1.4	0.0
DAMASCO VIDES	52.9	75.7	123.8
EL CEDRITO	6.6	6.0	7.5
EL DESCANSO	0.0	0.6	0.9
EL ESPINGO	53.6	60.7	105.5
EL GUAYABAL	5.5	0.0	3.0

INDIGENOUS RESERVE	2014	2015	2016
EL HACHA	54.9	67.0	88.9
EL PORTAL	2.7	4.8	1.9
EL PORVENIR - LA BARRIALOSA	1.1	0.0	1.8
EL QUINCE	0.6	3.2	1.3
EL TABLERO	2.6	7.3	9.5
EL TRIUNFO	0.7	0.7	4.4
GETUCHÁ	0.0	0.0	0.8
HERICHA	4.2	8.0	23.6
JACOME	3.5	3.9	5.4
JERICÓ-CONSAYA	2.2	8.3	0.0
JERUSALÉN-SAN LUIS ALTO PICUDITO	58.4	55.3	71.7
LA AGUADITA	47.5	54.4	58.1
LA CRISTALINA	0.0	0.0	0.8
LA ESPERANZA	0.0	1.0	0.0
LA FLORIDA	0.0	1.1	1.7
LA ITALIA	15.0	30.6	40.3
LA PAYA	5.7	10.3	10.6
LA SIBERIA	0.0	0.6	0.0
LA TEÓFILA	1.3	0.8	0.6
LAGARTO COCHA	0.0	0.6	0.0
LOS GUADUALES	7.2	8.5	18.4
MATICURÚ	12.8	6.7	13.5
NIÑERAS	15.0	13.8	29.2
PLAYA LARGA	22.7	23.3	33.7
PREDIO PUTUMAYO	19.3	19.3	21.2
PUERTO ZÁBALO Y LOS MONOS	2.8	0.0	0.3
SAN ANDRES - LAS VEGAS - VILLA UNION	64.4	97.9	174.4
SAN ANTONIO DEL FRAGUA	2.2	8.7	9.2
SAN LUIS	12.4	15.1	18.2
SAN MIGUEL	2.8	3.1	5.9
SAN MIGUEL DE LA CASTELLANA	4.4	3.2	2.3
SANTA CRUZ DE PIÑUÑA BLANCO	1.0	0.5	1.2
SANTA ROSA DE JUANAMBÙ, CAMPO ALEGRE, ALPES ORIENTALES Y LA FLORESTA	39.8	77.0	69.9
SANTA ROSA DEL GUAMUÉZ	13.1	22.9	26.7
SELVA VERDE	17.4	35.3	62.0
SIMORNA	1.4	8.2	10.4
TUKUNARE	1.4	2.4	1.1
VEGAS DE SANTANA	3.1	5.5	9.9
VILLA CATALINA-DE PUERTO ROSARIO	91.8	124.6	161.9
WASIPANGA	2.4	2.3	6.3
WASIPUNGO	3.1	7.3	1.5
WITORA O HUITORA	0.8	0.8	1.1
YARINAL (SAN MARCELINO)	20.0	108.9	151.6
YURAYACO	1.8	1.8	2.8
ZIT-SET DEL QUECAL	1.3	1.7	2.9
Sierra Nevada			
ARHUACO DE LA SIERRA NEVADA	0.9	1.6	0.0
KOGUI-MALAYO ARHUACO	4.7	4.1	22.9
Overall	**7,799.5**	**11,837.3**	**15,665.1**

ANNEX 5.
HISTORICAL SERIES OF COCA CROPS, AERIAL SPRAYING AND MANUAL ERADICATION BY GME

Table 45. Historical series of coca crops, 2001 -2016 (hectares).

