UNODC
United Nations Office on Drugs and Crime

Central Committee for Drug Abuse control

Lao National Commission for Drug Control and Supervision

South-East Asia

Opium survey 2011

Lao PDR, Myanmar

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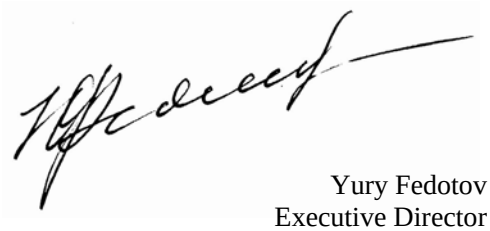
PREFACE

Using helicopter, satellite and village surveys, UNODC has created a detailed study of opium in South-East Asia. Unfortunately, the situation in the region is not positive, and in 2011, there were significant increases in cultivation. From 2007—2010, UNODC has seen a persistent rise in poppy cultivation in South East Asia. In 2011, there was a 16 per cent increase in the amount cultivated compared to the previous year. Overall cultivation has doubled in the region since 2006. Combine these statistics with the fact that regional production, trafficking and consumption of Amphetamine-Type-Stimulants (ATS) is growing and the picture grows dimmer.

To reverse this situation, the international community needs to better understand the nature of transnational organised crime and drug control in the region. To support these initiatives, we must all be proactive on every front and do our utmost to promote cooperation and partnership in the region. In particular, we need to redouble our efforts to achieve security, stability and sustainable development, which are key drivers for reducing opium production. The high prices for opium in the Lao DPR and Thailand, as well as steep price increases in Myanmar, are also making production attractive to farmers.

Food insecurity in some of the opium-growing 'risk' areas is generally high, and it is estimated that around 35 per cent of surveyed households have had insufficient food over the past 12 months, both in opium and non-opium growing households. Although the international community has supported alternative development for many years, and with great success, there is a need for increased investment.

In Myanmar, the country is presently home to 91 per cent of the region's opium cultivation, and there is a need for more programmes that support alternative development for opium poppy growers. These programmes must also take into account the issues of poverty reduction, environmental protection, food security and improved social and economic conditions as key objectives. Indeed, these projects are a necessity because reductions in illicit crop cultivation and opium production can bring tangible benefits to the lives of ordinary people.



Yury Fedotov
Executive Director
UNODC

PART 1. REGIONAL OVERVIEW

FACT SHEET - SOUTH EAST ASIA OPIUM SURVEYS 2011

	2010	2011	Change from
Opium poppy cultivation[1]	41,389 ha	47,917 ha	+16%
Lao PDR	3,000 ha	4,100 ha	+37%
Thailand*[2]	289 ha	217 ha	-25%
Myanmar	38,100 ha	43,600 ha	+14%
Weighted average dry opium yield			
Lao PDR	6.0 kg/ha	6.0 kg/ha	0%
Thailand*	15.6 kg/ha	15.6 kg/ha	0%
Myanmar	15.2 kg/ha	14.0 kg/ha	-8%
Potential production of opium[1]	603 mt	638 mt	+6 %
Lao PDR	*18 mt*	*25 mt*	*+37%*
Thailand*	*5 mt*	*3 mt*	*-25%*
Myanmar	*580 mt*	*610 mt*	*+5%*
Opium poppy eradication	9,125 ha	7,928ha	-13%
Lao PDR	*579 ha*	*662ha*	*+14%*
Thailand*	*278 ha*	*208 ha*	*-25%*
Myanmar	*8,268 ha*	*7,058 ha*	*-15%*
Average price of opium[3]			
Lao PDR	1,670 US$ /kg	1,640 US$ /kg	-2%
Thailand*	2,700 US$/kg	1,420 US$/kg	-47%
Myanmar	305 US$/kg	450 US$/kg	+48%
Total potential value of opium production	> US$ 219 million	> US$ 319 million	+46 %
Of which Lao PDR	*US$ 30 million*	*US$ 40 million*	*+34 %*
Thailand	*US$ 12 million*	*US$ 4 million*	*-65 %*
Myanmar	*US$ 177 million*	*US$ 275 million*	*+56 %*

** The Office of the Narcotics Control Board, Government of Thailand, is acknowledged for providing the figures on Thailand.*

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[1] These figures differ slightly from those published in the World Drug Report 2010 and 2011, which subsumes Thailand under the category of "other countries". The actual cultivation and production figures could be slightly smaller for all three countries due to the governments' eradication campaigns that may have occurred after the surveys.

[2] The cultivation figures in Thailand are based on satellite images and aerial reconnaissance flights.

[3] Prices are not directly comparable between countries as they refer to farm-gate prices in Myanmar and to prices at an unspecified trading level in Lao PDR.

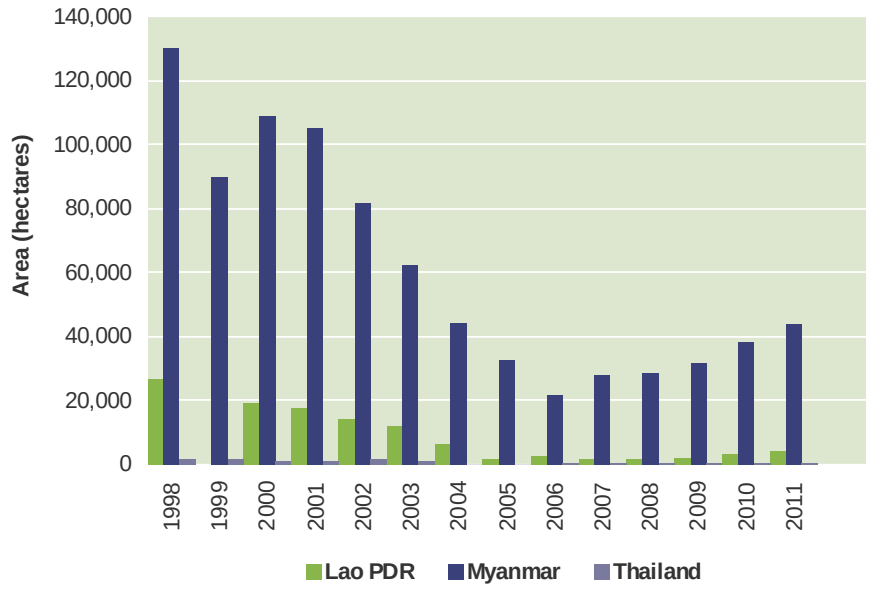
REGIONAL OVERVIEW

In order to assess the scope of opium poppy cultivation and opium production, UNODC has been conducting opium surveys in cooperation with the respective Governments in Lao PDR (since 1992) and in Myanmar (since 2002). Thailand has established its own monitoring system. This report contains the results of the UNODC-supported opium poppy cultivation surveys in Lao PDR and Myanmar. In addition, the results from the opium poppy surveys implemented by the Thai Office of the Narcotics Control Board are presented in this regional overview.

Opium poppy cultivation in South East Asia

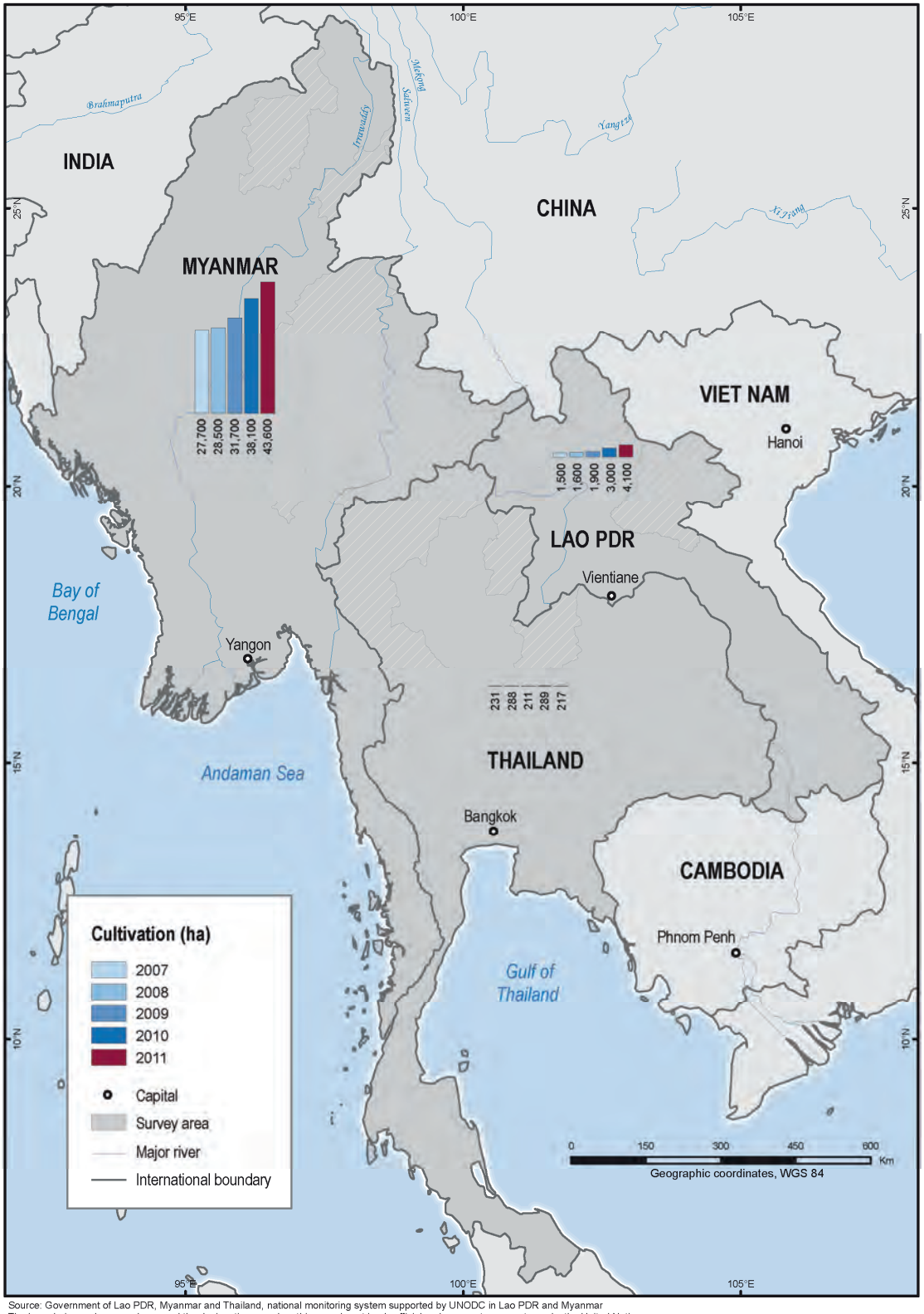
The major part of opium poppy cultivation in South East Asia takes place in Lao PDR, Myanmar and Thailand, with a total area of 47,917 hectares in 2011. The Government of Vietnam indicates that only a negligible amount of opium poppy is cultivated there. Between 1988 and 2006, the cultivation of opium in these three countries decreased from an estimated total of 157,900 hectares in 1998 to only 24,157 hectares in 2006. However, since then, opium poppy cultivation has increased in Myanmar and a mixed pattern of increases and decreases have been observed in Lao PDR and Thailand. Overall, opium poppy cultivation in the region has doubled since 2006.

Figure 1: Opium poppy cultivation in South East Asia (hectares), 1998 - 2011



Myanmar, the largest opium growing country in the region, saw major decreases over the years, from 130,300 ha in 1998 to only 21,500 ha in 2006 (an 83% reduction over the period 1998-2006). This downward trend from 2000 to 2006 had been consistent. Since then, opium poppy cultivation has increased although at a relatively slow pace.

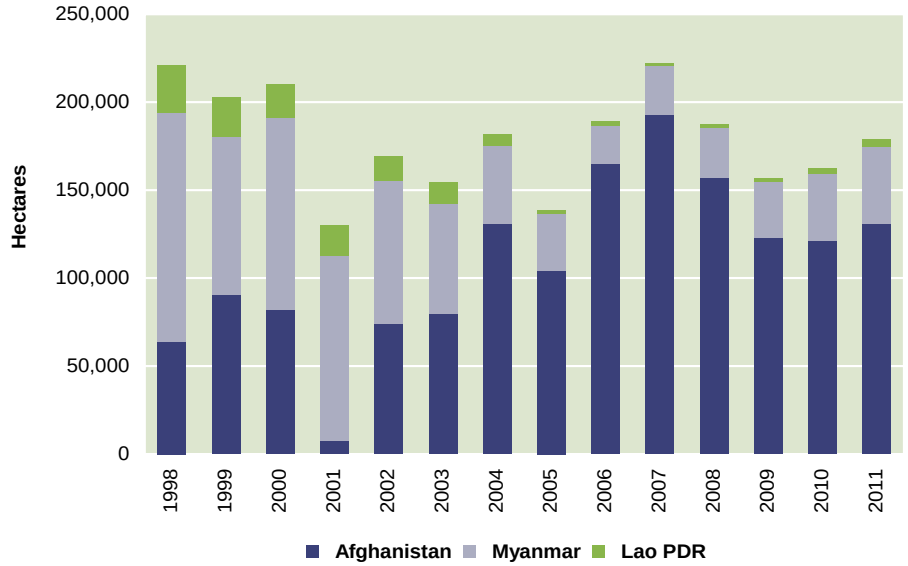
Map 1: Opium poppy cultivation in South East Asia (hectares), 2006 - 2011



Source: Government of Lao PDR, Myanmar and Thailand, national monitoring system supported by UNODC in Lao PDR and Myanmar
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

In Lao PDR, the area under opium poppy cultivation decreased from 26,800 ha in 1998 to only 1,800 ha in 2005, the largest relative decline among the three countries. Since 2005 however, figures have shown increases alternated with decreases. In 2011, cultivation increased to 4,100 hectares.

