



UNITED NATIONS
Office on Drugs and Crime



PERU

Coca Cultivation Survey



June 2004

Abbreviations

ENACO	National Coca Enterprise
GIS	Geographical Information Systems
GPS	Global Positioning System
ICMP	UNODC Illicit Crop Monitoring Programme
DIRANDRO	Dirección Anti-Drogas, Policía Nacional del Perú
OFECOD	Drug Control Office, Peruvian Ministry of Interior
NAS	Narcotics Affairs Section, United States Embassy
UNODC	United Nations Office on Drugs and Crime
CONTRADROGAS	Committee for the Fight Against Drug Consumption
DEVIDA	National Commission for Development and Life without Drugs
CORAH	Control and Reduction of Coca Leaf in Alto Huallaga

Acknowledgements

The following institutions and individuals contributed to the 2003 coca survey in Peru and in the preparation of the present report:

Peruvian Government
National Commission for Development and Life without Drugs (DEVIDA)

UNODC
Humberto Chirinos, Project Coordinator, Peru
Paloma Lumbré, Digital Classification, Cartography and GIS Specialist, Peru
Aldo Gutarra, Multi-spectral Analysis Specialist, Peru
Germán Galvez, Surveying, Cartography and GIS Specialist, Peru
Lorenzo Vallejos, Digital Classification, Cartography and GIS Specialist, Peru
Victor Rojas, Photo-Interpretation and Cartography Specialist, Peru
Walter Huamaní, Photo-Interpretation, Digital Classification and Cartography, Peru
Carlos Coello, Cartographic Technician, Peru
Aldo Lale-Demoz, UNODC Representative for Peru and Ecuador

Thibault le Pichon, Chief, Research and Analysis Section, Vienna
Denis Destrebecq, Programme Management Officer, Research and Analysis Section, Vienna
Ayako Kagawa, Associate Statistician and Spatial Analyst, Vienna

The implementation of UNODC's Illicit Crop Monitoring Programme in the Andean countries, and of the present Peru Coca Survey 2003, is possible thanks to the financial contributions from the governments of Italy, the United Kingdom and France.

This report, and other ICMP survey reports can be downloaded from:
www.unodc.org/unodc/en/crop_monitoring.html

Preface

Illicit coca reduction is a central feature of the drug control policies now in place in the Andean region, all of which were elaborated following the UN General Assembly Special Session on Drugs held in 1998. During the five-year period since 1998, the total area devoted to coca cultivation in the Andean region (Bolivia, Colombia and Peru) declined by 20 percent, reaching a 14-year low of 153,800 hectares in 2003. In Peru, coca surface stood at 44,200 hectares in 2003, representing a 13 percent reduction since 1998.

Peru's share of total Andean coca cultivation fell from 54 percent in 1995 to 29 percent in 2003. This is a remarkable achievement. However, there are indicators suggesting that the illicit coca-cocaine industry in Peru is offsetting at least part of the loss resulting from a reduction in area under coca cultivation by increasing yields per hectare. In order to test the relevance of such reports on aggregate annual dry coca leaf production, the United Nations Office on Drugs and Crime has developed better methods to measure productivity. They are currently being validated for application in next year's Peru coca cultivation survey.

We must take seriously the possibility that the reduction in coca surface could be counterbalanced, at least partially, by increased productivity at the coca farm level. Clearly, this is no time for the Peruvian Government to lower its guard, and even less for the international community to diminish its support to this country. It is equally important for the main cocaine consumer market of the Americas and Europe to strengthen their demand reduction efforts.

Continued international support for Peru remains essential for several reasons. Government presence to deliver social programmes and the rule of law remains thin in most of Peru's 14 coca areas, home to about 50,000 coca farming households. This facilitates drug production, promotes corruption and undermines sustainable development. Despite a legislative framework, the diversion and clandestine manufacture of precursor chemicals remain serious problems. Customs controls are insufficient to stem the tide of significant overseas drug shipments mostly using the maritime route. In several rural areas, including many coca-growing regions, roadblocks and strikes are frequent, and a climate of insecurity and social tension or violence prevails. This is no platform for sustainable development.

Peru can point to numerous alternative livelihoods schemes that have replaced coca-cocaine economies with legal and sustainable farming economies and commercially viable enterprises. In fact, thousands of former coca growers are today able to find markets for their products, often competing successfully in demanding international markets. However, sustainable livelihoods programmes in Peru do not reach enough coca growers. Far too many farmers remain dependent on coca.

The United Nations Office on Drugs and Crime calls on donors and the international financial institutions to help Peru deliver sustainable development opportunities in illicit crop areas. There is no lack of sound and sustainable licit livelihood models on offer for their geographic expansion and replication. Support is also required to empower local governments to play their rightful role in the development of legal farming economies, and to involve the private sector in initiatives aimed at increasing lawful employment, production and productivity in illicit crop areas.



Antonio Maria Costa
Executive Director

Table of content

1. EXECUTIVE SUMMARY.....	5
2. INTRODUCTION.....	6
2.1. Monitoring of coca cultivation in Peru	6
2.2. Legal status of coca cultivation in Peru.....	6
2.3. Evolution of coca leaf cultivation in Peru	6
2.4. Poppy cultivation.....	7
3. FINDINGS	8
3.1. Coca cultivation estimates.....	8
AltoHuellaga.....	12
Aguaytia.....	17
Apurimac Ene.....	19
La Convención and Lares.....	22
Central Selva.....	24
Inambari and Tambopata.....	24
San Gaban.....	26
Other areas.....	28
3.2. Estimates on production of coca leaf and byproducts.....	29
Alto Huallaga.....	30
Aguaytia.....	31
Apurimac.....	32
La Convencion and Lares.....	32
Inambari and Tambopata.....	33
3.3. Coca leaf and by-product prices.....	33
Dry coca leaf at the national level.....	33
Potential value and farmers' annual income.....	34
Dry coca leaf prices by area.....	34
Prices of coca by-products.....	36
3.4. Reported eradication.....	37
Eradication conducted by CORAH.....	39
Eradication promoted by DEVIDA.....	39
4. METHODOLOGY.....	41
4.1. Organisation and staff.....	41
4.2. General pattern of coca cultivation in Peru.....	41
4.3. Determination of the extent of coca cultivation.....	42
4.4. Dry coca leaf yield	47
4.5. Determination of prices of coca leaf and coca by-products	50
5. Annexes.....	53

1. Executive Summary

Under its global Crop Monitoring Programme, UNODC has been assisting the Peruvian Government in the implementation and refinement of a national coca monitoring system since 1998. Annual surveys have been produced since the year 2000, and the present report provides the findings of the coca survey for 2003.

Coca cultivation in Peru takes place in plots under one hectare on average, involving approximately 50,000 farmer families. Most of the coca production occurs in the following six river basins: Alto Huallaga, Aguaytia, Apurimac-Ene, La Convención-Lares, Inambari-Tambopata and San Gabán).

Coca cultivation is estimated on the basis of satellite images covering all coca growing areas in the country, complemented by aerial and field verification and computer-assisted interpretation of data.

In the year 2003, the total area under coca cultivation in Peru was estimated at 44,200 hectares, representing a 5.4 percent decline over 2002. Coca cultivation in 2002 was 46,700 hectares, or 2,500 hectares higher. The bulk of the decline took place in the basins of Huallaga Central, Aguaytia and Alto Huallaga. Coca cultivation in Peru remains well below the levels recorded in the mid-1990s.

The reduction in coca area is attributable mainly to four factors: (i) temporary abandonment of coca cultivation (coca fields left abandoned but that farmers can easily regenerate) (ii) programmed coca crop elimination campaigns, (iii) voluntary coca reduction initiatives by farmers in exchange for new alternative development schemes, and (iv) reduction as a result of ongoing alternative development projects.

The total production of dry coca leaf for 2003 was estimated at 50,790 metric tons, representing a 3.3 percent (or 1,759 metric tons) reduction over the year 2002.

The average price of dry coca leaf on the illicit market was 2.2 US\$/kg in 2003, with a maximum of 3.34 US\$/kg in the Monzon river basin and a minimum of 1.02 US\$/kg in the Apurimac/Ene basin. The gross potential farm-gate value of the dry coca leaf production harvested in 2003 is estimated at US\$112 million.

In 2003, the Peruvian Government reported the eradication of 11,312 hectares of coca, of which 7,022 hectares (62 percent) under programmed illicit crop elimination campaigns and 4,290 hectares (38 percent) under farmers' voluntary coca reduction initiatives in exchange for sustainable livelihood schemes.

The coca surface decline reported in this survey and the significant proportion of coca elimination resulting from voluntary schemes are encouraging developments but constitute no grounds for complacency. In 2003, the Peruvian national coca monitoring system detected in key coca growing areas an improvement in coca farming techniques that may in future years result in higher yields per hectare. Equally important, the year 2003 has been characterized by heightened social tension and violence in Peru's coca growing areas that could result in a reversal of the positive reduction achieved in 2003 in terms of surface and total dry coca leaf production.

2. Introduction

2.1 Monitoring of coca cultivation in Peru

In response to the decisions of the 1998 United Nations General Assembly Special Session on Drugs, UNODC developed and implemented a global Illicit Crop Monitoring Programme (ICMP). Through this programme, UNODC supports member states in establishing a crop monitoring system to monitor illicit cultivation of coca and opium poppy. The Programme is currently operating in Afghanistan, Myanmar, Laos, Colombia, Peru, Bolivia and Morocco.

In 1998, UNODC started working with DEVIDA to develop a similar coca monitoring system in Peru. Using aerial photography, the project produced a detailed mapping (at 1/20,000 scale) of all the coca cultivation areas in 2000. Subsequently, in 2001, 2002 and 2003, satellite images were used to update the estimates. This report presents the findings of the 2003 Survey.

2.2. Legal status of coca cultivation in Peru

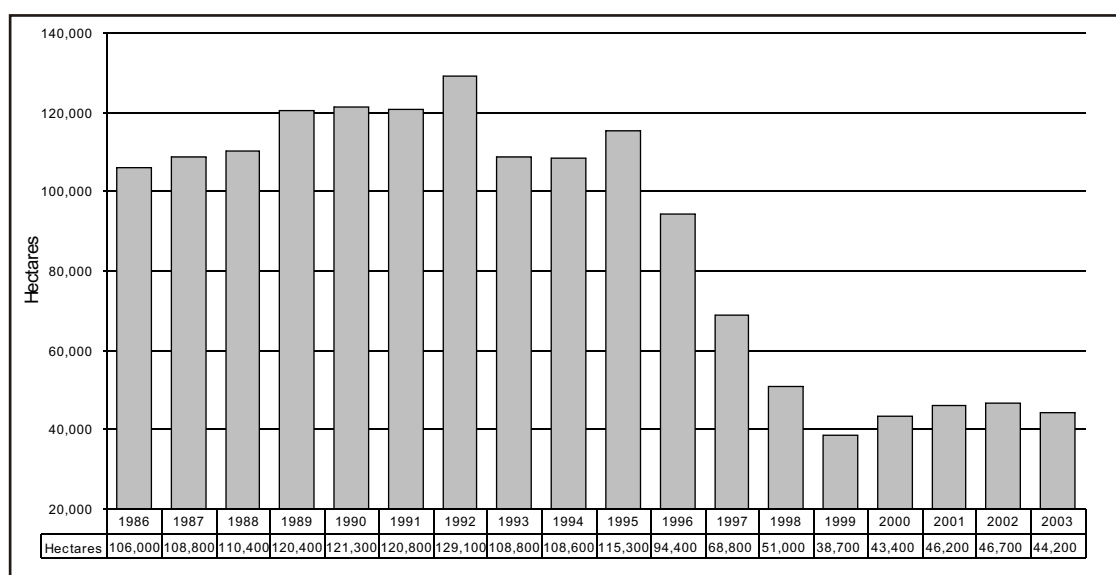
The General Law on Drugs enacted in 1978 prohibits the cultivation of coca and seedlings in new areas within the national territory. This reference to “cultivation” includes the grafting and renovation of existing coca bushes. In 1978, another law established the National Coca Firm (ENACO), which has a monopoly on the commercialization and industrialization of the coca leaves. Therefore, the selling of coca leaves to any party other than ENACO is illicit.

The Government also established in the mid-1990s a Committee for the Fight Against Drug Consumption (CONTRADROGAS), renamed National Commission for Development and Life without Drugs (DEVIDA) in 2001. DEVIDA's objectives are to design, coordinate and implement policies and activities aimed at national drug control.

2.3. Evolution of coca leaf cultivation in Peru

Until the mid-1990's, Peru was the world's main coca cultivating country. Today, it is the second major producer of coca far behind Colombia.

Figure 1: Coca cultivation since 1986 (in ha)



Since 2000, estimates come from the national monitoring system established by the Peruvian government with the support of UNODC. Previous estimates are based on US Department of State data.

The reduction in coca cultivation in Peru in the mid-1990's was linked to the sharp decline in both the coca leaf price and the demand for Peruvian coca leaf. In 1995, trade in coca leaf on the local market ceased and, from 1996 to 1998, the price of coca leaf remained lower than its production costs. Farmers abandoned their coca fields and coca cultivation dropped from 115,300 ha to 38,700 ha, or 66%, between 1995 and 1999.

After 1999, coca prices increased slowly while the price of licit crops (coffee and cacao) decreased. Farmers started to re-activate their abandoned coca fields and coca cultivation rose again in Peru. To some extent, the increase has been contained by the introduction of eradication measures, which include both forced eradication conducted by CORAH (Ministry of Interior) and voluntary eradication schemes conducted by DEVIDA.

2.4. Poppy cultivation

Ten years ago, low levels of poppy cultivation were observed in the northern department of Cajamarca which borders on Ecuador. More recently, eradication of opium poppy fields and seizures of opium latex have been reported in five departments (Cajamarca, Piura, Amazonas, San Martin and Huanuco).

The UNODC-supported national illicit crop monitoring system has not yet established a reliable methodology for the detection of opium poppy in Peru and no data was available for 2003.

Nevertheless, the level of opium poppy cultivation is considered to remain very low in Peru. In 2003, DIRANDRO reported a decrease of opium poppy eradication and seizures, indicating that the level of opium poppy cultivation is not expanding.

3. FINDINGS

3.1. Coca Cultivation Estimates

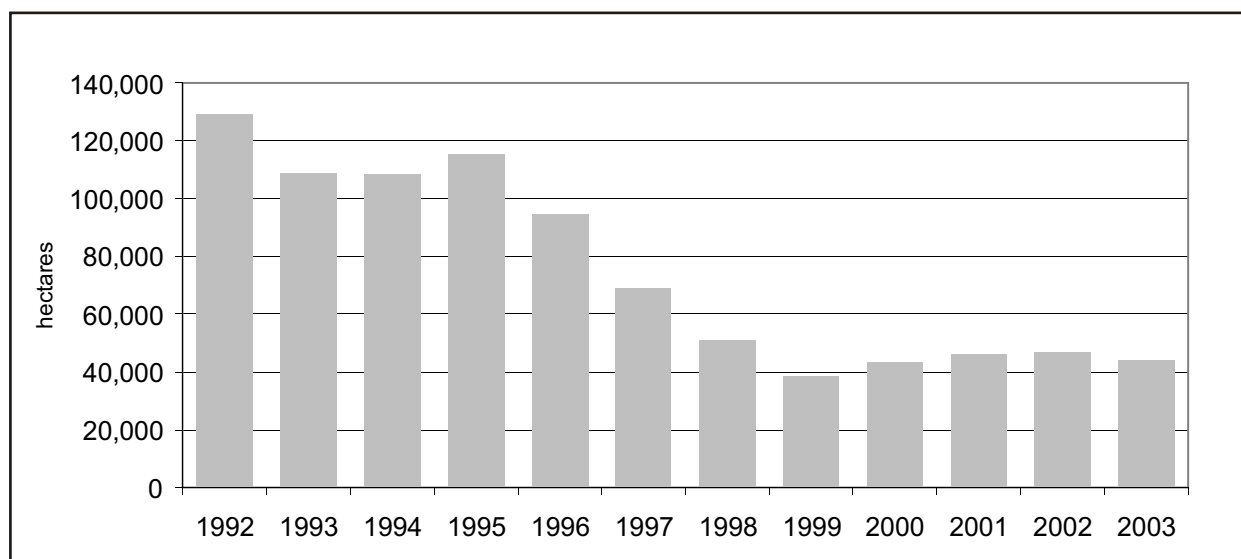
In 2003, the total area under coca cultivation in Peru was estimated at 44,200 ha. This represented a reduction of 5.4% over the 2002 estimate of 46,700 ha, and a reduction of over 60% as compared to estimates from the mid-1990s.

Table 1: Annual coca cultivation 1992-2003 (in ha)*

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
129,100	108,800	108,600	115,300	94,400	68,800	51,000	38,700	43,400	46,200	46,700	44,200

* Sources: 1992-1999: USG; 2000-2003: UNODC

Figure 2: Annual coca cultivation since 1992 (in ha)



The decrease in 2003 was attributed to a combination of four factors: programmed eradication implemented by CORAH (7,022 ha), voluntary eradication against compensation supported by DEVIDA (4,290 ha), abandonment of coca fields (by farmers) without compensation (possibly to escape forced eradication) and alternative development programs.



Eradication conducted by CORAH (Peruvian Ministry of Interior)



Close-up view of an abandoned coca field. Aguaytia

The most important decreases in cultivation were noted in the areas of Central Huallaga, where coca cultivation has virtually disappeared (750 ha were estimated in 2002), as well as in Aguaytia (-52%) and in Alto Huallaga (-11%).