Department	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Amazonas	532	783	625	783	897	692	541	836	312	338	122	98	110	173	111	167
Antioquia	3,171	3,029	4,273	5,168	6,414	6,156	9,926	6,096	5,096	5,350	3,104	2,725	991	2,293	2,402	8,855
Arauca	2,749	2,215	539	1,552	1,883	1,306	2,116	447	430	247	132	82	69	25	17	9
Bolivar	4,824	2,735	4,470	3,401	3,670	2,382	5,632	5,847	5,346	3,324	2,207	1,968	925	1,565	1,044	4,094
Boyaca	245	118	594	359	342	441	79	197	204	105	93	10	17	14	8	15
Caldas			54	358	189	461	56	187	186	46	46	16	8	0	0	0
Caqueta	14,516	8,412	7,230	6,500	4,988	4,967	6,318	4,303	3,985	2,578	3,327	3,694	4,322	6,542	7,712	9,343
Cauca	3,139	2,121	1,443	1,265	2,705	2,105	4,168	5,422	6,597	5,908	6,066	4,327	3,326	6,389	8,660	12,595
Cesar								5				12	13	10	32	26
Choco	354		453	323	1,025	816	1,080	2,794	1,789	3,158	2,511	3,429	1,661	1,741	1,489	1,803
Cordoba	652	385	838	1,535	3,136	1,216	1,858	1,710	3,113	3,889	1,088	1,046	439	560	1,363	2,668
Cundinamarca	22	57	57	72	56	120	131	12		32	18			0	0	0
Guainia	1,318	748	726	721	752	753	623	625	606	446	318	301	81	66	37	22
Guaviare	25,553	27,380	16,163	9,770	8,658	9,477	9,299	6,629	8,660	5,701	6,839	3,851	4,725	5,658	5,423	6,838
La Guajira	385	354	275	556	329	166	87	160	182	134	16	10	6	0	0	0
Magdalena	480	644	484	706	213	271	278	391	169	121	46	37	37	9	7	35
Meta	11,425	9,219	12,814	18,740	17,305	11,063	10,386	5,525	4,469	3,008	3,040	2,699	2,898	5,042	5,002	5,464
Nariño	7,494	15,132	17,628	14,154	13,875	15,607	20,259	19,612	17,639	15,951	17,231	10,733	13,177	17,285	29,755	42,627
Norte de Santander	9,145	8,042	4,471	3,056	844	488	1,946	2,886	3,037	1,889	3,490	4,516	6,345	6,944	11,527	24,831
Putumayo	47,120	13,726	7,559	4,386	8,963	12,253	14,813	9,658	5,633	4,785	9,951	6,148	7,667	13,609	20,068	25,162
Santander	415	465	632	1,124	981	866	1,325	1,791	1,066	673	595	110	77	26	21	37
Valle del Cauca	184	111	37	45	28	281	453	2,089	997	665	981	482	398	561	690	752
Vaupes	1,918	1,486	1,157	1,084	671	460	307	557	395	721	277	254	184	109	33	97
Vichada	9,166	4,909	3,818	4,692	7,826	5,523	7,218	3,174	3,228	2,743	2,264	1,242	713	511	683	699
National Overall	**144,807**	**102,071**	**86,340**	**80,350**	**85,750**	**77,870**	**98,899**	**80,953**	**73,139**	**61,812**	**63,762**	**47,790**	**48,189**	**69,132**	**96,084**	**146,139**

Inicio

Table 46. Historical series of aerial spraying, 2001 - 2015 (hectares)[167].