Figure 2: Opium poppy cultivation in major cultivating countries (ha), 1998 - 2011

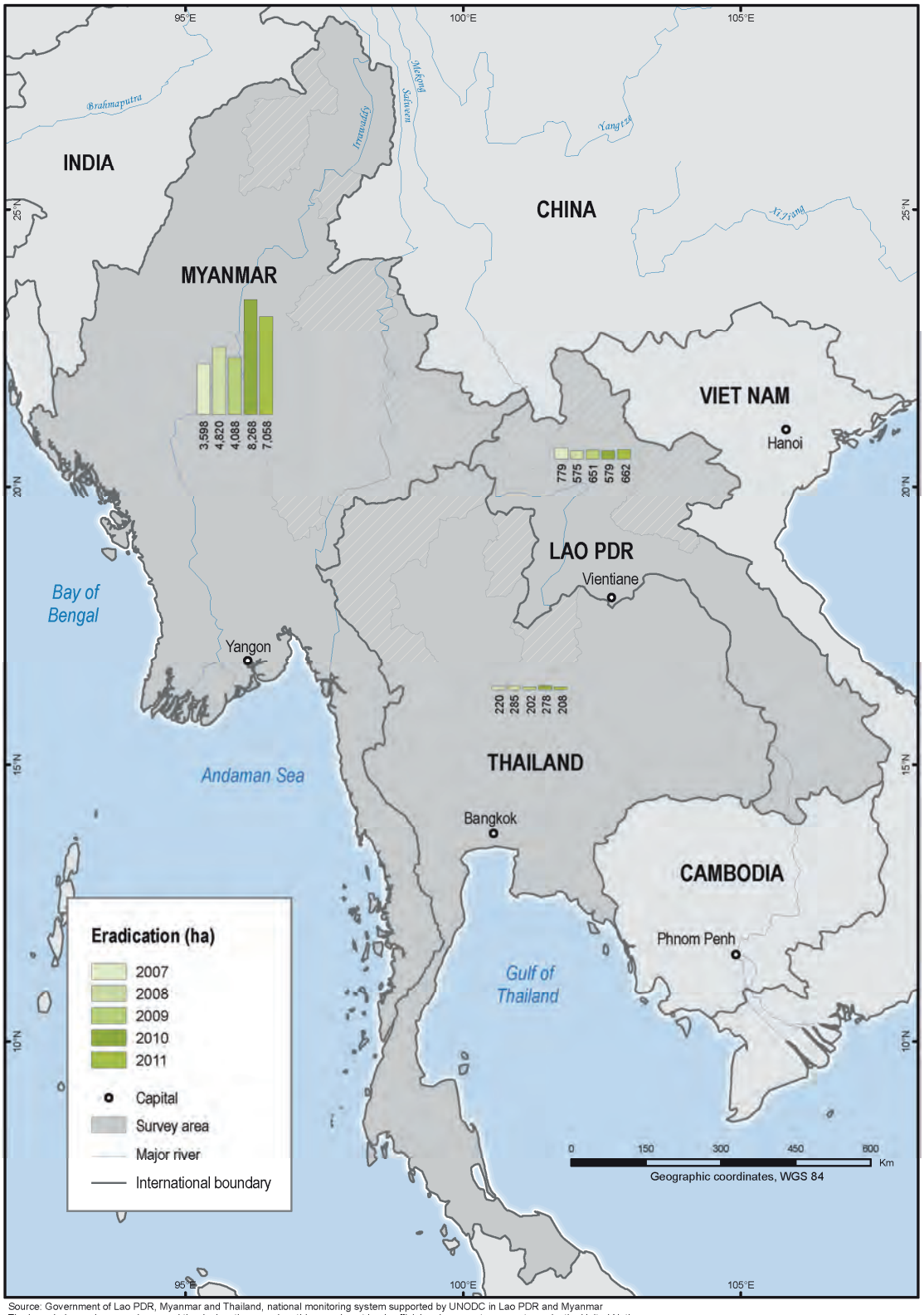


Despite years of dramatic decreases in opium poppy cultivation between 1998 and 2006, Myanmar remains the second largest opium poppy grower in the world after Afghanistan. Myanmar contributed 23% of opium poppy cultivation among major cultivating countries in 2011. Lao PDR accounted for 2% in 2011. Since 2003, South East Asia has clearly ceased to be the largest opium poppy cultivating region, and Afghanistan has become by far the largest opium poppy cultivating country.

Eradication

Official reports from the Governments of Lao PDR, Myanmar and Thailand indicated that a total of 7,928 ha of opium poppy were eradicated in 2011. This represents a decrease of 16% compared to 2010 when 9,125 ha were eradicated in the region. A total of 662 ha were eradicated in Lao PDR, 7,058 ha in Myanmar and 208 ha in Thailand.

Map 2: Opium poppy eradication in South East Asia (hectares), 2006 - 2011



Source: Government of Lao PDR, Myanmar and Thailand, national monitoring system supported by UNODC in Lao PDR and Myanmar
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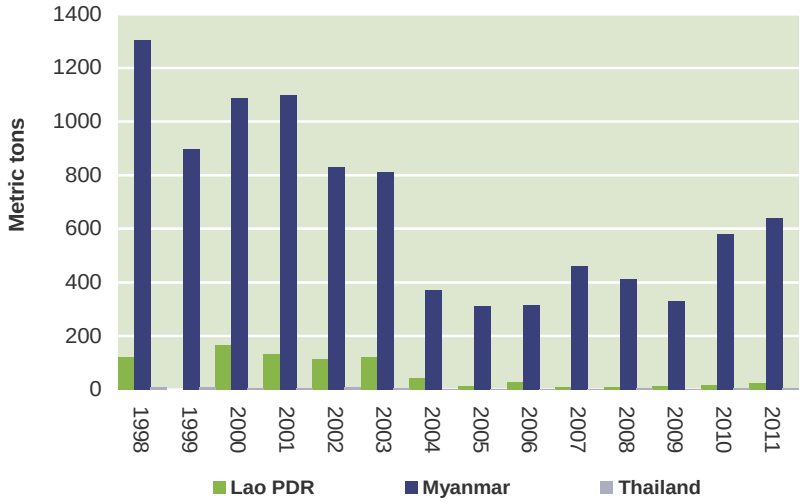
Opium yield and production

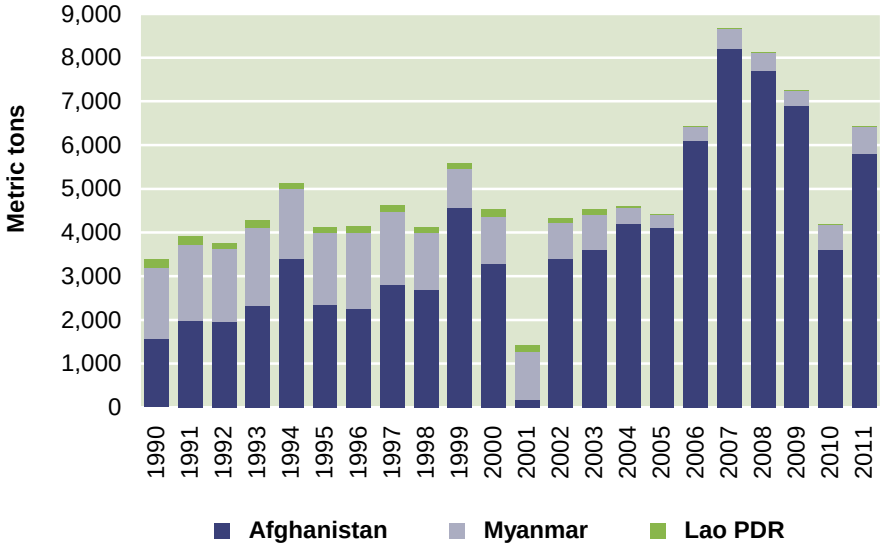
Opium poppy in South East Asia is mostly cultivated on steep hills with poor soil and no irrigation facilities. Opium yields are much lower than in Afghanistan where the crop is often cultivated on good soils and flat, irrigated land. In 2011, opium yields were estimated at 6 kg/ha in Laos, 14.0 kg/ha in Myanmar and 15.6 kg/ha in Thailand. The total potential opium production in South East Asia has decreased from an estimated 1,435 mt in 1998 to only 640 mt in 2011. This figure represents a decrease of 57% over that 12-year period.

Figure 3: Opium production in South East Asia (metric tons), 1998 - 2011



Since last year, opium production in Myanmar increased by 5%, and its share of opium production among major producing countries reached 9%. This represents a decrease in light of last year when Myanmar's share was still 13%. This is due to a production increase of 61% in Afghanistan where poppy plants gave substantial higher yields in 2011.

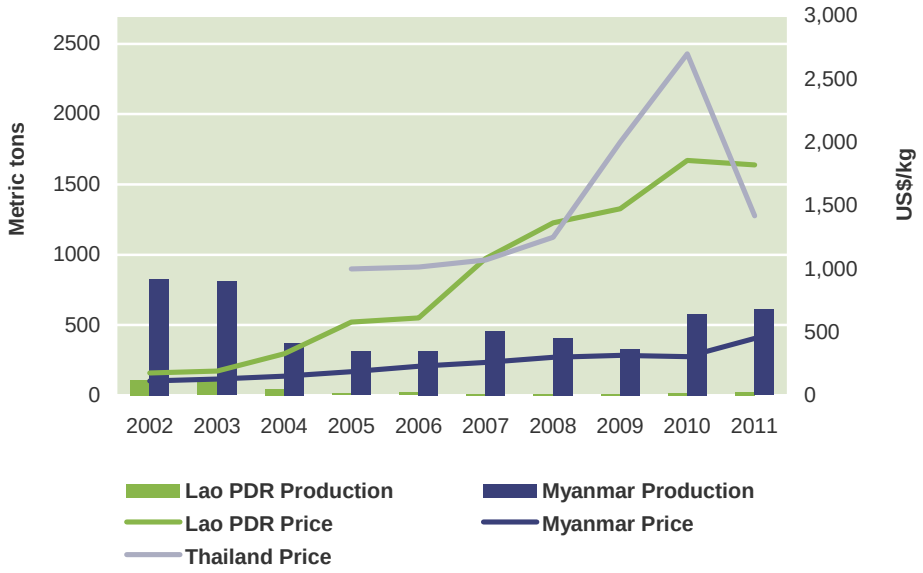
Figure 4: Opium production in major producing countries (metric tons), 1998 - 2011



Opium prices

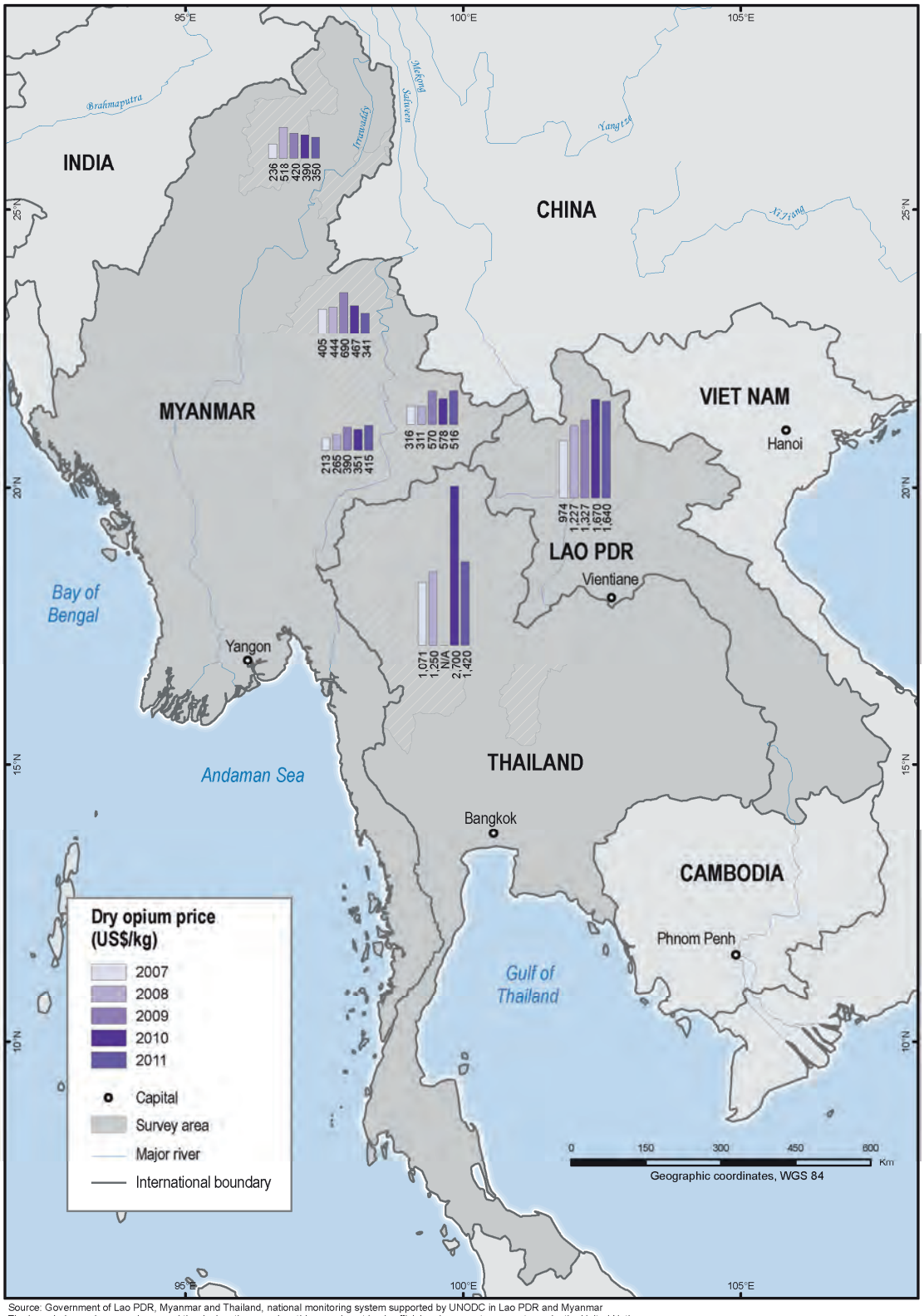
On the whole, opium prices in South East Asia have risen in recent years. Nonetheless, there are pronounced price differences between countries as well as between regions within these countries. In 2011, the average price of opium dropped sharply but was still at a high level in Thailand with prices of US$ 1,420/kg, yet prices were much lower in Myanmar at US$ 450/kg (at the farm-gate in 2011).[4] In Lao PDR, prices stayed stable but remained at very high levels and were reported at US$ 1,640/kg practically the same as in 2010. This high price levels in Lao PDR and Thailand continue due to the scarcity of opium in these countries. In some regions, opium cultivation has been completely eliminated or is very scarce, while demand remains relatively high. In Myanmar, by far the largest producer, prices have been rising much slower, but made a big jump in 2011 from US$ 305/kg in 2010 to US$ 450/kg in 2011.

Figure 5: Opium production and prices in cultivating areas in Lao PDR, Myanmar, and Thailand, 2002 - 2011



[4] Prices between countries are not directly comparable as they refer to farm-gate prices in Myanmar and to prices at an unspecified trading level in Lao PDR and Thailand.

Map 3: Prices of opium in South East Asia (US$/kg), 2011



Source: Government of Lao PDR, Myanmar and Thailand, national monitoring system supported by UNODC in Lao PDR and Myanmar
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PART 2. LAO PDR

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ABBREVIATIONS

DCDC	District Committee for Drug Control
GoL	Government of Lao PDR
ICMP	Illicit Crop Monitoring Programme
LCDC	Lao National Commission for Drug Control and Supervision
NTFP	Non-timber forest products
PCDC	Provincial Committee for Drug Control
PFU	Program Facilitation Unit
SASS	Statistics and Surveys Section (UNODC)
UNODC	United Nations Office on Drugs and Crime

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FACT SHEET - LAO PDR OPIUM SURVEY 2011

	2010	2011	Change from 2010
Opium poppy cultivation[1]	3,000 (1900 to 4,000) ha	4,100 (2,500 to 6,000) ha	+38%
Average dry opium yield[2]	6 kg/ha	6 kg/ha	-
Potential production of dry opium	18 (11 to 24) mt	25 (15 mt to 36 mt) mt	+38%
Average retail/wholesale price of opium[3]	US$ 1,670 (580 to 2,700)	US$ 1,640 (810 to 2,600)	-2%
Eradication[4]	579 ha	662 ha	+16%

[1] Range refers to the 95% confidence interval of the estimate.

[2] In the absence of a yield survey in 2011, the yield per hectare for 2007 was used.

[3] Source LCDC, Provincial authorities survey. Due to the limited market for opium, a clear distinction between farm-gate, wholesale and retail prices could not be established. The range refers to the lowest and highest provincial price observed, respectively.

[4] Source: LCDC. Since 2008, eradication campaigns were conducted during and after the survey.