Table 2: Coca Cultivation by area 2002- 2003 (figures rounded - in ha)

Area	2002	2003	Change 2002 - 2003	Percentage of 2003 Total
Alto Huallaga	15,290	13,650	-11%	31%
Aguaytia	1,070	510	-52%	1%
Apurimac	14,170	14,300	1%	32%
La Convencion - Lares	12,170	12,340	1%	28%
Central Selva	350	250	-29%	1%
Inambari - Tambopata	2,430	2,260	-7%	5%
San Gaban	n.a.	470		1%
Others	1,250	450	-64%	1%
Total	46,700	44,200	-5%	

Figure 3: Coca cultivation by area in 2002 and 2003 (in ha)

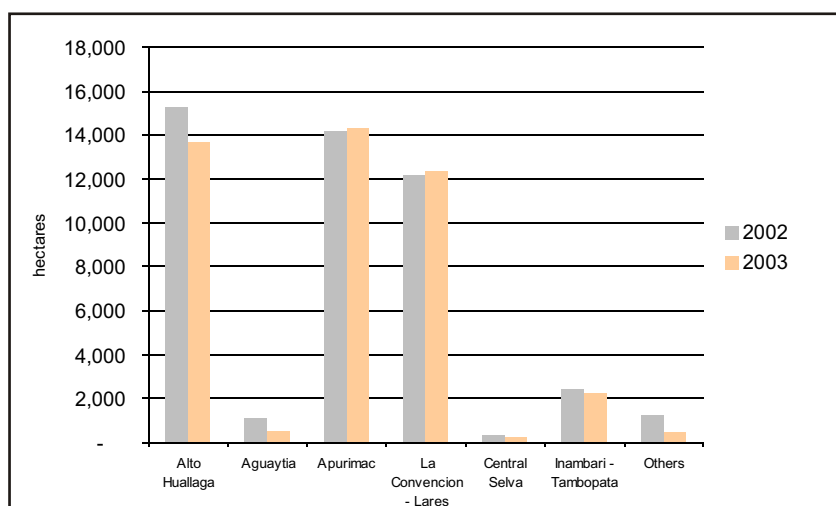
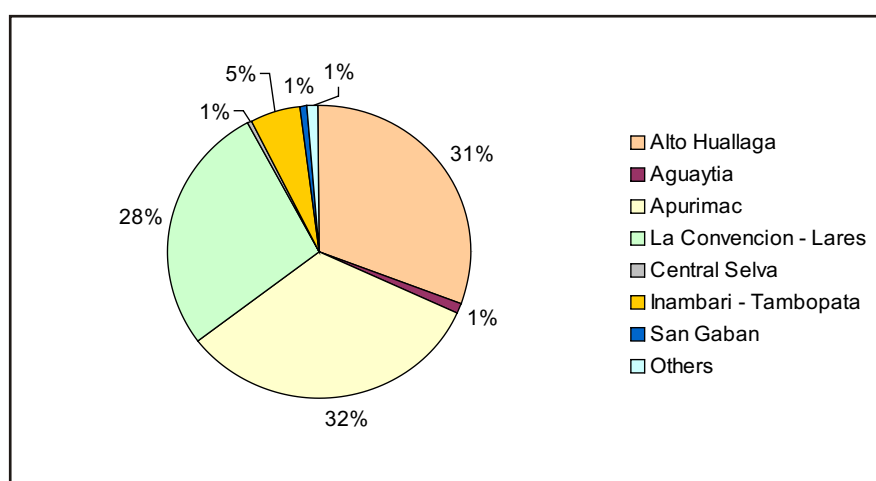


Figure 4: Distribution of 2003 Coca Cultivation by Area (in %)



Map 1: Coca cultivation 2003



Source: UNODC Peru Coca Survey 2003.
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

Map 2: Peru Coca Cultivation Change 2002 - 2003



Source: UNODC Peru Coca Survey 2003.

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

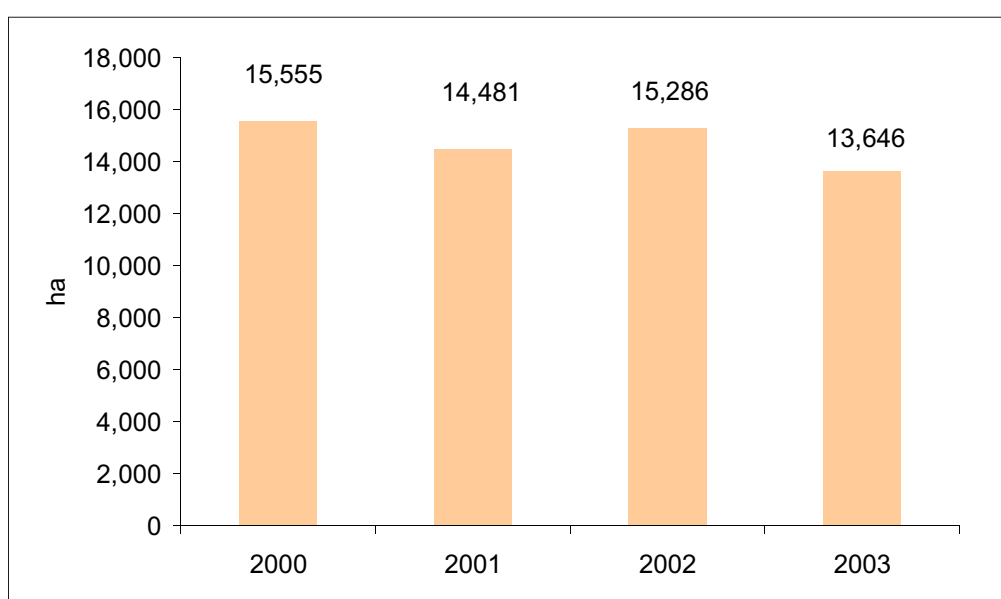
Coca Cultivation per area

Alto Huallaga

In 2003, coca cultivation in Alto Huallaga was estimated at about 13,646 ha, representing 31% of the total area under coca cultivation in Peru. It represented a decrease of 1,640 ha, roughly 11%, compared to the 2002 estimate of 15,286 ha. Although the reasons for the decline vary from one valley to another, for the most part it can be attributed to (i) farmers abandoning their fields without any compensation and (ii) eradication activities.

Whereas in 2002 Alto Huallaga was the country's foremost coca cultivating area, in 2003 it fell behind Apurimac which now accounts for the greatest number of hectares.

Figure 5: Coca cultivation in Alto Huallaga 2000 - 2003 (in ha)

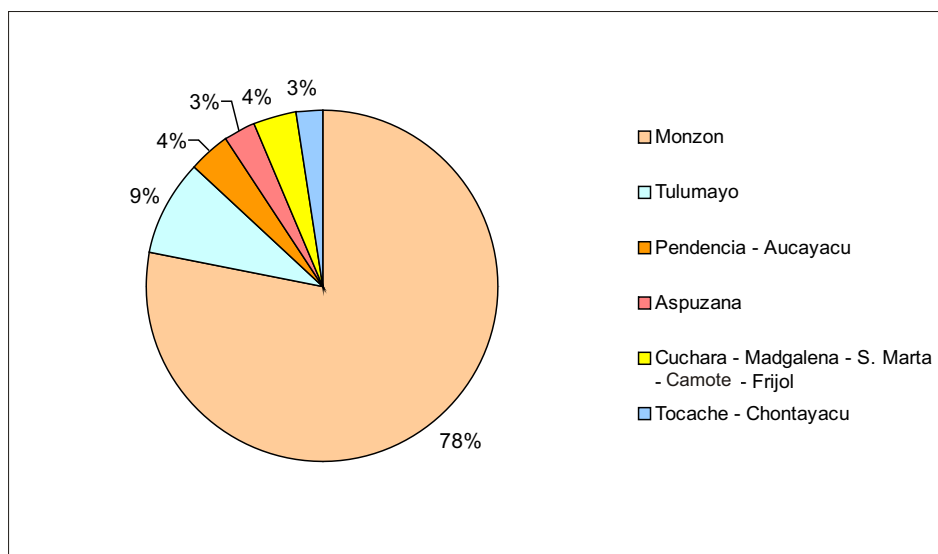


The Alto Huallaga area is made up of valleys that can be combined into six groups based on their geographical proximity and topologic characteristics. Cultivation estimates according to this grouping are presented below.

Table 3: Coca cultivation in Alto Huallaga, 2002-2003 (in ha)

Valley	2002	2003	Change 2002 - 2003	% of 2003 total
Monzon	10,935	10,659	-3%	78%
Tulumayo	1,438	1,188	-17%	9%
Pendencia – Aucayacu	1,147	560	-51%	4%
Aspuzana	488	373	-24%	3%
Cuchara - Madgalena - S. Marta - Camote – Frijol	587	510	-13%	4%
Tocache – Chontayacu	691	356	-48%	3%
Total Alto Huallaga	15,286	13,646	-11%	100%

Figure 6: Distribution of coca cultivation in Alto Huallaga area (in % of 2003 total)



The Monzon valley has traditionally been the area with the highest level of coca cultivation in Alto Huallaga. In 2003, 78% of the coca cultivation of Alto Huallaga was located in Monzon.

Between 2002 and 2003, coca cultivation was relatively stable in Monzon (-3%). No new coca fields were observed. There was no forced eradication or any large-scale abandonment of coca fields in 2003.



*Appearance of temporary abandoned coca areas. Predominance of bushy vegetation (shapumbales)
Alto Huallaga area*

Coca cultivation is concentrated on steep mountain slopes, where only 5% of the land is suitable for agricultural purposes. Here, coca cultivation is by far the predominant crop. In these areas, recent studies undertaken as part of UNODC's alternative development programme estimate that 80% of farmers' income derives from coca cultivation. Coca cultivation is not as predominant in the more productive soils of Monzon's lower valleys.

Insecurity and violence brought about by organizations of coca farmers in Monzon have been constant throughout 2003, especially in the higher areas where coca cultivation is concentrated. While this situation prevented the implementation of activities that would have reduced coca cultivation, it also prevented the coca farmers from increasing coca cultivation.

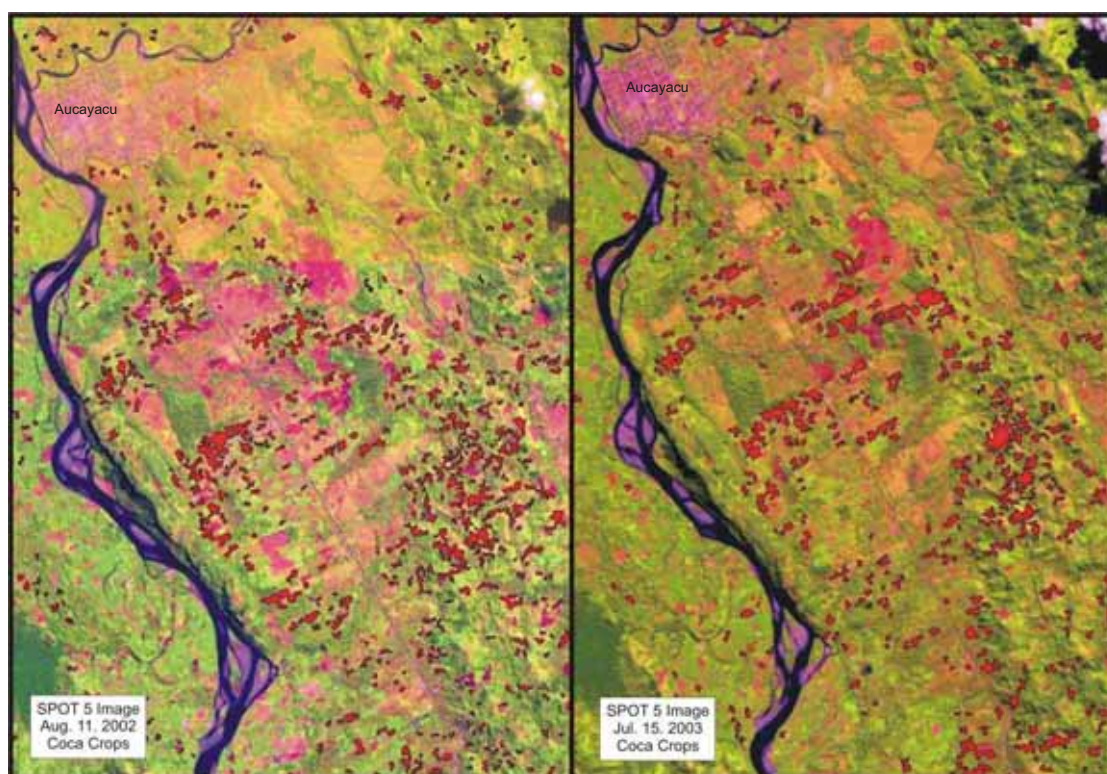
UNODC implements two projects in this area: an alternative development project benefiting 707 farmer households, of which 74% possess coca crops, and a recently launched forestry project targeting 500 beneficiaries. Both projects have played a part in stabilizing coca cultivation in Monzon, but social tension in Monzon as a whole have delayed project operations in 2003.

Compared to Monzon, there was a stronger decline (-33%) in coca cultivation in all other areas of the Alto Huallaga, especially on the eastern side of the Alto Huallaga river, between

the cities of Tingo Maria y Ramal de Aspuzana. In these areas, agriculture is more diverse and coca cultivation accounts for only a marginal fraction of farmers' income.



Nursery for forestry project UNODC. Monzon

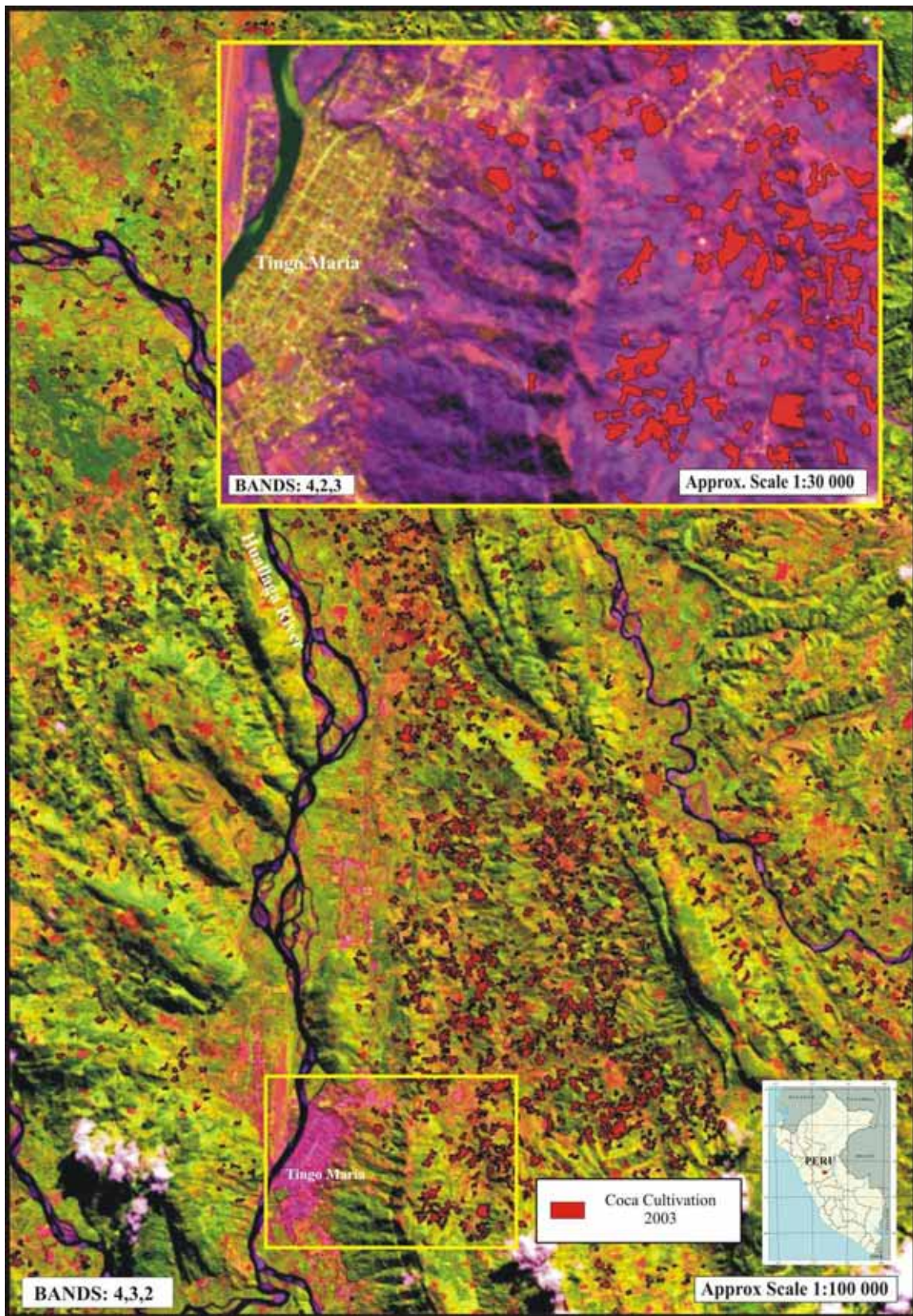


Coca declined in the valleys of Tocache and Chontayacu. The survey found a total of 356 ha of coca cultivation in 2003 compared to 691 ha in 2002.

The general decline in 2003 could be a result of the voluntary eradication programme promoted by DEVIDA. In 2003, forced eradication conducted by CORAH in Alto Huallaga was limited, in contrast to the previous year when eradication was more extensive.

