



Bolivia

Coca Cultivation Survey



data collection

data transfer

data transfer

June 2007

PREFACE

The evidence from the 2006 Bolivia Coca Survey sends mixed signals. Overall, there is an 8% increase in cultivation over 2005 for a total of 27,500 hectares. Dire forecasts have not been borne out. Nevertheless, there are warning signs that should be heeded.

Under Bolivian law, 12,000 hectares may be grown for traditional consumption or other legal uses: this Survey shows that the limit was exceeded in the Yungas of La Paz where most of the cultivation usually takes place.

At the same time there has been a dramatic (19%) increase in the Chapare region, including more than 2,300 hectares of coca being grown in national parks in the Tropics of Cochabamba – a threat to the precious eco-system of the Amazon forests. The good news from this same region is that the amount of land devoted to the cultivation of alternative crops – such as bananas, pineapple, and palm heart – now exceeds the area used to grow coca. There are signs of hope that licit crops can help liberate vulnerable communities from poverty.

Nevertheless, the considerable increase in seizures and the displacement of drug production to areas outside the coca growing areas, as reported by the Bolivian drug control police, demonstrates the need for sustained drug law enforcement of the Bolivian Government.

Bolivia's drug policy is in the spotlight. The Government needs to reassure the world that its support for coca growers will not lead to an increase in cocaine production. It can be assisted in this task by greater investment in projects that will benefit poor agricultural regions, and greater support for regional counter-narcotics security that will cut the import of precursor chemicals and the export of drugs.



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FACT SHEET – BOLIVIA COCA SURVEY FOR 2006

	2005	Variation on 2005	2006
Coca cultivation in ha	25,400	8%	27,500
<i>Of which in the Yungas of La Paz</i>	<i>18,100</i>	<i>4%</i>	<i>18,900</i>
<i>in Chapare</i>	<i>7,000</i>	<i>19%</i>	<i>8,300</i>
<i>in Apolo</i>	<i>300</i>	<i>0%</i>	<i>300</i>
<i>Of which permitted by Bolivian law 1008</i>	<i>12,000</i>		<i>12,000</i>
<i>non-permitted by Bolivian law 1008</i>	<i>13,400</i>	<i>16%</i>	<i>15,500</i>
<i>Of which in national parks</i>	<i>1,950</i>	<i>18%</i>	<i>2,298</i>
Average annual sun-dried coca leaf yield			
in Chapare	2,764 kg/ha		2,764 kg/ha
in the Yungas of La Paz	1,300 kg/ha		1,317 kg/ha
in the Yungas, traditional coca growing areas	1,220 kg/ha		1,220 kg/ha
Production of coca leaf	43,000 mt	11%	47,700 mt
Maximum potential production of cocaine	80 mt	18%	94 mt
in percent of global cocaine production	8	2	10
National weighted average farm-gate price of coca leaf (outside state market)	4.3 US\$/kg	-10%	3.9 US\$/kg
Chapare average farm-gate price of coca leaf	4.1 US\$/kg	-27%	3.2 US\$/kg
Total farm-gate value of coca leaf production	US\$ 180 million	0%	US\$ 180 million
GDP	US\$ 8.4[1]billion ¹	3.5%	US\$ 8.7[2]billion ²
Farm-gate value of coca leaf production in percent of GDP	2.10%		2.00%
Value of agricultural sector GDP ³	US\$ 1.5 billion		US\$ 1.37 billion
Farm-gate value of coca leaf production in percent of value of 2006 agricultural sector	12%		13%
Reported seizure of cocaine paste	10,152 kg	26%	12,779kg
Reported seizure of cocaine hydrochloride	1,300 kg	1%	1,309 kg

¹ GDP 2005 calculated from the 2004 GDP and with a projected growth of 4.5 % source: INE, Bolivia

² GDP 2005 calculated from the 2004 GDP and with a projected growth of 3.5 %

³ GDP of the agricultural sector, source INE Bolivia

Executive Summary

Under its Illicit Crop Monitoring Programme, UNODC assists the Bolivian Government in the implementation of a national coca monitoring system. This joint Bolivian Government-UNODC report, the fourth since 2003, provides an estimate of coca cultivation at the national level for the year 2006. It also presents information on coca yield, prices and other issues related to coca cultivation in Bolivia.

This year's Survey revealed that **27,500 ha** were under coca bush cultivation in Bolivia in 2006, **an increase by 8%** compared to last year's estimate of 25,400 ha. This increase almost compensates the decrease achieved between the years 2004 and 2005. Coca cultivation in Bolivia accounted for 18% of global coca cultivation in 2006, far below the levels estimated in the early- to mid-nineties when Bolivia accounted for about a quarter of the global total. In 2006, coca cultivation in Bolivia remained below cultivation levels in Colombia and Peru.

The increase in coca cultivation in Bolivia between 2005 and 2006 was due to an increase in the two main areas of coca cultivation, the Yungas of La Paz and Chapare. Coca cultivation in the Yungas reached 18,900 ha, an increase of 4% and in Chapare 8,300 ha, an increase of 19%. The Yungas of La Paz accounted for 69% of the total cultivation in 2006.

The total estimate of 27,500 ha also included the 12,000 ha (44% of total cultivation) permitted by the Bolivian Law No 1008 ("Law on the Regime Applicable to Coca and Controlled Substances", 1988) for traditional uses such as leaf chewing, medicinal preparations and coca tea. Further, the total included an additional 3,200 ha of coca cultivation temporarily authorized in October 2004 by the Government of Bolivia in the Chapare region by a decree.

In Chapare, a total of 2,228 ha of coca cultivation was found in two National Parks, this represented 27% of the coca cultivation of Chapare region. Ecosystems in National Parks are particularly fragile and the deforestation for the establishment of coca fields is thought to contribute to fragmentation of habitats, loss of biodiversity, and soil erosion, among other environmental problems.

The overall area under coca cultivation produced an estimated 47,800 metric tons of sun-dried leaf, of which 33,200 metric tons were estimated to be available for cocaine production. These figures are based on the result of a new coca leaf yield study implemented by UNODC in 2006. Applying a conversion ratio for Chapare of 370 kg of coca leaf for one kg of cocaine and for Yungas of 315 kg of coca leaf for one kg of cocaine, the potential **cocaine** production in Bolivia amounted to **94 metric tons** in 2006. This corresponded to **an increase of 18%** compared to the 2005 estimate of 80 metric tons.

Farm-gate prices of sun dried coca leaf decreased in 2006, to US\$ 3.9/kg. The decrease in prices was mainly due to the decrease of the price in Chapare, probably following increasing availability in 2006. Prices of coca leaf and its derivatives, coca base and cocaine hydrochloride, also declined. Between 2005 and 2006, total **seizures of coca leaves increased from 886 mt to 1,342 mt, while cocaine HCL seizures in 2006 remained stable at 1,309 metric tons.**

The farm-gate value of coca leaf production in Bolivia reached **US\$180 million** in 2006. This estimate took into account the total value of coca leaf in the market controlled by DIGCOIN, as well as the farm-gate value of coca leaf outside this market. The total value was equivalent to 2% of the country's GDP for 2006 (US\$ 8.7 billion) or 13% of the value of the agricultural sector in 2006 (US\$ 1.37 billion).



Coca cultivation in steep slopes in Coripata Municipality



Water streams from the Carrasco National Park Conform the Isarzama River close to similarly named town in Cochabamba Tropics



Arapata Town surrounded of coca fields in Yungas of La Paz

1 INTRODUCTION

The objectives of UNODC's Illicit Crop Monitoring Programme (ICMP) are to establish methodologies for the collection and analysis of data on illicit crops and to improve Governments' capacity to monitor these crops in the context of the strategy adopted by Member States at the General Assembly Special Session on Drugs in June 1998. ICMP is currently active in seven countries: Afghanistan, Bolivia, Colombia, Lao PDR, Morocco, Myanmar and Peru.

The Bolivian Government and UNODC launched the project "Land use management and monitoring system in the Yungas of La Paz" in October 2001. Initially, the project focused only on the Yungas of La Paz, but since 2003 it has extended its scope to provide estimates on coca cultivation at the national level. This report presents the project's findings and methodology for 2006.

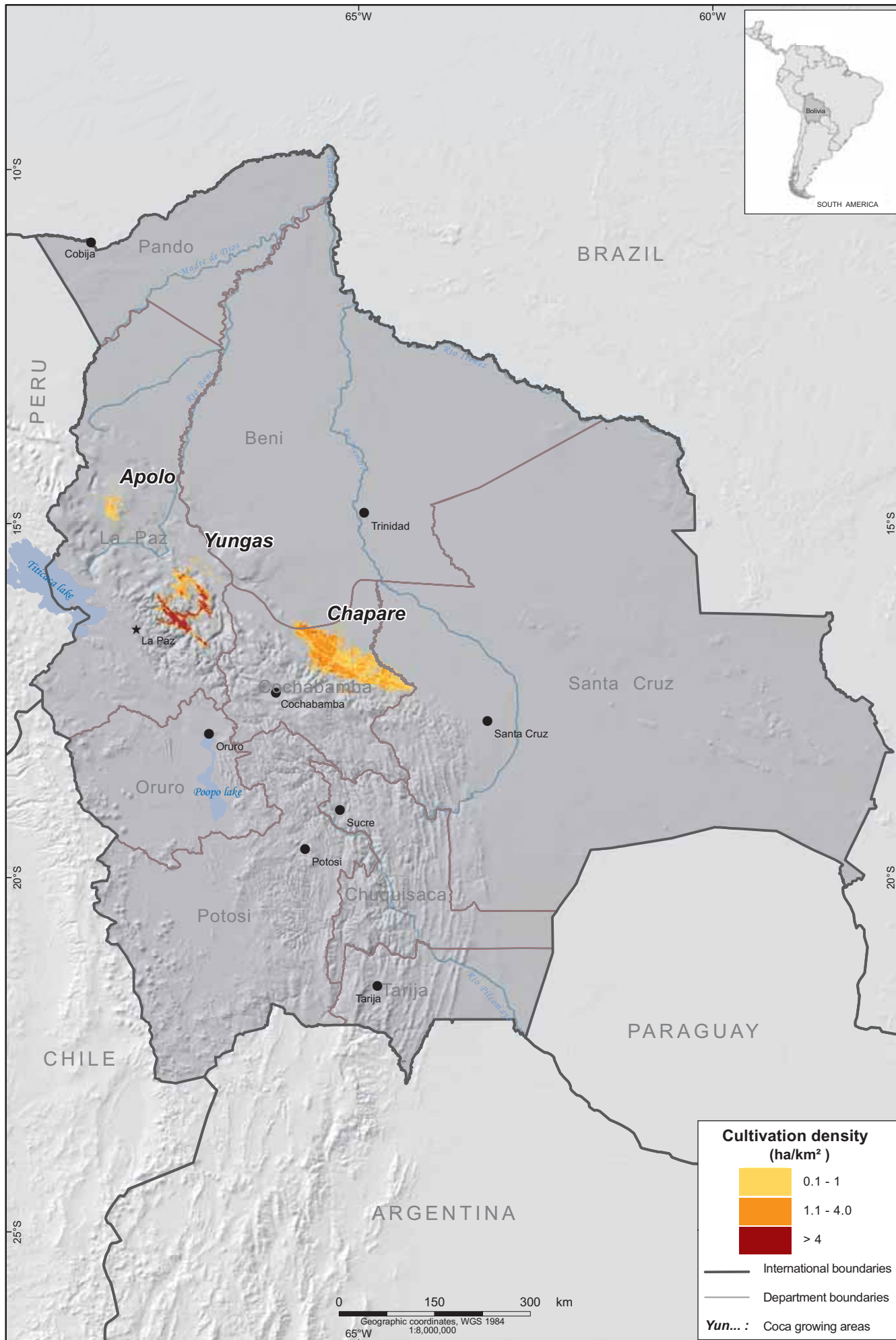
During 2006, the project was implemented in cooperation with the National Direction of Development for the Coca Growing Regions (DIGPROCoca, former DIRECO), Vice-Ministry of Coca and Integral Development. DIGPROCoca provided logistical support during the implementation of ground activities, including the collection of a large number of ground control points, mainly in the Chapare area. The Bolivian National Government, through the National Council of Fight against Illicit Trafficking of Drugs (CONALTID) uses the information provided by this project for planning and implementing its strategy for the fight against illicit drug trafficking.

Coca cultivation decreased significantly in Bolivia at the end of the 1990s, following a significant reduction in the area under coca cultivation in the Chapare region. Bolivia is now the third largest coca producer worldwide, far behind Colombia and Peru. Coca cultivation is concentrated in the departments of La Paz (in the areas of the Yungas of La Paz and Apolo) and in the Chapare area (department of Cochabamba).

Bolivian Law 1008 ("Law on the Regime Applicable to Coca and Controlled Substances", 1988) permits up to 12,000 ha of traditional coca cultivation for traditional consumption and other legal uses. Most of this area is located in the Yungas of La Paz. In addition, in October 2004, the Bolivian Government temporarily authorized the cultivation of 3,200 ha of coca in the Chapare region. Law No 1008 does not provide a precise definition of the geographic limits of the traditional coca growing areas, however, the Bolivian Government is preparing a study which is intended to lead to legal delineations of the areas where coca for traditional use will be cultivated.

The National Government is also planning to develop a study to determine the national coca leaf demand for traditional purposes.

Coca cultivation density, Bolivia 2006



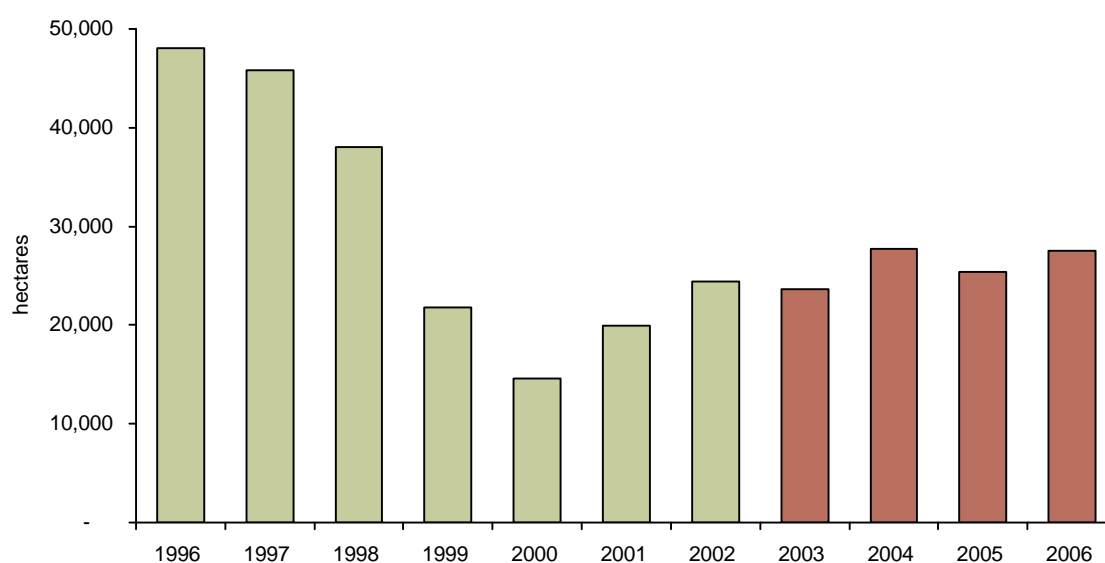
Source: Government of Bolivia - National monitoring system supported by UNODC.
 The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

2 FINDINGS

2.1 COCA CULTIVATION

In 2006, the total area under coca cultivation in Bolivia was estimated at 27,500 ha, an increase of 8% over last year's estimate of 25,400 ha. The increase at the national level was due to the increase in the main cultivation regions, Yungas of La Paz and Chapare. In the Chapare region, the increase occurred mainly in the North-West part, in the surroundings of and inside the Isiboro Secure National Park. The significant increase inside the Park could be attributed to the absence of eradication during 2006 in this isolated area (see map 10). In the Yungas of La Paz, low levels of eradication combined with migration processes from the impoverished areas of Bolivia, to the Yungas are the reason for a continued increasing trend since 2002.

Figure 1. Coca cultivation in Bolivia, 1996 – 2006 (ha)



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

Table 1. Coca cultivation in Bolivia, 1996– 2006 (ha)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Rounded total	48,100	45,800	38,000	21,800	14,600	19,900	24,400	23,600	27,700	25,400	27,500

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

At the global level, the increases in Bolivia and Peru were more than offset by an even stronger decrease in Colombia, and coca cultivation in the Andean region declined by 2% to 156,900 ha. Coca cultivation in Bolivia represented 18% of the global coca cultivation in 2006, compared to 16% in 2005. Bolivia remained the third largest coca cultivator, behind Colombia and Peru.

Figure 2. Coca cultivation in the Andean region, 1990 – 2006 (ha)

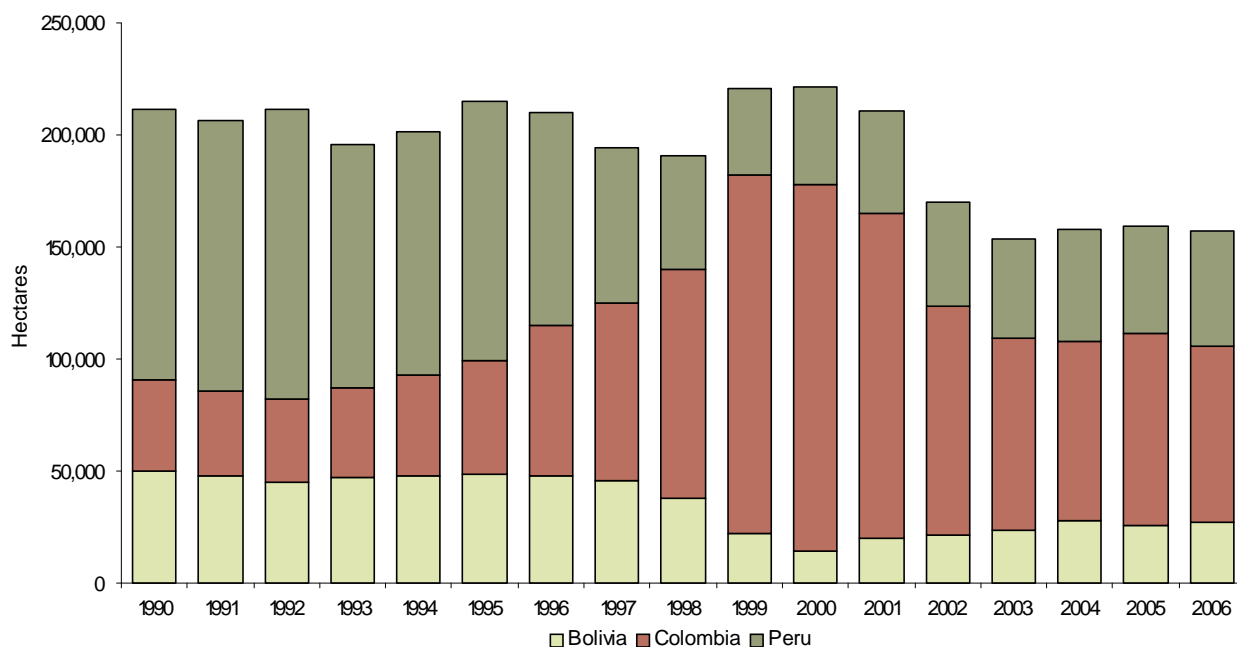


Table 2. Coca cultivation in the Andean region, 1996- 2006 (ha)

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	% change
Bolivia	48,100	45,800	38,000	21,800	14,600	19,900	21,600	23,600	27,700	25,400	27,500	8%
Colombia	67,200	79,400	101,800	160,100	163,300	144,800	102,000	86,000	80,000	86,000	78,000	-9%
Peru	94,400	68,800	51,000	38,700	43,400	46,200	46,700	44,200	50,300	48,200	51,400	7%
Total	209,700	194,000	190,800	220,600	221,300	210,900	170,300	153,800	158,000	159,600	156,900	-2%

Sources United States Department of States National Monitoring Systems Supported by UNODC

Coca cultivation density in the Andean Region, 2006



Sources: National monitoring systems supported by UNODC - Governments of Bolivia, Colombia and Perú
 The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

Coca cultivation changes 2005 - 2006, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC.
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2.1.1 REGIONAL ANALYSIS

An increase in coca cultivation at the national level, from 25,400 ha to 27,500 ha or 8% is the result of the combined increase in the Chapare and Yungas areas.