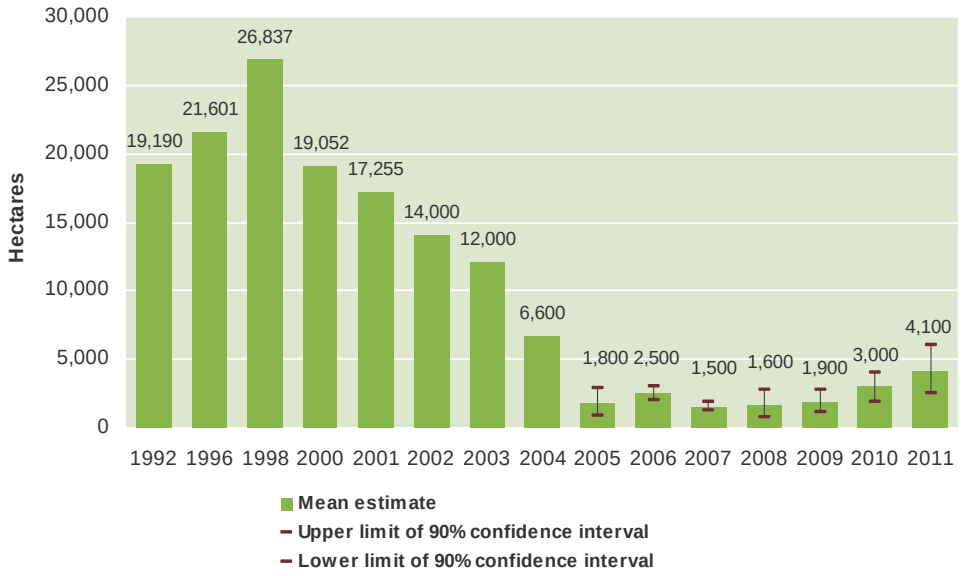
EXECUTIVE SUMMARY

The Lao PDR Opium Survey 2011 was undertaken and produced by the Government of Lao PDR and UNODC. From 2005 to 2011, the survey methodology has consisted of an aerial survey by helicopter covering sample sites in opium poppy producing provinces in northern Lao PDR. Like in 2010, the survey focused on four Provinces (Phongsaly, Houaphan Luang Namtha and Xieng Khouang). Observations show that the poppy cultivation was concentrated in two of these provinces, namely Phongsaly and Houaphan. Cultivation in Luang Namtha and Xieng Khouang had become marginal in the past years, however, in 2011 some large concentrations were spotted in Luang Namtha. Although no survey took place in Oudomxay province, the survey team received information that some poppy was growing again in the North of this province.

Opium poppy cultivation

In 2011, opium poppy cultivation was found in all of the four surveyed provinces. The total area under opium poppy cultivation in the Lao PDR expanded to 4,100 hectares in 2011 (an increase of 38% from 2010) with a confidence interval from 2,500 ha to 6,000 ha. In spite of this increase, the overall level of opium poppy cultivation in the country remains low compared to a decade ago. Following the trend noticed over the last two years, more fields are gathered in strings covering the mountainsides around the villages, which might indicate that cultivation is becoming more common.

Figure 1: Estimated area under opium poppy cultivation in Lao PDR, 1992-2011

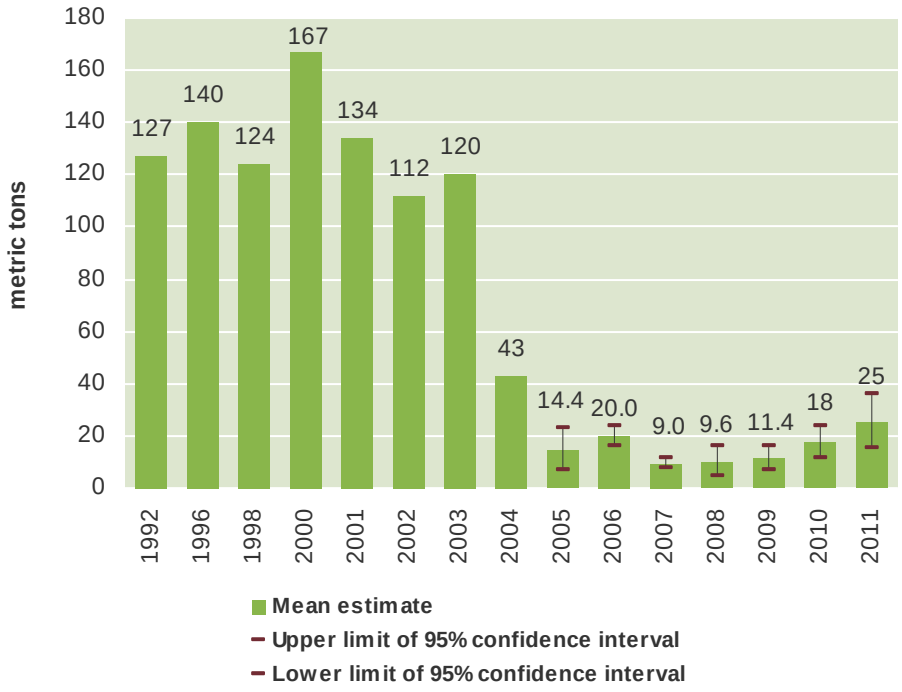


Opium yield and production

In the absence of yield data for 2011 a yield of 6 kg/ha measured in 2007 was used to calculate opium production.

The potential production of opium for the year 2011 was estimated at 25 metric tons (with a confidence interval between 15 mt and 36 mt) representing a 38% increase in production over 2010, in line with the estimated area under cultivation.

Figure 2: Potential opium production (metric tons), 1992-2011



Opium prices and trade

The low level of cultivation, remote and dispersed locations of opium poppy fields and security issues (caused by the continued enforcement of the opium ban) prevented the collection of price data at the farm-gate level. However, opium prices were collected at the provincial level by local authorities during or soon after the 2011 opium harvest[5]. The average opium price increased by 2% over the same period in 2010 reaching US$ 1,640/kg in 2011. As in 2010, the minimum price recorded of 810 US$/kg in Bolikhaxay and the maximum price was US$ 2,590/kg in Vientiane Province.

Strong regional disparities in prices indicate that there are significant local variations in supply, as well as variations in market access.

Opium poppy eradication

The opium survey does not monitor or validate the results of the eradication campaign carried out by the Government of Lao PDR. In 2011, the Government of Lao PDR reported eradication in 10 Provinces, and a total of 662 ha[6]. The largest area was in Houaphan where 261 ha, or 39% of the total eradicated area, were eradicated, followed by Phongsaly (110 ha) and Oudomxay (109 ha).

[5] Source PCDC. Since 2006, no clear distinction can be made between retail, wholesale and farm-gate prices and data are provided as is.

[6] The eradication took place during the growing season, before or after the helicopter survey. This means that the total cultivation and production figures might be slightly higher than the actual figures.

1 INTRODUCTION

This report presents the results of the eleventh Lao PDR opium survey. The survey has been conducted annually since 1999 by the Lao National Commission for Drug Control and Supervision (LCDC) and UNODC.[7]

From 2005 to 2009, the survey covered six provinces of northern Lao where opium poppy cultivation had taken place and where the probability of finding poppy fields remains relatively high. Since 2010, the observations were concentrated on Phongsaly, Houaphan and Luang Namtha provinces where the majority of poppy is cultivated. Some observations were also made in Xieng Khouang.

In 1999, the Government of Lao PDR and UNODC developed the programme strategy "Balanced approach to opium elimination in the Lao PDR." In November 2000, Prime Minister Order Fourteen stipulated concrete Government measures against opium poppy cultivation and opium abuse. In 2001, the 7th National Party Congress called for opium production and use to be eliminated by 2005, in the context of poverty reduction. A National Campaign against Drugs was launched in October 2001 to encourage communities to give up opium production. The Government increased the momentum of this campaign in 2004 and 2005 with measurable success, and the Government declared Lao PDR opium free in February 2006.

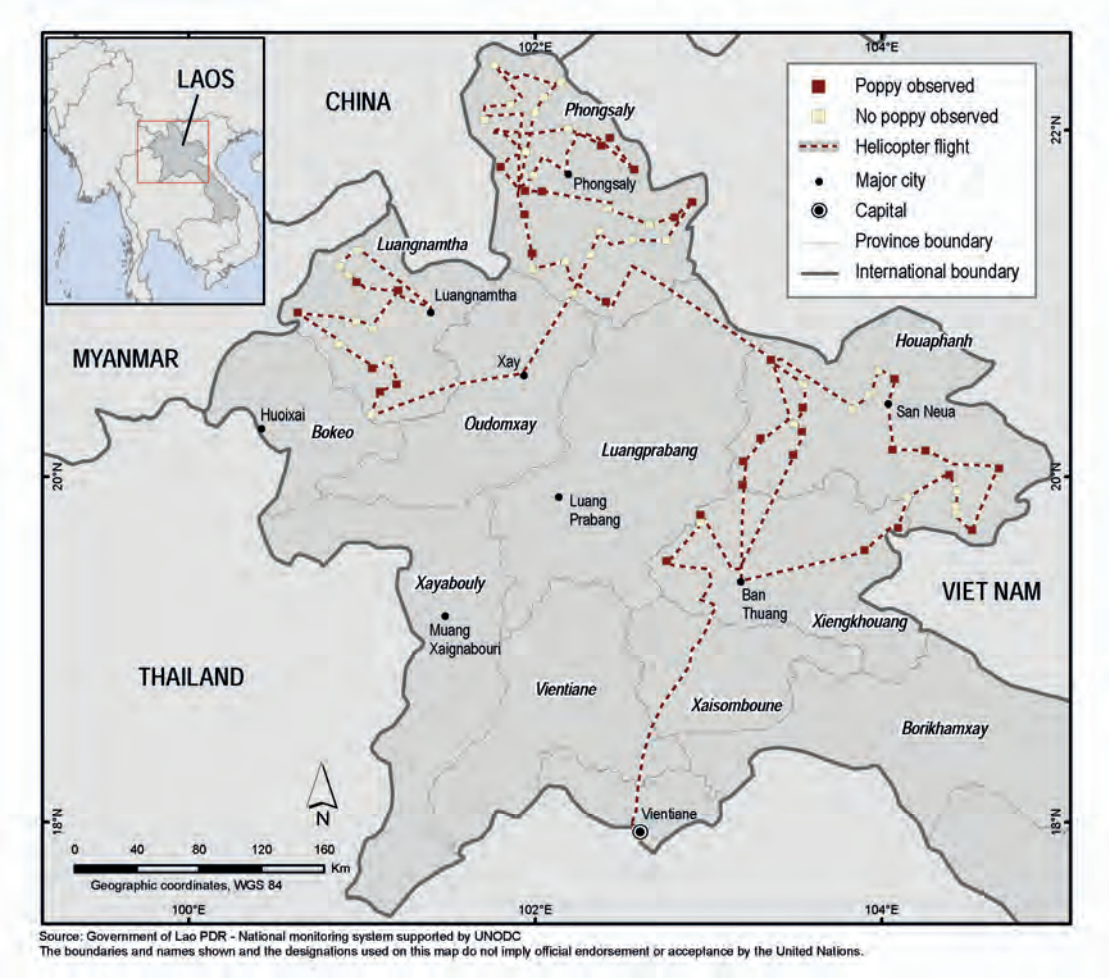
However, subsequent survey results demonstrate that the total elimination of opium poppy cultivation has not been achieved. The presence of opium cultivation in the country indicates that local production is still used to supply local addiction; and opium cultivation is still a source of livelihood for some communities. Opium could easily become a livelihood strategy for more communities in the absence of other development initiatives.

In order to reduce the countries' economic dependence on opium, it is necessary to study coping strategies for ex-opium poppy farmers in order to effectively facilitate the transition to licit economic activities. Based on the area estimates, the number of households cultivating poppy would have increase as well. In 2011 it is estimated that between 8,300 and 20,000 households cultivate poppy. However, only 10% of the 1,100 former opium poppy cultivating villages identified by the Government for immediate priority alternative development (AD) assistance received any such assistance.

In order to monitor the impact of alternative development programmes, it is necessary to continue monitoring of opium cultivation.

[7] UNODC began to survey the cultivation of opium in Lao PDR in 1992 based on an inventory of all known opium producing villages. Similar surveys were conducted in 1996, 1998 and then annually since 2000

Map 1: Sample segments surveyed by helicopter, Northern Lao PDR, 2011



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

2 FINDINGS

The helicopter survey implemented by UNODC in coordination with the Ministry of Defence of Lao PDR covered the four northern provinces of Lao PDR. The survey covered a distance of approximately 3,000 km over the provinces of Phongsaly, Luang Namtha, Xieng Khouang, and Houaphan during more than 29 flight hours. The aerial survey covered 70 randomly sampled segments of 5x5 km each. The total area covered during the flight was 1,381 km^2, corresponding to 5.8% of the total risk area in the four provinces surveyed. In addition, observations were made from the helicopter in the corridors between the segments. This information was not used for statistical analysis but as a reference for future surveys.

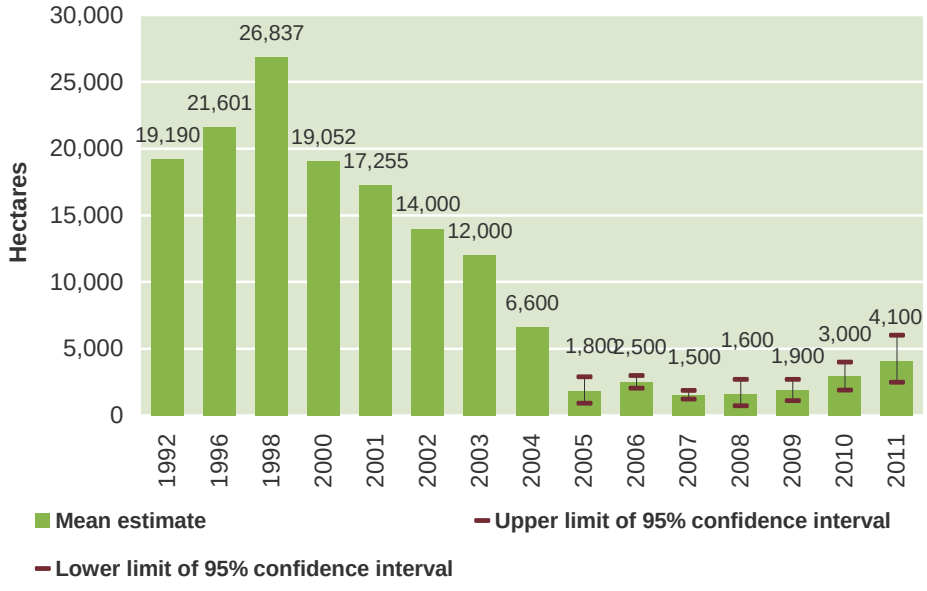
Data on opium yield could not be collected during the helicopter survey for the year 2011.

2.1 Area under opium poppy cultivation

The aerial survey in 2011 revealed the existence of opium poppy cultivation in four provinces in northern Lao PDR, namely Phongsaly, Luangnamtha, Houaphan and Xieng Khouang. Data from the Government of Laos indicates that other northern provinces were also growing some poppy especially in the northern part of Oudomxay.