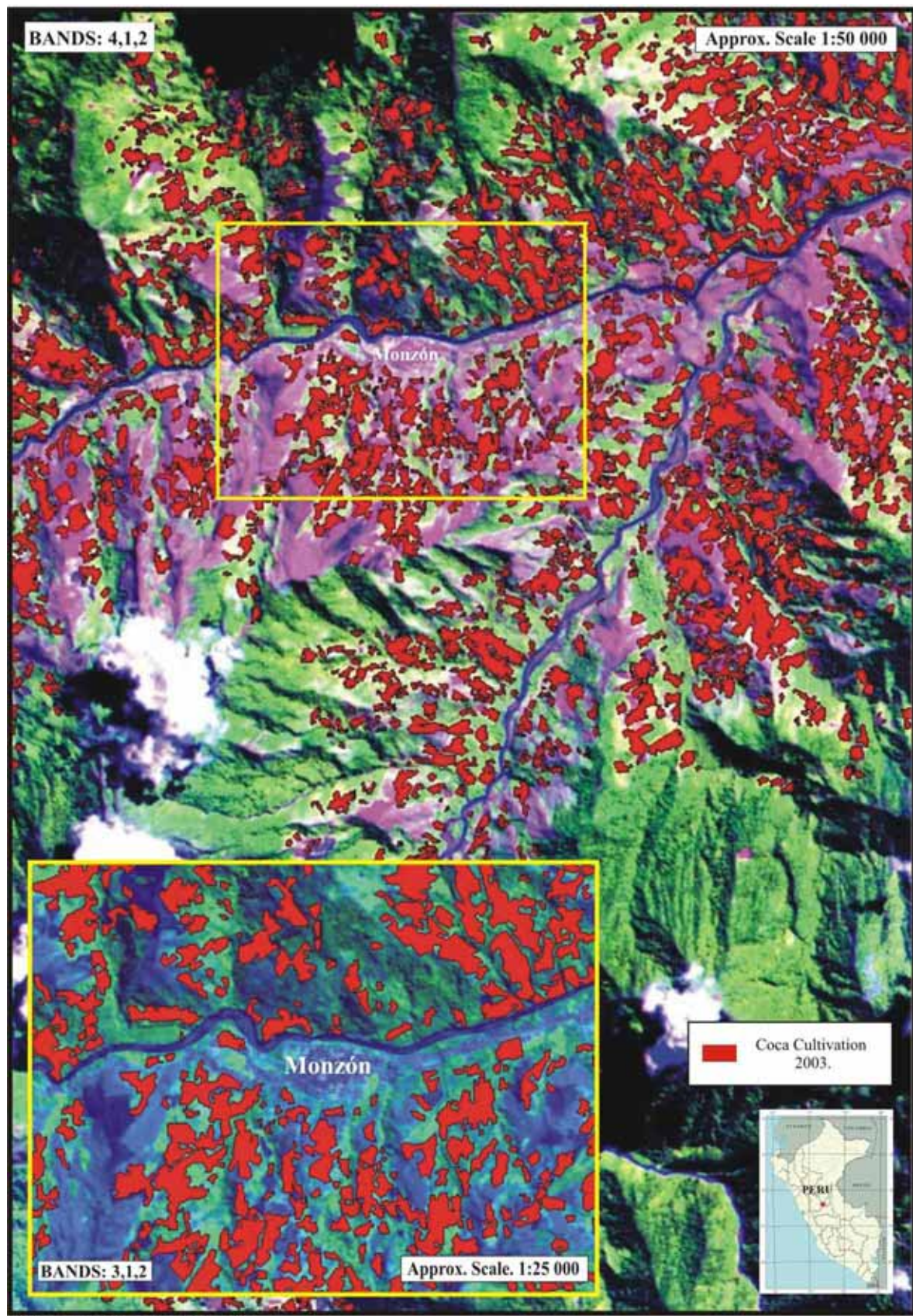
There are direct and indirect indicators suggesting that farmers have adopted a strategy of avoiding forced eradication by abandoning their fields. This may have contributed to the overall coca cultivation decrease reported for the year 2003. Abandoned coca fields are rapidly covered by vegetation, hindering efforts to eradicate them. Once the risk of eradication disappears, abandoned coca fields can quickly be reactivated at a cost which is lower than establishing a new coca field.

Map 3: Result of Classification on SPOT 5 Images in Alto Huallaga Basin 2003



SPOT 5 Image, July 15th 2003

Map 4: Result of Classification on SPOT 5 Images in Monzón sub-basin 2003

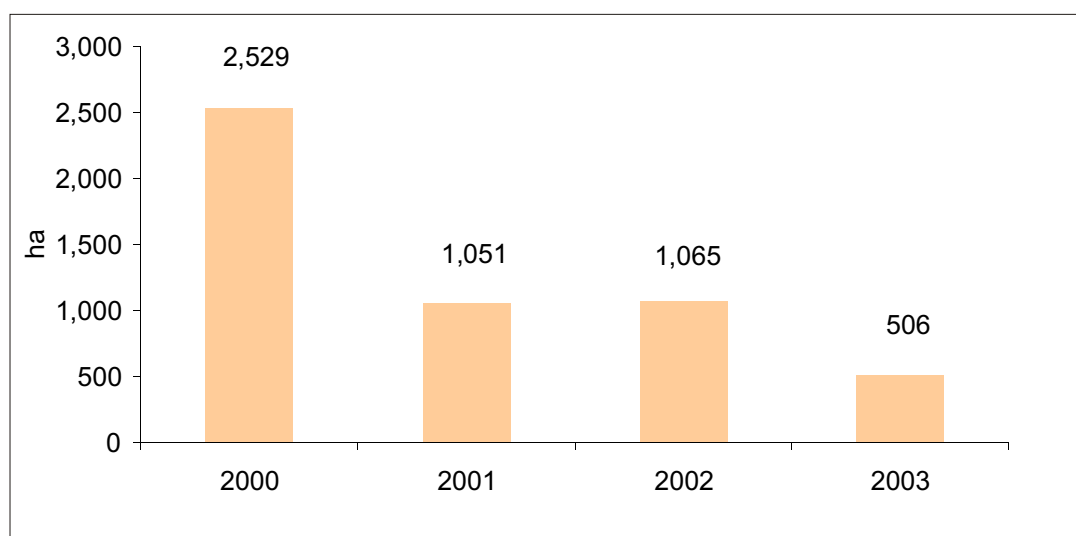


SPOT 5 Images. July 15th 2003

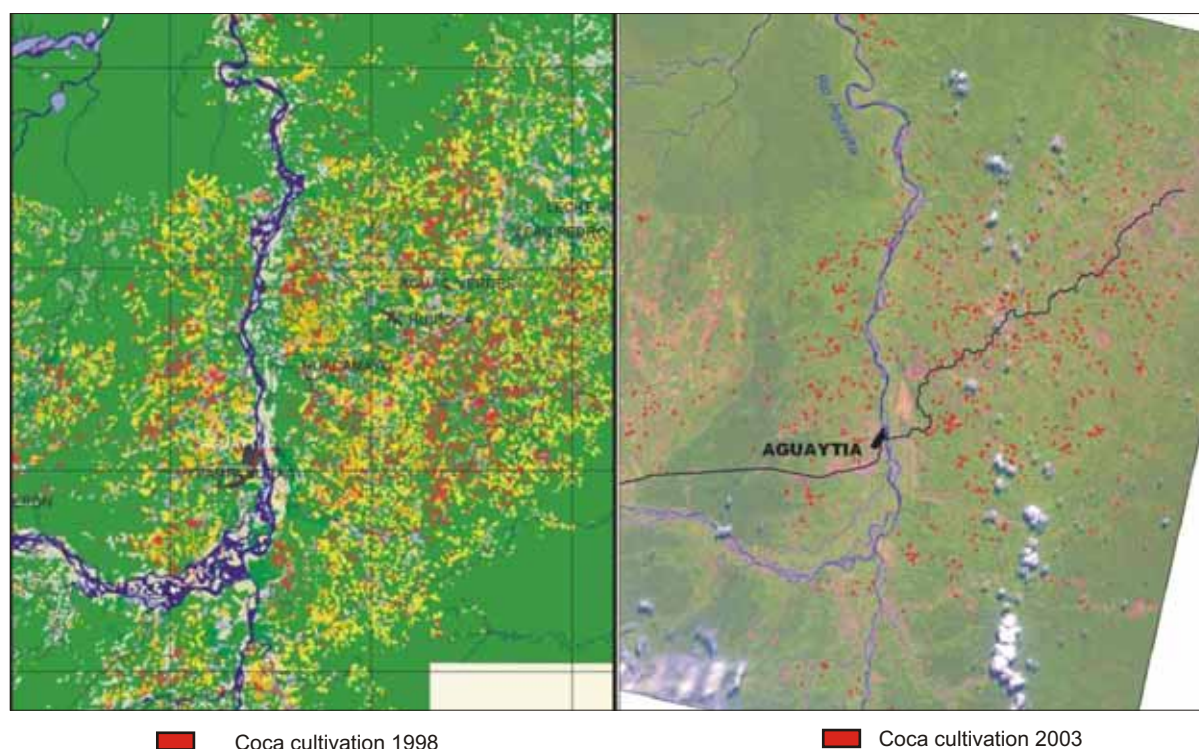
Aguaytia

Of all the areas included in the 2003 survey, Aguaytia recorded the second largest decrease in coca cultivation (-52%). This reduction was mainly due to the voluntary eradication programme promoted by DEVIDA involving one farmer organization in Shambillo. Other peasant organizations rejected the voluntary programme but the resulting social tension did not lead to an expansion of coca cultivation.

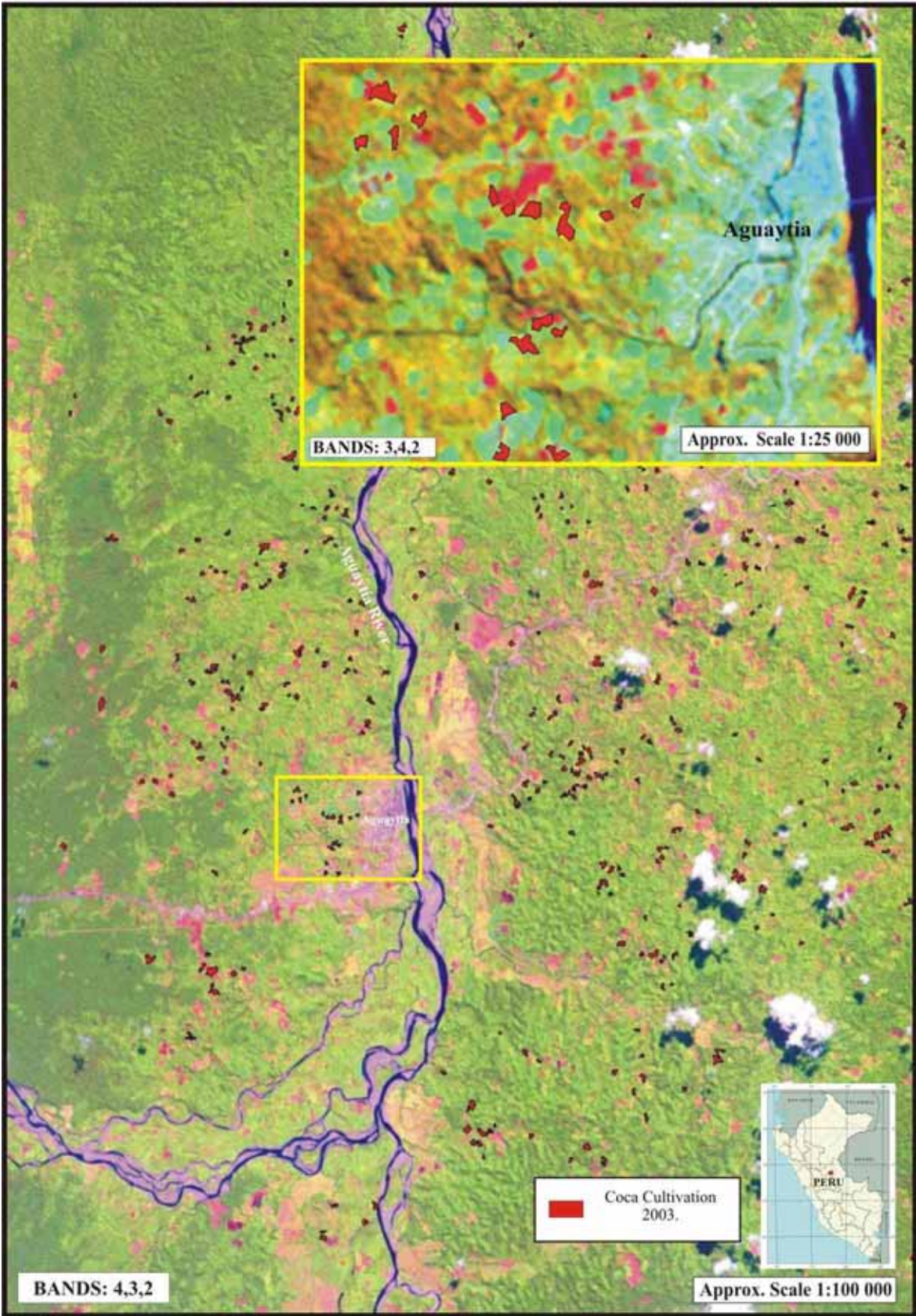
Figure 7: Coca cultivation in Aguaytia 2000 - 2003 (in ha)



In 1995, coca cultivation in this area was estimated at 18,000ha. It declined in the second half of the 1990s due to low coca leaf prices and sustained eradication efforts by CORAH. Aguaytia now accounts for 506 ha of coca, or 1% of the national total.



Map 5: Result of Classification on SPOT 5 Images in Aguaytia basin 2003



SPOT 5 Image. August 31st 2003

Commercially viable alternatives to coca cultivation are being developed in Aguaytia around the Palm Oil Programme initiated by UNODC in the town of Shambillo in 2000. The key elements of the sustainable livelihood strategy are:

- identification of palm oil as a viable and sustainable alternative to coca;
- UNODC's experience in developing such activities in a difficult environment
- participation of the population in the establishment of a private enterprise model;
- environmental and agricultural conditions conducive to the development of this alternative crop;
- supporting all stages of the palm oil business cycle, from harvest to marketing;
- availability of road infrastructure

The programme's target is to establish 2,000 ha of oil plants for 400 beneficiaries, and to construct an oil processing plant that will generate an average income of around 800 to 1,200 US\$/ha/year, representing around US\$1,600,000 to US\$2,400,000 a year for the local economy. Over time, these and other development activities will form the basis for the development of a sustainable licit farming economy to prevent the return of illicit markets.



Oil palm nursery. Aguaytia

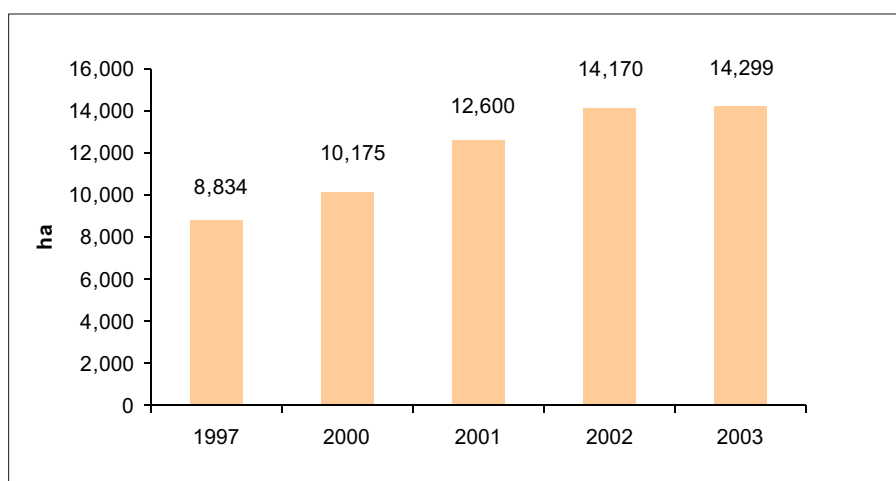


Oil palm processing plant (under construction). Aguaytia

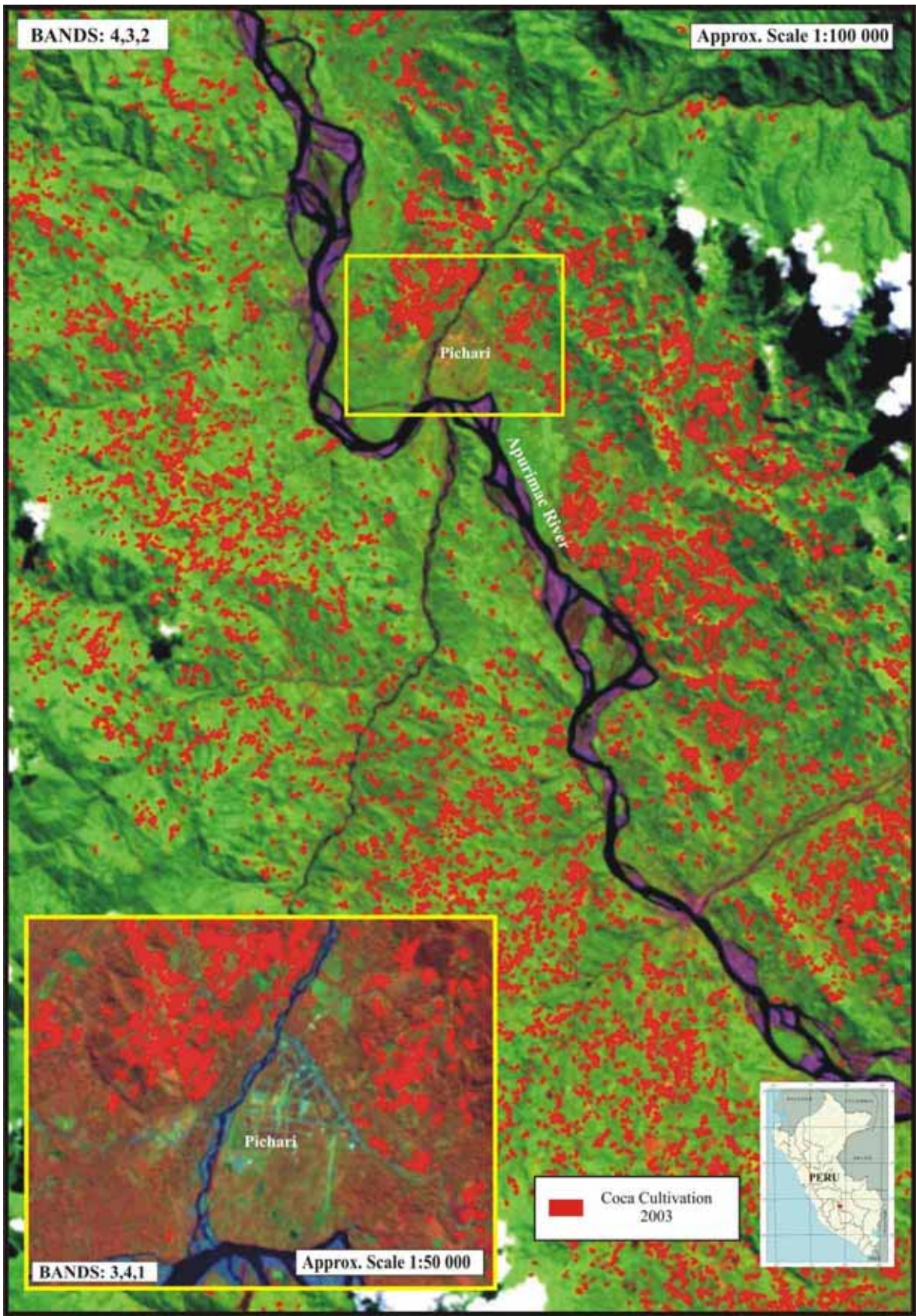
Apurimac - Ene

In 2003, coca cultivation in Apurimac-Ene was estimated at around 14,299 ha, representing a one percent increase over 2002. Accounting for 32% of the national total, this area became in 2003 the country's foremost coca producing area.