In most of the Chapare region, farmers are cultivating an average of 0.16 ha of coca, locally called “cato”, which is the surface allowed according to an agreement reached between the Government and social organizations of coca farmers in October 2004. Nevertheless, in some isolated regions, bigger fields were found. Unlike what happened in the year 2005, the eradication efforts in Chapare were followed by a replanting, mainly in the Isiboro Secure National Park.

Aerial photographs and geo-videos taken over Chapare during the survey clearly show the trend to cultivate coca on fields with the size of one *cato* in most parts of this region.

In both Yungas and Chapare regions, the new cultivation occurs mainly in isolated places, where controls and eradication are difficult to implement.

Table 3. Coca cultivation estimates by region, 2002 – 2006 (ha)

Region	2002	2003	2004	2005	2006	% change 2005-2006	% of 2006 total
Yungas of La Paz	13,800	16,200	17,300	18,100	18,900	4%	69%
Chapare	n.a.	7,300	10,100	7,000	8,300	19%	30%
Apolo	n.a.	50	300	300	300	0%	1%
Country total		23,550	27,700	25,400	27,500	8%	100%

Figure 3. Coca cultivation estimates by region, 2002 – 2006 (ha)

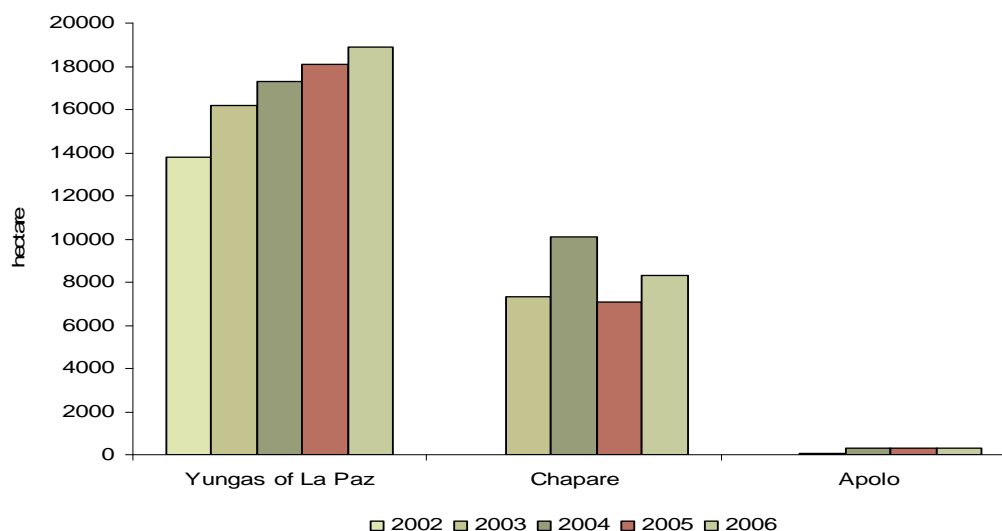
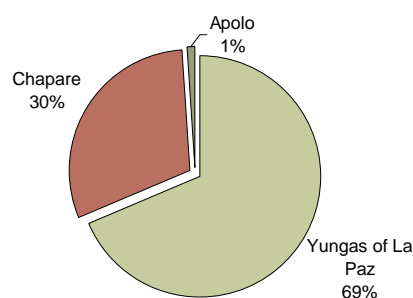
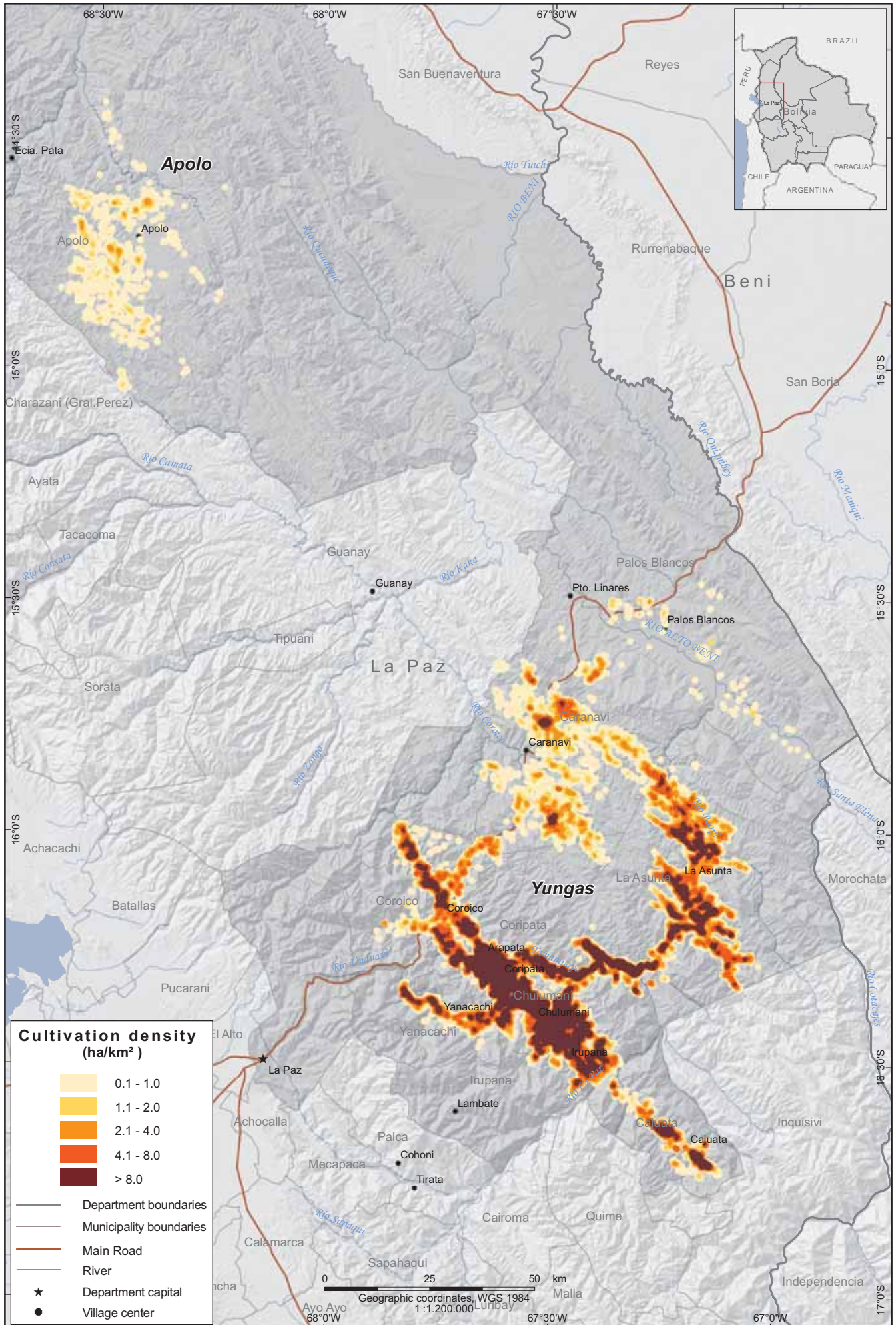


Figure 4. Distribution of coca cultivation in Bolivia by region, 2006



Coca cultivation density for the Yungas of La Paz and Apolo, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC.
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2.1.2 Coca cultivation in the Yungas of La Paz

The Yungas of La Paz, situated at about 150 km from the city of La Paz, at the eastern side of the Andes Range, is a region of uneven relief with steep slopes, turbulent rivers and elevations ranging from 300 to 4,000 meters above sea level. Significant climatic variations are observed even over short distances. Coca bush is predominantly cultivated on narrow terraces built on high gradient hills.



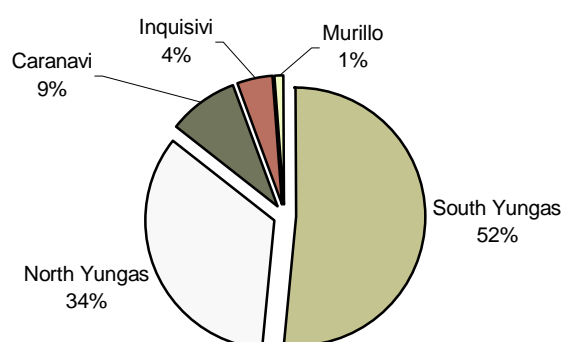
Coca cultivation in the municipality of La Asunta

The survey revealed 18,900 ha of coca cultivation in the Yungas of La Paz in 2006, representing an increase of 4% compared with the 18,100 ha found in 2005. Most of the cultivation continued to take place in the provinces of South Yungas and North Yungas, accounting respectively for 52% and 34% of the regional total. The largest annual increase (24%) was observed for third year in a row in Caranavi province, but this province only accounted for 9% of the regional total in 2006. It has been the fifth consecutive annual increase observed by the monitoring project in the Yungas of La Paz. Between 2002 and 2006, coca cultivation increased by 37% in this region.

Table 4. Distribution of coca cultivation in the Yungas of La Paz, 2002-2006 (ha)

Province	2002	2003	2004	2005	2006	% change 2005-2006	% of 2006 total
South Yungas	7,182	8,356	8,867	9,395	9,753	4%	52%
North Yungas	5,187	5,914	6,166	6,257	6,432	3%	34%
Caranavi	491	889	1,248	1,381	1,714	24%	9%
Inquisivi	741	801	805	807	809	0%	4%
Murillo	151	210	217	223	225	1%	1%
Rounded total	13,800	16,200	17,300	18,100	18,900	4%	100%

Figure 5. Distribution of coca cultivation in the Yungas of La Paz, 2006 (ha)

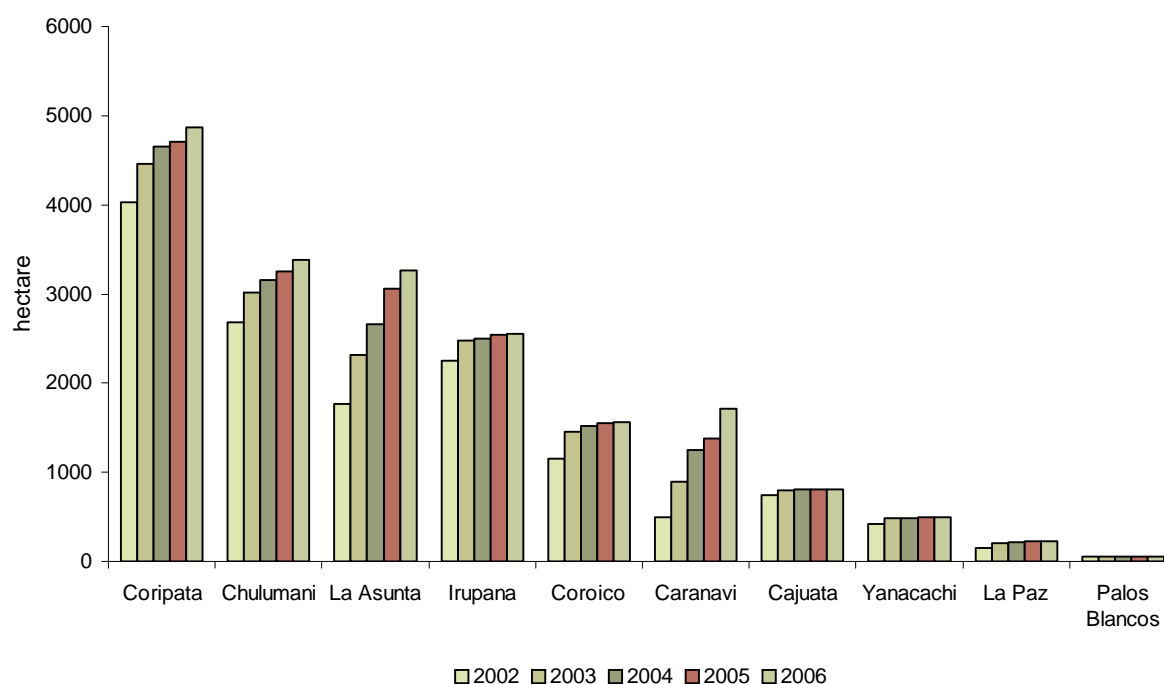


In this year's survey, the municipality of Caranavi - the only municipality of the province of Caranavi- registered the largest annual rate of increase in coca cultivation with 24%. However, the municipality of Coripata in North Yungas province remained the most important centre of coca cultivation in the region of the Yungas of La Paz, with 4,872 ha in 2006 (or 26% of the regional total). Compared with 2005, coca cultivation increased in all municipalities, except in Palos Blancos, where a small decrease was observed.

Table 5. *Distribution of coca cultivation by municipality in the Yungas of La Paz, 2002-2006 (ha)*

Province	Municipality	2002	2003	2004	2005	2006	% change 2005-2006	% of 2006 total
North Yungas	Coripata	4,032	4,456	4,651	4,708	4,872	3%	26%
South Yungas	Chulumani	2,678	3,020	3,157	3,252	3,386	4%	18%
South Yungas	La Asunta	1,771	2,314	2,666	3,055	3,266	7%	17%
South Yungas	Irupana	2,253	2,481	2,502	2,544	2,553	0%	14%
North Yungas	Coroico	1,155	1,458	1,515	1,549	1,560	1%	9%
Caranavi	Caranavi	491	889	1248	1381	1714	24%	8%
Inquisivi	Cajuata	741	801	805	807	807	0%	4%
South Yungas	Yanacachi	421	483	488	494	499	1%	3%
Murillo	La Paz	151	210	217	223	225	1%	1%
South Yungas	Palos Blancos	59	58	53	50	49	-2%	0%
TOTAL		13,800	16,200	17,300	18,100	18,900	4%	100%

Figure 6. *Distribution of coca cultivation by municipality in the Yungas of La Paz, 2002-2006 (ha)*



Bolivian Law 1008 ("Law on the Regime Applicable to Coca and Controlled Substances", 1988) permits up to 12,000 ha of traditional coca cultivation for traditional consumption and other legal uses. Most of this area is located in the Yungas of La Paz, although the law does not provide for a geographic delimitation of the traditional coca cultivation area. Most of the coca leaf produced in the Yungas of La Paz is traded through the coca market, controlled by DIGCOIN, of Villa Fatima in La Paz-city.

Only a small amount of coca fields were eradicated in Yungas in 2006. In this region, once again, it was observed that there were settlements emerging, mainly populated with people coming from the Altiplano (La Paz, Potosí, Oruro, etc). These new settlements were established in previously uninhabited areas of La Asunta and Caranavi, and their primary agricultural activity was coca cultivation.

A study on coca leaf yield conducted by UNODC and the Government in the Yungas in 2006 confirms that farmers were using more sophisticated agricultural techniques in their coca fields, employing more fertilizers, pesticide and mechanical irrigation to improve the yield of their coca fields. In Caranavi, new coca fields are often established at the expenses of the primary forest or coffee plantations, benefited from higher yields due to the richer soils.