The total area under opium cultivation in 2011 is estimated to be 4,100 ha (between 2,500 ha and 6,000 ha with a 95% confidence interval). This represents an increase of 38% compared to the 2010 estimate but total area still remains low compared with Afghanistan and Myanmar. Also it can be assumed that the actual area harvested was slightly smaller due to the Government's eradication efforts after the survey.

Figure 3: Estimated area under opium poppy in Lao PDR (ha), 1992 – 2011



The estimated area under opium poppy cultivation was calculated based on a sampling frame which included the potential areas for opium poppy cultivation in Phongsaly, Luang Namtha, Houaphan, and Xieng Khouang. Taking into account the results of previous surveys as well as information from the Government and UNODC projects, it is assumed that opium poppy cultivation outside the sampling frame was negligible.

Opium poppy fields were found in 36 out of 70 randomly targeted villages. The proportion of opium poppy fields observed in very remote locations (far from any villages and/or access roads) was less than last year. Following the same trend observed last year, there was a higher number of large fields and closer to the villages than in the years before. Eradication was still difficult in

Phongsaly and Houaphan because a majority of the fields were located in dense forests. In many cases it was impossible to identify the village owning the opium poppy fields and this diminished the risk of villages being targeted by eradication campaigns. Temporary settlements were observed near these fields, most likely used by labourers during the opium poppy growing season.

In 2011 the total number of households associated with the cultivation of opoium poppy was estimated to be between 8,300 to 20,000, a significant increase from 2010 (6,300 to 13,300), 2006 (5,800) and 2005 (6,200). The number of households associated with opium poppy cultivation not estimated between 2007 and 2009.

Year	No. of opium growing villages	No. of opium growing households
2003	1,537	40,000
2004	846	22,800
2005	270	6,200
2006	n/a	5,800
2007	n/a	n/a
2008	n/a	n/a
2009	n/a	n/a
2010	n/a	6,300 to 13,300
2011	n/a	8,300 to 20.000

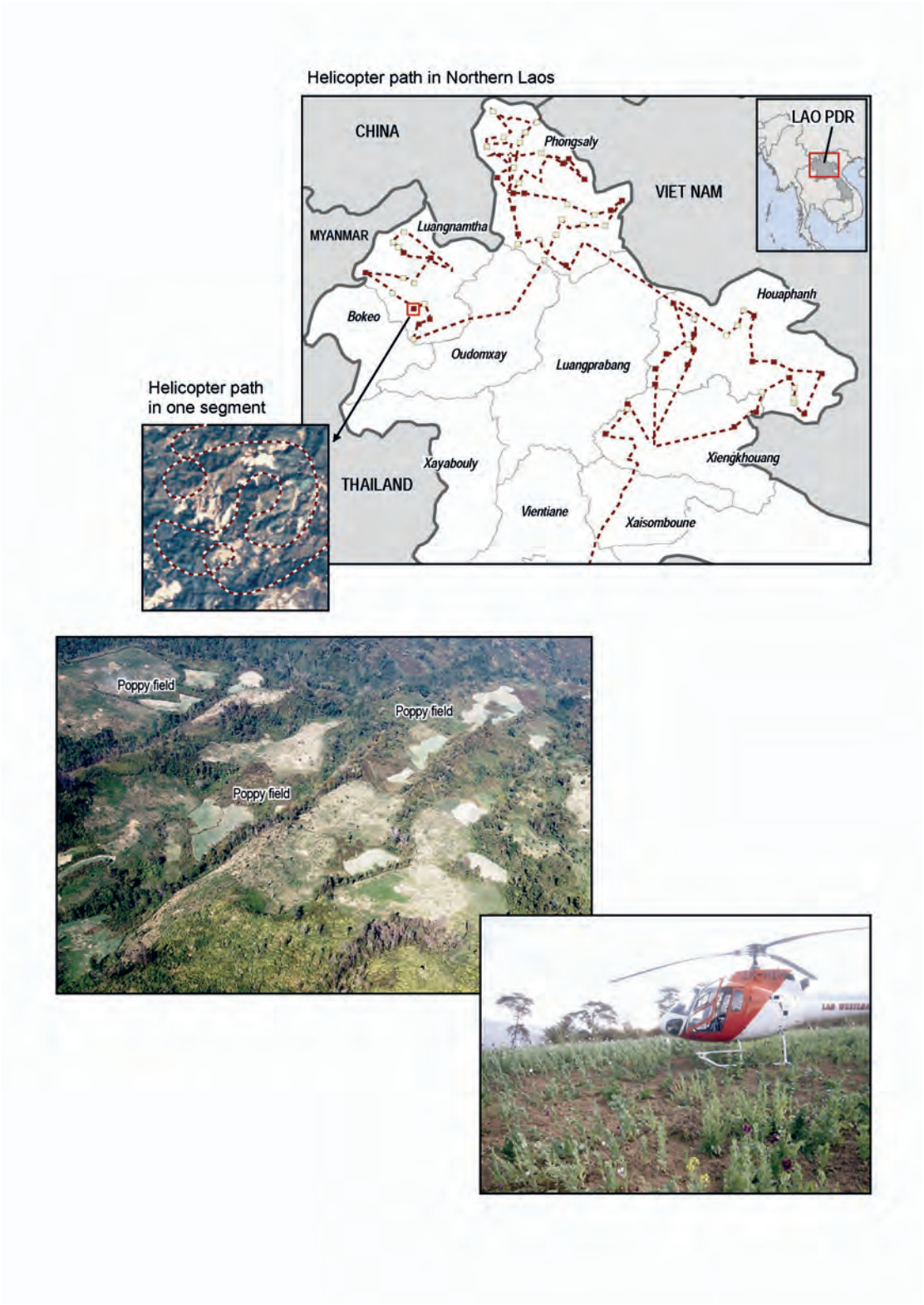
2.2 Cultivation practices and crop calendar

As noticed during the previous years, multi-staged cropping (planting the same crop at different time intervals in the same field) was observed. This is usually done to avoid eradication of the entire harvest and also to stagger the maintenance of the poppy fields (labour requirements) especially during the harvest. Usually, the opium poppy grower lives alone, for at least three months, in the field and cannot count on external labour especially during the time of the harvest

Table 1: **Crop calendar**

	Field preparation	Sowing	Harvest
Average	Mid Sept – end October	Early October – mid November	End January – mid March

Map 2: Example of opium poppy fields identified during the helicopter survey



2.3 Yield and production

As in previous years, no yield survey was conducted in 2011. Observations made from the helicopter showed that this year opium poppy plants were healthier than in previous years but in the absence of a proper yield survey, the yield of 6 kg/ha (estimated in 2007), was used to calculate total opium production. It was also noticed that opium growers were using pesticides in the poppy fields and that some had constructed basic irrigation systems.

Pesticide sprayer pump found in the hut of an opium poppy farmer

Basic irrigation system made of bamboo

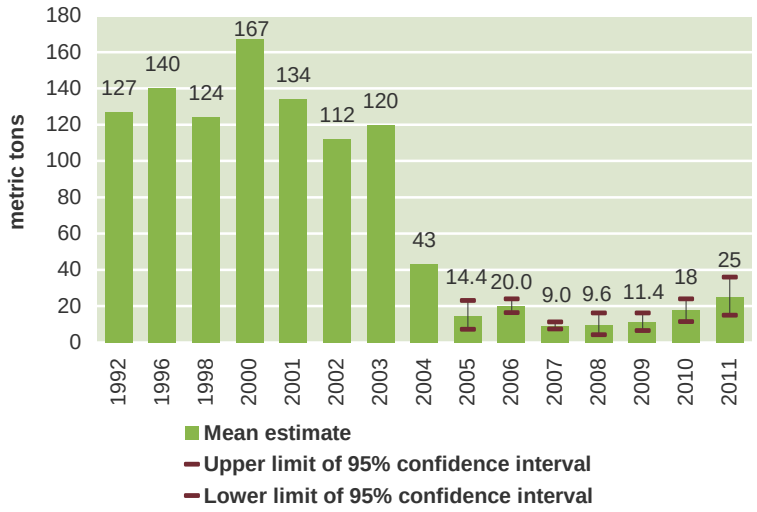
Based on the estimated area under cultivation, the potential production of dry opium for the year 2011 was 25 mt, which represents a 38% increase over 2010. Nevertheless, the actual amount of opium harvested in 2011 could be lower than the estimated potential production due to the impact of the Government's eradication efforts that occurred after the survey.

Table 1: **Opium yield (kg/ha), 1992 - 2010**

	1992	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Potential opium yield (kg/ha)	6.6	6.4	4.6	8.7	7.2	8	10	6.5	8	8	6	6	6	6*	6*

** although the yield seems to have improved since 2010, due to the absence of a proper yield survey, since 2007 a yield of 6kg/ha is used*

Figure 4: **Potential opium production (metric tons), 1992 - 2011**



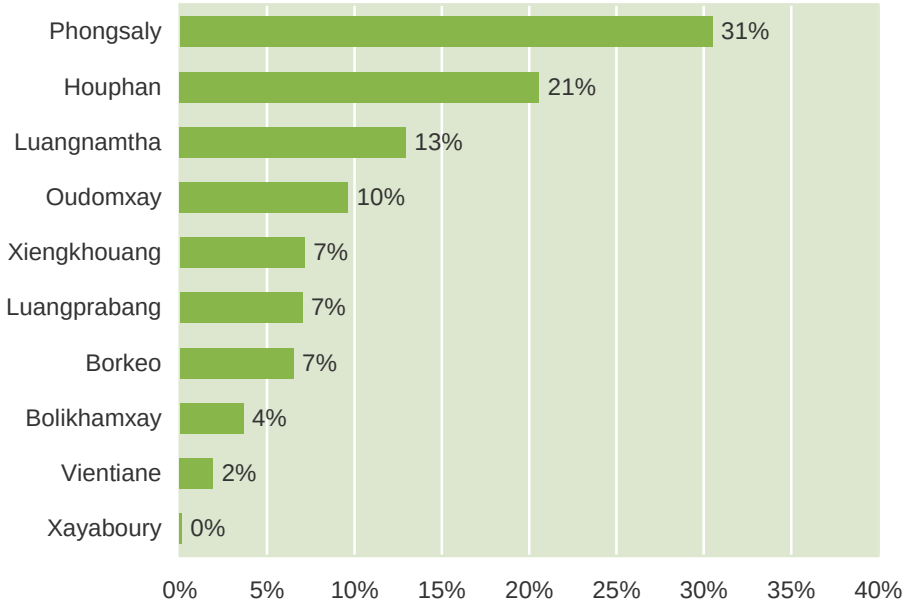
2.4 Opium poppy eradication

This opium survey was not designed to monitor or validate the results of the eradication campaign carried out by the Government of Lao PDR. According to Government reports, eradication took place on 662 ha during or after the helicopter survey, and in most cases at a time when opium harvesting was already underway. The largest area eradicated was in Houaphan where 261 ha (39% of the total eradication) were eradicated, followed by Phongsaly (110 ha) and Oudomxay (109 ha). Most of the opium cultivation is concentrated in remote areas which complicates the work of eradication teams to reach and destroy opium fields.

Table 2: Reported eradication by province (ha), 2011

NO	Province	Eradication area in hectares
1	Phongsaly	109.9
2	Luangnamtha	90.5
3	Oudomxay	108.6
4	Bokeo	3.7
5	Houaphan	260.9
6	Luangprabang	20.3
7	Xiengkhouang	41.8
8	Xayabouly	2.0
9	Vientiane	8.5
10	Bolikhamxay	16.1
Total		**662.3**

Figure 5: Reported eradication by province (in % of total eradicated), 2011

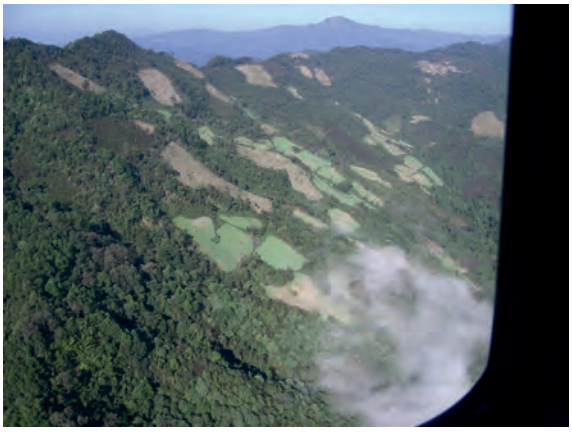


2.5 Opium addiction

Like in 2010, it was not possible to get any data regarding new opium addicts, those untreated or those who had relapsed.

Remote fields with poppy cultivation embedded in dense forest.

They are difficult to find for the eradication squad. Farmers who cultivate the poppy live in small shacks during months. They feed themselves with game hunted around their camp and from fish caught in water bodies together with rice that they carried along from their villages



Poppy cultivation fields with easy access. Large areas are now found not far from villages especially in the Northern part of Phonsaly sometimes closed to a mountain road.

3 METHODOLOGY

3.1 Helicopter survey 2011

Under its global illicit crop-monitoring programme, The United Nations Office on Drugs and Crime (UNODC) has established methodologies for data collection and analysis, with a view to increasing the government's capacity to monitor illicit crops and assist the international community in monitoring the extent, growth and contraction of illicit crop cultivation.

In Lao PDR, the area under opium poppy cultivation is small, not easily accessed and widely distributed. In such circumstances an aerial survey by helicopter is an efficient method for estimating the extent of cultivation.

The survey team visited selected sites by helicopter and an estimation of the area covered by poppy was made for each field within the selected site. In order to calibrate the poppy cultivation area estimated from the helicopter, various ground measurements were made and compared to the estimate from the air.

3.2 Sampling frame

The quality of the data collected from the aerial survey depends to a large extent on the quality of the sampling frame from which the sample is selected. Building the sampling frame and estimating the extent of illicit crop cultivation in Lao PDR is challenging as cultivation is highly dispersed and normally takes place in small plots.