Figure 8: Coca cultivation in Apurimac-Ene, 1997-2003 (in ha)



Map 6: Result of Classification on SPOT 5 Images in Apurimac-Ene 2003



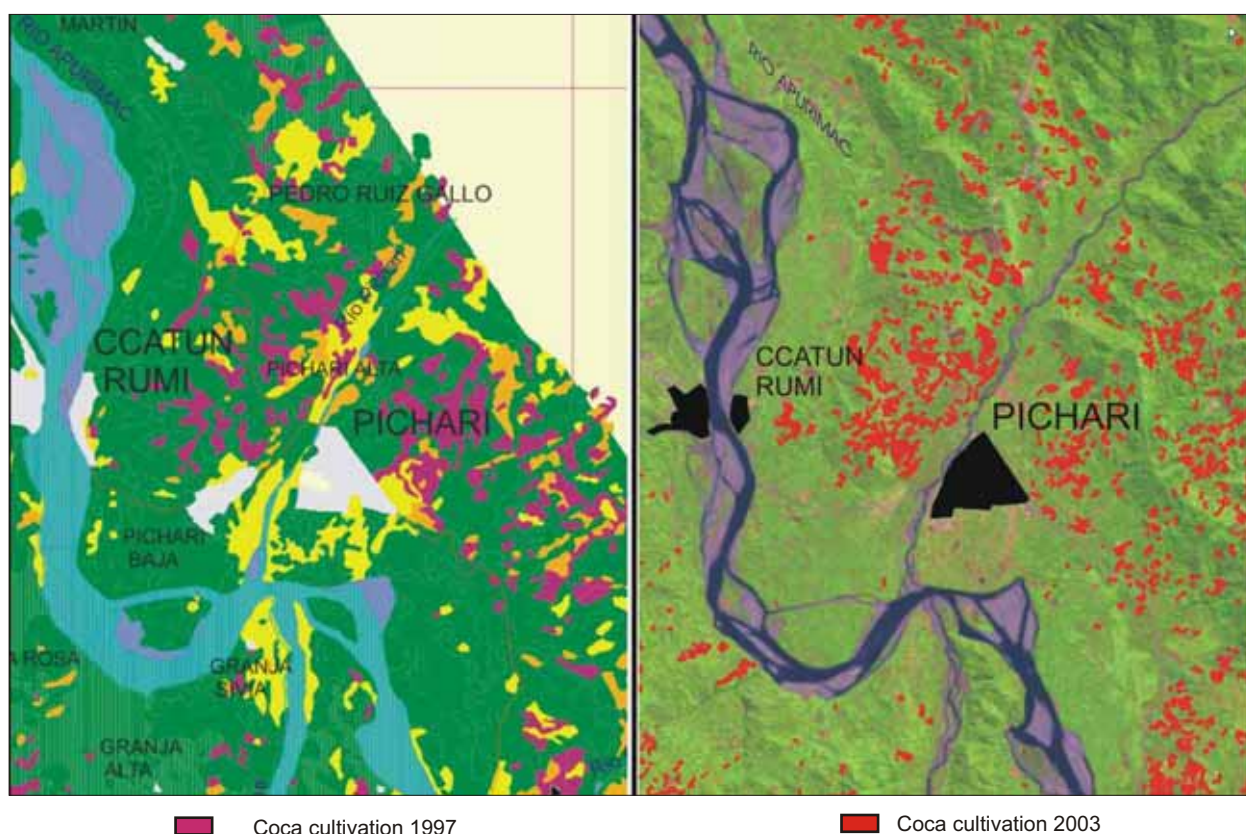
SPOT 5 Image, August 21st 2003

The main centers of coca cultivation in Apurimac continued to be around the cities of Palmapampa, Santa Rosa, and Acon-Llochegua. Coca cultivation was less important around the towns of Monterrico, San Antonio, Quillabamba, Catarata, Alto Pichari, Mayapo, and Canaire.

As in the previous two years, the increase in coca cultivation occurred mainly along the Ene river between the towns of Boca Mantaro, Valle Esmeralda and Kiteni.

Between 1990 and 1994, coca cultivation in this area was estimated at about 30,000 ha, second in importance only to Alto Huallaga. Following the fall in coca leaf prices in the mid-1990s, and subsequent to the government's drug control efforts, coca cultivation fell sharply to around 9,000 ha in 1997.

Beginning in the second semester of 1998, the price of coca leaf increased providing an incentive to further coca cultivation. By 2000, according to UNODC data, about 10,175 ha were under production, representing a 15.17% increase over 1997.



Coca cultivation continued to grow reaching 12,600 ha in 2001 and 14,170 ha in 2002. The increase was due mainly to the rehabilitation and improvement of abandoned coca fields rather than the establishment of new crops. It costs approximately US\$ 400 to rehabilitate an abandoned coca field and the first harvest is obtained after 3 or 4 months. In contrast, the cost for establishing a new hectare ranges from US\$1,500 to US\$1,800 and the first harvest is produced only after 9 or 15 months.

The somewhat stable level of coca cultivation which occurred throughout 2002 and 2003 could be an indication that almost all the previously abandoned coca fields have been rehabilitated, and that coca farmers have chosen not to risk investing in new crops in an environment of frequent political and social turmoil. In this context, farmers prefer to increase the use of fertilizer and the plant

density of existing fields (it is not uncommon to find fields with more than 100,000 plants per hectare).



New coca crops. Apurimac



High density coca crops. Apurimac

Thus far, no eradication measures have been carried out in Apurimac, mainly because of the continuous social unrest and demonstrations by coca growing organizations. In several communities, the existence of alternative development programmes (including UNODC) have contributed to the stabilization of coca cultivation.

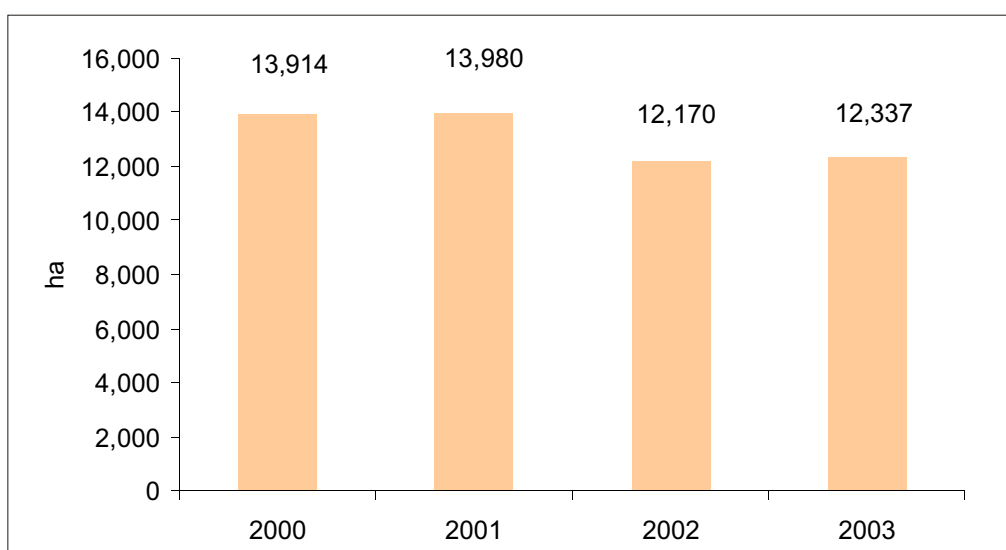


Coffee crop promoted by UNODC. Apurimac

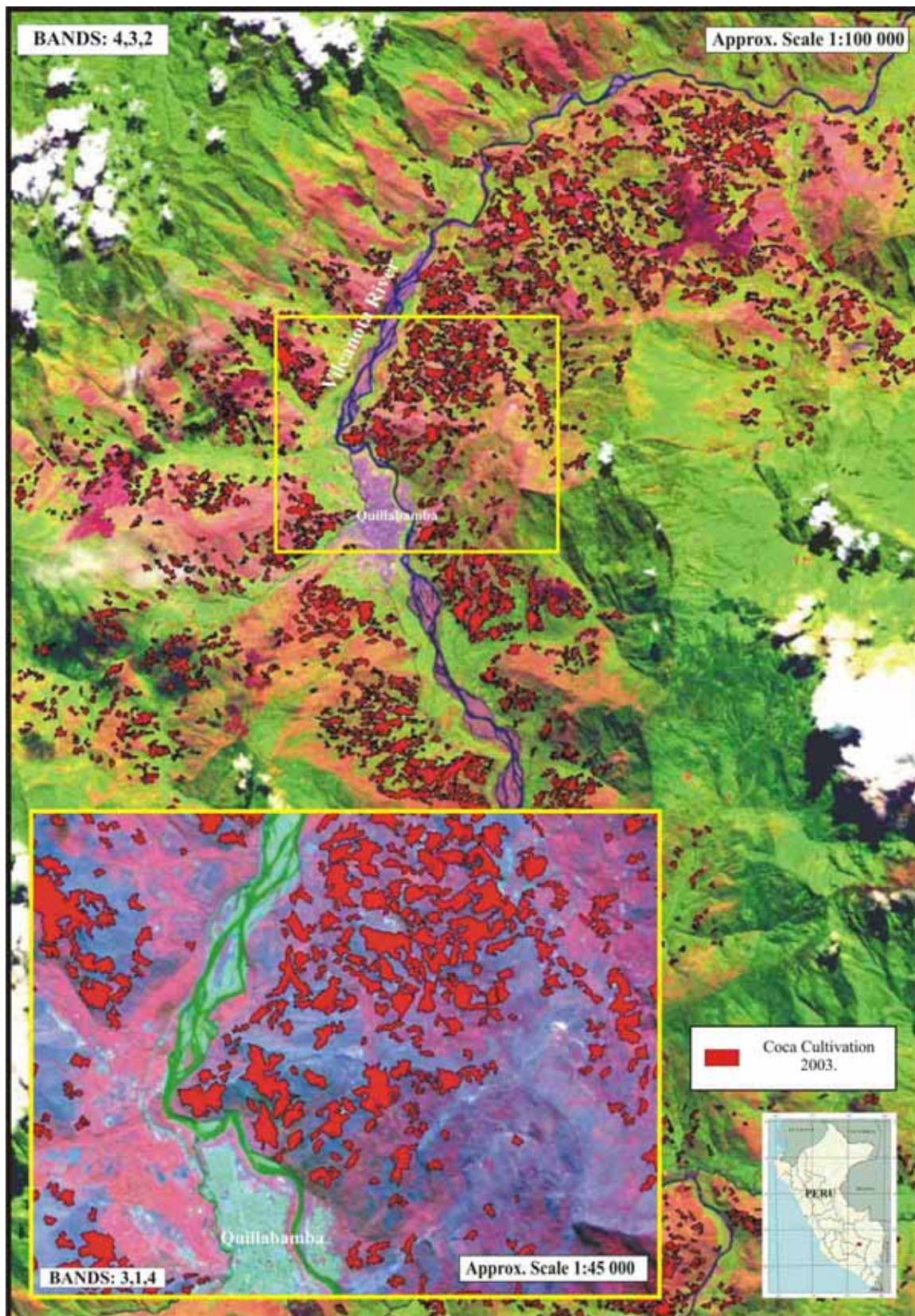
La Convención and Lares

With 12,337 ha of coca cultivation in 2003, La Convencion and Lares contributed to 28% of the national total, the third largest area under cultivation after Apurimac and Alto Huallaga. Compared to 2002, there was an increase of 167 ha, or 1%.

Figure 9: Coca cultivation in La Convención and Lares 2000-2003 (in ha)



Map 7: Result of Classification on SPOT 5 Images in La Convención and Lares 2003



SPOT 5 Image. September 1st 2003

La Convencion and Lares is the source of coca leaf for traditional purposes, such as chewing and infusions. It is also where ENACO has its Headquarters. 10,670 ha of coca bush are registered with ENACO which has the monopoly on the commercialization of coca leaves produced in this traditional coca-growing area. Some 12,685 coca farmers are registered with ENACO, and the organization processes between 2,500 and 3,500 metric tons of coca leaf annually. The balance of coca leaf, between 2,000 and 2,500 metric tons, enter the illicit market.

Fluctuations in coca cultivation in this area (decrease in 2001-2002 and increasing in 2002-2003) are mainly attributable to crop rotation, a traditional method employed to stabilize the soil nutrient content and to increase agricultural productivity.



Pruned coca crops (cuchupearados). La Convención and Lares



High density crops. Quillabamba

Central Selva

Central Selva comprises the basins of the Pichis, Palcazu, Santa Isabel and Pachitea rivers.

In 2003, approximately 250 ha of coca were identified in the Selva Central area, representing a 29% reduction compared to the 2002 estimates of 350 ha.

Coca crops have been present in this area since 1986, when coca farmers were displaced from the Alto Huallaga region. Throughout the 1990's, a total of about 12,000 ha of coca were cultivated. The sharp reduction in the 2000-2003 period is due to the fall in coca leaf prices during the 1990's.

Recently, there have been reports of farmers rehabilitating their abandoned fields while leaving some of the overgrown vegetation to serve as camouflage to escape aerial detection. It was confirmed, this development is not very significant since covered coca fields yield much less coca than open fields.

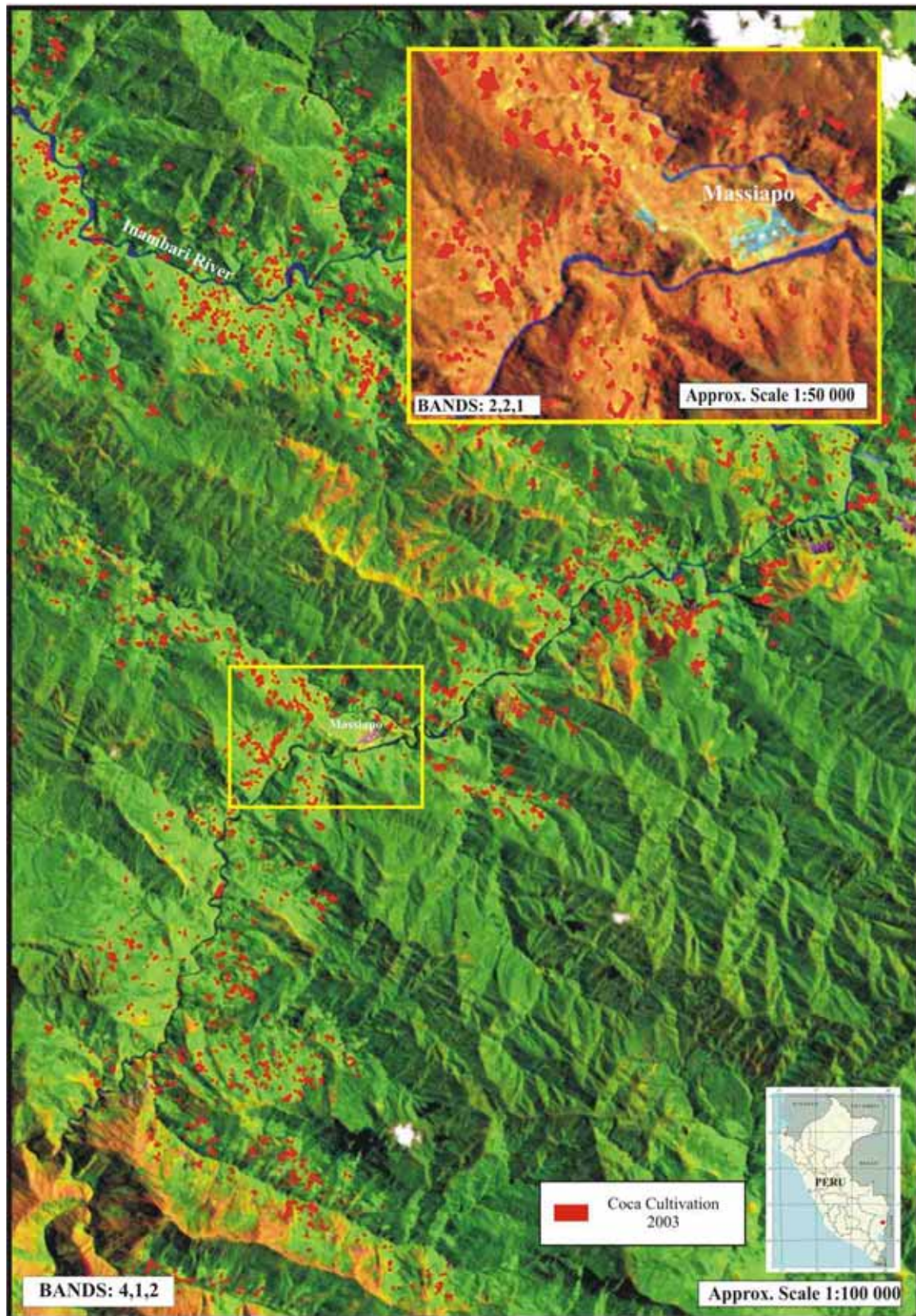
Inambari and Tambopata

These two areas, and in particular Tambopata, were part of ENACO's traditional coca producing area. In 1990, there were 1,778 registered coca producers cultivating a total of 783 ha of coca.