Figure 7. 3-D view in South Yungas La Paz, 2006



3-D Visualization of satellite image showing coca cultivation in steep slopes



Picture corresponding to the 3-D satellite image

Figure 8. Example of the evolution of the coca cultivation in La Asunta Chica

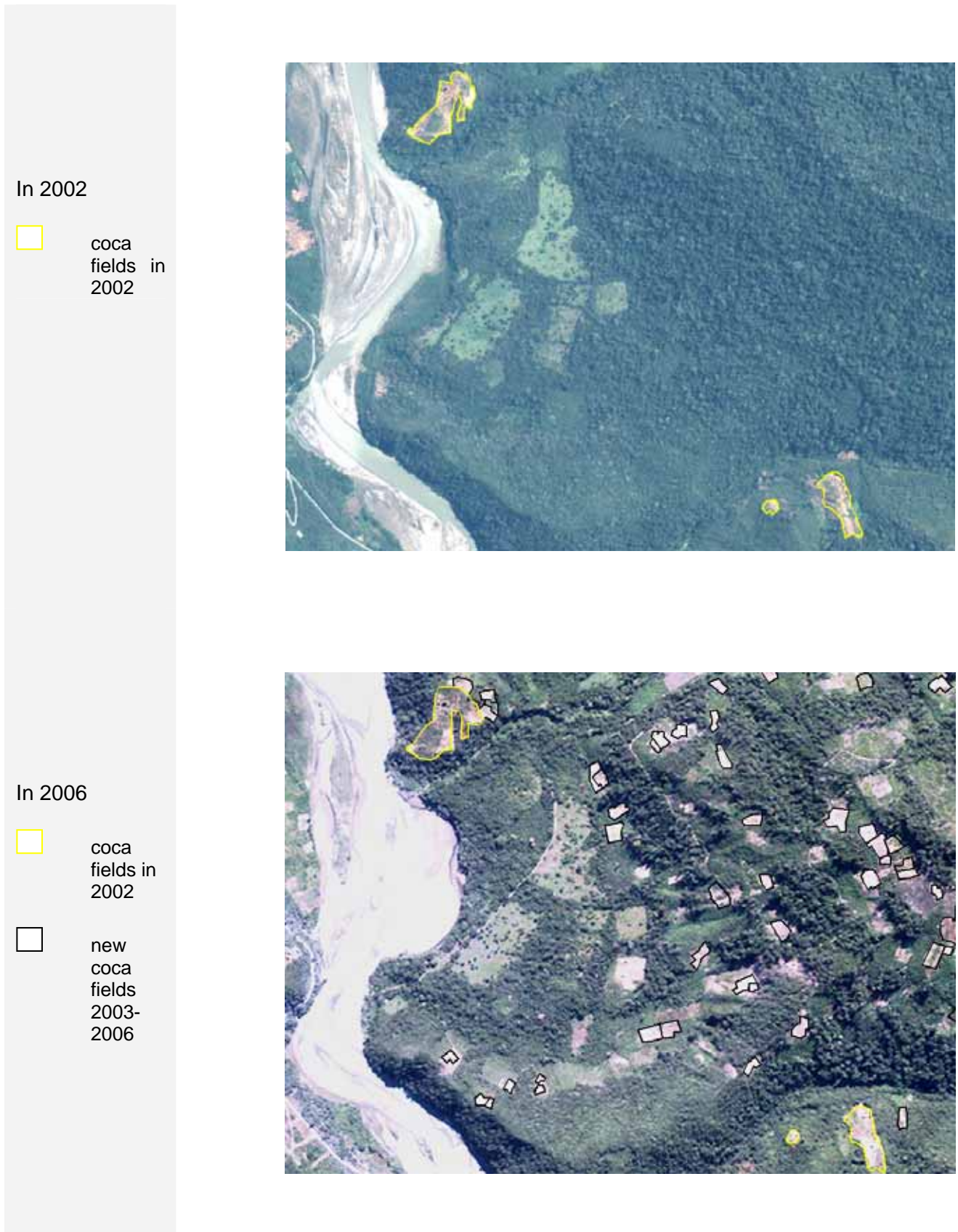
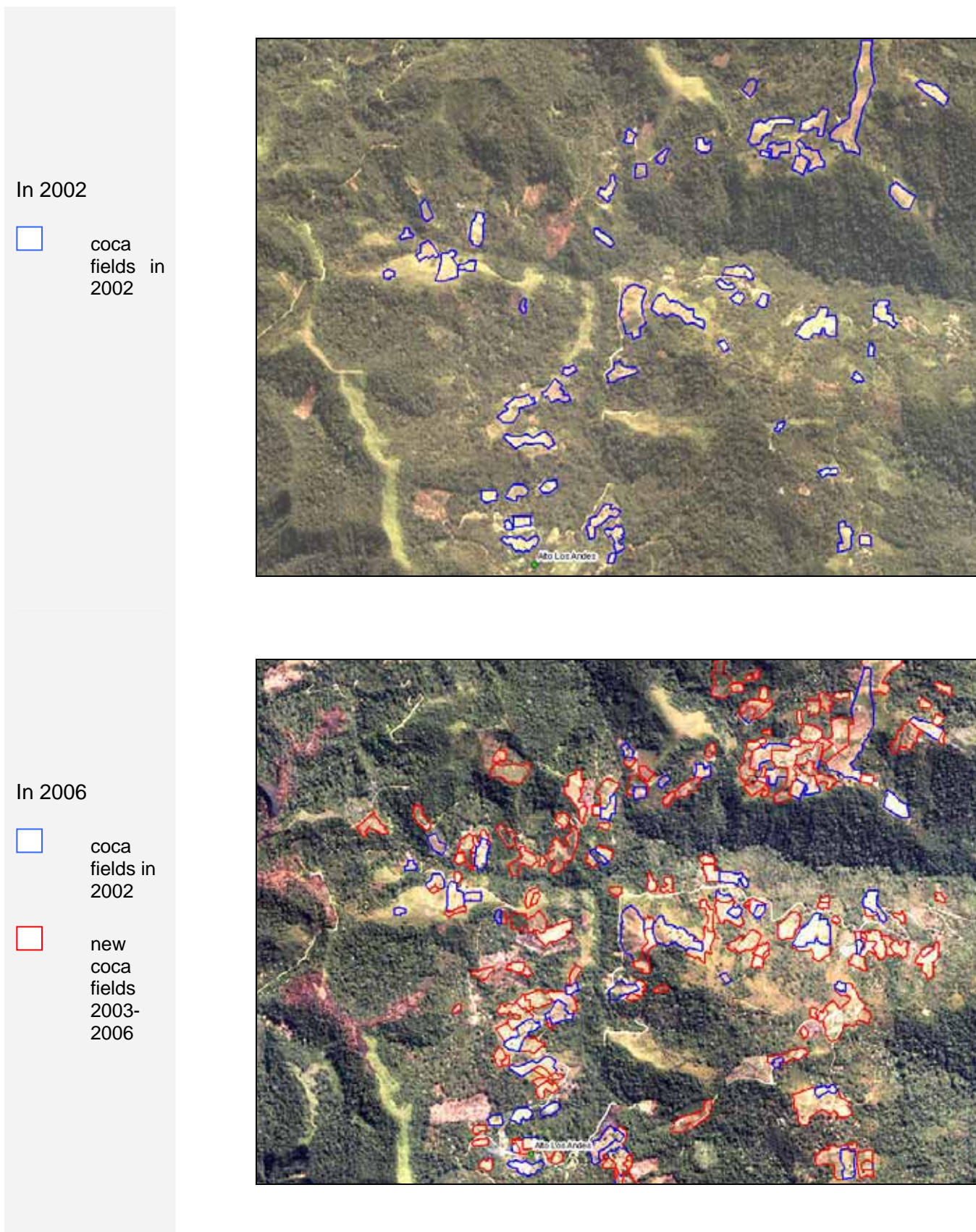


Figure 9. Example of the evolution of the coca cultivation in La Asunta Chica



Coca cultivation techniques in the Yungas of La Paz

1. Burning of land and soil preparation: The burning of land often takes place during the dry season (May to August), but it can also happen until the month of December if the weather conditions are suitable.



2. Terraces construction: Most of the coca fields are established on wuchus (terraces) to avoid erosion and soil nutrients loss. This practice prolongs the life of the crop. The width of the terraces varies from forty-five centimeters to one meter, depending on the slope. The lines of furrows for coca cultivation are established transversally to the slope direction. This practice is widely used in traditional areas, while in the rest of the Yungas, terraces are not built.



The width and shape of the wuchus varies according to the slope and structure of the terrain.

3. Seedling and transplant: The coca seeds are obtained from plants of 5 years old or older. The seeds are settled in a seedling nursery of rich soil and abundant irrigation. They are protected from the sun for about 4-6 weeks before their transplantation to the field.

Coca seeds before start a seedling



Young plants are carefully transplanted into the new field



4. Young crop and first harvest: The small plants are carefully planted in the field, at a distance of 20 cm between each other. During the first few days, they are continuously irrigated. A new crop produces its first harvest usually 12 months after the transplantation, but there have been reports of fields harvested as soon as 8 months after transplantation thanks to the use of fertilizer.



In the Yungas of La Paz, harvest of coca fields is mainly done by women and children.

5. Maintenance: In the Yungas of La Paz, a phytosanitary treatment is applied to coca bushes using fertilizers, and pesticides. Irrigation is also widely used. Typically, the pesticides are applied to the bushes right after the harvest, in order to protect the crop from a variety of plagues, including larvae, fungus and ants. At 4-5 years old, the plant is totally pruned, leaving only the base of the trunk. This practice known as *pillu* greatly increases the yield of the crop starting from the next harvest, which is produced after 6-8 months. The life of a coca field is about 30 years old.



The intensive use of chemical pesticides, and foliar fertilizers may produce coca leaves which are not suitable for traditional consumption like *Akulliku* (mastication) and tea preparation.

The bottom picture show organic fertilizer being applied to coca plants 3 months after pruning.



Mechanical irrigation is widespread in coca fields.



Example of *pillu* (pruning) in a more than 20 year old coca field. The large trunks at the base reveal that several *pillus* have been practiced to this plants



6. Drying and transport of the leaves: Drying is done carefully to protect the leaves and maintain their quality. After the harvest, the fresh coca leaves are stored for at least one night in the dark and after that spread for sun drying. In the traditional area, the leaves are spread over a special floor built of dark stones called *cachi*. The *cachi* accelerates considerably the time of drying. In other areas, the leaves are spread over agricultural nets. If the coca leaves are spread right after the harvest, they become damaged and their value reduces drastically. If rain comes over the drying coca leaves, or the farmer picks them up before complete drying, the leaves are also damaged.



Coca leaves sun-drying in a *cachi*



Dried coca leaves being packed for further transport and sale

2.1.3 Coca cultivation in Apolo

Apolo is located at the northern part of the department of La Paz, on the eastern edge of the Andean mountain range. With relatively dry weather conditions and poor soils, coca fields in Apolo often have a low yield and are cultivated for only for about three to five years.

In 2004, DIRECO conducted a cadastral survey of coca cultivation in the Apolo region, measuring in situ all the coca fields located in the region. The DIRECO survey revealed that coca cultivation reached 289 ha in 2004. The UNODC/Government project monitored Apolo completely for the first time in 2004, finding 273 ha of coca cultivation.

In 2006, no imagery was acquired in the Apolo region. A field verification was undertaken in September. Some increase in coca cultivation was observed, mainly in the southern part of the Province Franz Tamayo, in areas with fragile ecosystems, while in other parts of Apolo, the team found some abandoned coca fields. New coca fields were located in areas where there used to be primary forest, on both sides of the Camata River, along the border of the provinces Franz Tamayo and Bautista Saavedra. These new coca fields do not represent a significant cultivated surface yet; however, due to the risk of a potential expansion, the project will continue monitoring this area in the coming years.

Table 6. *Coca cultivation in Apolo region, 2003 and 2006 (ha)*

Province	Municipality	2003	2004	2005	2006	% change 2005 - 2006
Franz Tamayo	Apolo	50	300	300	300	0%

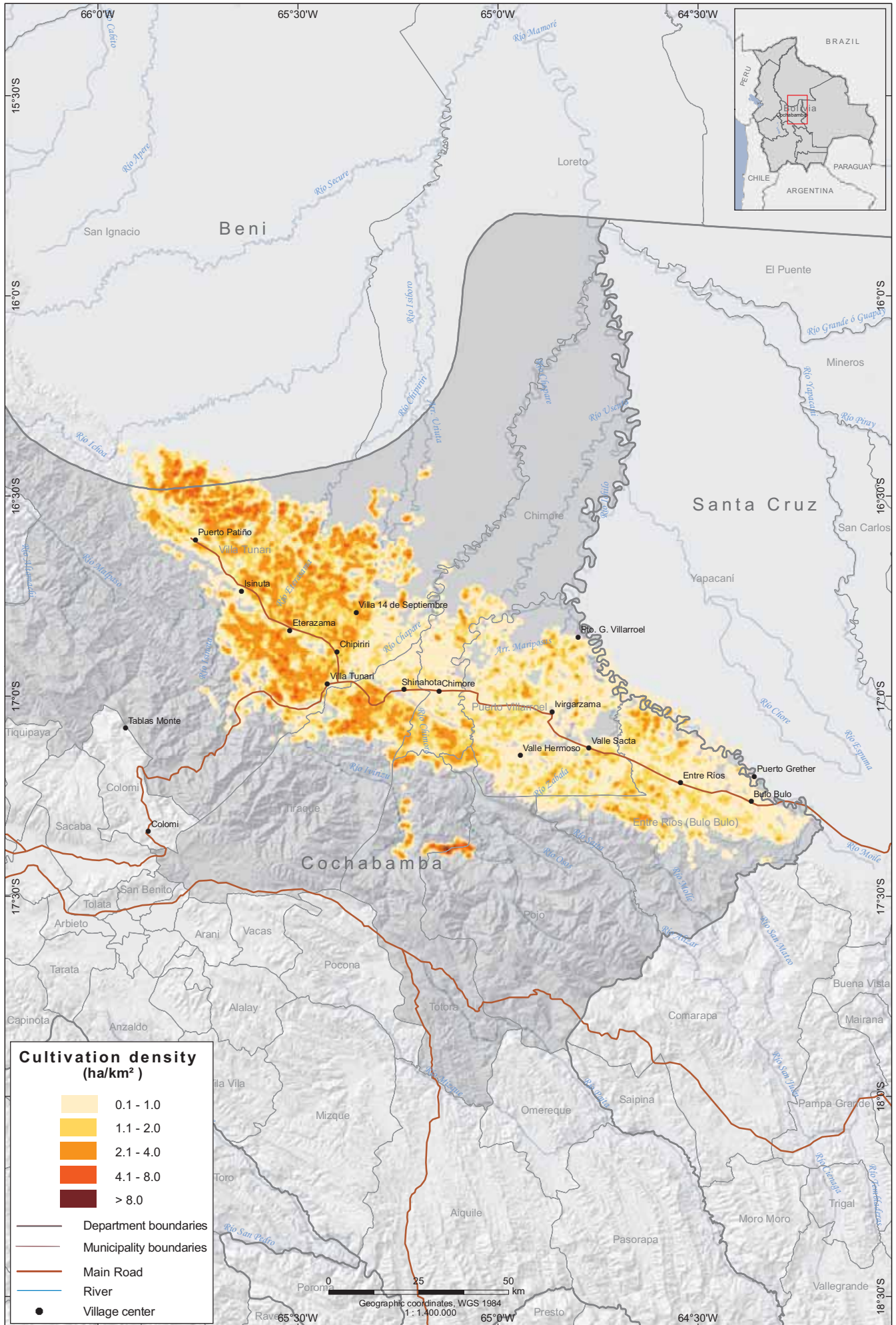
Coca cultivation in Apolo region is traditionally associated with cassava to take advantage of the same furrow for two different crops. The coca fields in central Apolo are scattered and relatively small (about 200 m²) compared to the new coca fields found in the southern part or elsewhere in the country. Terraces are not used. The coca cultivation techniques and coca leaf sun drying are similar to techniques used in the Yungas area of La Paz.

The northern part of Apolo is part of the Madidi National Park, the largest biosphere reserve in Bolivia. Only a few dispersed and small coca fields were found on the western side of the Madidi Park. In Apolo, coca cultivation is considered traditional according to law 1008. No eradication is undertaken in this area.



Expansion of coca cultivation at the southern part of Franz Tamayo Province, bordering the Camata River

Coca cultivation density for Chapare, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC.
The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

2.1.4 Coca cultivation in Chapare

The Chapare region is situated in Cochabamba department, and the region is also referred to as the Cochabamba tropics, extending over the provinces of Chapare, Carrasco and Tiraque. In contrast to the Yungas of La Paz, Chapare region has moderate slopes and huge rivers. Elevations vary from 300 to 2500 meters, with coca cultivated between 300 and 1000 meters. The highest mountains are located in the south and the country's large tropical savannas begin in the northern part of Chapare. Temperatures are tropical and the area records the highest precipitation levels in Bolivia.

In the nineties, the Chapare region held the largest amount of coca cultivation, but following sustained eradication efforts and alternative development programmes, cultivation decreased dramatically.

The 2006 survey found 8,300 ha of coca cultivation in Chapare, representing an increase of 19% compared to the 7,000 ha found in 2005. The increase is mainly due to the planting of new coca bushes inside the Isiboro Secure National Park, where no eradication was undertaken during 2006. In Chapare, the average field size is around 0.16 Ha. This is in line with an agreement signed between the coca farmers and Government in October 2004, which temporarily authorizes 3,200 ha of coca cultivation in Chapare, and the current Government policy of authorizing one *cato* (0.16 ha) of coca per household. The aerial photographs and field missions revealed that a significant number of coca fields were the size of a *cato*.

Between 2005 and 2006, coca cultivation increased in all three provinces of Chapare.

Table 7. Distribution of coca cultivation by province in Chapare region, 2003-2006 (ha)

Province	2003	2004	2005	2006	% change 2005-2006	% of 2006 total
Chapare	4,250	5,844	4,094	4,857	19%	59%
Carrasco	2,864	3,520	2,312	2,791	21%	34%
Tiraque	214	723	605	691	14%	8%
Rounded Total	7,300	10,100	7,000	8,300	19%	100%

Table 8. Distribution of coca cultivation by municipality in Chapare region, 2003-2006(ha)

Province	Municipality	2003	2004	2005	2006	% change 2005-2006	% of 2006 total
Chapare	Villa Tunari	4,250	5,841	4,094	4,857	19%	59%
Carrasco	Entre Ríos	1,106	1,921	817	870	6%	10%
Carrasco	Puerto Villarroel	1,394	821	818	1,110	36%	13%
Tiraque	Tiraque	214	724	605	691	14%	8%
Carrasco	Chimore	250	525	432	542	25%	7%
Carrasco	Totora	114	253	245	270	10%	3%
Rounded Total		7,300	10,100	7,000	8,300	19%	100%

The municipality of Villa Tunari continued to be the most important area of coca cultivation in the region representing 59% of the coca cultivation in Chapare in 2006, and showing an increase of 19% in this municipality between 2005 and 2006. The municipality includes part of the Isiboro Secure National Park, which remained the national park with the highest level of coca cultivation in the country and the region with the largest increase.

It should be noted that political boundaries are not properly defined between the departments of Cochabamba and Beni. For this reason, although some coca cultivation might actually be located in Beni Department, all the coca fields identified during the survey along the undefined departmental border were counted as part of the municipality of Villa Tunari, in the Department of Cochabamba.

Figure 10. Distribution of coca cultivation by municipality in Chapare region, 2003 – 2006 (ha)

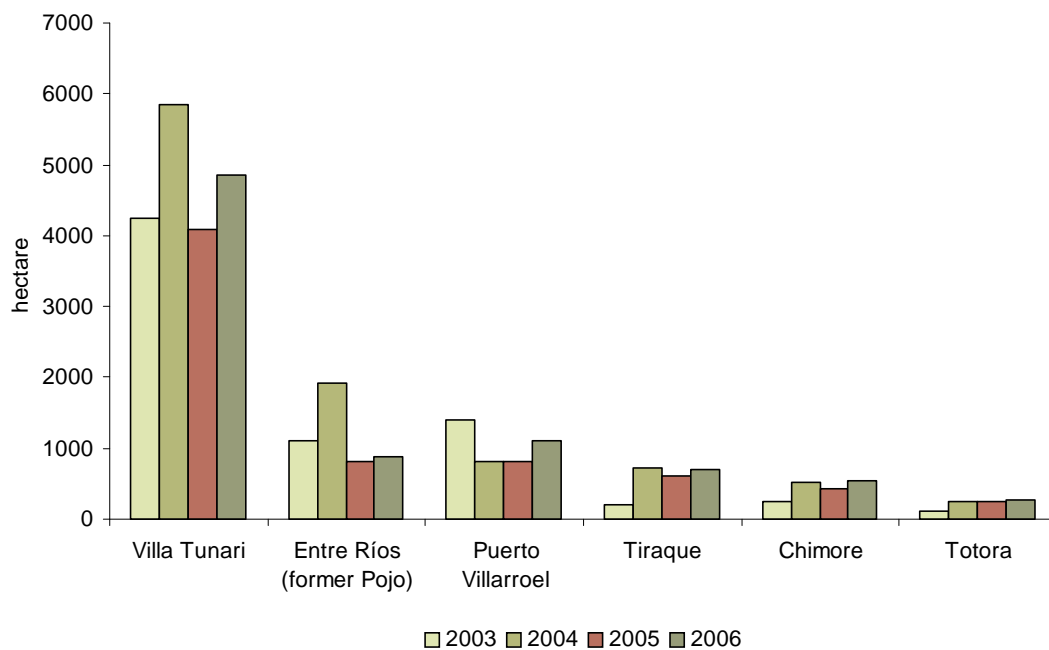


Figure 11. Distribution of coca cultivation by municipality in Chapare region, 2006 (ha)

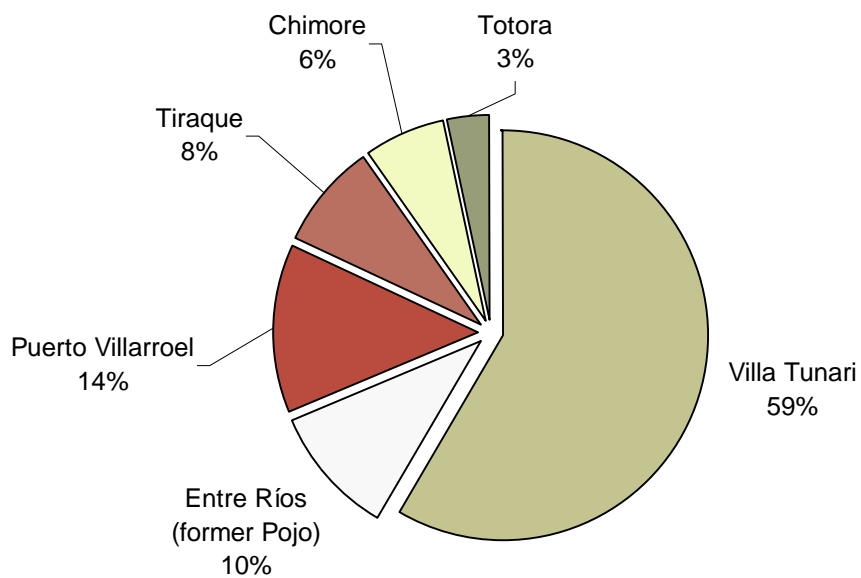


Figure 12. Coca fields of 1 *cato* size in Chapare



Aerial photo with interpreted coca fields of *cato* size



Field picture of a *cato* example

In past years, farmers of the Cochabamba Tropics used to intersperse or hide coca bushes in order to avoid detection and eradication. These practices are not very common nowadays because of the “cato” policy, and most coca fields were found were free of association with other crops.