Department	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Antioquia	-	3,321	9,835	11,048	16,799	18,022	27,058	10,028	9,281	3,026	9,847	6,971	944	2,063	3,253	0
Arauca	-	-	11,734	5,336	2,584	1,400	2,695	2,296	-	-	-	-	-	0	0	0
Bolivar	11,581	-	4,783	6,456	6,443	2,662	7,050	2,214	8,715	4,412	3,564	2,740	1,925	411	1,221	0
Boyaca	-	-	-	-	925	831	-	166	117	-	-	-	-	0	0	0
Caldas	-	-	-	190	1,090	1,068	284	-	169	-	-	-	-	0	0	0
Caqueta	17,252	18,567	1,060	16,276	5,452	4,575	5,084	11,085	6,652	16,947	12,888	5,638	5,784	5,393	5,201	0
Cauca	741	-	1,308	1,811	3,292	1,536	3,557	6,891	11,136	14,450	11,834	10,697	3,409	2,982	2,191	0
Choco	-	-	-	-	425	-	-	-	-	-	4,287	13,259	7,464	7,460	3,396	0
Cordoba	-	734	550	-	1,767	5,588	6,259	3,561	742	546	3,128	1,632	1,183	156	599	0
Cundinamarca	-	-	-	-	43	41	-	-	-	-	-	-	-	0	0	0
Guaviare	7,477	7,207	37,493	30,892	11,865	14,714	10,950	13,061	12,584	17,633	8,917	11,088	6,796	8,478	3,450	0
La Guajira	-	-	-	449	572	-	-	-	-	-	-	-	-	0	0	0
Magdalena	-	-	-	1,632	383	-	-	-	-	-	-	-	-	0	0	0
Meta	3,251	1,496	6,974	3,888	14,453	25,915	15,527	9,057	6,756	5,825	2,545	3,152	423	1,821	3,857	0
Nariño	8,216	17,962	36,911	31,307	57,630	59,865	36,275	54,050	39,992	25,940	34,988	37,831	8,101	15,205	5,506	0
Norte de Santander	10,308	9,186	13,822	5,686	899	1,687	2,683	2,864	1,883	149	-	-	-	0	0	0
Putumayo	32,506	71,891	8,343	17,524	11,763	26,491	26,766	11,898	3,777	11,434	9,480	6,504	8,755	11,052	8,135	0
Santander	-	-	5	1,855	2,042	2,146	1,754	422	1,269	153	92	-	-	0	0	0
Valle del cauca	-	-	-	-	5	-	-	-	-	-	719	986	2,269	511	226	0
Vaupes	-	-	-	756	340	-	-	-	-	-	-	-	-	0	0	0
Vichada	2,820	-	-	1,446	-	5,485	7,193	5,901	1,699	1,425	1,014	51	-	0	164	0
National Overall	**94,152**	**130,364**	**132,817**	**136,551**	**138,775**	**172,025**	**153,134**	**133,496**	**104,772**	**101,940**	**103,303**	**100,549**	**47,053**	**55,532**	**37,199**	**0**

167 Aerial spraying operations in Colombia have been suspended by decision of the National Government since the end of 2015.

Table 47. Historical Series of Manual Eradication of Coca by GME, 2007 - 2016 (hectares).

Department	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Amazonas			147							
Antioquia	4,390	16,473	4,416	3,774	2,507	1,461	891	783	494	326
Arauca	90									
Bolivar		3,726	1,193	1,419	682	77	124	577	1,198	338
Boyaca		228	107	15	52	74	60	2	16	14
Caldas	160	101		12	193	64	37		5	
Caqueta	283	2,310	2,971	1,047	1,236	253	98	181	326	531
Cauca	833	1,693	1,562	1,557	88	10		3	19	39
Cesar	92					9	26	23	25	16
Choco	414	253	1,180		64	668	341	638	1,361	562
Cordoba	3,071	7,174	2,036	2,081	1,581	2,498	167	2		
Cundinamarca					1					497
Guaviare	611		1,818	759	735	325	870	686	144	
La Guajira		99	30	14	49	15	1	9	6	
Magdalena	163	117	47	53	167	10	19	9	79	1
Meta	2,703	5,994	4,674	900	748	517	119			651
Nariño	14,059	7,557	14,772	13,706	12,822	2,488	4,026	1,880	985	458
Norte de Santander	339	2,384	2,179	1,394	324	843	1,894	179	15	3
Putumayo	23,886	28,571	4,031	1,459	1,815	3,603	610	82		25
Santander	604	779	1,550	733	137	228	186	6	23	17
Valle del Cauca		167	616	566	412	528	229	121	209	53
Vaupes								135		
Vichada	326	6,801	4,328	1,030	1,229	689	129	10		24
National overall	**52,024**	**84,427**	**47,657**	**30,519**	**24,842**	**14,360**	**9,827**	**5,326**	**4,905**	**3,555**