UNODC estimated coca cultivation to be 2,520 ha in 2001 and 2,430 ha in 2002, most of it taking place along the Inambari river.

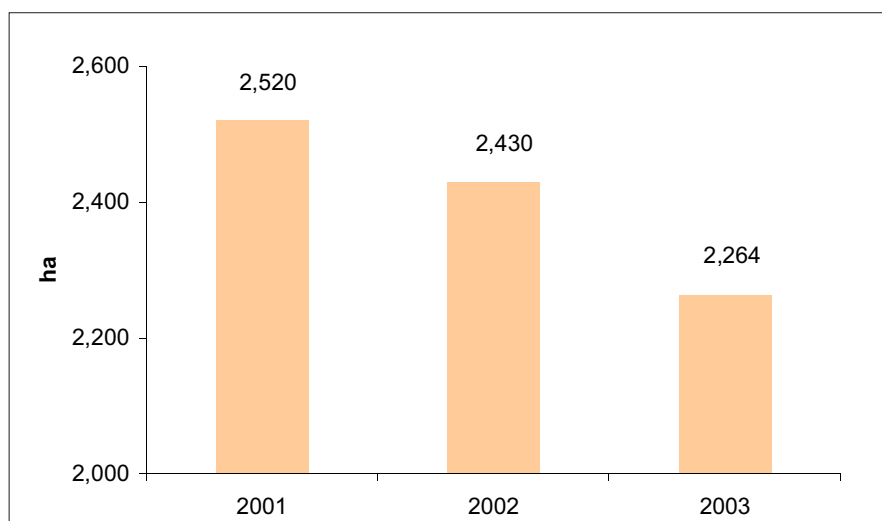
In 2003, the survey identified 2,264 ha, equivalent to 5% of the national total. Compared to 2002, coca cultivation declined by 166 ha, or -7 percent.

Map 8: Result of Classification on SPOT 5 Images in Inambari - Tambopata 2003



SPOT 5 Image March 3th, 2003

Figure 10: Coca cultivation in Inambari and Tambopata 2001-2003 (in ha)



No important social or political mobilizations have been reported in 2003 in this area. No forced or voluntary eradication actions have been carried out. However, this is an area posting a high concentration of coca cultivation, and there have been reports of farmer hostility (in the Inambari basin) toward outsiders entering their communities.

San Gaban

In 2003, following field observations of coca cultivation, San Gaban was added for the first time to the areas covered by UNODC under its monitoring activities in Peru.

This first estimation of coca cultivation in this area was obtained in May 2003 from satellite imagery covering an area including San Gaban city and a 20 km stretch down river.

The survey reported an estimated 465 ha of productive coca fields in the San Gaban area, equivalent to 1% of the national total.

Coca cultivation was minimal in the late 1990s but started expanding since 2002. It was reported that most of the coca leaf production went to the illicit market.

Despite its relatively recent appearance, coca production already plays an important role in the local economy.

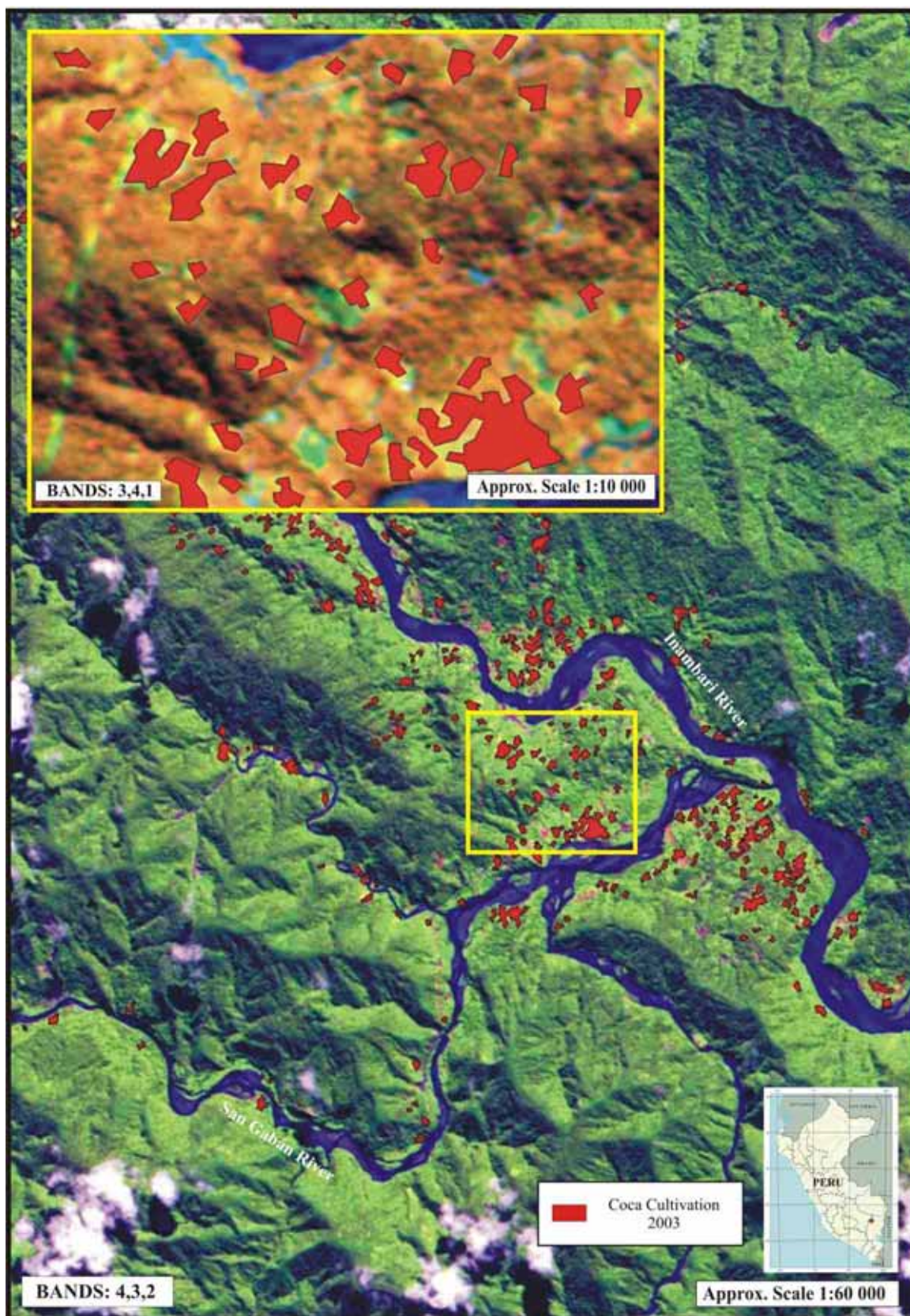


Coca crops in areas near to San Gaban river



Coca crop associated with permanent crop. San Gaban

Map 9: Result of Classification on SPOT 5 Images in San Gaban 2003



SPOT 5 Image, May 10th 2003

Other areas

Over the past two years, following eradication campaigns and the consolidation of alternative development initiatives in several communities, coca cultivation has virtually disappeared in the areas of Alto and Bajo Mayo, Central Huallaga and Bajo Huallaga.

In the Alto Marañón area (departments of Ancash, La Libertad and Cajamarca), coca cultivation in 2003 is estimated at 450 ha.

The Alto Marañón river basin has a rugged topography, characterized by high mountain ridges. Cultivation takes place in small flat plots. ENACO considers the basin to be a traditional coca leaf producing area. It has 900 registered producers with a total of 300 ha of coca.

Over-flights confirmed these to be very old crops on irrigated fields. The plant density was estimated at around 25,000 plants per hectare.



Coca crops in alluvial fans. Marañón



3.2 Estimates on production of coca leaf and byproducts

The total dry coca leaf production in 2003 was estimated at 50,790 metric tons, representing an average annual dry leaf yield of about 1,100 kg per ha at the national level.

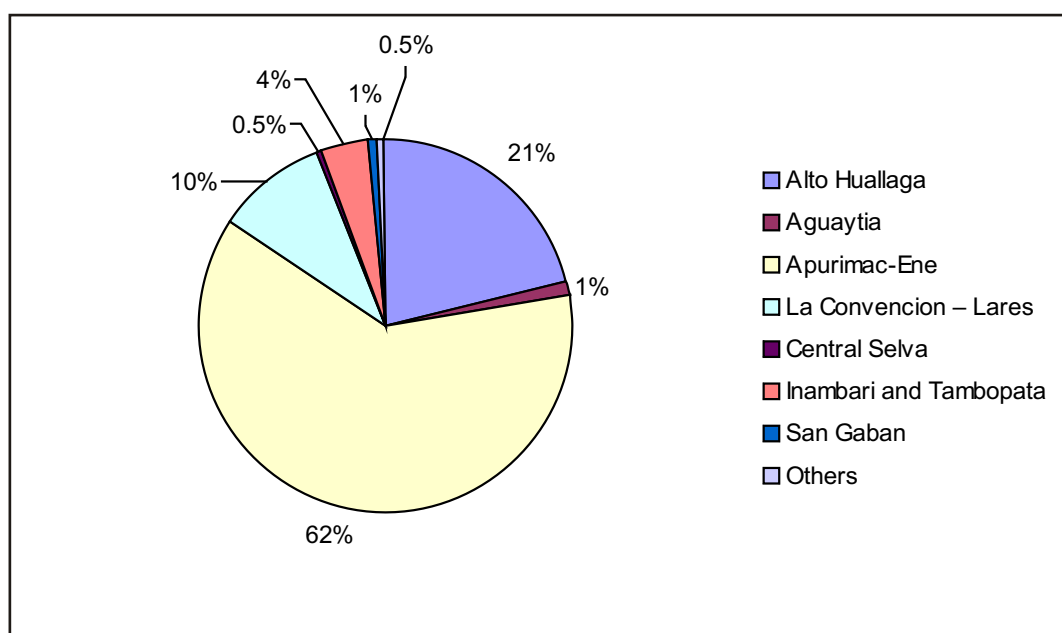
The 2003 coca leaf production estimate was based on productivity baselines developed by UNODC in 2001 on the basis of research in thirteen coca parcels. These benchmarks were also used in 2002. For San Gaban, included in the annual survey for the first time, the average coca leaf yield applied was an approximation resulting from field visits.

The 2003 dry coca leaf production decreased by 1,759 metric tons, or 3.3%, over 2002.

Table 4: Annual dry coca yield and production by area

Area	Annual Dry Coca Leaf Yield (kg/ha)	Coca Cultivation 2003 (ha)	Dry Coca Leaf Production 2003 (metric tons)	Percentage of Total 2003 Production
Alto Huallaga	798	13,646	10,890	21%
Aguaytia	960	506	486	1%
Apurimac-Ene	2,200	14,299	31,458	62%
La Convencion – Lares	400	12,337	4,935	10%
Central Selva	1,000	250	250	0.5%
Inambari and Tambopata	900	2,264	2,038	4%
San Gaban	1,000	465	465	1%
Others	600	450	270	0.5%
TOTAL		44,217	50,790	100%

Figure 11: Distribution of Dry Coca Leaf Production by Area



It is worth noting that whereas coca in Apurimac-Ene represents 32% of the total 2003 coca surface, it represents 62% of the total 2003 coca leaf production. This is due to the estimated dry coca leaf yield of about 2,200 kg/ha, a figure twice as high as the national average yield estimate.

Assuming a conversion ratio of 328 kg of dry leaf to 1 kg of pure cocaine hydrochloride, and further assuming that all dry coca leaf production was converted into cocaine hydrochloride, the potential cocaine production in Peru for 2003 amounted to 155 metric tons.

A UNODC study at the end of the 1990s estimated that 120 to 130 kg of dry coca leaf could produce 1 kg of cocaine base yielding around 0.5 kg of washed coca base. The conversion rate from washed coca base and cocaine hydrochloride was estimated at 80%, thus 0.5 kg of washed cocaine base would produce 0.4 kg of cocaine hydrochloride. This equals the above conversion rate of 325 kg of dry coca leaf to 1 kg of cocaine hydrochloride.

More recently, reports have surfaced suggesting that drug traffickers have become more efficient in the conversion of coca leaf into cocaine, especially in the use and management of chemical precursors.

Preliminary results of the 2003 coca leaf yield assessment

There have been reports since 2001 suggesting that farmers, rather than expanding the area under coca cultivation, were achieving improvements in coca yields through increasing plant density and improving field management practices, notably the use of fertilizers.

Starting in June 2003, UNODC initiated a one-year survey based on field visits to assess coca yields during each of the four annual harvests. By the time this report was published, data collected

covered three harvests. The data set will be thoroughly reviewed once the research has been completed. Preliminary results (see table below) should be handled with caution as the entire exercise will have to be evaluated rigorously once all annual yield data has been collected. It should also be noted that the results from the 14 test parcels which are presented here are not weighted against the coca cultivation estimates strata, and that these preliminary results were not used to determine total dry coca leaf production in 2003.

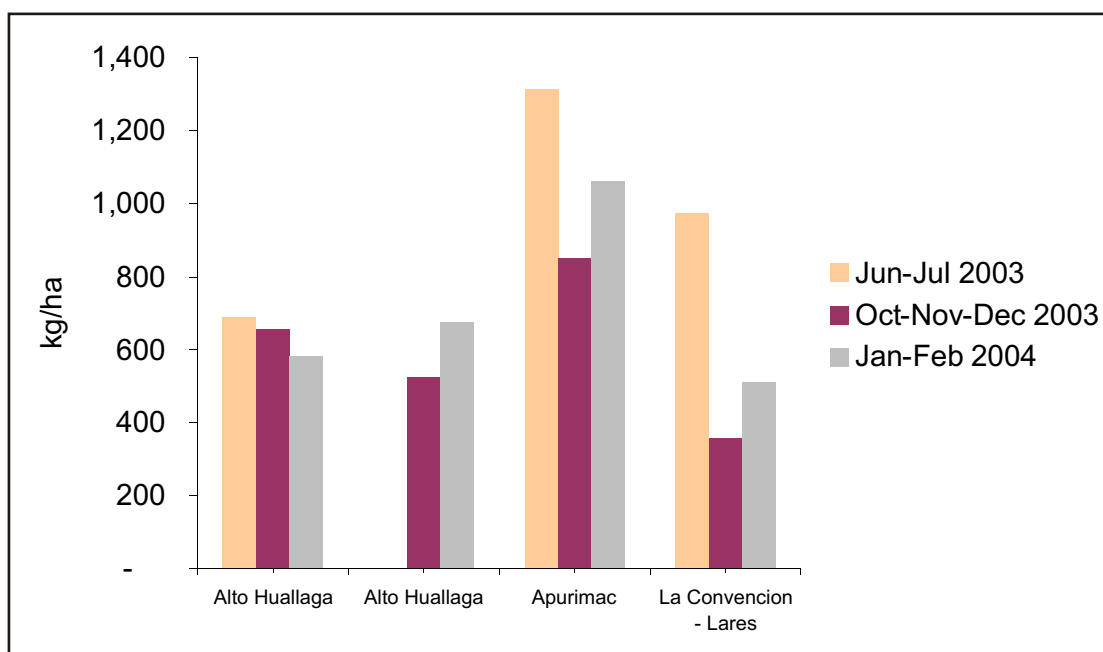


Productivity data gathering, Apurimac

Table 5: Preliminary results of dry coca leaf yield survey

Area	# fields	Location	Simple average kg/ha/harvest			Total (kg/ha for 3 harvests)	Average per harvest (kg/ha)
			Jun-Jul 2003	Oct-Nov-Dec 2003	Jan-Feb 2004		
Alto Huallaga	2	Tocache-Uchiza	689	658	580	1,927	642
Alto Huallaga	2	Tingo Maria		523	677	1,199	600
Apurimac	6	S.Rosa/Palmapampa/Pichari	1,315	851	1,063	3,228	1,076
La Convencion - Lares	4	Quillabamba	975	358	509	1,842	614
Total	14	Average	993	597	707	2,049	766

Figure 12: Preliminary results of coca leaf yield (kg/ha per harvest)



Dry Coca Leaf Production per area

Alto Huallaga

UNODC estimated that in 2001 the average yield in the basin of Alto Huallaga was about 798 kg/ha/year. However, along the Monzon river, average yield did not exceed 500 kg/ha/year because of the relatively old age of the crop (over 20 years) and the low density of coca plants per hectare (in general less than 25,000 plants/ha).