It is generally accepted that coca cultivation is done with much more care in Yungas than in Chapare, and the techniques of cultivation differ from the ones used in Yungas. For example, the seedbeds in Chapare are usually not covered.



The picture shows encircled in red a seedling prepared for further transplantation in the already burned field

Since the terrain is flat, there is no need to build terraces. The coca bushes in Chapare are bigger than in Yungas. The practice of pruning coca bushes does not exist. This could be due to the intensive eradication of the past years, resulting in most of the coca fields being younger than four years old and do not need pruning.



Harvesting a coca field free of association or coverage

Association with other crops or coca cultivated under canopy was a common practice in past years, but it is now only present in certain areas of Chapare.

The association of coca with other crops is sometimes done to take advantage of the same opened space, or coca is placed under leguminous trees, which fix nitrogen in the soil which improves the yield.



Coca field partially covered by canopy



Coca field associated with banana

In Chapare, the coca leaves are also sun dried on bare floor before commercialization, but not with the same care as in the Yungas. According to FELCN, part of the production is marketed outside the region and another part is used for local consumption (chewing and medicines).

Coca bushes in Chapare may last on average 30 years if they can develop normally. Isolated, scattered old plants of big dimensions have been observed, still yielding substantial quantity of coca leaves. Fertilizers and pesticides are also widely used in the Chapare.



Sun drying coca leaves over bare floor



The high resolution aerial photographs allowed observing sun-drying coca leaves

2.2 COCA YIELD AND PRODUCTION

In December 2005, UNODC started a new coca yield study in the Yungas of La Paz. The survey was implemented jointly by the UNODC Illicit Crop Monitoring Programme through its experts in Bolivia and in Vienna. The field work was implemented by researchers from the Unidad Académica Campesina (UAC) of Carmen Pampa, Yungas de La Paz.

During the survey, samples of sun-dried coca leaf were weighted from 98 coca parcels selected randomly across the region. To determine the sun-dried coca yield in los Yungas de La Paz, the Bolivian survey is based on a "Multistage Stratified Area Frame Sample Design",

Sample frame

As in any survey, the quality of the data collected from the sample surveys depends to a large extent on the quality of the sampling frame from which the sample is to be selected. The sampling frame was constructed according to the principles of the Area Sampling Frame methodology. The basis for the construction of the frame was the coca fields interpreted during the 2004 Coca Cultivation Survey in the Yungas in Bolivia. Within the limits of coca cultivation interpreted in this survey, the frame was divided in a collection of one km² grids.

Stratification

Most surveys estimating crop production are based on stratified multistage cluster designs. Stratification divides the units in the population into mutually exclusive and collectively exhaustive subgroups or strata. Separate samples are then independently selected from each stratum. The main purpose of stratification is to improve the precision of the survey estimates. Therefore, the construction of the strata should be such that units in the same stratum are as homogeneous as possible and units in different strata area as heterogeneous as possible with respect to one or more characteristics of interest to the survey.

Based on previous experience acquired on site by the project team and by the researchers of Carmen Pampa University, the variables that have been considered for stratification were terrain slope and the altitude. These two variables were combined and used as the basis for the stratification of the sampling frame.

Sample Size and sampling allocation

The sample size was decided taking into account the desired precision of the estimates, the constraint of verification of all steps of the survey, the necessity to obtain estimates at the regional level, and the availability of the field researchers to reach the fields.

The precision of an estimate is measured by its standard error. The degree of precision required for the coca yield was set at about +/- 10% of the true value with a 95 per cent probability that it contains the true value.

The sample size has been defined in a way that a thorough verification process can be performed at any time and at every step of the implementation. This assures the high quality of the data collected and the confidence of the estimates generated.

The table below summarizes the sample frame along the different strata.

Table 9. *Coca yield stratification in the Yungas of La Paz*

Strata	Strata definition		Grids	Coca Hectares (2004)	Number of coca Polygons	Number of Samples
	Elevation (m)	Slope (Degrees)				
1	300-1000	0-15	490	1,455	3,890	10
2	300-1000	15-38	11	47	109	10
3	1000-2000	0-15	1,563	10,418	28,124	45
4	1000-2000	15-38	496	3,580	8,246	15
5	> 2000	0-15	170	780	2,368	10
6	> 2000	15-38	163	599	2,080	10
Total			2,893	16,880	44,817	100



Measuring a sample coca field



Weighting a sample of recently harvested fresh leaves

2.2.1 New findings on coca yield in the Yungas of La Paz

The averages presented in this section are derived from the field survey, and corresponded to the simple averages found in the survey sample and extrapolated to the full extent of the sampling frame.

From the analysis of the collected data, the annual sun dried coca leaf yield was estimated at 1,300 kg/hectare. The highest annual sun dried coca leaf yield was found in stratum 1 (elevation between 300 and 1,000 meters, and slope less than 15 degrees), and the lowest annual sun dried coca leaf yield was found in stratum 5 (elevation greater than 2,000 meters and slope less than 15 degrees). The complete averages are described below.

Table 10. *Yield results in the Yungas of La Paz for 2005 and 2006*

Strata	Coca surface (ha)		% Increase	Number of Samples	2005 weighted Average Yield mt/Ha/Year	2006 weighted Average Yield mt/Ha/Year	Estimated potential amount of sun dried coca leaf (mt)	
	2005	2006					2005	2006
1	1,480	1,900	28%	6	2.17	2.17	3,211	4,123
2	48	50	4%	0	1.29	1.29	62	65
3	10,594	10,700	1%	71	1.25	1.25	13,242	13,375
4	4,102	4,200	2%	12	1.21	1.21	4,963	5,082
5	1,111	1,200	8%	6	0.82	0.82	911	984
6	765	850	11%	3	1.49	1.49	1,140	1,267
	18,100	18,900	4%	98	1.300	1.317	23,530	24,895

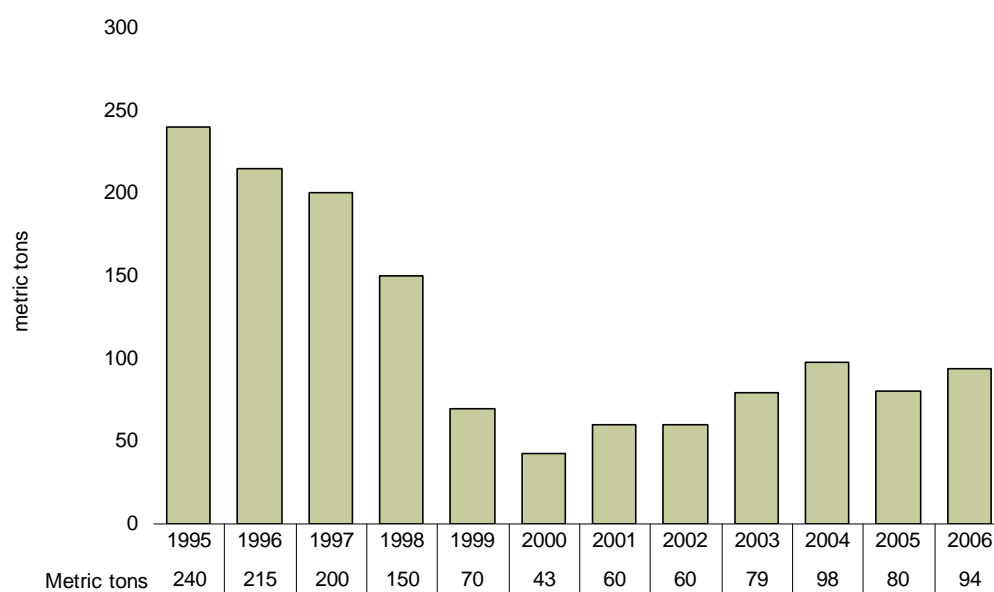
The analysis of the yield survey data concluded that the estimated production of sun dried coca leaf in the Yungas is approximately 24,895 metric tons in 2006. This would represent an increase of 6% in comparison to 2005, if 2006's annual sun dried coca leaf yields are applied to the coca cultivation areas estimated in 2005 (the estimated production of sun dried coca leaf would amount to 23,530 metric tons in 2005).

Law 1.008 authorizes 12,000 ha of coca cultivation in the traditional region. This area is dispersed among the strata 3, 4, 5 and 6. Therefore the weighted sun dried coca leaf yield for this region in 2006 is estimated at 1.22 metric tons/ha/year. The total estimated production of sun dried coca leaf under this law is estimated at 14,660 metric tons in 2006.

In the absence of detailed study on coca leaf conducted jointly the Government of Bolivia and UNODC in Chapare, coca leaf production in that region was estimated from yield estimates previously used by UNODC, from information from the United States Government under the Operation Breakthrough. Thus, sun dried coca leaf production in Chapare was estimated at 22,941 metric tons.

Therefore, the total potential production of cocaine in the country is estimated at about 80 metric tons of cocaine in 2005 and 94 metric tons in 2006, which represents an increase of 17% from 2005 to 2006. The 2005 estimate differs from the one presented in the coca survey in 2005, due to the use of new findings from the yield study undertaken by UNODC in the Yungas of La Paz in 2006.

It should be noted that this estimate represents the potential coca leaf and cocaine production. Due to lack of data, it does not take into account the so far unknown amount of coca leaf from Chapare region destined for local consumption (chewing and medicinal preparation).



Source: UNODC World Drug Report 2007

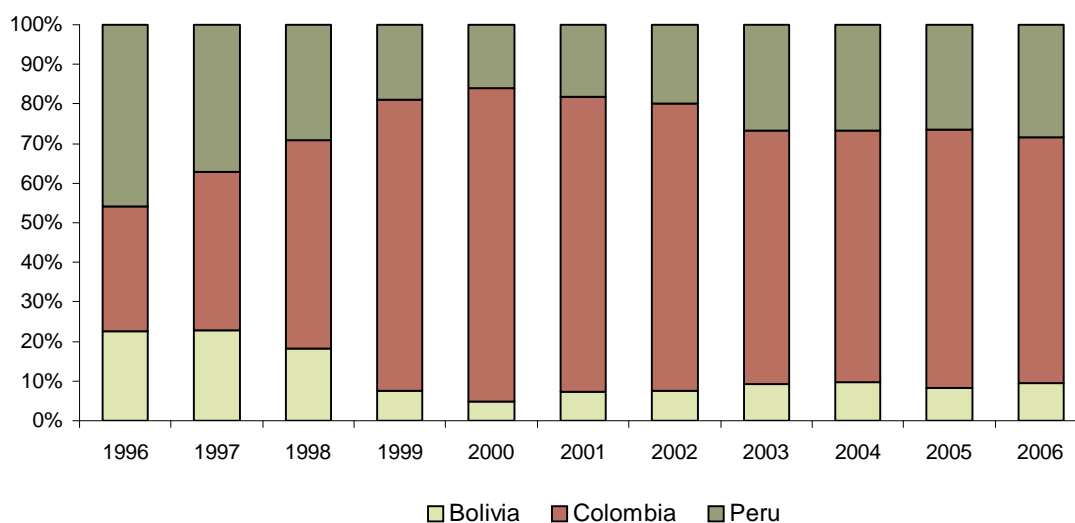
In 2006, potential cocaine production in Bolivia accounted for 10% of the global potential cocaine production of 984 metric tons. Although there is an increase in relation with 2005, the percentage is much lower than in the mid nineties, when Bolivia accounted for about a quarter of the global cocaine production.

Table 11. Potential cocaine production in the Andean Region 1996-2006 (in mt)

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	%change 2005-2006	% of 2006 Total
Bolivia	215	200	150	70	43	60	60	79	107	80	94	18%	10%
Colombia	300	350	435	680	695	617	580	550	640	640	610	-5%	62%
Peru	435	325	240	175	141	150	160	230	270	260	280	8%	28%
Total	950	875	825	925	879	827	800	859	1,017	980	984	0%	

Source: UNODC World Drug Report

Figure 13. Potential cocaine production in the Andean region 1996 - 2006 (in %)



2.3 COCA PRICES AND TRADING

In Bolivia, sun-dried coca leaf trade is regulated by the National Directorate of Coca Leaf Commercialization and Industrialization DIGCOIN, former DIGECO that controls the quantity and prices of coca leaf traded in the two market facilities authorized by the Government: The market of Villa Fatima in La Paz city and the market of Sacaba in Cochabamba department, close to Cochabamba city.

Of the 13,209 metric tons of coca leaves that fell under the control of DIGCOIN in 2006, the largest amount, 12,960 metric tons or 98%, was traded in Villa Fatima, and the remaining 249 metric tons in Sacaba. Prices of coca leaves in Villa Fatima market were higher than in Sacaba market, with respective annual averages of 32 Boliviano/kg (US\$ 4.0/kg) and 25 Boliviano/kg (US\$ 3.1/kg). The annual average weighted price for coca leaves on these two markets was 31 Boliviano/kg (US\$ 3.9/kg) in 2006.

Table 12. *Reported monthly price of coca leaf marketed through DIGCOIN in 2006*

Month	Chapare: Sacaba market	La Paz: Villa Fatima market	Weighted average	
	Price BOL/kg	Price BOL/kg	BOL/kg	US\$/kg
January	27	34	34	4.2
February	26	36	35	4.4
March	24	35	35	4.4
April	23	30	30	3.7
May	19	27	27	3.3
June	28	33	33	4.1
July	28	34	34	4.2
August	22	34	34	4.2
September	28	19	19	2.4
October	28	36	36	4.5
November	22	32	32	4.0
December	22	28	28	3.5
Total	25	32	31	3.9

Source: DIGCOIN

In 2006, DIGCOIN introduced a new way to trade coca leaves by authorizing the direct exchange and sale of coca leaves from coca producers to traditional consumers. According to DIGCOIN, about 196 metric tons of coca leaves have been exchanged under this scheme, out of which 121 metric tons were from Yungas of La Paz, and the remaining 75 metric tons from the Cochabamba Tropics.

Including this new way of trading, a total of 13,081 metric tons were traded from the Yungas, and 324 metric tons from the Chapare, According to the yield study, the area equivalent is 9,931 ha of coca grown in the Yungas of La Paz and 117 ha in the Chapare.

Each trader is authorized by DIGCOIN to trade up to 500 pounds (227 kg) of dry coca leaf per month. DIGCOIN's authorization specifies where the coca leaf are bought (Villa Fatima or Sacaba) and the point of final destination for its retailing. Coca is retailed in packages of maximum 15 pounds (6.8 kg).

The following map shows the distribution of traded coca leaves throughout the country according to the DIGCOIN registry. As in 2005, in 2006, most of the coca leaves ended up in Santa Cruz department, followed by the departments of Tarija, La Paz and Potosi. In Santa Cruz, coca leaves are supplied mostly for the workers of large scale industrial farms of soy beans and sugar canes who use to chew it. Coca chewing is also widespread among miners of the departments of La Paz,

Potosi and Oruro. Although not documented, it is likely that an increasing quantity of coca leaves traded in the southern of the country is smuggled to neighboring Argentina.

The total value of the coca leaves traded through the control of DIGCOIN amounted to 415 millions Boliviano or US\$ 51.2 millions in 2006, with no significant variation compared to 2005.

Including the new ways of coca commercialization, between 2005 and 2006, the volume of trade increased by 4% (from 12,872 mt to 13,422 mt), while the average annual prices decreased by 8% (from Bs. 35/kg to Bs. 32/kg). It seems that this market responded to the economic law of supply and demand: when the quantity available for trade increases, prices tend to decrease.

Farm-gate prices of sun dried coca leaf have been collected in Chapare on a monthly basis by DIGPROCOCA (former DIRECO) since 1990 and by the UNODC monitoring project in the Yungas of La Paz since 2004. Average annual prices for coca leaf were higher in the Yungas of La Paz with 36 Boliviano/kg (US\$4.4/kg) than in the Chapare with 26 Boliviano/kg (US\$ 3.2/kg).

Table 13. *Monthly sun dried coca leaf price in the Yungas of La Paz, 2006*

Month	Municipality of Coripata	Municipality of Chulumani	Municipality of La Asunta	Municipality of Caranavi	Average	
	Bol/Kg	Bol/Kg	Bol/Kg	Bol/Kg	Bol/Kg	\$US/Kg
Jan	35	34	37	37	36	4.4
Feb	35	33	37	37	36	4.4
Mar	34	33	37	37	36	4.4
Apr	33	34	36	37	35	4.4
May	33	35	36	38	36	4.4
Jun	36	35	38	38	37	4.6
Jul	36	35	38	38	37	4.5
Aug	36	35	38	37	36	4.5
Sep	34	34	37	37	36	4.4
Oct	34	34	37	37	35	4.4
Nov	36	34	37	37	36	4.4
Dec	33	34	37	37	35	4.4
Annual average	35	34	37	37	36	4.4

Source: UNODC monitoring project

Compared to 2005, in 2006 sun dried coca leaf prices decreased slightly to Bs. 36/kg in the Yungas.