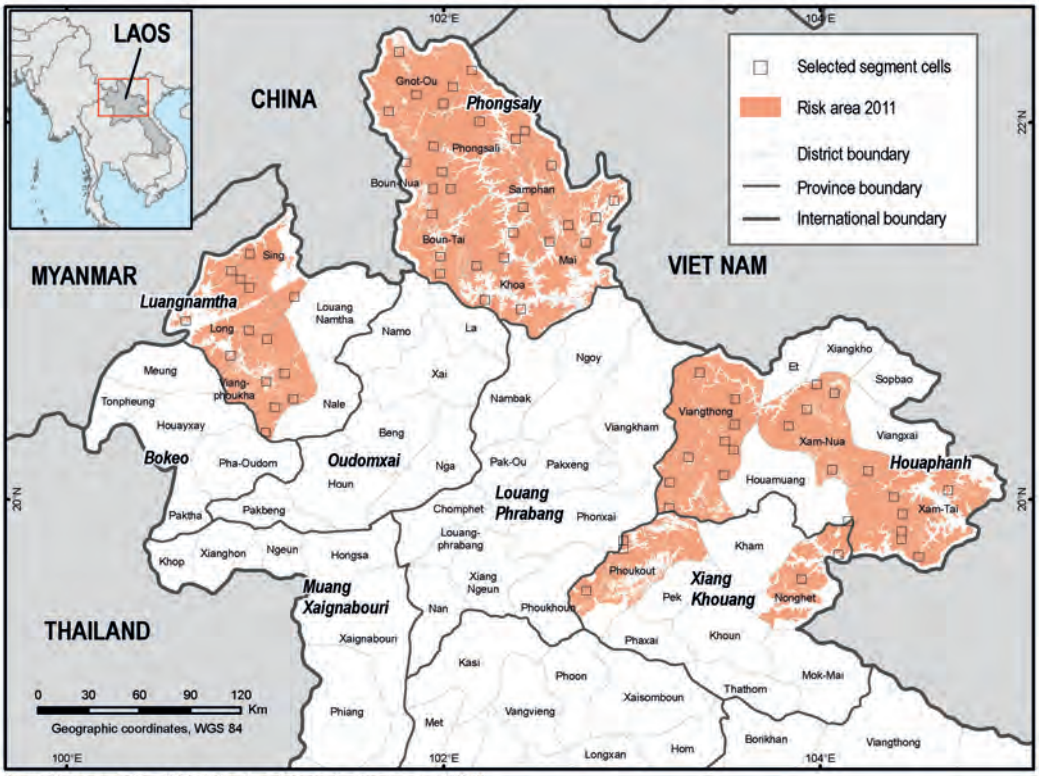
The process to define the sampling frame begins with a selection of provinces and districts where poppy cultivation is thought to occur. This assumption is based on information from local experts and on previous surveys. In 2011, the sampling frame for the area estimation was established by defining the potential land available for opium poppy cultivation within the four selected provinces in Northern Lao PDR (Phongsaly, Luang Namtha, Houaphanh, and Xieng Khouang). Within this frame, a sample of plots was selected. The estimate for opium poppy cultivation in the 2011 survey is only for the area within the sampling frame, even though there might be some remnants of cultivation in other provinces.

In Northern Lao PDR, opium plots are mainly found in mountainous areas. Farmers avoid the large, sparsely forested plains and densely inhabited/settled areas, located at lower altitudes. Past surveys have indicated that up to 80% of opium poppy-growing villages are above 700 meters in altitude and on slopes with inclines of over 10%. Because these topographic conditions correspond so closely with actual cultivation patterns (past) and probable cultivation patterns (forecast) they were used to define the frames themselves. The calculations were performed with the help of a Geographic Information System. A digital elevation model (90 meter pixels) and its derived slope map were used to delineate areas above 700 meters altitude and slopes of more than 10% incline. The sampling frame was further defined by a 3 kilometre buffer area along the country's international borders which was completely excluded from all survey activities for security reasons.

Poppy fields area photographed at 500 feet (160 m) above the ground and the same fields observed from the ground.

The final sampling frame consisted of 23,596 km^2. This area was divided into 1,159 grids measuring 5 km by 5 km (area of 25 km^2).

Map 3: Sampling frame and selected segment cells in Northern Lao PDR, 2011



3.3 Sample size and sample selection

On the one hand, the larger the sample size the greater the accuracy of the estimate. However, on the other hand, financial resources limit the size of the sample. As a compromise, the sample size was calculated as a function of the costs associated with the helicopter flying time and the precision of the estimate.

The budget available limited the number of flying hours up to the maximum of 28 hours. Therefore, in order to estimate the number of potential selected segments, it was necessary to investigate the helicopter characteristics.

The helicopter used for the survey was a "Squirrel" helicopter. This type of helicopter is used mostly for rescue, aero-medical, survey and military roles. The Squirrel has a maximum cruise speed of 220 kph powered by a single jet engine. It can accommodate up to four passengers and carry loads of up to 750 kg.

On the basis of financial resources the total number of segments can be estimated from the following formulae:

$$T = nt_s + n(d/v)$$

$$n = \frac{T}{t_s + (d/v))} \approx 70$$

where T is total helicopter time available for sampling (= 28 hours minus 3 hours for transit time between regions and refueling), given by an estimate of total time spent sampling in all segments plus an estimate of total time travelling between segments;

n is the number of segments;

t_s is the average time required to complete sampling within a segment (= 10 minutes);

v is the average speed of helicopter between segments (200 kph);

d is the average distance between segments (= 35 km, based on total flight path from previous surveys).

The 70 selected grids contain 1,381 km2 of risk area from the sampling frame of 23,596 km2, which represents 5.9%, covering a reasonable amount of the sampling frame.

The sample of 25km^2-grids was selected using systematic random sampling across the whole frame over Northern Laos.

3.4 Area estimation procedure

The estimation of the area under opium poppy cultivation was based on the information collected during the helicopter survey.

Ratio estimation formulae were used to estimate the extent of the opium poppy cultivation using the equations described below. Two of the 70 segments were not surveyed due to poor weather conditions.

a. Average proportion of opium poppy cultivation over the risk area:

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{68} P_i / R_i$$

where *n* is the number of surveyed segments, P_i is the area of poppy in segment *i* and R_i is the risk area in segment *i*.

b. Estimate of area of opium cultivation in Lao PDR.

$$A = R_s \bar{y}$$

where R_s is the total risk area in the sampling frame.

To obtain confidence intervals for the area estimate bootstrapping was performed.

To calculate the opium production the area of opium cultivation, A, is multiplied by the yield.

PART 3. MYANMAR

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ABBREVIATIONS

CCDAC	Central Committee for Drug Abuse Control
GOUM	Government of the Republic of the Union of Myanmar
ICMP	UNODC Illicit Crop Monitoring Programme
SASS	Statistics and Surveys Section (UNODC)
SR	Special Region
UNODC	United Nations Office on Drugs and Crime

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Martin Raithelhuber	Programme Officer, ICMP/SASS
Suzanne Kunnen	Public Information Assistant, STAS

FACT SHEET - MYANMAR OPIUM SURVEY 2011[1]

	Year 2010	Year 2011	Change from 2010
Total opium poppy cultivation*	38,100 ha (23,200 to 53,900)	43,600 ha (29,700 to 59,600)	+14 %
Opium poppy cultivation in Shan State*	35,000 ha (22,700 to 50,100)	39,800 ha (25,900 to 59,600)	+14 %
Average opium yield (weighted by area)	15.2 kg/ha	14.0 kg/ha	-8%
Total potential production of dry opium (including the Shan State)*	580 mt (350 to 820)	610 mt (420 to 830)	+5%
Total opium poppy eradication[2]	8,268 ha	7,058 ha	-15 %
Average farm-gate price of opium[3]	US$ 305/kg	US$ 450/kg	+48 %
Total potential farm-gate value of opium production[4]	US$ 177 (107 to 250) million	US$ 275 (189 to 374) million	+55 %
Estimated number of households involved in opium poppy cultivation[5]	224 (102 to 342) thousand	256 (175 to 351) thousand	+14 %
Household average yearly income in Shan State:			
Non-opium producing households	US$ 850	US$ 1,180	+39 %[6]
Opium producing households (income from opium sales)	US$ 830 (US$ 360)	US$ 1,030 (US$ 560)	+24 %[7] (+56 %)

**It can be assumed that the actual area harvested and production was slightly smaller due to the Government eradication that may have occurred after the survey.*

[1] Numbers between brackets indicate upper and lower bounds of the best estimate.

[2] Source: CCDAC.

[3] At harvest time.

[4] This is a result of dry opium production and farmgate price which can be a mixture of semi-dry and fresh opium prices. Due to the different times of storage the difference between fresh and dry opium is not clearly differentiated by the farmers.

[5] The estimated number of households involved in the cultivation of poppy is calculated according to the estimated area cultivated by region divided by the average area of opium poppy cultivated per household.

[6] This is equivalent to a 30% increase in Kyats.

[7] This is equivalent to a 16% increase in Kyats.

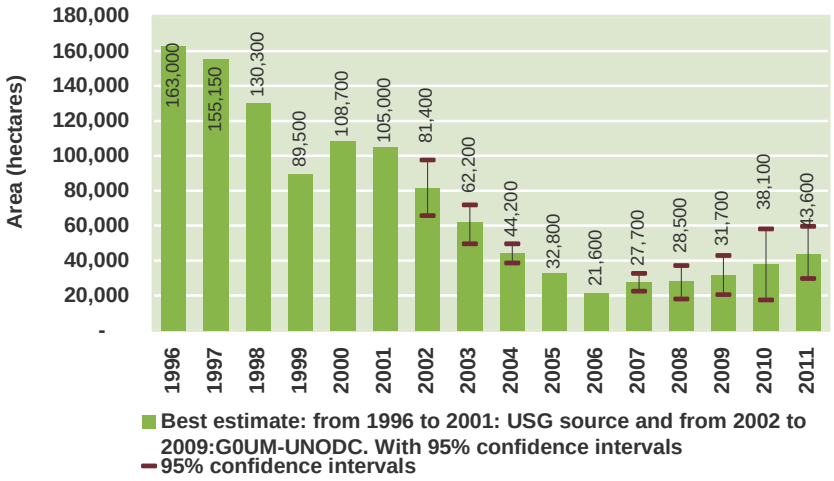
EXECUTIVE SUMMARY

The Government of the Republic of the Union of Myanmar (GOUM) and the United Nations Office on Drugs and Crime (UNODC) jointly conducted the 2011 Opium Survey in Myanmar. Through satellite imagery and village and field surveys, information was gathered to determine the extent of opium poppy cultivation and production, as well as the socio-economic status of farmers.

Opium Poppy Cultivation

In 2011, for the fifth year in a row, opium poppy cultivation increased in Myanmar. The total area under opium poppy cultivation was estimated at 43,600 ha, an increase of 14% compared to 2010 (38,100 ha). This upward trend started in 2007 after six years of decline between 2001 and 2006. Shan State accounted now for 91% of opium production in Myanmar, while the largest increase in poppy cultivation was observed in Kachin State (+27%). In Shan State most of the increase in the area cultivated took place in South Shan (+21%) followed by North Shan (+17%). There was no significant change in East Shan (+1%).

Figure 1: Opium poppy cultivation (ha), 1996-2011



Opium yield and production

In 2011, the national average opium yield was estimated at 14.0 kg per hectare, which represents a decrease of 8% compared to last year's yield. Nevertheless, the larger area under cultivation resulted in an increase in total opium production of 5%, from 580 mt in 2010 to 610 mt in 2011.

Opium prices

Opium prices in Myanmar have significantly increased in 2011. The average farm-gate price of opium (weighted by the estimated area under cultivation) was US$ 450/kg in 2011, up some 48% from US$ 305/kg in 2010. Opium prices have continued to increase since 2002. The most recent increase can be explained by the strong demand in opium from neighbouring countries as well as the depreciation of the Kyat against the US$ (by some 14% over the past year).

Household income from opium

The average annual cash income of opium-producing households increased by almost 24% in the Shan State, from US$ 830 in 2010 to US$ 1,030 in 2011. However, opium farmers in Myanmar generally remain poorer than non-opium growing farmers. For non-opium cultivating households (including those that never cultivated or have stopped opium poppy cultivation), the average annual cash income was almost US$ 1,200. On average, income from opium accounts for 54% of total cash income among poppy-growing farmers and in South Shan even more than 60%. For

these farmers, opium cultivation is the principal income to survive, which is illustrated by the comments of farmers that had stopped cultivating opium and had to purchase food on credit or borrow food and rely on relatives and friends.

Addiction

Data on opium and other drug addiction was collected via interviews with village headmen. Headmen were asked about the number of daily opium users and the number of 'regular' users of other drugs (without specifying frequency of use). According to the headmen, daily opium use in Shan State and in Kachin affects 0.8% of the population aged 15 years and above. As in previous years, the prevalence rate was higher in opium-growing villages (1.3%) than in non-opium-growing villages (0.4%). Although the number of amphetamine type stimulant (ATS) users is increasing, the prevalence rate remained very low, at 0.2% of the population in opium-growing areas which is almost the same ratio as last year. Heroin use is also reported to be very low, affecting less than 0.1% of the population aged 15 and above. However, information on drug use must be interpreted with caution, as respondents may have been reluctant to report opium, heroin and ATS consumption in the context of the Government's efforts to curb drug use and addiction.

Reported Eradication

This survey did not monitor or validate the results of the eradication campaign carried out by the Government of Myanmar (GOUM). According to the GOUM, a total of 7,058 ha were eradicated in the 2010-2011 opium season, which is 15% less the area eradicated in 2009-2010. Most of the eradication continued to take place in Shan State (85% of the total), notably in South Shan (51%). 44% of the eradication concentrated in three townships in the southern part of South Shan, namely Pinlaung, Pekong and Sisaing townships.

Food security and coping strategies

Food security remains a major problem in almost all regions where the survey took place for both poppy-growing and non-poppy-growing villages. The erosion of food security is of particular concern because it could trigger a further increase in opium cultivation. In order to meet their food deficit, households across all regions most frequently sought assistance from friends and/or took loans to buy food.

The high (and rising) price of opium in Myanmar is making opium production more attractive. In fact, as a proportion of total income, opium income has increased among opium growing farmers. Among opium growing farmers, the proportion of total household income derived from opium production is also now increasing. Between 2003 and 2009, the income generated by opium was a declining proportion of opium-growing farmers' total cash income falling (from 70% to about 20% during the period). However, in 2010, this trend reversed and the proportion of total cash income coming from opium is now 54%. With the cultivation of one hectare of opium farmers earned 9 times more than from rice cultivation in low lands, and 15 times more than rice cultivated in uplands. This makes it more difficult to convince farmers to abandon opium and switch to other crops. Nonetheless, this survey provides important information to help design and target alternative livelihood-programmes.