Since 2001, there have been improvements in crop management. In June 2003, the Tropical Crop Institute carried out a productivity experiment and calculated a yield of 345 kg/ha per harvest. This would place the annual yield of four harvests well above the 800 kg/ha/year used in this survey.

The research carried out by UNODC elsewhere in Alto Huallaga (Uchiza and Tingo Maria) in 2003 also supports the reports that farmers are improving coca yields on existing plots instead of increasing the surface of their cultivation.



Traditional coca crop. Monzon Sector



High density coca crop. Monzon Sector

Aguaytia

Unlike in other areas, there was no report of increase in coca plant density in Aguaytia, despite the 52% reduction in coca cultivation between 2002 and 2003.

Coca plant density is relatively low in this area and most of the coca fields have a density of less than 40,000 plant/ha.



Low density coca crop. Aguaytia sector

Apurimac

With 2,200 kg/ha/year, the coca yield in Apurimac is the highest in the country and twice as high as the national coca yield estimate of 1,100 kg/ha/year.

Coca fields in Apurimac are well tended, and a coca plant density above 100,000 plants per hectare is common. In some cases plant density reaches 300,000 plants per hectare. The use of fertilizers is widespread.

On the basis of the preliminary findings of the UNODC yield survey, annual dry coca leaf production in Apurimac could exceed 3,000 kg/ha/year.



High density coca crops. Apurimac



Close view of high density coca crop. Apurimac

La Convencion and Lares

Coca leaf production in this area is mainly for traditional purposes. It is estimated that ENACO collects approximately 50% of the total coca crop in the area. The remaining 50% is sold in other centers, but mainly for traditional use.

Coca field density had traditionally varied between 30,000 to 40,000 plants per hectare, with distances of 1 m between lines and 0.30 to 0.50 m between plants. However, in the last three years, plant density has increased, with farmers adding new plants to existing fields. The presence of numerous coca nurseries indicates a high demand for young coca plants.

The preliminary finding of the UNODC dry coca leaf yield survey indicated that the coca leaf yield, in some areas, could be above 1,800 kg/ha/year.



Traditional crops enrichment

Inambari Tambopata

According to ENACO reports from 1990, only 5 to 10% of leaf produce actually ended in the official coca market in Inambari Tambopata.

Coca fields have usually been planted with densities of 20,000 to 30,000 plants per hectare. Coca was often associated with licit crops like yucca, maize corn and plantain. Similar to developments in other areas, there are reports that farmers have now started increasing the coca plant density in their fields.



High density new coca crop. Puddle system. Inambari

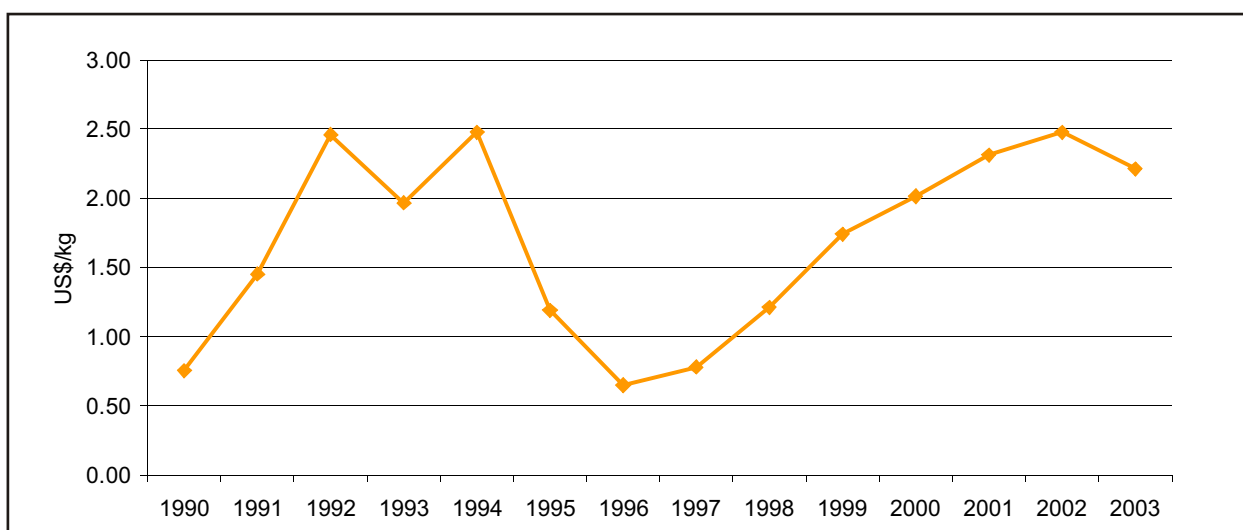
3.3. Coca leaf and by-product prices

Dry coca leaf at a national level

In 2003, the average price paid for coca leaf on the illegal market was 2.22 US\$/kg, with a maximum of US\$3.34 in the month of February in Monzon, and a minimum of US\$1.02 in the month of April in the Apurimac valley.

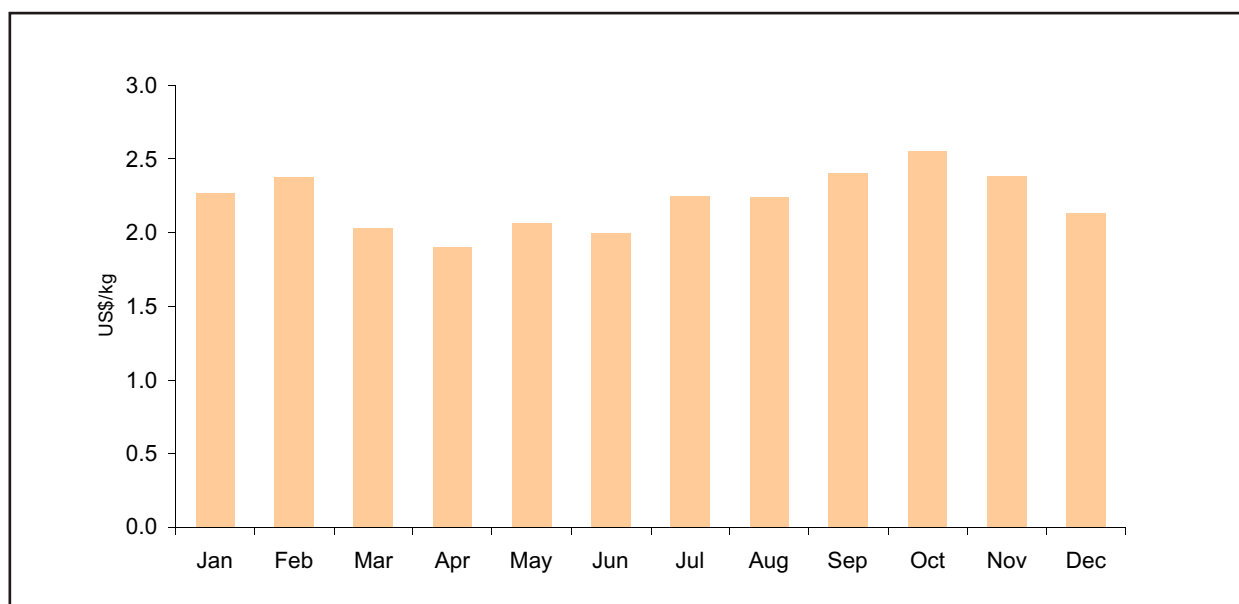
This represents a decline of 11% compared to last year's average coca leaf price of 2.48 US\$/kg. Lower prices are attributable to increased drug interdiction efforts throughout 2003, especially in Alto Huallaga (Monzon), Apurimac and Aguaytia

Figure 13: Dry coca leaf price since 1990s (US\$/kg)



The monthly coca leaf prices since 1990 are presented at annex 2.

Figure 14: Average prices of illegal coca leaf at a national level for 2003 (US\$/kg)



Potential value and farmers' annual income

At the country level, the gross potential farm-gate value of the dry coca leaf production harvested in 2003 amounted to US\$112 million. This estimate was obtained by multiplying the dry coca leaf production of 50,790 metric tons by the average annual dry coca leaf price of 2.2 US\$/kg.

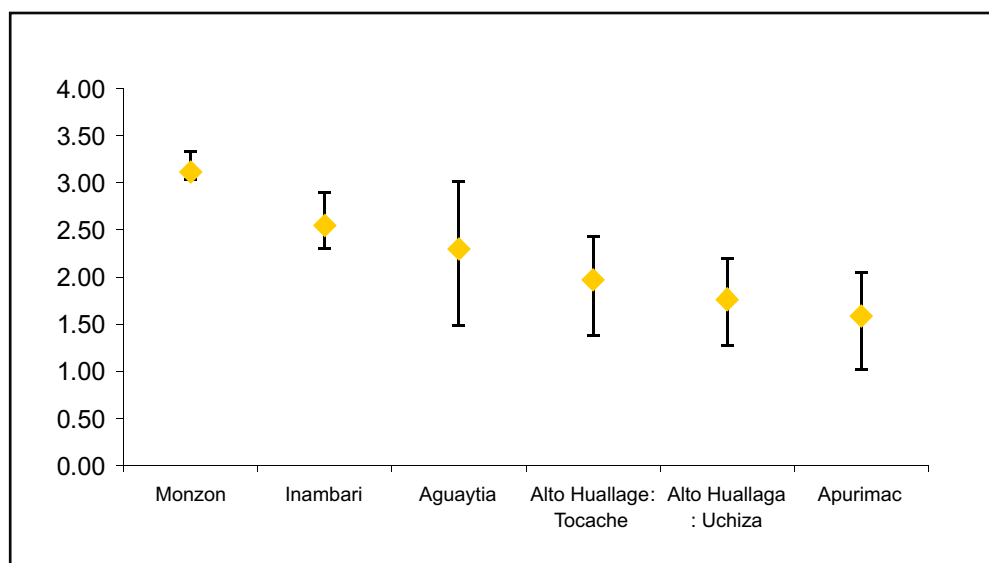
Considering that 50,000 households cultivate coca in Peru, the average gross income per household would be around US\$2,240 per year. Discounting maintenance costs, the net income per household derived from the sale of coca leaf is around US\$1,344 per year, or US\$ 112 per month.

Dry coca leaf price by area

Table 6: 2003 Dry Coca Leaf Prices per Area (US\$/kg)

Area	Average	Maximum	Minimum
Alto Huallaga: Monzon	3.11	3.34	3.04
Inambari	2.55	2.9	2.31
Aguaytia	2.30	3.02	1.49
Alto Huallaga: Tocache	1.97	2.43	1.39
Alto Huallaga : Uchiza	1.77	2.2	1.28
Apurimac	1.59	2.05	1.02

Figure 15: 2003 Dry Coca Leaf Prices per Area (US\$/kg)



Aguaytia

In the Aguaytia area, the price of coca leaf on the illegal market in 2003 was about 2.3 US\$/kg, which was similar to the prices reported in the last survey (2.4 US\$/kg). In 2003, the highest price (3.02 US\$/kg) was recorded in October and the lowest (1.49 US\$/kg) in June.

The coca leaf price in the first quarter remained above the annual average and dropped in the second and third trimester following episodes of social instability in the area. Coca prices increased in the last quarter, reaching an average of 2.6 US\$/kg.

Apurimac

In Apurimac, the average for 2003 was US\$1.59 per kg. of dry leaf. The highest price was recorded in September (2.05 US\$/kg) and the lowest price in April (1.02 US\$/kg). Coca leaf prices have been very low in this area for the past five years, reflecting the high supply of coca leaf in Apurimac.

Inambari

In Inambari the average price for dry coca leaf was 2.55 US\$/kg of dry leaf. Prices fluctuated only minimally throughout the year, reflecting the stability of the market in this area. There was no social unrest in 2003 and no eradication or voluntary abandoning of coca fields. Prices offered to farmers in Masiapo and Yanamayo were higher on the illegal market than the prices offered by ENACO.

Prices for cocaine precursor products (kerosene, cement, sulphuric acid, chloridric acid among others) were also collected in this area. The availability of such products indicates that there is production of coca base and cocaine in the area.

Alto Huallaga: Monzon

It is noted that the deteriorating security situation in 2003 prevented the collection of coca leaf prices in Monzon starting in May 2003. The average price of 3.11 US\$/kg for 2003 is based on data collected between January and April 2003.

It has been reported that prices remained stable in Monzon until the last quarter of the year, when prices fell as a consequence of a major drug interdiction campaign carried out by the Peruvian Anti-drugs Police.

Coca prices in Monzon have traditionally been higher than elsewhere in the country because of the higher alkaloid content of the coca leaf.

Alto Huallaga: Tocache

The price for dry coca leaf was 1.97 US\$/kg and lower than the national average. The highest prices were recorded in September, October and November (2.43 US\$/kg) and the lowest in March and December (1.39 US\$/kg.)

ENACO offered US\$ 1.5/kg for first-quality coca leaf and US\$1.2/kg for lower grade.

Alto Huallaga: Uchiza

In Uchiza, the average price paid for coca leaf in 2003 was 1.77 US\$/kg. The highest monthly price was for October (2.20 US\$/kg) and the lowest for March and December (1.28 US\$/kg).

ENACO bought coca leaf, with prices similar to those paid in Tocache.

Prices of coca by-products

The average price of row cocaine paste in 2003 was about 305.0 US\$/kg, with a maximum of 380 US\$/kg recorded in Inambari and a minimum of 227 US\$/kg in Monzon (Alto Huallaga).

Washed cocaine base in the Aguaytia, Apurimac, Monzon, Tocache and Uchiza areas averaged 630 US\$/kg, a slight increase compared to 2002. The highest price for washed cocaine was recorded in Monzon in March (700 US\$/kg) and the lowest in Apurimac February and April (480 US\$/kg).



Maceration puddle. Courtesy of CORAH

Regarding cocaine hydrochloride, the average

price in Aguaytia was about 1,000 US\$/kg. In Tocache-Uchiza (Alto Huallaga) the prices varied between 600 and 800 US\$/kg. This difference could be explained by lower quality cocaine sold in Tocache-Uchiza. It was reported that in this area cocaine had sometimes been mixed with amphetamines or inert material, in some cases amounting up to 40% of the final product.

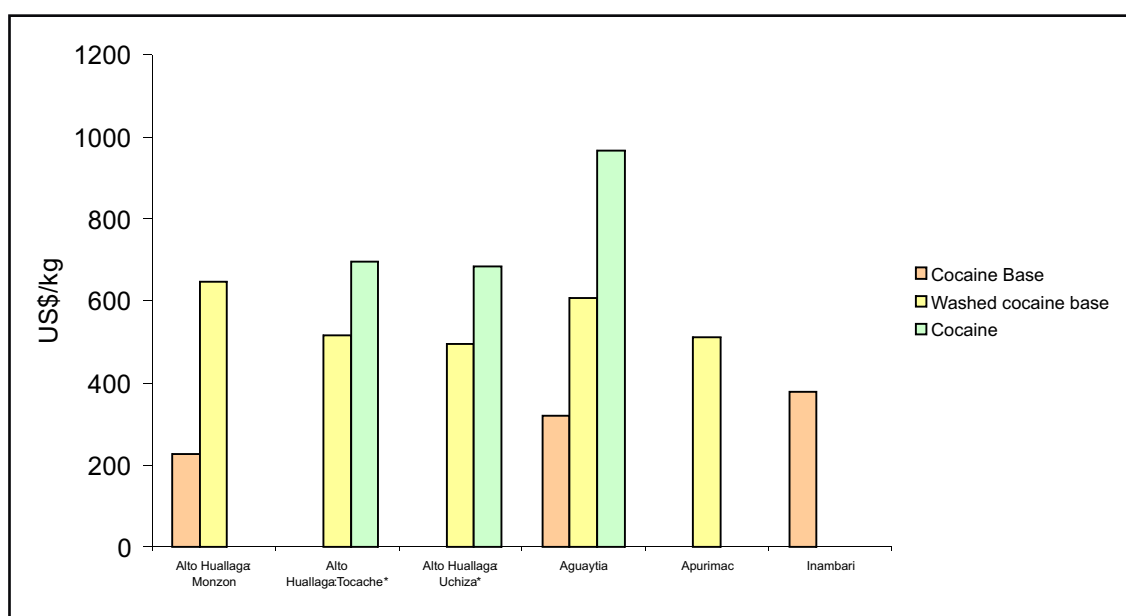
The main coastal cities (Ica, Trujillo, Chiclayo and the outskirt of Lima) continued to be the main centers for the production of cocaine hydrochloride. In these cities, the gross price for cocaine hydrochloride varied between 1,300 and 1,600 US\$/kg, depending on the quality. The street prices for the consumer were around 6 US\$/gram (6,000 US\$/kg) for high-quality cocaine and between 3 to 4 US\$/gram (3,000 US\$/kg 4,000 US\$/kg) for lower grade cocaine.

Table 7: 2003 prices (US\$/kg) for cocaine base, washed cocaine base and cocaine

Areas	Cocaine Base	Washed cocaine base	Cocaine
Alto Huallaga: Monzon	227	648	
Aguaytia	320	608	967
Apurimac		511	
Inambari	379		
Alto Huallaga: Tocache		517	695*
Alto Huallaga: Uchiza		495	684*

* adulterated cocaine

Figure 16: Average cocaine hydrochloride price per area, 2003



3.4. Reported Eradication

In 2003, the Peruvian Government reported the eradication of 11,312 ha of coca fields, the second highest result in 20 years. Of this total, 7,022 ha were eradicated by CORAH and 4,290 ha were voluntary eradicated through programmes promoted by DEVIDA.