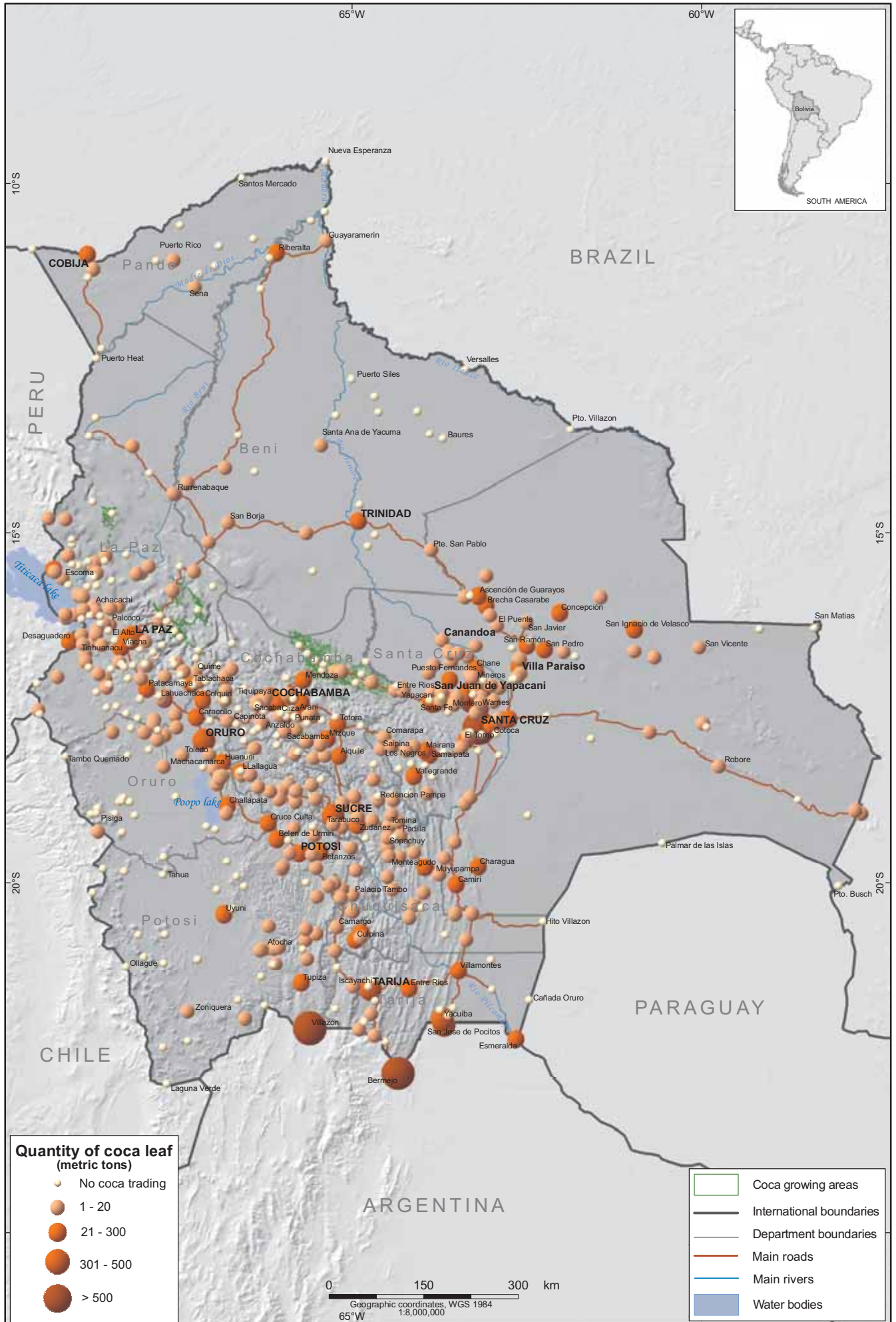
Table 14. *Reported monthly sun dried coca leaf prices in the Chapare, 2006*

Month	Bol/Kg	\$US/Kg
January	32.4	4.0
February	26.4	3.3
March	22.9	2.8
April	21.7	2.7
May	2.0	2.7
June	25.4	3.1
July	28.4	3.5
August	24.9	3.1
September	27.7	3.4
October	29.5	3.7
November	26.5	3.3
December	26.5	3.3
Annual average	26.2	3.2

Source: DIGPROCOCA

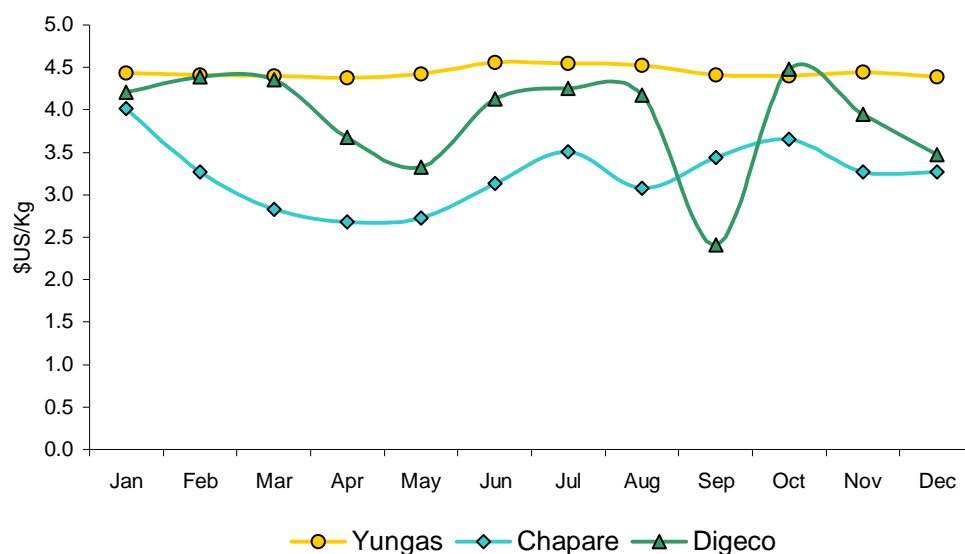
For second year in a row, coca leaf prices in Chapare region decreased, from Bs. 33/kg in 2005 to Bs. 26.2 in 2006 (-26%). The decrease in prices can be attributed to the increase in the offer, and also to the increased interdiction efforts in the region that disturbed the coca market and made it less attractive in general for coca buyers.

Coca leaf trading authorized by DIGCOIN, Bolivia 2006



Source: Government of Bolivia - DIGECO - National monitoring system supported by UNODC. The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

Figure 14. Monthly sun dried coca leaf price in the Yungas of La Paz and Chapare Bolivia 2005



Sources: UNODC monitoring project/ /DIGPROCOCA/ DIGCOIN

Weighted by production, the annual average price for coca leaf outside the market controlled by DIGCOIN was US\$ 4.1/kg. This was a higher price than the price US\$ 4.0/kg on the market controlled by DIGCOIN. However, during the dry season when less coca leaves were available, prices from the markets controlled by DIGCOIN were similar and even larger than prices on other markets.

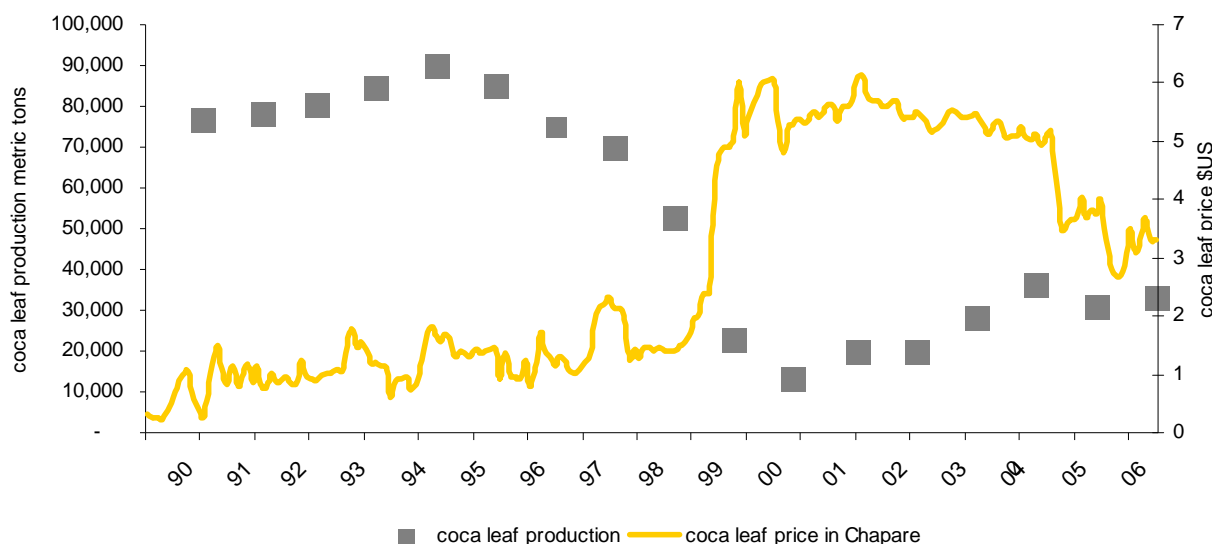
Prices of coca leaves have not been systematically recorded for Apolo. Anecdotal information reported much lower prices in Apolo than elsewhere in the country, ranging from US\$2.5 to US\$2.8/kg in 2005. The reason for lower prices in Apolo could be attributed to the remoteness of the region, far from the main trading centers. The low coca leaf production in Apolo (281 mt) was rather negligible compared to the national total, and therefore was not taken into account in the establishment of the national annual price estimate.

The long term trend of prices can be appreciated with prices of coca leaves from Chapare collected by DIRECO since 1990. Following a strong price rise in 1999 – in line with a strong increase in eradication – sun dried coca leaf prices reached a peak of US\$5.7 /kg in 2000. Since then, prices fell to the lowest level since 1998 to \$US 3.2/kg in 2006. However, coca leaf prices in Bolivia continued to be substantially higher than in neighboring Peru (US\$ 2.5/kg).

Table 15. Reported monthly prices of sun dried coca leaf in Chapare (US\$/kg)

Month	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
January	1.0		0.9	1.4	0.9	1.1	1.3	2.0	5.9	5.4	5.7	6.1	5.4	5.3	4.9	4.0
February	0.8	1.4	0.9	1.3	1.3	1.2	1.5	2.4	6.0	5.5	5.6	5.8	5.3	5.1	5.1	3.3
March	0.9	1.8	0.7	1.3	0.8	1.4	1.5	2.4	6.0	5.6	5.6	5.7	5.2	5.2	5.2	2.8
April	1.2	1.5	0.8	1.4	1.1	1.9	1.4	3.7	6.0	5.6	5.7	5.7	5.2	5.3	4.4	2.7
May	0.9	1.5	1.2	1.4	1.7	2.2	1.5	4.8	5.3	5.3	5.7	5.6	5.3	5.2	3.5	2.7
June	0.9	1.4	1.6	1.4	1.4	2.2	1.4	4.9	4.8	5.6	5.4	5.6	5.4	5.1	3.5	3.1
July	0.9	1.2	1.8	1.4	1.3	2.3	1.4	4.9	5.3	5.6	5.4	5.7	5.5	5.1	3.6	3.5
August	1.0	1.2	1.7	1.4	1.2	2.1	1.4	5.0	5.3	5.7	5.4	5.7	5.5	5.1	3.7	3.1
September	1.0	1.1	1.5	0.9	1.3	2.1	1.5	6.0	5.4	6.1	5.5	5.4	5.4	5.3	4.0	3.4
October	1.0	1.1	1.7	1.4	1.2	2.0	1.5	5.1	5.3	6.1	5.4	5.4	5.4	5.0	3.7	3.7
November	1.1	0.6	1.5	0.9	1.1	1.3	1.7	5.4	5.3	5.8	5.3	5.4	5.4	5.0	3.8	3.3
December	1.0	0.9	1.3	0.9	1.0	1.4	2.0	5.7	5.5	5.7	5.2	5.5	5.5	5.1	3.7	3.3
Annual Average US\$/kg	1.0	1.2	1.3	1.3	1.2	1.8	1.5	4.4	5.5	5.7	5.5	5.6	5.4	5.2	4.1	3.2

Figure 15. Prices in Chapare since 1990



The estimation of the total farm-gate value of coca leaf production in Bolivia included the total value of the market controlled by DIGCOIN, and the farm-gate value of coca leaves outside this market in 2006, amounted to a rounded value of US\$180 million.

Table 16. Estimation of the total farm-gate value of coca leaf production in Bolivia, 2006

Region	Coca Weighted Average Price US/Kg		Coca Production (metric tons)			Coca Value US\$		
	Authorized market	Outside authorized market	Total production	Authorized market	Outside authorized market	Authorized market	Outside authorized market	Total value
Yungas	3.9	4.4	24,895	12,960	11,935	50,544,000	52,514,000	103,058,000
Chapare	3.1	3.2	22,941	249	22,692	771,900	72,614,400	73,386,300
Rounded Total			48,000		35,000	52,000,000	126,000,000	180,000,000

The decrease of coca value in 2006, in spite of the increase in the production, is attributed to the decrease in prices in both, Yungas and Chapare regions.

The total farm-gate value of coca leaf production in 2006 was thus equivalent to 2.0% of the projected Bolivian GDP⁴ of US\$ 8.7 billions for 2006, or 13% compared with the projected value of the licit agricultural sector of US\$ 1.1 billions in 2006. These figures suggest that, for the country as a whole, coca production still has an impact on the Bolivian economy, and continues to play an important role within the coca producing regions.

The FELCN also reported street prices of cocaine paste and cocaine of unknown purity from the major cities and coca growing regions in Bolivia.

Table 17. *Reported prices of cocaine base and cocaine HCL, Bolivia, 2006 (US\$/kg)*

City	Cocaine base	Cocaine HCL
La Paz	950	2,000
Cochabamba	1,550	1,760
Santa Cruz	1,200	1,850
Region		
Yungas of La Paz	800	1,100
Chapare	1,000	1,500

Source: FELCN

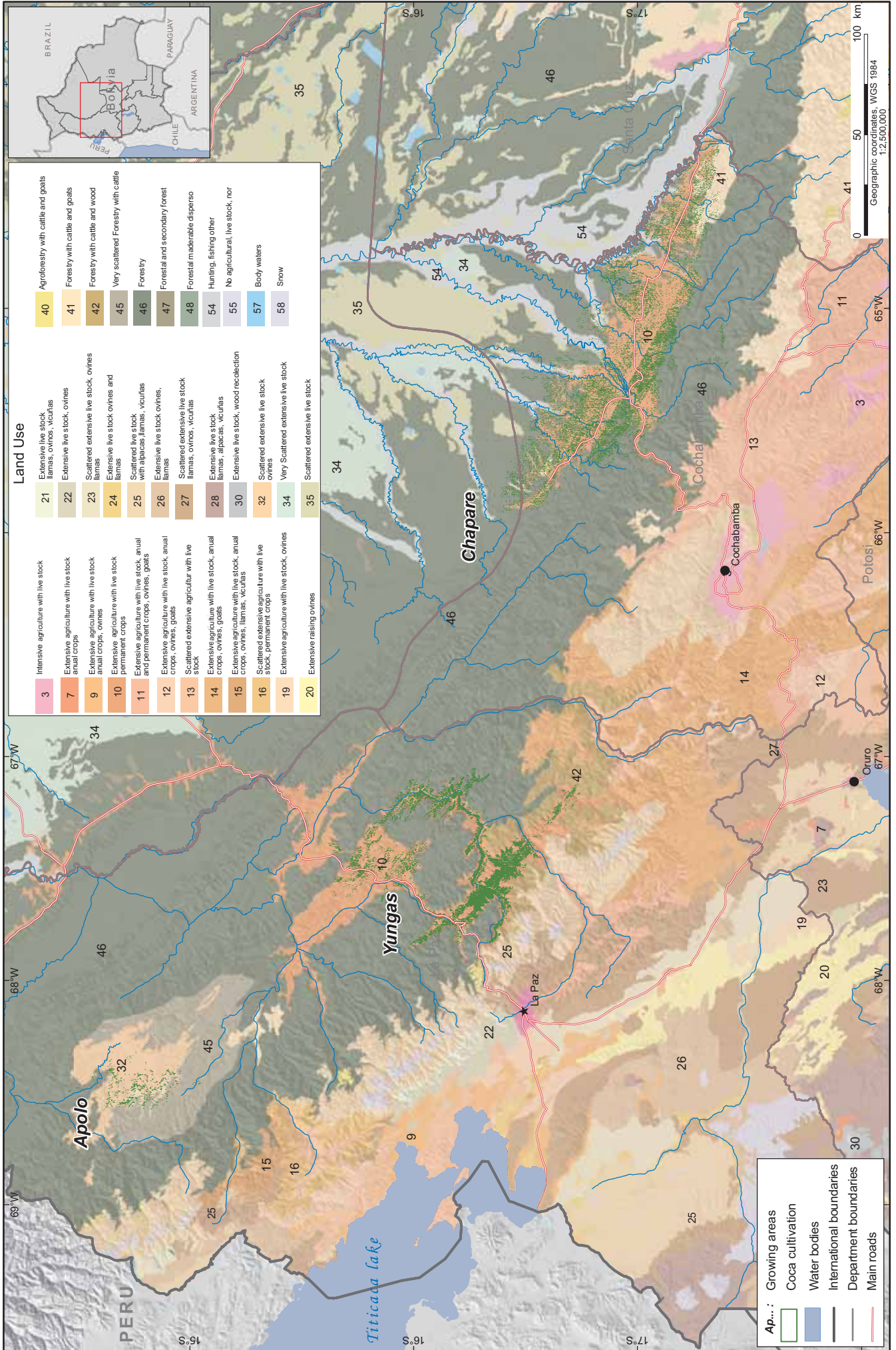
It is interesting to note that prices for coca leaf and its derivatives were consistently higher in Bolivia than in neighboring Peru.

Table 18. *Prices for coca leaf and its derivatives in Peru and Bolivia, 2006 (US\$/kg)*

Products	Peru	Bolivia
Coca leaf	2.52	4.1
Cocaine base (in coca producing regions)	550	900
Cocaine HCL	823	1,800

⁴ sources: INE, 2006

Land use and coca cultivation, Bolivia 2006



Source: Government of Bolivia - Land Management 2001 - National monitoring system supported by UNODC. The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

2.4 COCA CULTIVATION AND RELATED ISSUES

2.4.1 COCA CULTIVATION AND LAND USE

The Bolivian National Authorities of Land Management ('Ordenamiento Territorial') released in 2002 a country wide map of major land use, based on the classification of Landsat images. This map was superimposed on the map of coca cultivation since to 2003. This analysis revealed that coca cultivation is found over four main types of land use: Extensive livestock and agriculture with permanent crop; timber forest; timber forest and cattle; non-timber forest and cattle; hunting, fishing and non-timber forest products.

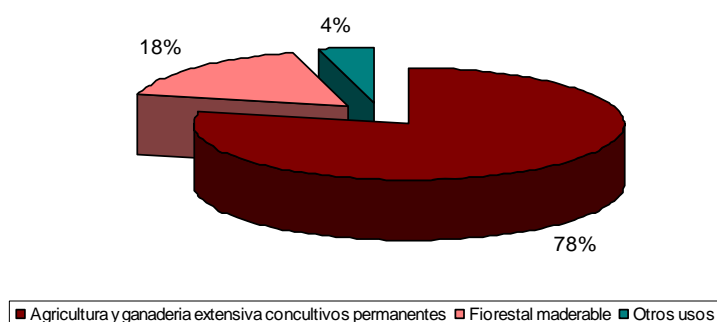
In 2006, 79% of coca cultivation took place on land dedicated to extensive livestock and agriculture with permanent crop, and 19% over land where the major land use is classified as timber forest. This last category corresponded mainly to the border of the Isiboro Secure National Park that is now protected, meaning that activities like extensive agricultural or logging are no longer permitted.