Type of food found in Myanmar villages

Stripping equipment - maize

Pumpkins stored for consumption in the rainy season

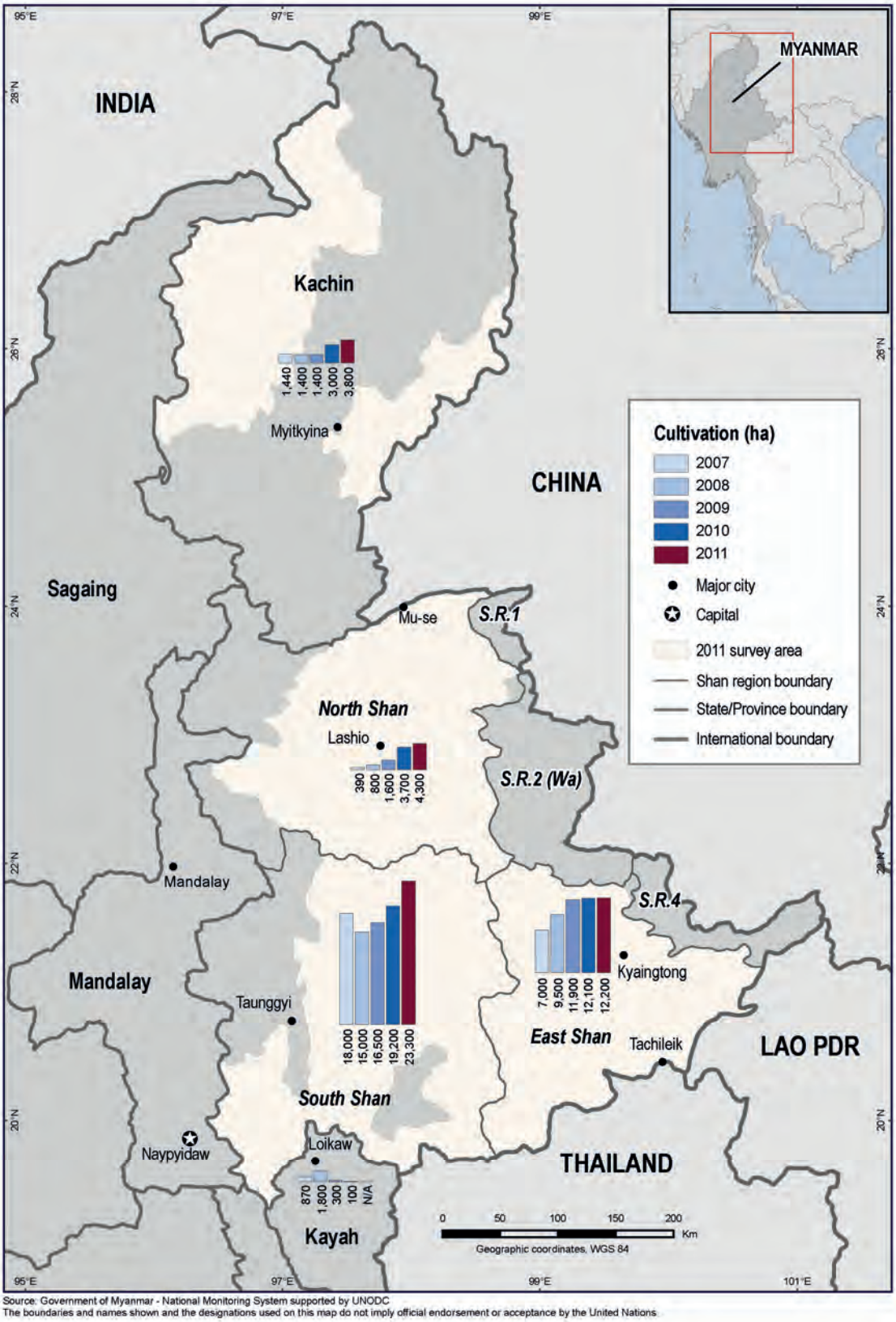
Cassava as alternative food (instead of rice)

Chillies drying

Rice stored in large buckets

Drying of sausage for consumption

Map 1: Opium poppy cultivation in Kachin, and Shan States, Myanmar 2006-2011



Source: Government of Myanmar - National Monitoring System supported by UNODC
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations

INTRODUCTION

This report presents the results of the ninth annual opium survey in Myanmar. It was conducted by the Central Committee for Drug Abuse Control (CCDAC) of Myanmar, with the support and participation of UNODC. Since 2001, UNODC has collected statistical information on illicit crop cultivation in Myanmar, within the framework of its Illicit Crop Monitoring Programme (ICMP). ICMP works with national governments to increase their capacity to monitor illicit crops and supports the international community in monitoring the extent and evolution of illicit crops in the context of the plan of action adopted by the United Nations (the 53rd session of the Commission on Narcotic Drugs in March 2009). The survey methodology combines satellite imagery with field and village surveys. In combination, these three survey methods provide the information used to determine the extent of opium poppy cultivation and production, and the socio-economic situation of farmers in Myanmar.

Opium poppy has been grown in Southeast Asia as a medicinal and cash crop for centuries. Some 150 years ago, cultivation of the crop was commercialized in the country. Opium poppy cultivation has remained village-based, widely dispersed and very "low tech". The agricultural economy of opium–growing regions of Myanmar is based on a traditional opium poppy-maize-rice cropping system.

In the 1980s, Myanmar was the world's largest producer of illicit opium. Between 1981 and 1987, it had an average annual production of about 700 metric tons. Opium production in Myanmar continued to increase until 1996, reaching annual production levels of some 1,600 metric tons. In 1991, Afghanistan replaced Myanmar as the world's largest producer of opium, primarily due to its higher opium yield per hectare. However, for another decade, up until 2002, the area under cultivation remained larger in Myanmar than in Afghanistan.

In 1996, the surrender of the notorious drug trafficker Khun Sa, leader of the Mong Tai Army, to the government authorities resulted in the collapse of several armed resistance movements and led toe government to the negotiation of a series of truce agreements with most break-away factions. This paved the way for greater control by the Government of opium poppy-growing regions and allowed the implementation of measures to reduce opium poppy cultivation.

In 1999, the Government of Myanmar and local authorities (in areas cultivating opium poppy) developed a 15-year plan to eliminate illicit crop production by the year 2014. Since then, there has been a considerable decrease in the total area under cultivation and a significant decline in opium production in Myanmar.

In recent years, opium poppy has now been confined almost entirely to the Shan State with a few pockets of cultivation in other states. Since a ban on opium cultivation was declared by the leading groups in the Wa Region in June 2005, the region remained poppy-free. Similarly, no significant opium poppy production has been observed in Kokang and in Special Region 4 since 2003. Nonetheless, after reaching a minimum level in 2006, opium cultivation began to increase again in 2007.

The achievements in reducing cultivation and production of opium, and the efforts made to treat opium users, can only be sustained if alternative livelihoods are available to local communities. Farmers are very vulnerable to loss of income derived from opium, especially those who depend on this income source for food security. Also, opium cultivation is generally linked to a lack of peace and security, which indicates the need for political, as well as economic solutions.

The annual opium surveys remain essential to assess the extent of opium poppy cultivation within the country and changes in cultivation patterns. It is also a useful tool for gauging the effectiveness of opium bans and their implications. It also helps to understand cultivation techniques and alternative livelihoods. Such information is essential for developing effective strategies to sustain the transition from an illicit economy to a licit economy.

FINDINGS

2.1 Opium poppy cultivation

In 2011, the annual opium survey in Myanmar covered the Shan State (North, East, and South Shan), and Kachin State, i.e. the main regions where opium poppy is cultivated. Information from law enforcement agencies and local authorities confirmed that the Special Regions in Shan (Wa Special Region 2, Kokang Special Region 1 and Special Region 4) remained poppy-free.

In 2011, the total area under opium poppy cultivation in Myanmar was estimated at 43,600 ha, representing an increase of 14% compared to the 38,100 ha in 2010. This upward trend started slowly in 2007 after six years of decline (2001 to 2006)[8].

Figure 2: Opium poppy cultivation (ha), 1996-2011

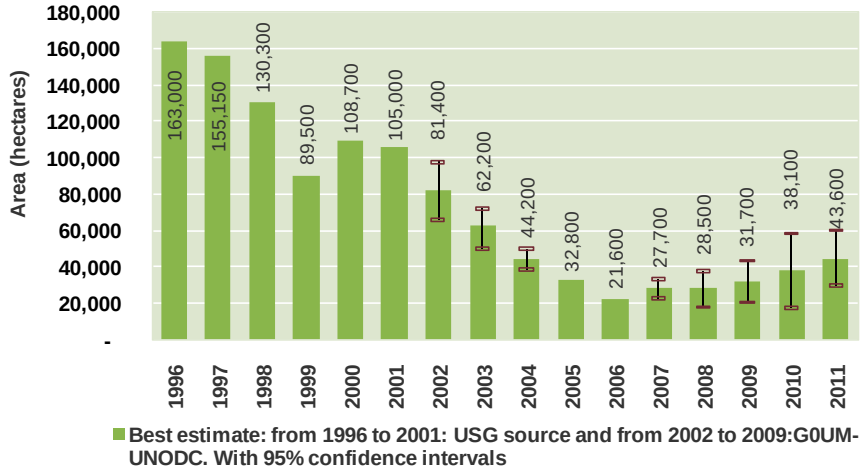


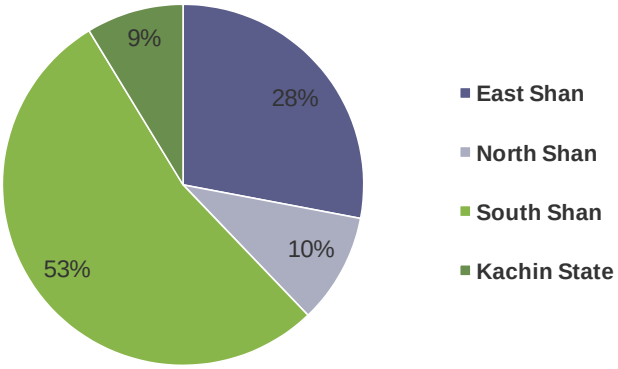
Table 1: Opium poppy cultivation (ha), 2002-2011*

Estimate	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
upper	97,500	71,900	49,600			32,600	37,000	42,800	53,900	59,600
lower	65,600	49,500	38,500			22,500	17,900	20,500	23,200	29,700
Mean	**81,400**	**62,200**	**44,200**	**32,800**	**21,600**	**27,700**	**28,500**	**31,700**	**38,100**	**43,600**

** In 2005 and 2006 upper and lower estimates could not be calculated.*

[8] In none of the surveys performed until now the cultivation figures were adjusted for the eradication that had taken place after the acquisition of the satellite images. So if poppy cultivation was observed in the images but these fields were eradicated afterwards it was not accounted for. However, the timing of the images targets the flowering time when most of the eradication campaigns have been finalized which minimizes the potential error. Nevertheless, the actual area harvested and opium production could be slightly smaller than stated in this report. This applies to the current and past figures for cultivation and production.

Figure 3: Area distribution of opium poppy cultivation by state in 2011



The vast majority of opium poppy cultivation in Myanmar continued to take place in South Shan (53%) and East Shan State (28%). In North Shan State, the share of opium poppy cultivation remained the same as last year, and accounted for 10% of the total area under poppy cultivation. The overall area under poppy cultivation in the Shan State accounted for 91% of total opium poppy cultivation in Myanmar, similarly to last year. The largest proportional increase was nevertheless observed in Kachin State, where most of the opium poppy cultivation outside of Shan State takes place. Cultivation in Kachin was found in the areas of Tanai and Waingmaw townships, and to a smaller extent in Putao township. In 2010 some small pockets of poppy cultivation were found in the northern part of Kayah State but the 2010 opium poppy survey estimated this to be only about 100 ha and was it therefore not surveyed again 2011, saving resources for more significant production areas.

Table 2: Opium poppy cultivation areas by region, 2009-2011[9]

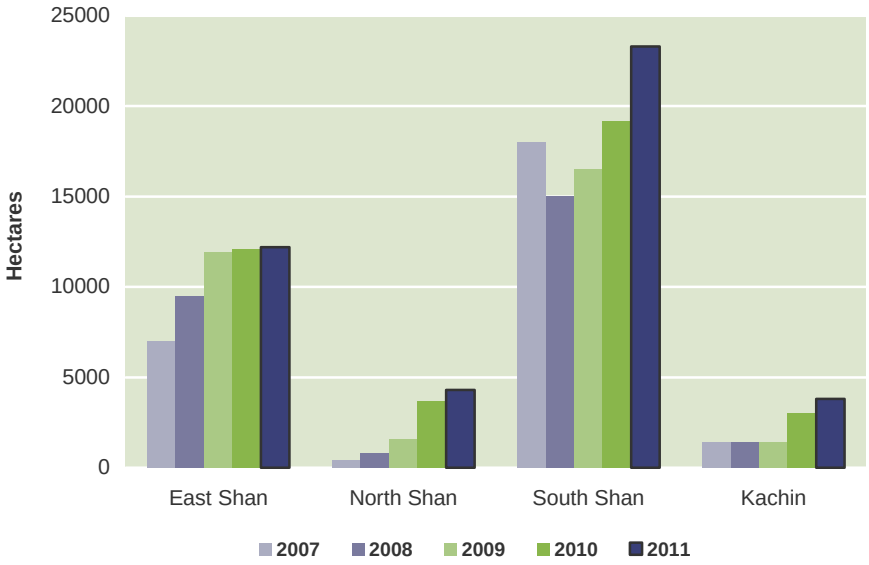
	2010	2011	Change 2010 -2011	% of total area of opium poppy cultivation
East Shan	12,100 (6,200 to 19,000)	12,200 (6,700 to 18,300)	+1%	28%
North Shan	3,700 (1,500 to 6,700)	4,300 (1,700 to 7,200)	+17%	10%
South Shan	19,200 (9,400 to 31,500)	23,300 (11,500 to 37,400)	+21%	53%
Shan State Total	35,000 (22,700 to 50,100)	39,800 (25,900 to 55,800)	+14%	91%
Kachin	3,000 (500 to 3,800)	3,80010	+27%	9%
Kayah	100	n/a	n/a	n/a
National Total (rounded)	38,100 ha (23,200 to 53,900)	43,600 (29,700 to 59,600)	+14%	100%

As in 2010, South Shan recorded the largest increase in 2011 in number of hectares (4,100 ha or a 21% increase). In the East Shan State, where less than one third of total cultivation takes place, poppy cultivation increased by 1%. There were continuing increases in North Shan State (+17%) and Kachin (+27%), however the total area of cultivation in both regions remained modest compared to other regions (10% and 9% of the total opium poppy area respectively).

[9] Numbers in brackets indicate upper and lower bounds of the best estimate.

[10] There is no range calculated since the Kachin estimate was based on changes in the satellite images from 2010 to 2011 which does not allow for a range calculation.

Figure 4: Opium poppy cultivation in the surveyed regions (ha), 2007-2011



Examples of large cultivation poppy fields in North Shan State

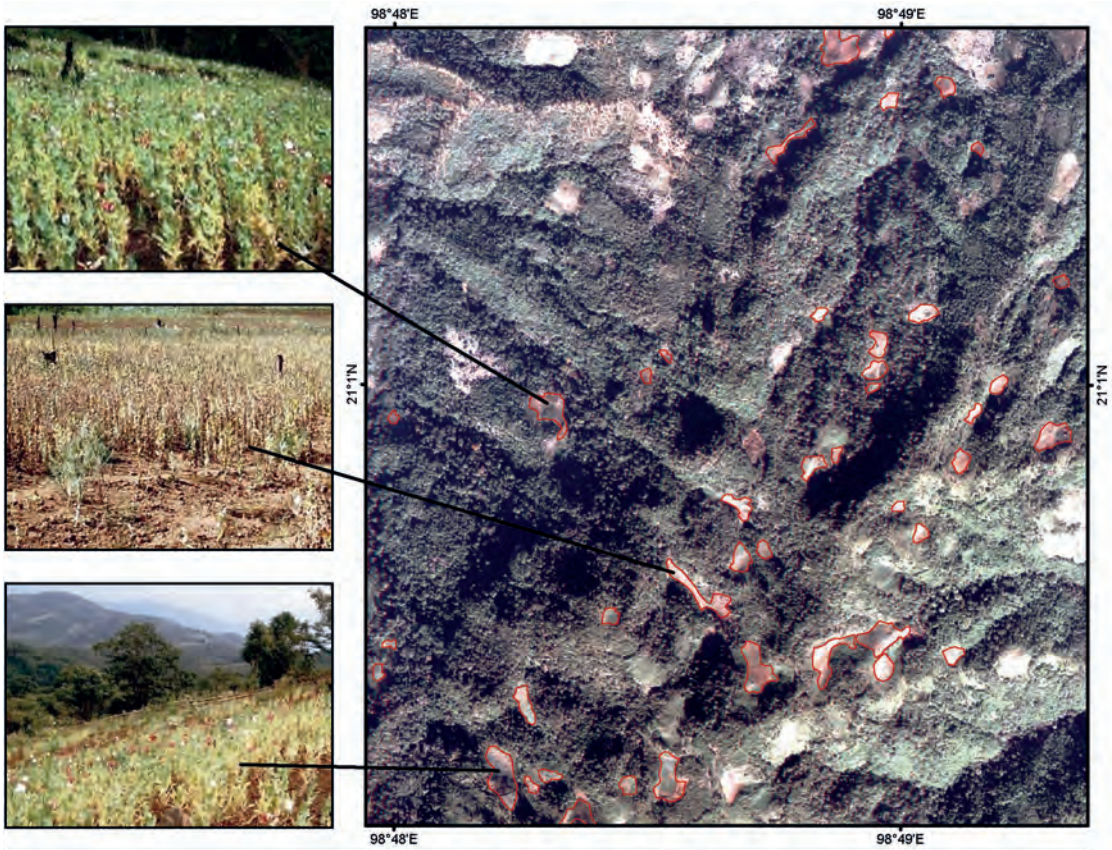
Poppy fields on all parts of a mountain in Namkham township (North Shan) under local militia control area