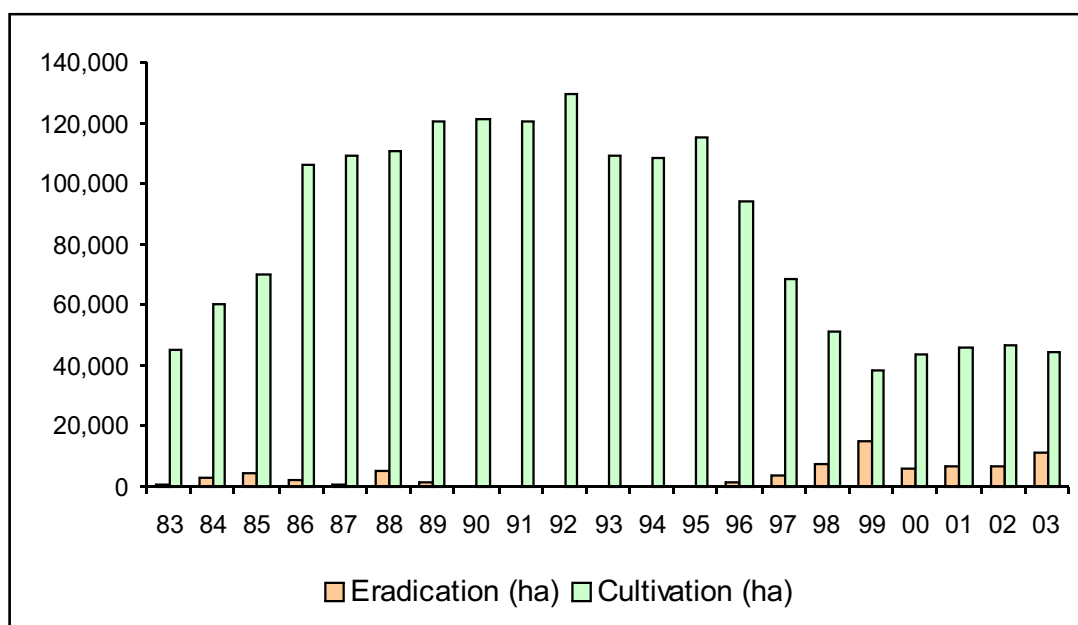
Eradication actions. Courtesy of CORAH

Table 8: Reported eradication since 1983 (in ha)

Years	Eradication (ha)	Cultivation (ha)
1983	700	45,000
1984	3,100	60,000
1985	4,800	70,000
1986	2,600	106,000
1987	400	108,800
1988	5,100	110,400
1989	1,300	120,400
1990	-	121,300
1991	-	120,800
1992	-	129,100
1993	-	108,800
1994	-	108,600
1995	-	115,300
1996	1,300	94,400
1997	3,500	68,800
1998	7,800	51,000
1999	14,700	38,700
2000	6,200	43,400
2001	6,400	46,200
2002	7,100	46,700
2003	11,300	44,200

Sources: CORAH, except for 2003: CORAH and DEVIDA

Figure 17: Coca cultivation and eradication since 1983 (in ha)



Eradication conducted by CORAH

The Project for the Control and Reduction of Coca Cultivation in Alto Huallaga (CORAH) operates under the responsibility of the Ministry of Interior's Drug Control Office (OFECOD). OFECOD provided CORAH with policy guidelines and the United States Embassy Narcotics Affairs Section (NAS) provides technical and financial support for eradication activities.

The breakdown by areas of the eradication data reported by CORAH are present below.

Table 9: Reported eradication in 2003 by areas (in ha) and other factors - Figures rounded

Area/Crop stage	in production	recently abandoned	abandoned	Total	% of total
in hectare					
Aguaytia	123	159	29	311	4.4%
Tarapoto	436	823	2702	3,961	56.4%
Ucayali	682	812	1256	2,750	39.2%
Total	1,241	1,795	3,986	7,022	100%
in %	17.8%	25.6%	56.8%	100%	
in number of field					
Aguaytia	120	148	35		
Tarapoto	417	569	1852		
Ucayali	665	482	709		
Total	1,202	1,199	2,596	4,997	

Source: CORAH

The analysis of the reported eradication figures showed that 3,986 ha (56.8%) of the total eradicated areas were abandoned fields, indicating a serious effort to prevent the rehabilitation of coca fields. It is indeed less costly for the farmers to rehabilitate a coca field rather than establishing a new one. In some areas, it has been noted that when eradication activities are extensive, some farmers voluntarily neglect their coca fields in an attempt to avoid detection while preserving the crop at a latent stage for later reactivation.

Eradication promoted by DEVIDA

The objective of this programme is to support farmers who have voluntarily eradicated their fields by providing economic compensation (180 US\$/ha eradicated) and alternative development support, including assistance to develop the social infrastructure of the areas.

Table 10: Reported eradication under DEVIDA programme in 2003 (in ha), by area and plant density of fields eradicated - Figures rounded

Area	Total	Plant density when eradicated			
		Very low	Low	Medium	High
		800 to 1,100 plants/ha	1,100 to 2,500 plants/ha	2,500 to 10,000 plant/ha	10,000 to 40,000 plant/ha
Aguaytia	2,527	134	1,672	577	145
Central Huallaga: Tarapoto	693	19	520	122	32
Alto Huallaga: Tingo Maria	339	40	102	114	83
Alto Huallaga: Tocache	548	223	122	152	50
Apurimac: Vrae	183	60	45	56	21
TOTAL	4,290	476	2,460	1,022	332
Percent share		11%	57%	24%	8%

The analysis of the reported eradication figures from DEVIDA showed that 68% of the voluntary eradication took place on fields of very low or low density. This suggests that fields had been abandoned, considering that the traditional density of productive coca fields in Peru is between 20,000 to 30,000 plants per hectare.

It is important to note that the elimination of abandoned coca fields limits the potential for the rehabilitation of old coca fields.

4. Methodology

4.1 Organisation and staff

The survey team is composed of eight professionals: one coordinator, one agricultural engineers and three forestry engineers, specialized in photo-interpretation, digital classification, cartography and GIS analysis, one system engineer specialized in multi-spectral analysis, one geographic engineer specialized in surveying, cartography and GIS, and one cartographic technician.

The project also relied on UNODC alternative development projects for the collection of data on prices and yield of coca leaf.

4.2 General pattern of coca cultivation in Peru

The coca bush is a resilient crop that prospers below 2,000 meters in many different regions of the eastern part of the Andes. It belongs to the *Erythroxylon* gender that includes around 250 species. Only two species contain cocaine: *Erythroxylon coca*, which is cultivated throughout the higher and lower tropical rainforest areas of Peru, and *Erythroxylon novogranatense*, which is mainly cultivated in Colombia.

In Peru, coca is cultivated in very small parcels of less than one hectare. About 80% of the coca fields are located on slopes of more than 20 degrees. Typically, the coca bush foliage in Peru covers between 40% to 60% of the soil. However, in some areas like Apurimac-Ene valley, the foliage can cover more than 60% of the soil.

Coca bush is not generally cultivated with other crops. However, during the past five years, a tendency to cultivate coca bush under the canopy of other plants has been observed, suggesting an attempt to avoid aerial detection.

In Peru, coca crops can be harvested from 3 to 5 times a year. The number of harvests per year depends on the field slope, the age of the plant and the agricultural techniques applied.

In areas of traditional coca cultivation, such as in La Convencion and Lares (Cusco), the use of fertilizers is minimal and there are only 3 to 4 harvests per year. In areas oriented toward the illicit market, like Apurimac-Ene, there are 4 to 5 harvests and, in some cases, even 6 harvests per year, due to the intensive use of agro-chemical and the higher plant density.

The harvest periods are closely related to the climatic conditions of the areas. In general, the first harvest is carried out between February and March. This is the period of highest rainfall and, consequently, the volume of coca leaf is higher than for any other harvest. The second harvest takes place 3 to 4 months later, i.e. between May and June. The third harvest, between August and September, and the fourth harvest, between November and December, are less productive because they coincide with the dry season.



Coca crops in units of less than one hectare. Monzon



Coca crops on a steepest slope. Monzon

The harvest periods determine the foliage density of the coca bush and affect the spectral pattern of the coca fields on satellite images.

4.3 Determination of the extent of coca cultivation

The coca census survey for 2003 was based on the acquisition of 12 satellite scenes covering a total area of 23,400 km² over the coca growing areas in Peru.

The survey area was covered by 11 multi-spectral SPOT5 images with a pixel resolution of 10 meter and one SPOT 4 image with a pixel resolution of 20 meters. Most of the images were acquired around August 2003.

The selection of the image type (SPOT5 or SPOT4) and the acquisition period was dictated by the weather conditions. Over the mountainous coca growing areas cloud cover is almost permanent.

Categories of coca fields identified

As in 2001 and 2002, only productive coca fields were taken into account in the implementation of the 2003 census survey. Productive coca fields can be grouped into the following five categories:

a) Young coca fields

This category corresponds to coca fields from 6 to 12 months old. The coverage of coca foliage accounts for 20% to 40% of the spectral characteristics of these fields, while the remaining spectral characteristics come from the soil. As the soil spectral characteristics play an important part in the identification of these coca fields, ground information and previous year's mapping information are crucial.



Coca fields in growing stage. Apurimac river valley

b) Mature coca fields

This category corresponds to coca field from 12 to 24 months old and all those that have been harvested more than one time. Coca fields have a high coca foliage density at this stage and therefore show a high level of contrast on the satellite images.

Generally speaking, the higher the density of coca plants, the higher the contrast on the satellite image. It is therefore easier to identify coca fields in areas where density is high, like in Apurimac, than in areas where it is lower, like in Monzon and La Convencion and Lares.



Foliage maturity Apurimac river valley

c) Harvested coca fields

This category corresponds to coca fields on which the leaves have been harvested and only nude plants and stems remain. Most of the spectral characteristics of these fields come from the colour of the soil. The identification and mapping of these fields therefore requires the use of additional information, such as the 2001 census, as well as field data on the surrounding environment.



Harvested coca crops. Apurimac river valley

d) Rehabilitated coca crops

This category corresponds to abandoned coca fields recently rehabilitated. The rehabilitation process includes weeding and planting of new coca plants in addition to old coca plants. These coca fields can be productive in a very short time. The first harvest can take place as early as 3 to 4 months after the rehabilitation.

The spectral characteristics of these fields are the same as for mature coca, but the use of the 2002 coca mapping enables the identification of these rehabilitated coca fields.



Rehabilitated coca. Uchiza

e) Mixed crops

This category includes parcels where the coca crop, while maintaining its structure in the field (furrows and/or alternating lines), shares the ground with licit crops. Associated crops are generally annual agricultural products, such as maize and cassava.

The spectral characteristics of these fields are the combination of the spectral characteristics of the coca foliage, the associated crop and of the soil.



Mixed coca field under papaya. La Convención

Classification of coca fields on training areas

The satellite images were first geo-corrected using ground control points, national base maps (scale 1/50,000) and 2001 and 2002 ortho-rectified images.

The appearance of the coca fields on the satellite images depends on the field slope, the sun exposure (shaded or sunny areas of the satellite images), and the stage of vegetation development. Based on their extensive field experiences and the 2000 mapping of all coca fields from aerial photography ("year zero"), the technicians defined the various interpretation patterns of the different coca field categories on training areas.

Once these patterns were defined, coca fields were then visually interpreted and their borders digitized on the screen. The best combination of the SPOT5 spectral bands on the screen color

channels for the detection of coca cultivation were:

Table 11: For medium to high levels of foliage coverage

Screen colour channel	SPOT5 spectral band
Red	Band 4
Green	Band 3
Blue	Band 2

Table 12: For low level of foliage coverage and mixed crops

Screen colour channel	SPOT5 spectral band
Red	Band 2
Green	Band 2
Blue	Band 3

The classification results of the training areas were then printed on a map at a scale of 1:50,000 for field verification.

Verification and correction of interpretation patterns

The field verification of the training areas concluded that the crop and land uses that were more likely to be confused with coca fields were: “purmas” (areas predominantly covered with shrub), annual crops with short vegetation period, small areas covered with pastures and recently cleared areas.

These conclusions enabled the correction of the preliminarily identification patterns, and improved the characterization of the confusing crops.

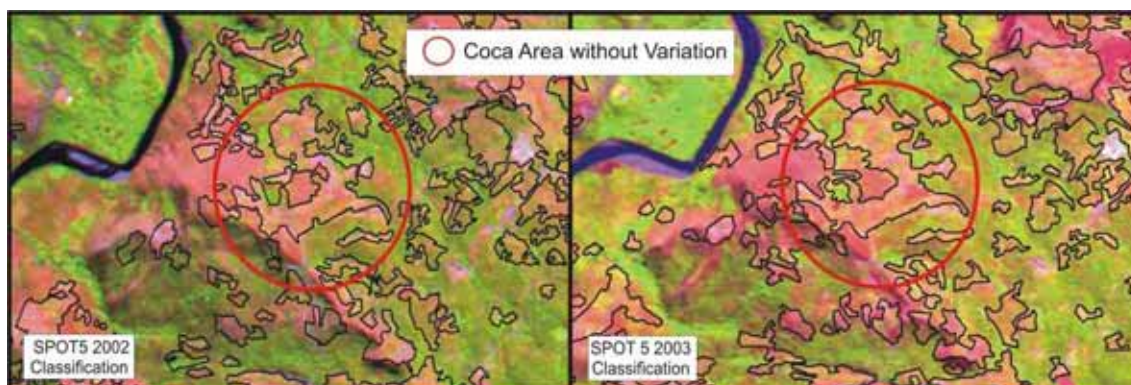
Final Classification

After the interpretation patterns were corrected and adjusted, coca fields were classified in the entire survey area.

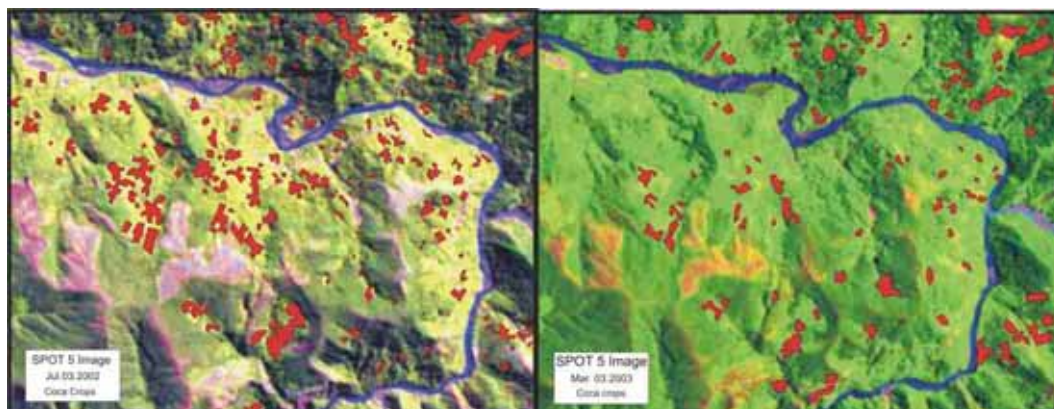
A total of 38,975 polygons areas (polygons) classified as coca cultivation were digitized; 15,697 in Apurimac-Ene; 12,212 in Alto Huallaga; 5,090 in the Yanatile and Urumbamba areas, 3,581 in La Convencion and Lares; 815 in the Aguaytia and 1,580 in other areas.

During the entire classification process, the “year zero” mapping from aerial photography (scale 1:20,000) was used. This mapping was derived from aerial photography at the 1:20,000 scale. It was used in combination with the 2002 classification of coca cultivation to perform the following activities:

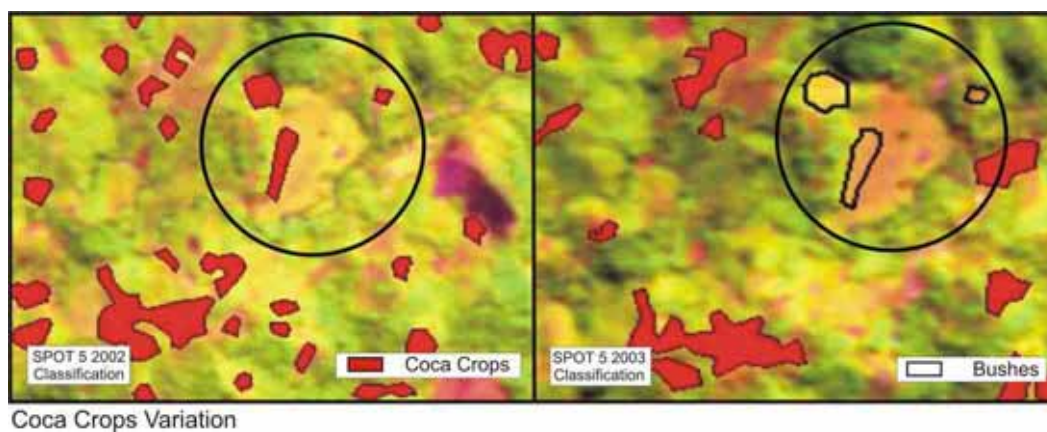
a) Comparison between the 2000, 2001 and 2002 land uses to ascertain the interpretation of coca fields on the 2002 satellite images.



b) Definition of the limits of the 2003 survey area



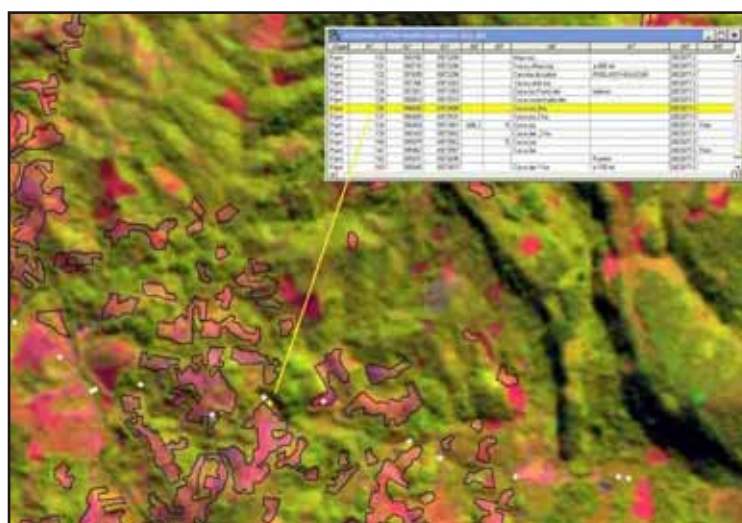
c) Identification of land use changes between 2002



Previous year's ground control points and mapping of coca fields were also used as reference information, in particular to identify the presence of new cultivation areas.