Table 19. Distribution of 2003 - 2006 coca cultivation by major land use and by region (ha)

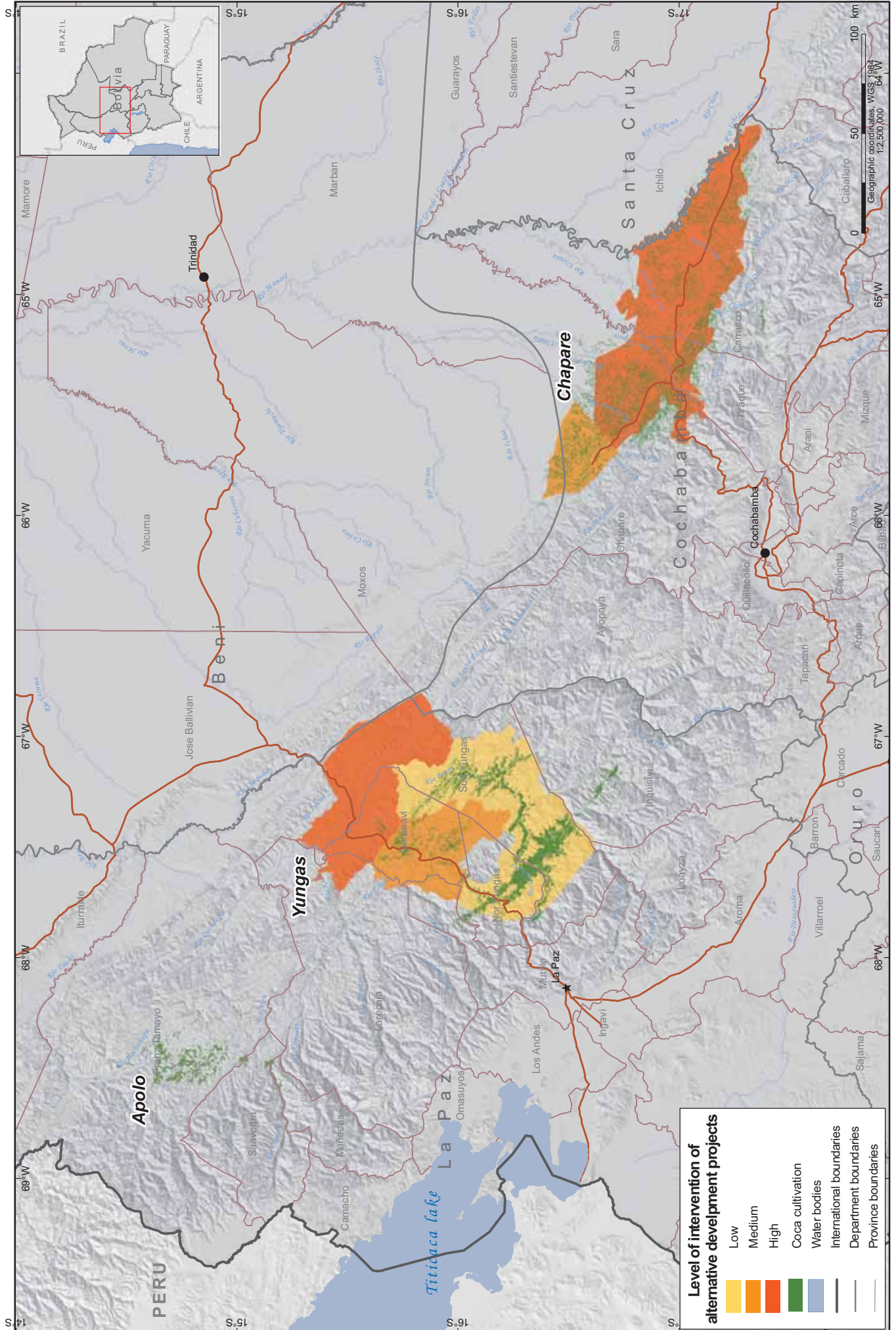
Region	Major land use	2003	2004	2005	2006	% change 2005 - 2006	% of 2006 total
Yungas	Extensive livestock and agriculture with permanent crop	14,908	15,878	16,381	17,160	5%	62%
	timber forest	1,069	1,270	1,498	1,534	2%	6%
	timber forest and cattle	186	189	204	208	2%	1%
Chapare	Extensive livestock and agriculture with permanent crop	3,265	3,659	3,366	4,401	31%	16%
	timber forest	3,442	5,433	3,069	3,285	7%	12%
	non-timber forest and cattle	369	495	298	302	4%	1%
	hunting, fishing and non-timber forest products	194	507	277	287	4%	1%
Apolo	Extensive livestock, sheep	50	178	178	178	0%	1%
	Timber forest		11	11	11	0%	0%
	Very scattered forest with cattle		51	51	51	0%	0%
	non-timber forest and cattle		61	61	61	0%	0%
Rounded total		23,600	27,700	25,400	27,500	8%	100%

The analysis of the location of the new coca cultivation that appears between 2005 and 2006 in the Chapare, showed that most of the new coca cultivation (1,000 ha over a total of 1,300 ha) took place over the land dedicated to extensive livestock and permanent crop. The remaining increase of 300 ha took place at the expense of forested areas, where coca cultivation increased by 8% between 2005 and 2006.

Figure 16. Coca cultivation and major land uses in Bolivia



Coca cultivation and alternative development projects, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC. The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

2.4.2 COCA CULTIVATION AND ALTERNATIVE DEVELOPMENT

In 2006, the project started the quantification and monitoring of the alternative crops in Chapare and in Yungas of La Paz, generating in this way a complete map of land use in both regions. These new data will be used to analyze the coca cultivation in relation with other crops.

Chapare

Chapare is the region where alternative development deployed most of its efforts.

In the Chapare, the alternative development actions are concentrated in the region Known as Multiple Use Forest or BUM, which covers the central area of the region, not considering the National Parks. The project performed the quantification of licit crops inside this area using satellite imagery since 2003.

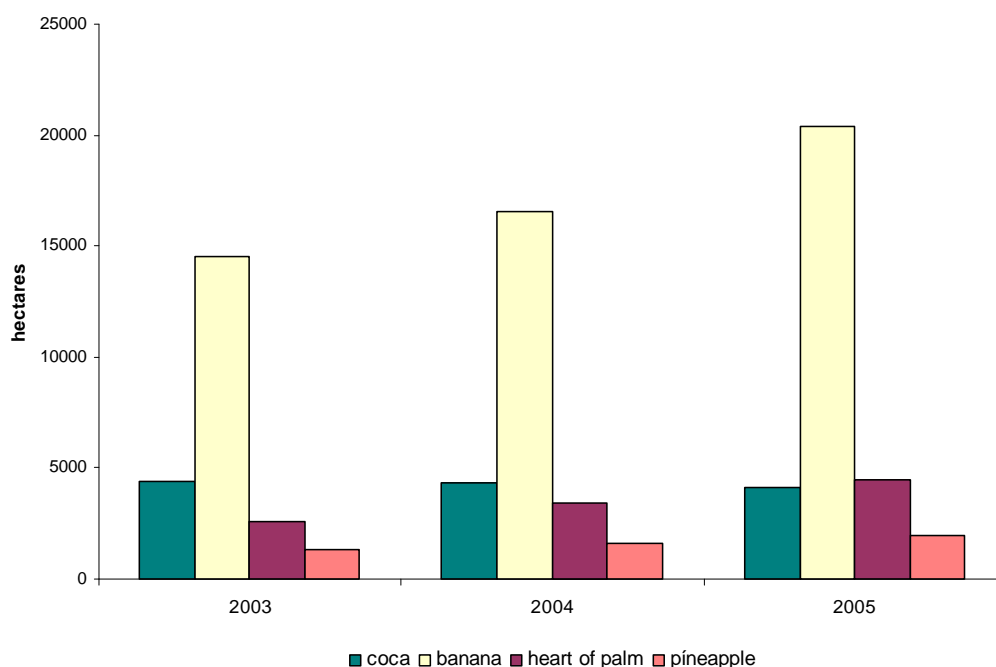
The following tables compare the area under coca cultivation and under the main exporting alternative crops:

Table 20. *Alternative development cultivation and coca cultivation in the BUM area (in ha)*

Crop	2003	2004	2005	2006	% of change 2003 - 2006
Coca	4370	4317	4107	5200	19%
Banana *	14555	16548	20358	n.a.	40%
Heart of palm *	2607	3428	4448	n.a.	71%
Pineapple *	1359	1582	1967	n.a.	45%

- Since there is not yet data available for 2006 The % of change for alternative crops is calculated for the period 2003-2005

Figure 17. *Coca cultivation and exporting alternative cultivation in the BUM area since 2003*



Although coca cultivation surface has increased in Chapare since 2003, there is no evidence of replacement of alternative crops by coca cultivation. In contrast, the alternative crops experienced a significant increase during the period 2003-2005, and this trend is expected to continue during 2006.

Yungas of La Paz

In the Yungas of La Paz, Bolivian government usually refers to four geographical zones for the implementation of Alternative Development projects: Caranavi North and Alto Beni, Caranavi Centre South, region of La Asunta, Inquisivi, and south-western region.

In the Yungas of La Paz, the area of major intervention of alternative development was the Northern part of the municipality of Caranavi and the Alto Beni, representing only 1% of the national total of coca cultivation in 2006. However, the region of South-western Yungas and La Asunta representing the largest proportion of coca cultivation in 2006 received fewer support from alternative development and contain no exporting crops, except scattered coffee plantations. Other crops are only for subsistence, and negligible compared with coca cultivation. These areas can be considered as mono-cultivators, since coca is the predominant crop.

Table 21. *Coca cultivation and alternative development in Yungas of La Paz*

Zone	level of interventions	Coca cultivation				% of change 2005 - 2006	% of 2006 coca cultivation total
		2003	2004	2005	2006		
Caranavi North Alto Beni	High	96	99	96	111	16%	1%
Caranavi Centro South	Medium	478	650	708	986	39%	5%
South-western Yungas and La Asunta	Low	14,825	15,802	16,470	17012	3%	90%
Inquisivi	Low	801	807	809	808	0%	4%
Total		16200	17358	18083	18917	4%	100%

Banana is the most successful exporting crop in Chapare.

The picture shows a huge banana plantation with packing facilities inside

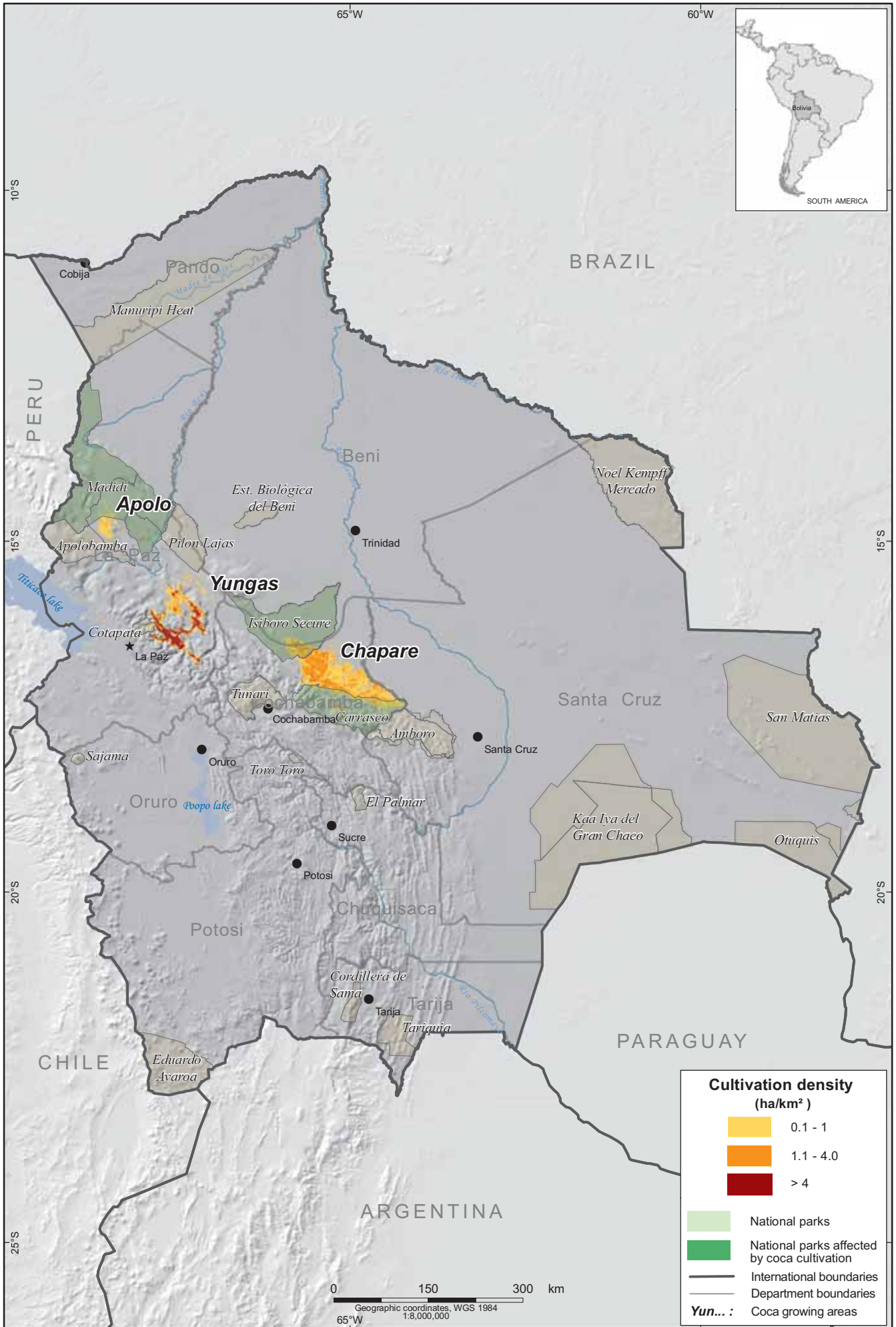


In the Alto Beni region of the Yungas of La Paz, coca cultivation is negligible compared with alternative crops like organic cacao and banana, which have an outstanding potential for exportation



Pineapple is another emerging alternative crop in Chapare with exporting quality

Coca cultivation and national parks, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC.
The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

2.4.3 COCA CULTIVATION IN NATIONAL PARKS

There are 21 protected areas and national parks in Bolivia, totaling an area of 165,000 sq km, representing 15% of the national territory. In 2006, once again coca cultivation was found in three national parks: In the national park of Madidi, in the Apolo region, only about 10 ha of coca cultivation were found. A much larger amount of 1,950 ha of coca cultivation was found in the two national parks Isiboro Secure and Carrasco, in Chapare region. Coca cultivation within these two National Parks represented 28% of the coca cultivation of Chapare region.

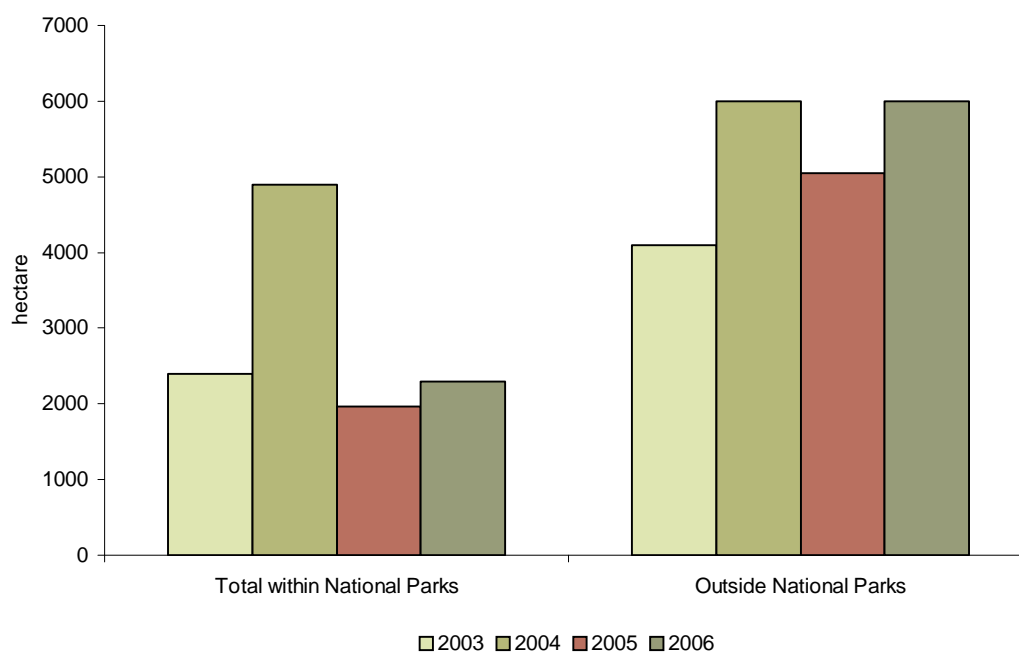
Between 2004 and 2005, coca cultivation decreased by 52% in the areas of the National Parks, nevertheless, between 2005 and 2006, the coca cultivation increase occurred mainly at the Isiboro Secure National Park did not reach the levels of past years.

Ecosystems of the National Parks are particularly fragile and the deforestation for the establishment of coca cultivation makes irreversible damages to their environment. Although eradication has been efficient, it should be noted that the damage to the forest due to coca cultivation is irreversible.

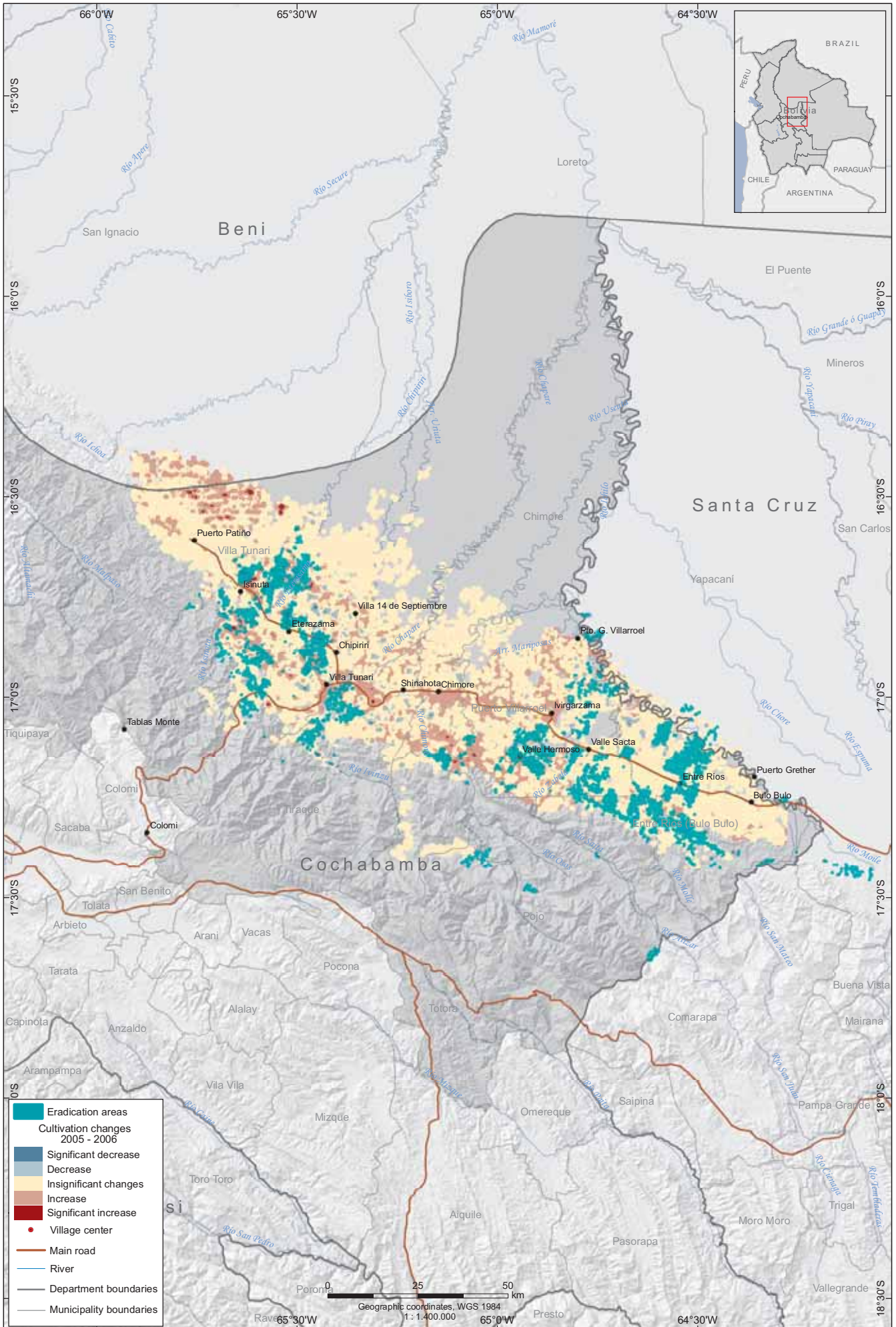
Table 22. *Coca cultivation estimates by national parks in Chapare 2003 – 2005 (ha)*

Area	2003	2004	2005	2006	% change 2005 - 2006	% of 2006 total
Isiboro Secure Nacional Park	1,605	2,807	1,161	1,451	25%	17%
Carrasco National Park	778	1,257	781	837	7%	10%
Madidi National Park	n.a.	10	10	10	0%	0%
Total within National Parks	2,383	4,074	1,952	2,298	18%	28%
Outside National Parks	4,917	6,026	5,053	6,002	19%	72%
Rounded Total	7,300	10,100	7,005	8,300	18%	100%

Figure 18. *Distribution of coca cultivation in Chapare region inside and outside national parks, 2004 – 2005 (ha)*