Poppy fields inside a village territory

Poppy cultivation grown at irrigated terraces after paddy harvesting. Tanyant township, North Shan

Poppy cultivation at early stage grown in a harvested paddy field

Figure 5: Poppy identification in a very high resolution satellite image and corresponding photos taken in the fields



Satellite image source: © Digital globe (2010), provided by European Space Imaging

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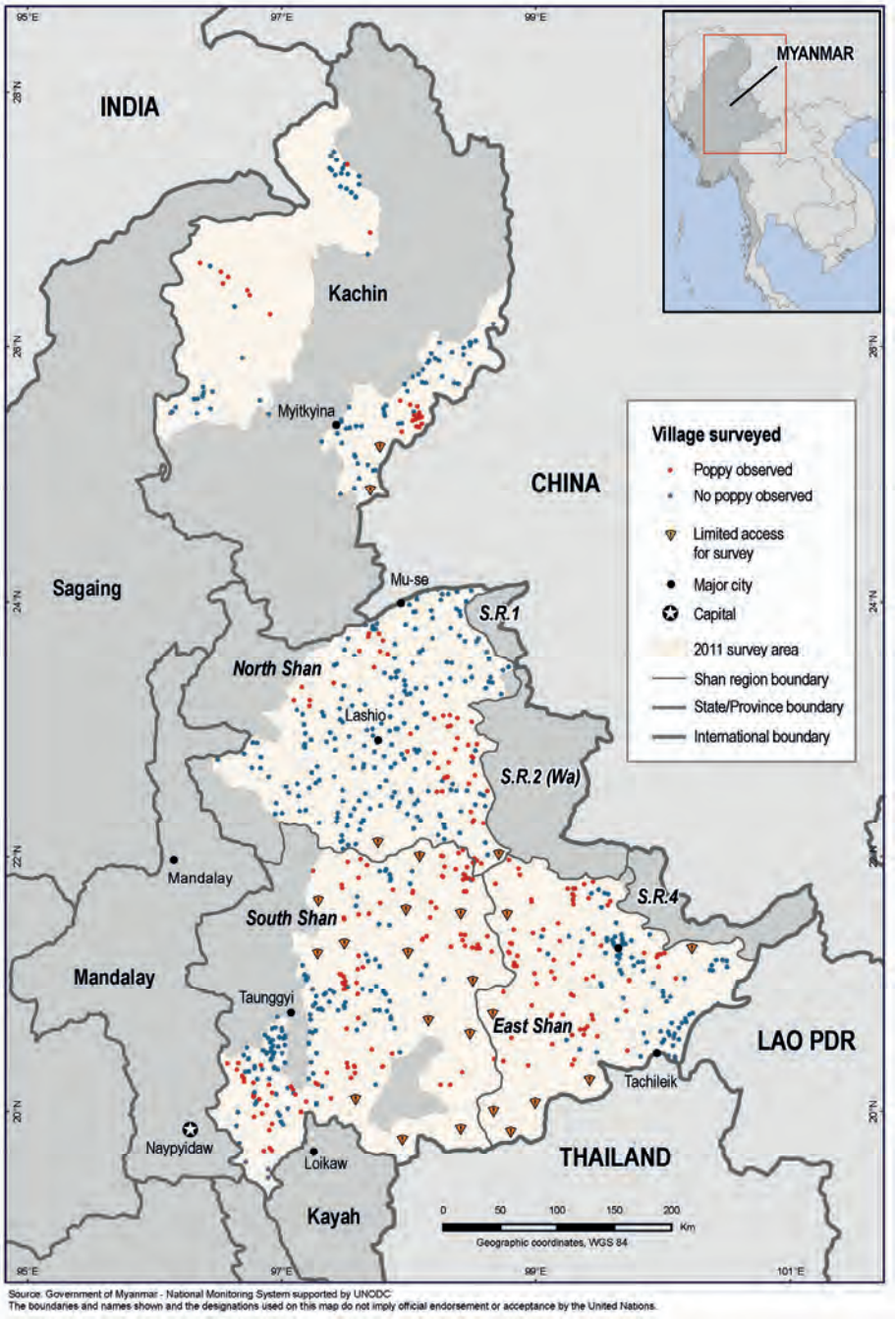
Villages and farmers involved in opium poppy cultivation

From the village survey it was estimated that a total of 256,000 households (175,000 to 351,000) were involved in opium poppy cultivation in Myanmar in 2011, 14% more than in 2010 and more than the number of households involved in opium poppy cultivation in Afghanistan (191,500 in 2011). Opium cultivation took place in 34% of the surveyed villages in Shan State, with high concentrations in East Shan State (44%) and South Shan State (46%).

Previous surveys indicated that the area under cultivation was 0.17 ha per household. These are small areas, compared to Afghanistan, where, in 2011, the average area under poppy cultivation was 0.5 ha per household. However, in Afghanistan, the fields are contiguous and mostly on flat land, while in Myanmar, most fields are scattered in the mountains which makes access and maintenance difficult.

Map 2: Surveyed villages and their opium poppy cultivating status, 2011



Growing seasons for opium poppy cultivation

Observations made during the implementation of the socio-economic survey showed that farmers as in previous years 'stagger' the planting of their opium crop to help distribute the workload and to avoid the risk of crop loss due to unfavourable weather during germination or harvest. The main opium poppy growing season is from September to March (the dry season). Opium poppy cultivation in the monsoon season occurs only in the southern parts of the Shan state (Pinlaung, Pekhon, Sisaing) but earlier surveys have shown that this area is very limited (about 500 hectares in 2009) and with very low yields. This monsoon season cultivation sometimes overlaps with an early crop in those regions. In Hsi Hseng township (South Shan) a continuous cultivation of opium poppy was observed in 2011, where opium poppy growers can harvest up to three times per year.

A practice called multi-stage cropping is also increasingly common. Multi-stage cropping is often employed in opium poppy fields where significant eradication campaigns have taken place or where there is a shortage of labour. During multi-stage cropping, opium poppy seeds are sown twice in the same field within an interval of a few weeks. Hence, plants of two different sizes are growing in the same field at the same time and some of the poppy plants will survive any eradication efforts.

Photos depicting multi-stage cultivation of opium poppy in the same area.

These photos were taking during the first week of March 2011. The first stage of the growing (see photo 1) was harvested during the beginning of the rainy season. The gum which was collected will be about the same as opium harvested during the monsoon in Pinlaung and Pekon township.

Field as an early stage of growing

Poppy at mature stage

Poppy at first lancing

Poppy at the end of the harvest (several lanced capsules)

Reasons for farmers to grow poppy

60% of the interviewed farmers reported that poppy is grown to supplement the lack of food; 35% to get more cash while 5% gave various other reasons like not having enough land to grow other crops or lack of markets to sell other products.

In terms of products that farmers would cultivate if they were to stop growing poppy, responses received this year are similar to those received during the 2010 survey. 23% of the farmers favour a substitution for vegetables, 24% for corn and 24% for upland rice while 14% favour the long term cultivation of such crops as rubber and fruit trees. The preference to replace poppy for crops that can either be eaten or sold in the short term is a further indication of the food deficit faced by many households.

Figure 6: Reasons to grow opium poppy as reported by farmers

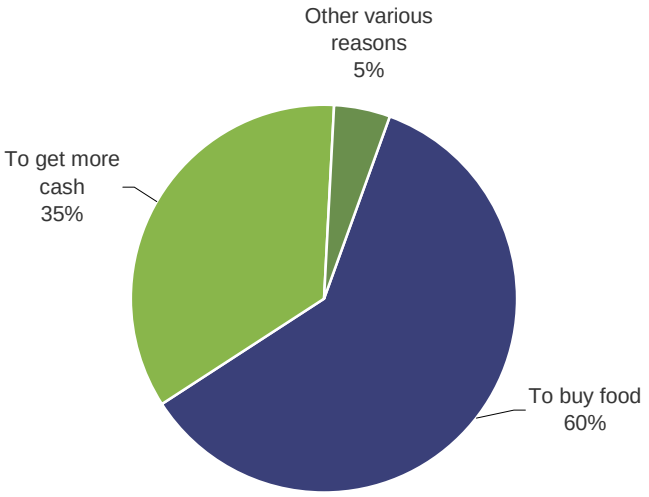
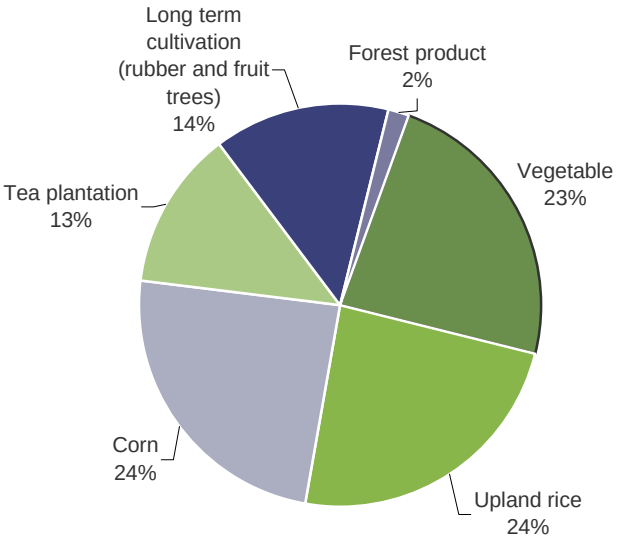


Figure 7: Farmers' opinion on crops that they would grow to substitute opium poppy



2.2 Yield and potential opium production

The national opium yield amounted to 14.0 kg per hectare, which represents a decrease of 8% compared to last year's yield. This is mainly due to weather conditions resulting in smaller capsules and a smaller number of yielding capsules. The yield was lower in all regions but

especially in North and South Shan where 20% less opium per hectare was harvested. The Myanmar yields are still far below the yields that are obtained in Afghanistan, which were estimated at 44.5 kg per hectare in 2011.

Figure 8: National opium yield (kg/ha) calculated during the surveys from 2002 to 2011[11]

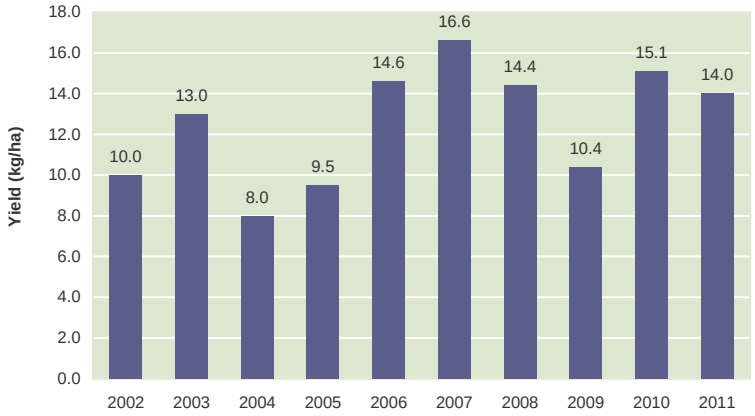


Figure 9: Opium yield by region (kg/ha), 2010-2011

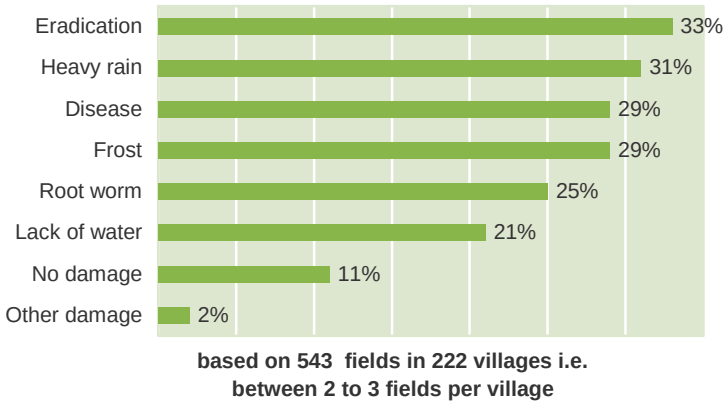
Region	2010 average yield (kg/ha)	2011 average yield (kg/ha)	Change 2010-2011
East Shan	12.6	11.9	-6%
North Shan	15.3	11.8	-23%
South Shan	16.8	13.6	-19%
Kachin	-[12]	24.7	N/A
National weighted average	**15.1**	**14.0**	**-7%**

Farmers reported reasons for any loss in opium harves ranging from extreme weather conditions (heavy rains and frost) to eradication and diseases.

[11] As of 2006 Kachin was included in the national yield estimate.

[12] In 2010 the average yield value (15.1 kg/ha) of the Shan state was applied to calculate the production for the Kachin state due to insufficient yield samples collected.

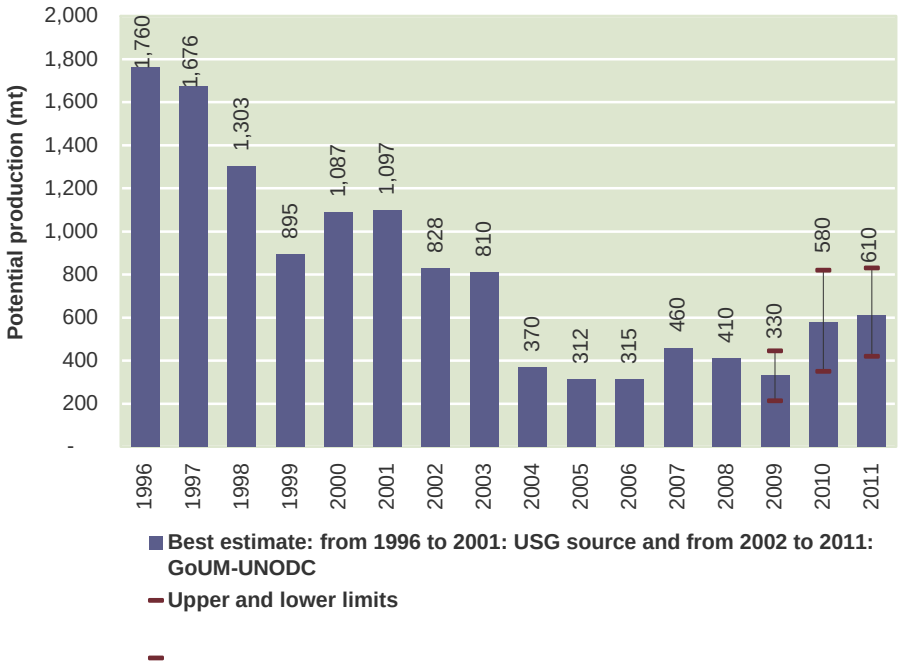
Figure 10: Problems affecting poppy fields according to farmers interviewed during the yield study (*), 2011



**The sum can be larger than 100% due to multiple problems mentioned per field.*

Despite declining yields, the larger area under cultivation resulted in an increase in total opium production by 5%, from 580 mt in 2010 to 610 mt opium in 2011. Opium production is now at its highest level since 2004.