Verification of results

The verification of the classification results was based on the aerial photographs used to establish the “year zero” mapping and the GPS points taken in the field. A total of 1,438 geo-referenced points were used over coca fields at various stages.



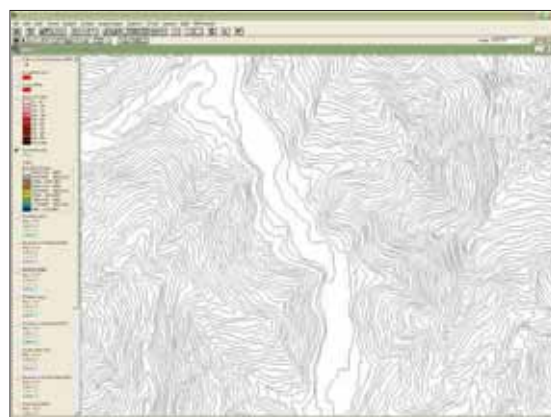
Slope correction

A 90% of the coca cultivation takes place on slope of more than 20 degree. To improve the accuracy of the area estimate, it is necessary to take the slope factor into account. For this, a Digital Elevation Model based on 1:50,000 contour lines was used to account for the field slope. The digitized coca fields areas (polygons) were superimposed on the slope map and their areas corrected based on the inclination of the underlying slope.

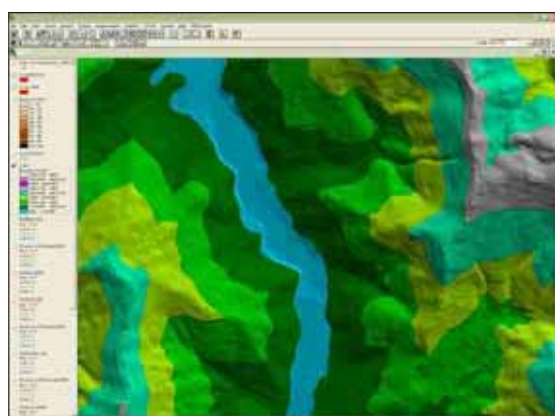
CORRECTION PROCEDURES



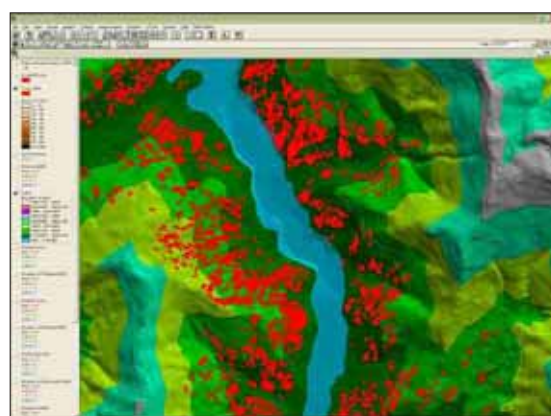
Spot Images - La Convención valley area



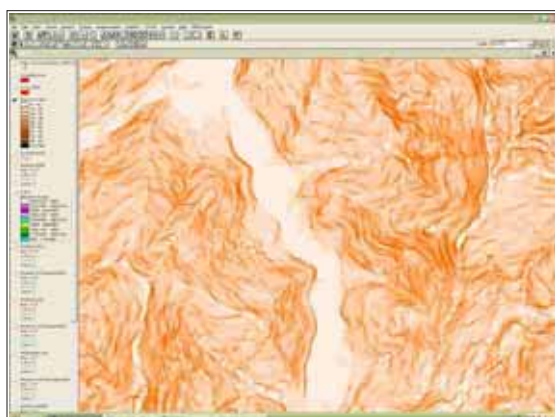
Contour interval



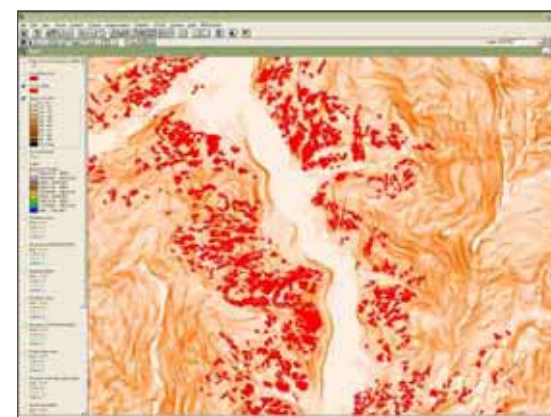
Altitudinal Map



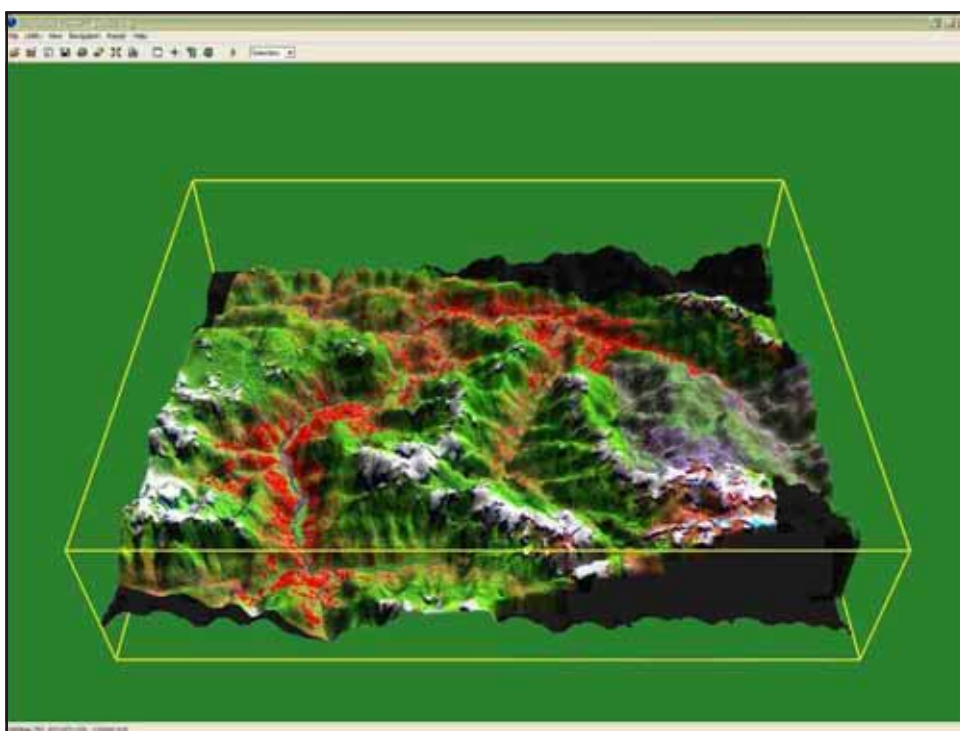
Altitudinal map showing coca crops



Altitudinal map and field slopes



Altitudinal map and field slopes with coca crops



La Convencion valley elevation model

4.4. Dry coca leaf yield

The 2003 coca leaf production estimate is based on baseline data obtained in 2001 by UNODC on the basis of research in thirteen coca parcels in Apurimac-Ene (3), Tocache-Uchiza (5), Aguaytia (3) and Monzon (2). Measurements were taken by weighing and recording the characteristics of fresh and dry coca leaf for each of the four annual harvests.

This estimate was based on the weighing of the complete crop during each of the four harvests. This methodology required that the survey staff remain in the field during the whole harvest time. As security in the coca fields has deteriorated, remaining in the coca field for such a long period is now considered too risky. For this reason, in June 2003, UNODC initiated a yield assessment survey based on brief field visits. The methodology is detailed below.

This type of yield assessment has to span one year and collect data from each of the four harvests. At time of the writing, data were only collected from three harvests. Once data have been obtained from the four harvests, the data set will be thoroughly reviewed and assessed. In particular, the results obtained from the brief field visits, when only a sample of the harvest is weighed as described below, will be compared with the results obtained from the weighing of the complete harvest from a few test fields where UNODC staff can work safely. It is only after validation of these results that the dry coca leaf yield estimate will be updated and used in the next survey.

Assessment of dry coca leaf yield from brief field visits

A total of sixteen coca fields were selected in the area of Alto Huallaga (4 fields), Apurimac (6 fields) and La Convención/Lares (4 fields) and Inambari Tambopata (2 fields). In each area, coca fields were selected to represent the prevailing local conditions of coca cultivation. The field selection

criteria included factors like slope, coca plant density and the use of fertilizer/insecticide, all of which impact on the coca yield.

Table 13: Characteristics of coca fields selected for the preliminary assessment of dry coca leaf yield

Number of field	Area	Field characteristics
2	Alto Huallaga – Uchiza	smooth slope (<20%), low coca plant density (<50,000 plant/ha), limited use of fertilizer/insecticide
1	Alto Huallaga – Tingo María	steep slope (>20%), low coca plant density (<50,000 plant/ha), limited use of fertilizer/insecticide
1	Alto Huallaga – Tingo María	smooth slope (<20%), low coca plant density (<50,000 plant/ha), limited use of fertilizer/insecticide
2	Inambari - Tambopata	steep slope (>20%), low coca plant density (<50,000 plant/ha), limited use of fertilizer/insecticide
2	Apurimac	steep slope (>20%), high coca plant density (>100,000 plant/ha), intensive use of fertilizer/insecticide.
2	Apurimac	smooth slope (<20%), high coca plant density (>100,000 plant/ha), intensive use of fertilizer/insecticide.
2	Apurimac	smooth slope (<20%), medium coca plant density (50,000 – 100,000 plant/ha), intensive use of fertilizer/insecticide.
2	La Convención/Lares	steep slope (>20%), low coca plant density (<50,000 plant/ha), limited use of fertilizer/insecticide
2	La Convención/Lares	steep slope (>20%), medium coca plant density (50,000 – 100,000 plant/ha), limited use of fertilizer/insecticide

Field work

The field work was based on the guidelines developed by UNODC and described in the “Guidelines for Yield Assessment of Opium Gum and Coca Leaf from Brief Field Visits” (Scientific Section and Illicit Crop Monitoring Programme, United Nations 2001). The field work forms are presented at annex 3.

The coca fields were selected at random within accessible areas. This approach could however bias the results. Future field work will be done to estimate how the finding obtained from accessible area could relate to a whole region in order to remove a possible bias.

Field work for the yield assessment should take place when the coca fields are mature, i.e. at the beginning of the harvest or close to the harvest time. The criterion used to define a mature field was that 80% of the coca leaf coverage should be ready for harvest.



-----	1st. month	2nd./3rd.months	3rd./4th.months
Harvested coca	Reborn coca	Growing coca	Coca in production. 80% of mature leaves
NO sampling	NO sampling	NO sampling	Sampling Period

Field work is usually completed in less than one day. Only part of the crop that was being harvested was sampled.

Coca leaves were collected from plants of five plots of five or ten meters long depending on the size of the field. The center of the field determined the center of the first sampling area. The other four were selected mid-way along the median of the coca field. As the coca plants are planted along regular lines, the sampled area is made up of coca plants along one furrow.



Tracing of dividing line



Location sketch of sampling points



The coca leaves of the five sampled plots were either harvested by the farmers themselves or jointly by the surveyors and the farmers.

The following data were collected from each of the five plots of 5 or 10 meter of the sampled fields:

fw_{plot} = weight of fresh coca leaf in kg
 sw_{plot} = weight of sun dry coca leaf (if possible) in kg
 n_{plants} = number of coca plants
 d_{plants} = distance between coca plants in meters
 d_{left} = distance to the left furrow in meters
 d_{right} = distance to the right furrow in meters

These data are then used to evaluate the dry coca leaf yield as follows:

1) sum of the weight of fresh coca leaf in the five plots: $\sum fw_{plot}$

2) calculated weight for a 100 meter line

for 5-meter long plot: $w_{line} = w * 4$

for 10-meter long plot: $w_{line} = w * 2$

3) average distance between furrow: $\bar{d} = \frac{d_{left} + d_{right}}{10}$

4) calculated number of furrow for a 100 meter line: $d_{line} = \frac{100}{\bar{d}}$

5) dry coca leaf yield (kg/ha) $y = w_{line} * d_{line} * 0.35$

The 0.35 constant is the conversion ratio from fresh coca leaf weight to dry coca leaf weight as described in the "Guidelines for Yield Assessment of Opium Gum and Coca Leaf from brief field visits", UNDOC 2001.

Future field work will consist of comparing the results of the extrapolation calculated from the five sampled plots with the actual completed harvest of the coca field. This will be done for a sub-sample of coca fields, and will require a presence in the field through the whole harvest.

There are three to five harvests a year in Peru. The productivity of each harvest varies according to the prevailing weather conditions. It is therefore important to obtain yield data from each harvest. At the time of writing this report, the annual harvest cycle had not be completed.

4.5. Determination of prices of coca leaf and coca by-products

Prices of dry coca leaf and other commodities are collected through a network of 13 collection points located in the following areas: Aguaytia (1), Apurimac (3), Inambari (3), Monzon (2), Tocache (1), and Uchiza (3).

Since August 1999, the survey has recorded the prices of 31 products grouped into four categories: (a) coca and its by-products, (b) agricultural and industrial raw materials with potential illicit use, (c) witness products and (d) licit agricultural products.

Prices are collected once a month by project specialists through semi-structured interviews of key informants selected among farmers, storekeepers and people who participate in the production and distribution of illicit drugs.

It should be noted that, in 2003, instability in the coca growing areas made data collection particularly difficult for the surveyors and the field informants, especially in the areas of Monzon, Aguaytia and Apurimac-Ene.

Map 10: Record of Prices Points 2003



5. Annexes

Annex 1	Peru Surveyed Areas
Annex 2	Monthly coca leaf prices since 1990 (US\$)
Annex 3	Field work productivity form

Annex 1

Peru Surveyed Areas



Source: UNODC Peru Coca Survey 2003.
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

Peru Coca Cultivation Survey 2003

Annex 2

Peru Coca Cultivation Survey 2003

Monthly coca leaf prices since 1990 (US\$/kg)

Month/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Jan	0.7	0.8	1.1	4.3	1.5	3.0	0.3	0.6	0.7	1.8	1.6	2.0	2.6	2.3
Feb	0.9	1.6	1.7	3.5	1.6	3.0	0.3	0.6	0.7	1.4	1.3	2.1	2.6	2.4
Mar	0.8	1.6	1.7	1.7	1.6	2.6	0.3	0.6	0.7	1.7	1.6	2.1	2.3	2.0
Apr	0.5	1.5	2.6	1.3	1.6	1.7	0.5	0.6	0.6	1.6	1.7	2.3	2.2	1.9
May	0.5	1.5	1.9	1.7	1.6	0.9	0.5	0.6	1.0	1.6	1.9	2.4	2.3	2.1
Jun	0.4	1.7	2.2	1.3	1.8	0.7	0.7	0.6	1.0	1.4	2.0	2.5	2.5	2.0
Jul	0.4	1.6	2.2	1.0	2.6	0.4	0.9	0.9	1.1	1.3	2.1	2.5	2.3	2.2
Aug	0.4	1.5	3.0	1.9	3.0	0.4	1.0	1.3	2.1	1.8	2.3	2.7	2.9	2.2
Sep	1.2	1.7	4.3	2.1	3.0	0.4	1.0	1.3	2.0	2.2	2.7	2.7	2.8	2.4
Oct	1.6	1.7	2.6	2.1	3.9	0.4	1.0	0.9	1.5	2.5	2.7	2.5	2.5	2.6
Nov	0.9	1.3	2.6	1.3	4.3	0.4	0.6	0.7	1.4	2.0	2.2	2.0	2.4	2.4
Dec	0.9	1.0	3.5	1.3	3.0	0.4	0.6	0.7	1.7	1.6	1.9	1.9	2.3	2.1
Average	0.8	1.5	2.5	2.0	2.5	1.2	0.7	0.8	1.2	1.7	2.0	2.3	2.5	2.2

Estimations up to 1998 provided by UNODC Alternative Development Projects, from 1999 to 2001 by UNODC-Project AD/PER98/D02 and from 2002 to 2003 by UNODC-Project AD/PER02/G34

Annex 3

Field work productivity form

FICHA MUESTREAL

Cuenca :	Fecha de Registro :
Localidad:	Registrador :
Parcela N°	Epoca de cosecha 1
Ubicación geografica: X	2
(Punto central parcela) Y	3
Pendiente (p%)	4
Extensión aprox.	5
Edad del cultivo	Tecnología

Observaciones

Muestra N°	Peso hoja verde	kg	
	Peso hoja seca	kg	
	N° plantas		
	Distancia golpe	m	
	Dist a surco der	m	
	Dist a surco izq	m	
Muestra N°	Peso hoja verde	kg	
	Peso hoja seca	kg	
	N° plantas		
	Distancia golpe	m	
	Dist a surco der	m	
	Dist a surco izq	m	
Muestra N°	Peso hoja verde	kg	
	Peso hoja seca	kg	
	N° plantas		
	Distancia golpe	m	
	Dist a surco der	m	
	Dist a surco izq	m	
Muestra N°	Peso hoja verde	kg	
	Peso hoja seca	kg	
	N° plantas		
	Distancia golpe	m	
	Dist a surco der	m	
	Dist a surco izq	m	