Eradication reported by DIGPROCoca, Bolivia 2006

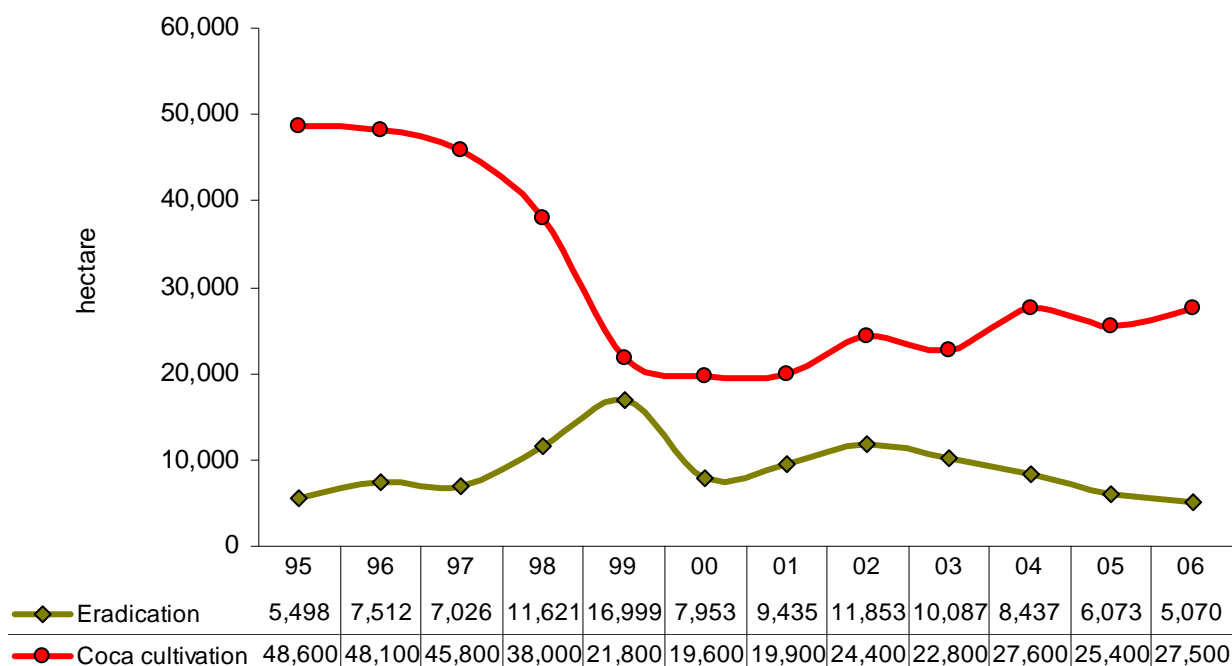


Source: Government of Bolivia - DIGPROCoca - National monitoring system supported by UNODC.
The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

2.5 REPORTED ERADICATION

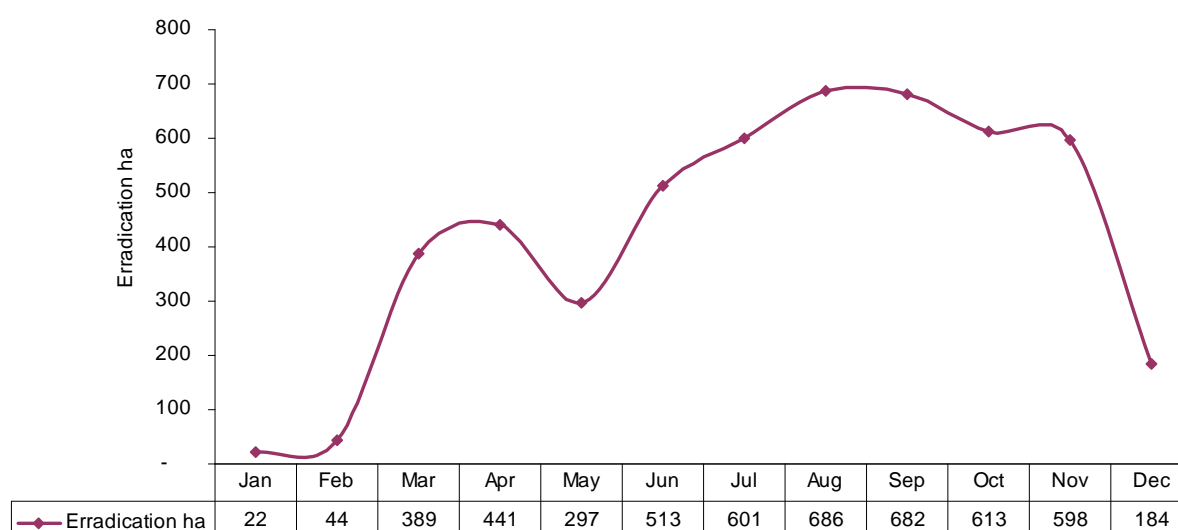
In 2006, the Bolivian Government reported the eradication of 5,070 ha of coca fields. Ninety-nine percent of this total has been eradicated in Chapare, and only one percent in Yungas of La Paz. Eradication decreased by 17% compared to the level of eradication in 2005. This is the lowest level of eradication in the past 10 years. In Bolivia, the eradication of coca cultivation is exclusively manual, and no chemical or spraying agents are used.

Figure 19. Reported eradication and coca cultivation in Bolivia, 1995 – 2006 (ha)



Sources: For coca cultivation: UNODC
For eradication DIGPROCOCA

Figure 20. Reported monthly eradication in Bolivia, 2006 (ha)



Source: DIGPROCOCA

The Bolivian government also reported the eradication of 57.5 ha of coca seedlings in the Chapare region, an increase of 9.8% compared to 2005. The increase in the eradication of coca seedlings helps to avoid the replanting of eradicated coca fields.

Table 23. *Reported monthly eradication of coca seedlings, 2003 -2006 (m²)*

Month	2003	2004	2005	2006
January	1,460	1,795	2,748	444
February	1,415	2,830	4,516	1,907
March	4,520	3,296	4,320	2,904
April	4,013	2,936	4,825	3,764
May	2,352	2,989	3,639	2,691
June	2,972	5,411	4,737	5,683
July	5,962	6,963	4,372	7,328
August	10,140	4,344	5,294	10,035
September	6,438	3,156	4,010	7,667
October	9,978	4,470	4,812	7,083
November	7,280	5,869	4,222	6,166
December	3,294	5,488	4,862	1,814
Total	59,823	49,547	52,357	57,486

Source: DIGPROCOCA



Manual eradication of a coca field in Chapare

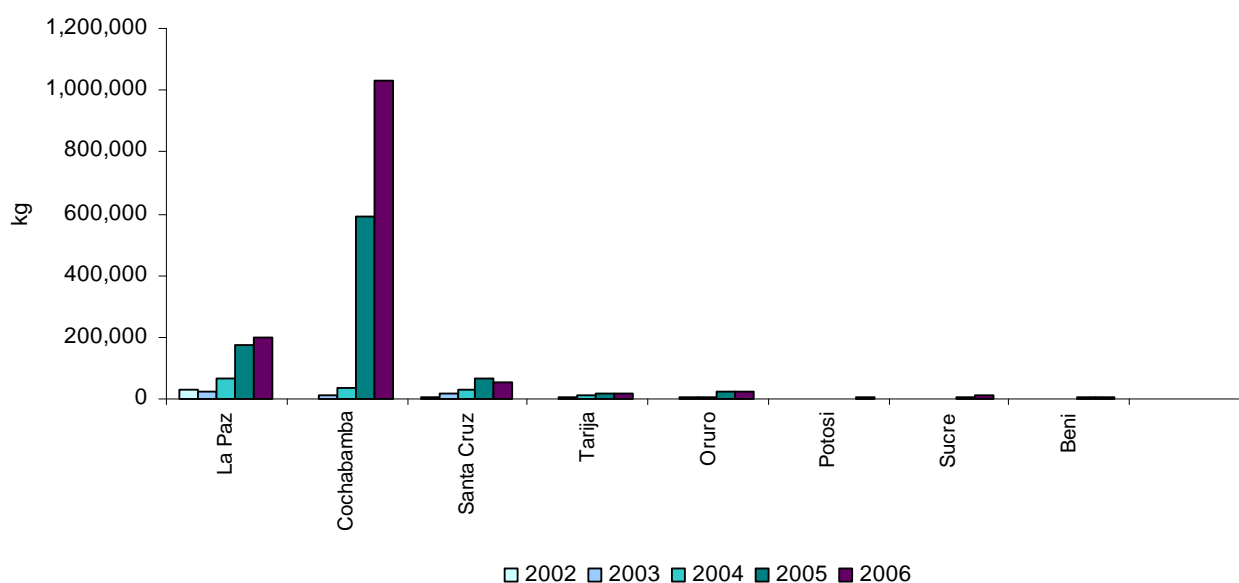
2.6 REPORTED SEIZURE

DIGCOIN controls the trade of coca leaves within the country, which also includes control over the transport of coca leaves. Coca leaves are seized if transported without license or outside the authorized route specified in the license. In 2006, DIGCOIN captured 1,343 metric tons of coca leaves, representing a significant increase of 52% compared to the reported seizure of 886 metric tons in 2005. The increase in seizure of coca leaf can be attributed to the strengthening of DIGCOIN's special force for the control of coca leaves (Grupo Especial de Control de la Hoja de Coca, GECC), which included the control of additional roads, and improvement in equipment and infrastructure.

Table 24. *Reported seizure of coca leaves, 2002 – 2006 (kg)*

Department	2002	2003	2004	2005	2006
La Paz	31,291	22,375	66,396	172,331	197,854
Cochabamba	214	11,105	37,748	591,803	1,030,834
Santa Cruz	7,343	20,828	30,441	68,508	52,018
Tarja	1,407	4,451	10,183	16,499	19,604
Oruro	1,205	4,682	6,120	24,814	21,913
Potosi	357	1,321	1,942	1,509	4,010
Sucre	0	1,450	1,448	3,229	11,780
Beni	728	600	904	7,525	4,778
Pando	0	0	0	50	271
Total:	42,544	66,811	155,182	886,268	1,343,062

Figure 21. *Reported seizure of coca leaves, 2003-2006 (kg)*



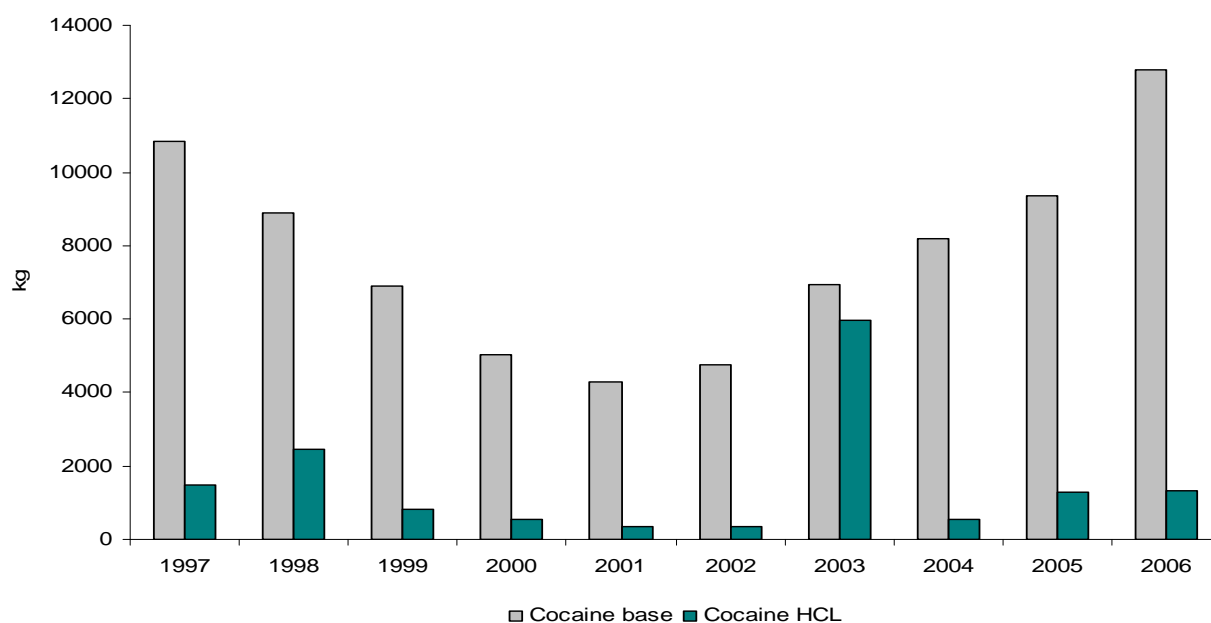
The Special Force for the Fight against Drugs (FELCN) reports annually on drugs seizures. Between 2005 and 2006, there was a significant increase of 36% in reported seizure of cocaine base.

Table 25. *Reported seizure of drugs, Bolivia, 1997 – 2006 (kg)*

Product	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Cocaine base	10,848	8,906	6,905	5,044	4,280	4,741	6,934	8,189	10,152	12,779
Cocaine HCL	1,477	2,440	802	555	334	362	5,969	531	1,300	1,309
Heroin	2.9	0.8	0	0	0	0	0	0	0	0
Cannabis	3,617	320	2,160	3,745	7,055	8,754	8,510	28,200	31,390	125,356

Source: FELCN

Figure 22. *Reported seizure of cocaine base and cocaine HCL, Bolivia, 1997 – 2006 (kg)*



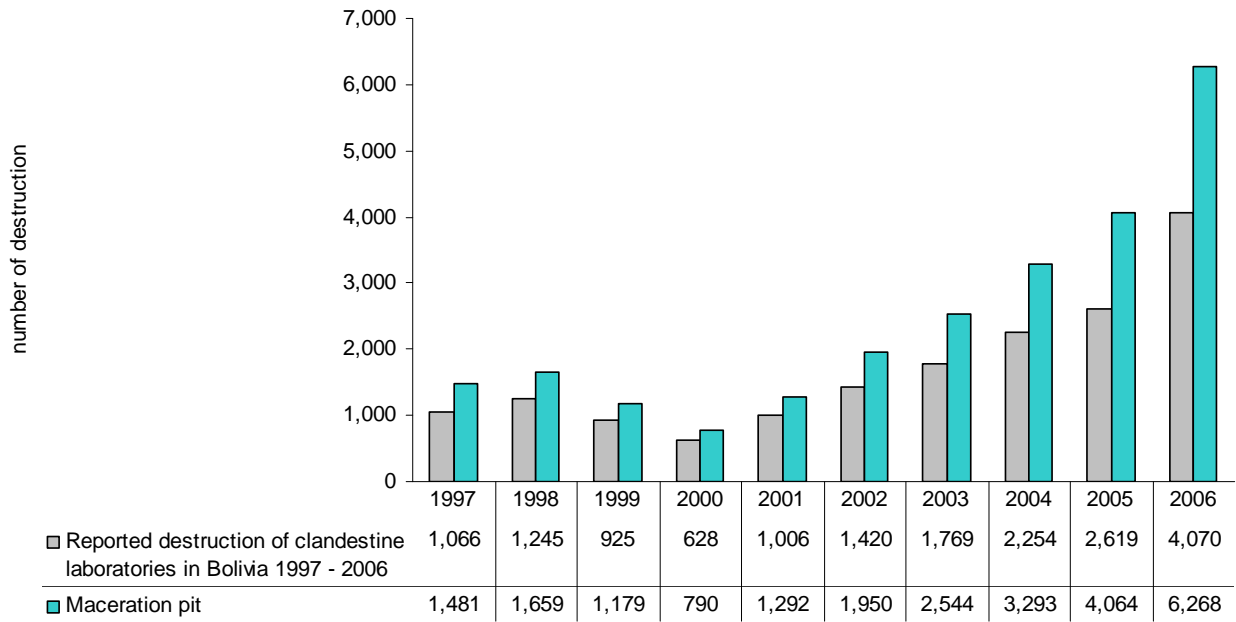
The peak in seizure of cocaine HCL in 2003 was due to an exceptional operation conducted by FELCN. The graph also shows that seizure of cocaine base increased steadily since 2001. The same trend can be seen in the report of destruction of maceration pit and clandestine coca paste or cocaine laboratories.

Table 26. *Reported destruction of clandestine laboratories and macerations pits*

Type	1998	1999	2000	2001	2002	2003	2004	2005	2006
Coca paste and/or cocaine laboratories	1,245	925	628	1,006	1,420	1,769	2,254	2,619	4,070
Precursors laboratories	15	8	3	2	6	0	3	2	2
cocaine laboratories only	4	3	17	3	1	0	4	3	3
Maceration pit	1,659	1,179	790	1,292	1,950	2,544	3,293	4,064	6,268

Figure 23. Reported destruction of clandestine laboratories and macerations pits

Correct clandestine laboratories on excel



METHODOLOGY

2.7 COCA CULTIVATION

The monitoring of coca cultivation in Bolivia has always been based on the interpretation of satellite images. However, for the 2006 census besides the use of satellite images, the project acquired for the first time digital aerial photographs. In this way the whole Cochabamba Tropics area was surveyed with aerial photos, which meant increased processing time but also improvement in spatial resolution facilitating the visual interpretation. The Yungas of La Paz region was surveyed once again using IKONOS satellite imagery.

The photo and imagery interpretation was supported by intensive field verification undertaken through the use of cutting edge technology like aerial geo-referenced videos in addition to field pictures and on site captured GPS control points.

In the Apolo region, the land use changes have been verified through a field control mission covering the most relevant areas in the region. The team observed minimal changes in the land use, therefore no imagery was required.

1) Identification and acquisition of the images

Table 27. Satellite images used for the 2006 survey in Bolivia

Region	Sensor	Resolution	Bands	Total area in square km
Yungas	IKONOS multispectral	4 meter	Red, Green, Blue, near infrared	5,900
Chapare	AIC digital camera	0.40 meter	Red, Green, Blue	7,500
Total				13,400

A total of 16 IKONOS scenes were taken over the Yungas, covering an area of 5,900 square kilometers, while 1,700 aerial photos were taken over the Cochabamba Tropics area, covering an area of 7,500 square kilometers.

In the previous survey, the Chapare region was surveyed with six SPOT satellite images of fixed size of 60x60km, covering 21,600 square km, but including large areas without agricultural activity. In 2006, the aerial photographs were focused on agricultural areas discarding regions occupied by marsh land and high areas which are not suitable for farming. The cloud cover in all scenes was less than 10%. The digital aerial photos have resolution of 40 centimeters.

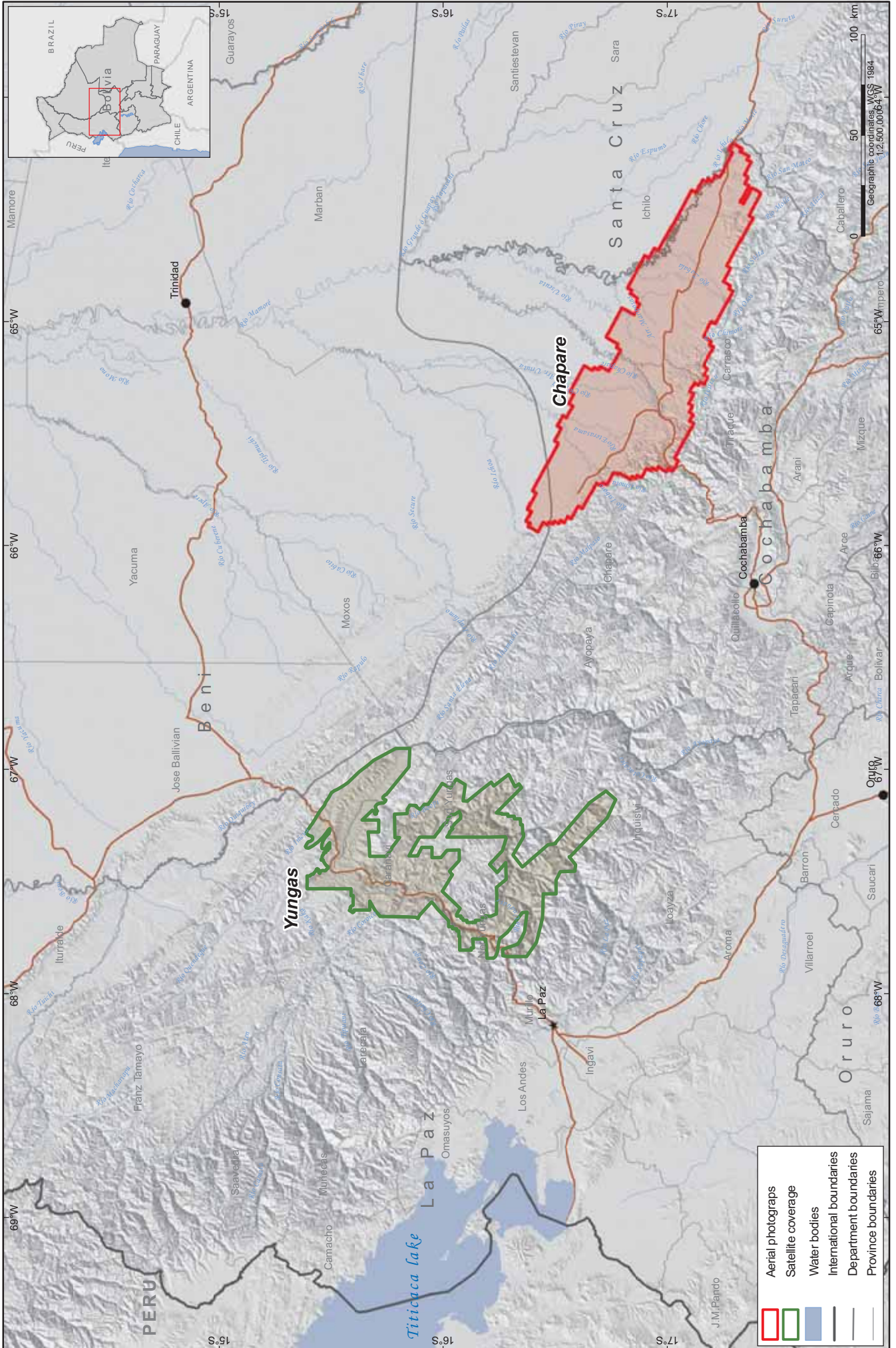
In 2006, in the Yungas of La Paz, the project included new additional areas of coca cultivation for which the IKONOS coverage was increased to 5,900 sq km. IKONOS multispectral images provided data at a four-meter spatial resolution in four spectral channels: the visible red, green and blue bands, plus one near infrared band.

2) Image pre-processing

First, the IKONOS images were ortho-rectified using a Digital Elevation Model derived from contour lines with a 20 meter interval. The ortho-rectification process was supported by ground control points.

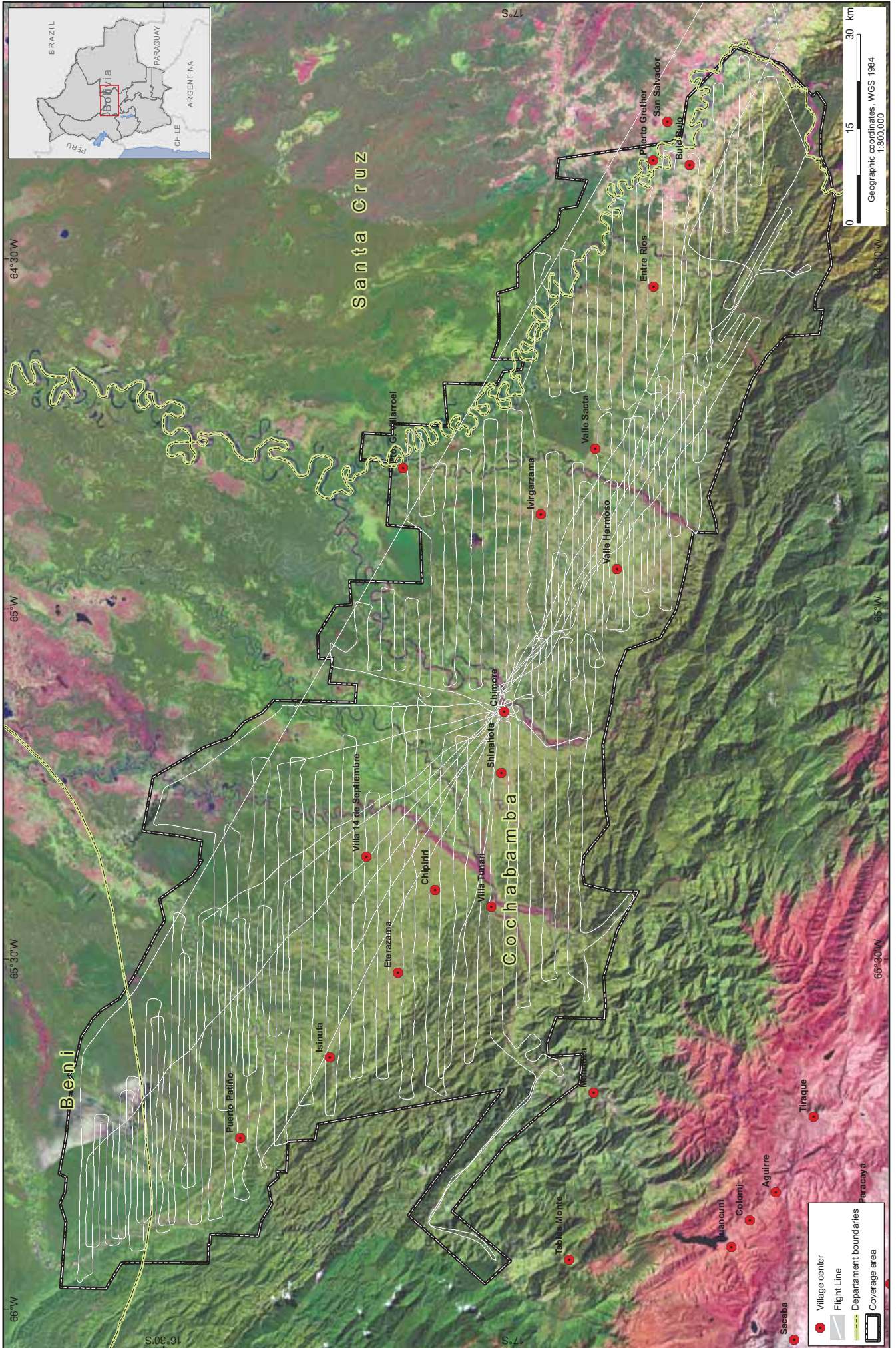
The aerial photographs were geometrically and radiometrically corrected through photogrammetric procedures. The resulting images were joint in a mosaic creating blocks according to the flight lines.

Satellite images and digital aerial photographs coverage, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC. The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.

Flight reconnaissance lines over Chapare area, Bolivia 2006



Source: Government of Bolivia - National monitoring system supported by UNODC. The boundaries and names shown and the designation used on this map do not imply official endorsement or acceptance by the United Nations.



Detection of large coca fields in isolated regions of Chapare using for the first time digital aerial photographs



The aerial photographs employed by the project enabled to appreciate details not visible in other sensors, like this group of catos representing different stages of coca cultivation, from the recently harvested to the pre-harvest stage

3) Digital classification of land use and vegetation

Over the IKONOS images, the project performed a supervised classification to determine the main land use classes. The automated land cover classification is not used to detect coca cultivation, but rather to study broadly the various land classes present on an image. That initial step helped to identify the areas where coca cultivation could be interpreted visually. The image classification was not performed over the aerial photographs.

4) Visual interpretation of coca fields

The classification of coca fields parcel by parcel relies on the visual interpretation of the Ikonos satellite images and the aerial photographs. In this year's survey, the project started systematizing the interpretation process with the support of the so called decision tree interpretation keys. In 2006, the project team attended a workshop on interpretation key development led by ICMP in cooperation with the University of Natural Resources and Applied Life Sciences (BOKU), Vienna. Since then, the project has been developing several interpretation keys for satellite imagery interpretation. The same methodology will be extended for the interpretation of aerial photographs.

Interpretation keys reflect the decision taking process of the interpreter, using typical characteristics like the shape, the texture, the context and the surroundings of the fields. No distinction is made between the different phenological stages of coca bushes.

In the traditional coca cultivation area of the Yungas of La Paz, coca is the dominant crop. The large size of parcels and the relative absence of other crops that could create confusion, make the identification of coca fields by visual interpretation less complicated than in areas where other agricultural activities take place.

In Chapare, the high resolution of the aerial photographs greatly helped to perform an accurate interpretation of coca fields. The spatial resolution of 0.40 m provided impressive details of the terrain and allowed to detect even small coca fields of 500 square meters.

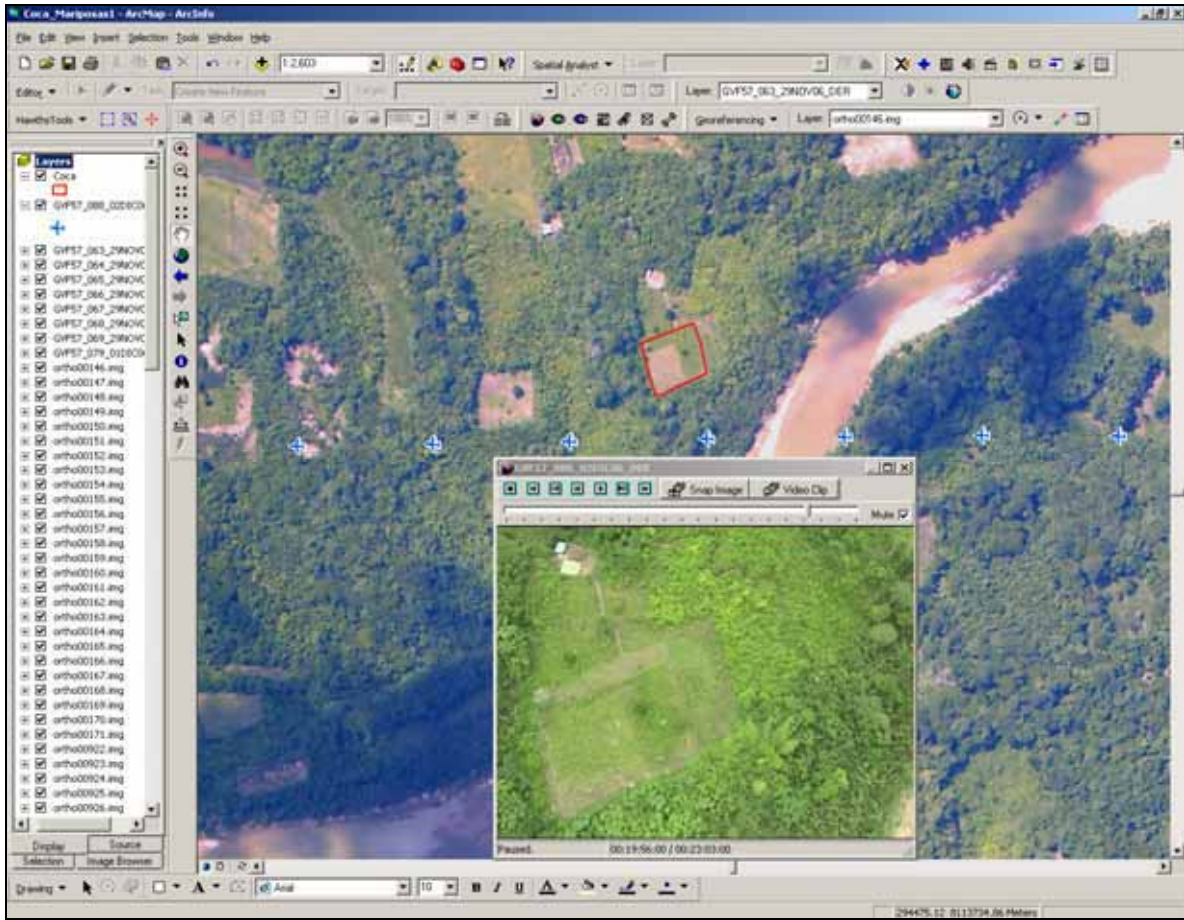
An example of interpretation keys for coca crops in National Parks is explained below

Category	Element for interpretation	Description
Coca renewing after harvest	shape	Regular – Rectangular
	size	< 2500 m ² or cato size (1,600m ²), with certain exceptions
	Tone/Color	Light green, with darker green spots
	Pattern	Vertical furrows and plant lines, slightly noted
	Texture	Fine
	Association	With small dwellings and coca-dryers
	Site	Interpretation key for coca crops in National Parks, isolated areas, far away from roads or settlements.
	Observation	In this site, the area of the crop trend to be larger than in the most populated areas.

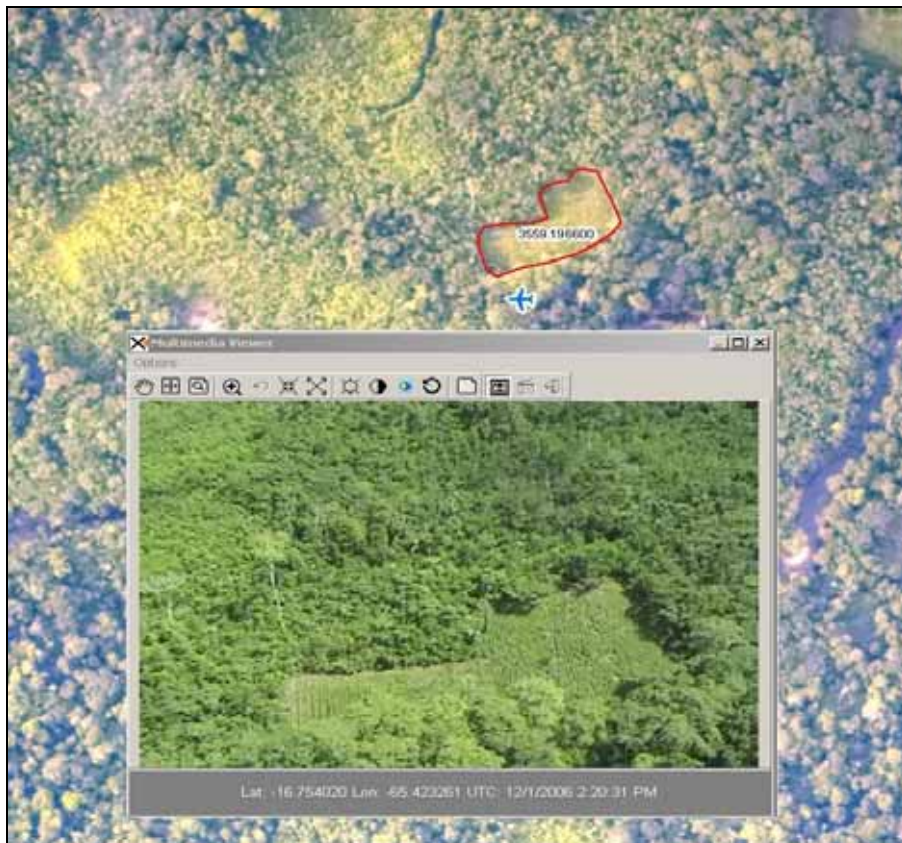


In addition, the interpretation process is substantially supported by the geo-video and geo-referenced field pictures obtained by helicopter. When the videos are played back on the computers embedded in the GIS software, the interpreter is able to compare the video with the aerial photos. Since the videos are geo-referenced, the link with the aerial photos is easily performed.

For a second year in a row, in 2006, geo-referenced videos were acquired over the whole area of the Cochabamba Tropics. The flight paths, with direction north-south or east –west, are shown on the map 12. A total of 40 hours were flown, covering a distance of 9,700 km and covering a total area of 9,800 sq km. More detailed videos have been taken over the Isiboro Secure National Park, where the most significant coca cultivation increase took place in 2006



Example of geovideo identifying a coca field of cato size in red over the aerial photo. The small plane Symbol is the flight lane, the camera is located at right of the aircraft, and the interpreter is able to accurately compare the video with the image.



Another example of Geo-video detecting a large coca field of irregular shape

5) On-site field verification

The use of high-resolution satellite images or aerial photos requires field verification. The data collected during the field verification enabled to delineate the survey area, to build the interpretation keys and to correct the confusion between different land cover classes.



Taking a Ground Control Point in a recently established coca field at the southern part of Apolo

In the Yungas of La Paz, the ground control points were obtained directly from the field, taking advantage of the complex topography, which allows obtaining visual information from the high points of hills and interpreting the images in the field. In Chapare, the collection of ground reference data is difficult due to the security situation and difficult access to the coca field areas. Therefore, to a large extent, the project obtained the reference data from helicopter flights using videography.

During five years of monitoring, the project obtained a large number of ground reference data, starting in 2002 in the Yungas of La Paz and, as of 2003, extending to Chapare and Apolo. Since 2002, more than 8,000 ground reference data were collected, of which 1,500 in 2006. All these points were obtained directly from the ground, using regular GPS techniques.

The visual interpretation was also facilitated by the ground control points of coca fields obtained from DIGPROCoca eradication campaign and from ground verification. Jointly with the project experts, DIGPROCoca personnel also participated actively in the visual interpretation of coca fields in the satellite images.

2.8 YIELD AND PRODUCTION OF COCA LEAF

In December 2005, UNODC started a new coca yield study in the Yungas of La Paz. The field work was implemented by selected students of Carmen Pampa University, located in the Municipality of Coroico. The knowledge of the terrain and the accessibility to the coca fields for the students was an appreciated advantage for the implementation of the field work.

The survey obtained a sample of 100 coca fields randomly selected among six strata. The strata were defined based on altitude and slope ranges, which are two physical factor that have influence in coca yield. The sample was designed by the statistician of the UNODC Illicit Crop Monitoring Programme.

The sampling approach used to estimate the average sun-dried coca leaf yield in Bolivia was a multistage stratified area probability sampling design. Sample selection was carried out within strata. The units selected at the first stage with PPS, know in the survey literature as Primary Sampling Units or PSU's (grids), were constructed on the basis of complete enumeration of areas identified in the coca bush census. The units selected at the second stage with PPS within each selected PSU are referred to as Secondary Sampling Units or SSU's (fields).

In the case of multistage designs, the base weights reflect the probability of selection at each stage. In general, the base weight of a sampled unit is the reciprocal of its probability of selection for inclusion in the sample.

Under this scheme of sampling with PPS of sampling units, the coca leaf yield estimation at the h-th stratum is calculated as the simple arithmetic mean of all the actual harvested parcels within the stratum. Therefore, in order to calculate the leaf yield for a region, the simple arithmetic means in the strata should be weighted by their area under coca cultivation.

The field methodology complies with UNODC standards for coca yield measurement, relying on weighing fresh and sun-dried coca leaves from a sample of harvest. The sample field were at least of 1,000 square meters size, and are distributed in all the Yungas area.

The study successfully concluded establishing an average annual yield, after weighing all the harvests that took place during the year.

In the Cochabamba Tropics, for the 2006 annual estimate of coca leaf and cocaine production, UNODC continues to rely on information available from other sources.

2.9 PRICES

The project collected coca leaf prices from farmers in the Yungas of La Paz on an ad hoc basis while performing the field verification missions. In the Chapare region, prices of coca leaf were collected by DIGPROCOCA on a monthly basis throughout 2005 in three points of the department of Cochabamba.