Figure 11: Potential opium production (mt), 1996-2011

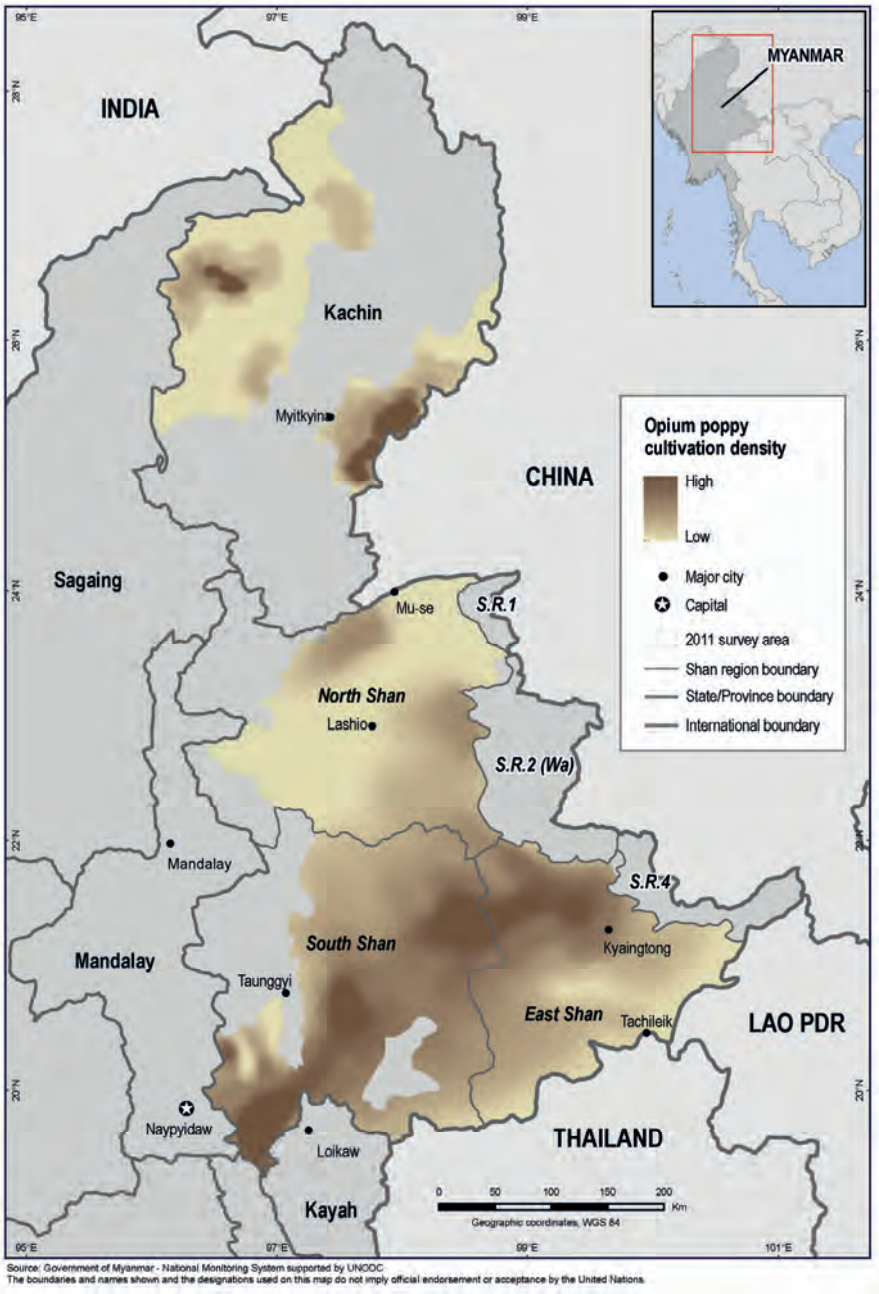


The Shan State accounted for 91% of total opium production in Myanmar. Most of the opium production continueed to take place in South Shan (292 tons) followed by East Shan (190 mt). The largest production increase was observed in Kachin state where production doubled and for the first time exceeded production levels in North Shan (93.9 mt versus 52.7 mt). The total production in Myanmar represents 11% of the opium produced in Afghanistan in 2011.

Figure 12: Potential opium production (mt) by region, 2010-2011

Region	Potential production (mt) 2010	Potential production (mt) 2011	Change 2010-2011	Share of production by state (%)
Kachin	45.6	93.9	+106%	15%
Kayah	1.5	-	-	-
East Shan	183.9	145.7	-21%	24%
North Shan	56.2	52.7	-6%	9%
South Shan	291.8	316.5	+8%	52%
Total (rounded)	**580**	**610**	**+5%**	**100%**

Map 3: Cultivation density map, Kachin and Shan States, Myanmar 2010



2.3 Opium prices

The average farm-gate price of opium (weighted by the estimated area under cultivation) increased by 48% from US$ 305/kg in 2010 to US$ 450/kg in 2011. Between 2010 and 2011, the value of the dollar against the Kyat decreased significantly (-14%) and the price increase in local currency was only 27% (from 308,000 Kyat/kg in2010 to 390,000 Kyat/kg in 2011). Large price increases often indicate an opium shortage. Nevertheless the prices had increased despite an increase in opium production. This year a similar pattern was observed in Afghanistan, where opium prices increased from USD 128/kg in 2010 to USD 180 in 2011 (an increase of 41%) whereas there was a significant increase in opium poppy production (+61%).

Fresh opium prices increased after the harvest in South Shan (US$ 420/kg) and in East Shan (US$ 580/kg), the main opium poppy growing regions.

Figure 13: Farm-gate price (weighted average) of fresh opium in poppy growing villages (US$ equivalent/kg), 2005-2011

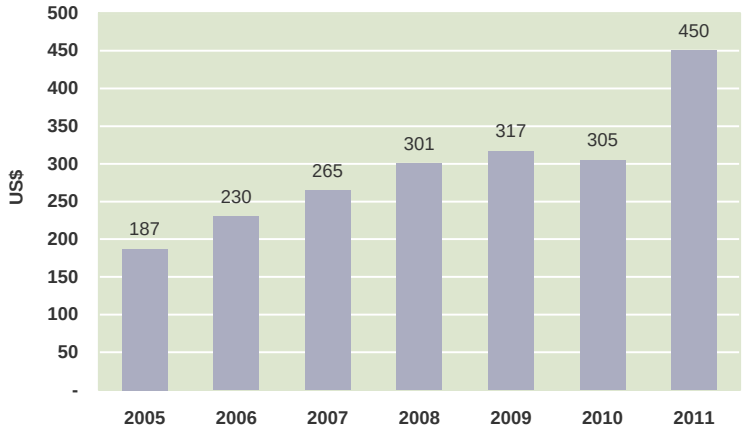
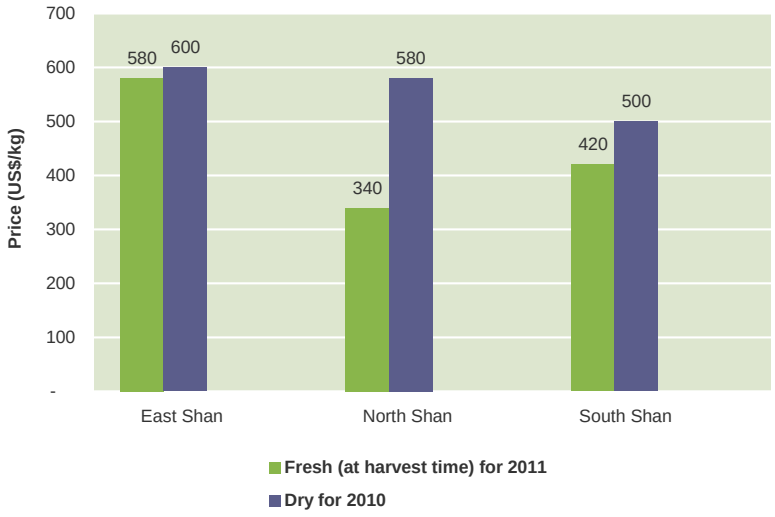
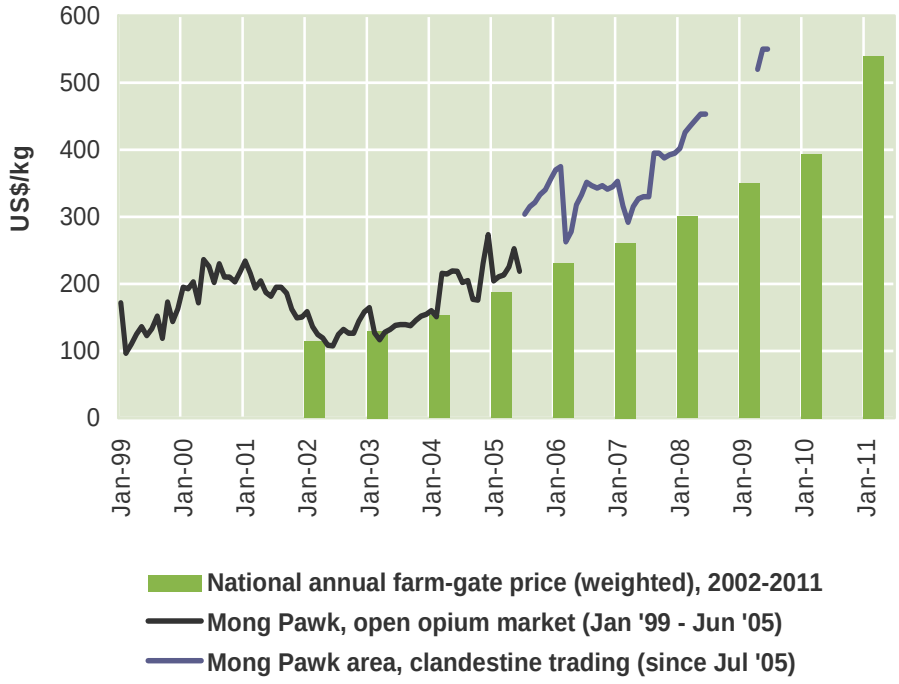


Figure 14: Farm-gate prices of fresh and dry opium in US$ equivalent/kg in Shan state



For many years, wholesale opium prices were monitored at Mong Pawk in the Special Region 2 (Wa), where UNODC has assisted authorities with an alternative development project. Unfortunately, the collection of prices in Mong Pawk was discontinued in 2009. The survey also collected data on dry opium kept by farmers after the harvest and sold during the year according to their needs. The average price of one kilogram of dry opium amounted to US$ 540. UNODC hopes that in the future, wholesale price collection will resume in South Shan State.

Figure 15: Monthly wholesale prices for dry opium at markets and farm-gate, Shan State (US$/kg), 1999-2011

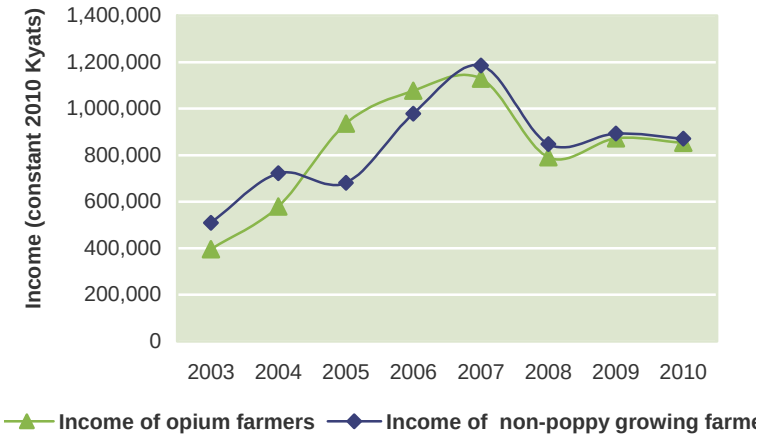


2.4 Household cash income in opium growing risk areas

The income questions are responded for the former year, since opium harvests were not completed yet when the survey was conducted. The average annual cash income of opium-producing households and non-opium producing households in 2010 decreased by 2% compared to the year before[13]. The income for opium-producing households was calculated, on average, at 853,000 Kyats (US$ 1,030) per household. The average annual cash income of non-opium cultivating households, including households that never cultivated and households that stopped opium poppy cultivation, was slightly higher at 871,000 Kyats (US$ 1,180).

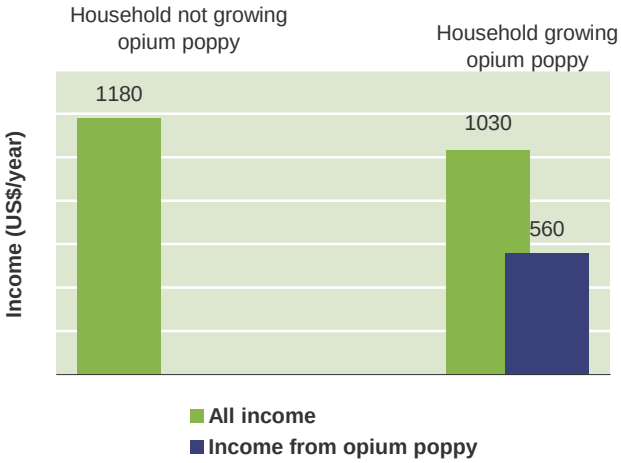
On average, income from opium accounted for 54% of total cash income among poppy-growing farmers.

Figure 16: Total average income of households in the survey area, 2003-2010 (in constant 2010 Kyats)* * adjusted for consumer prices changes



[13] Constant prices for 2010, corrected for inflation and exchange rates.

Figure 17: Total average income of households in the Shan state (US$/year) asked for 2010



Average 2010 household income in non-opium poppy growing villages located in opium growing risk areas (US$/year)

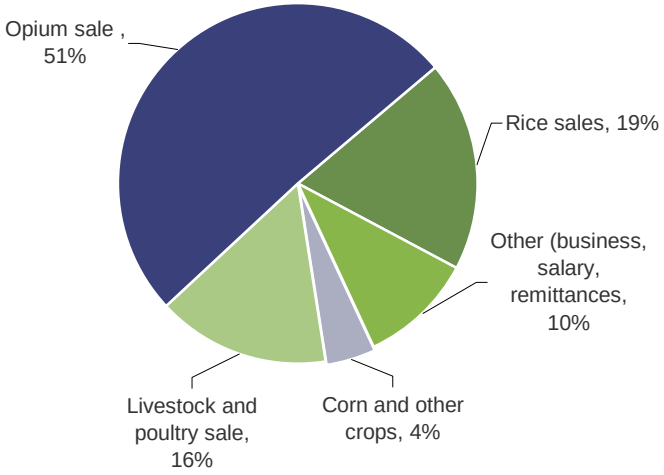
Source of income

Sales of rice, cattle, business, salary, remittance, corn and other crops represented in 2010 the main sources of income for villages that did not grow poppy. The calculated shares are almost identical with those of the previous year. In contrast, villages that grow poppy depended less on rice cultivation for income. As a proportion of total income, opium income increased significantly. A large proportion of opium sold appears to compensate for the lack of rice.

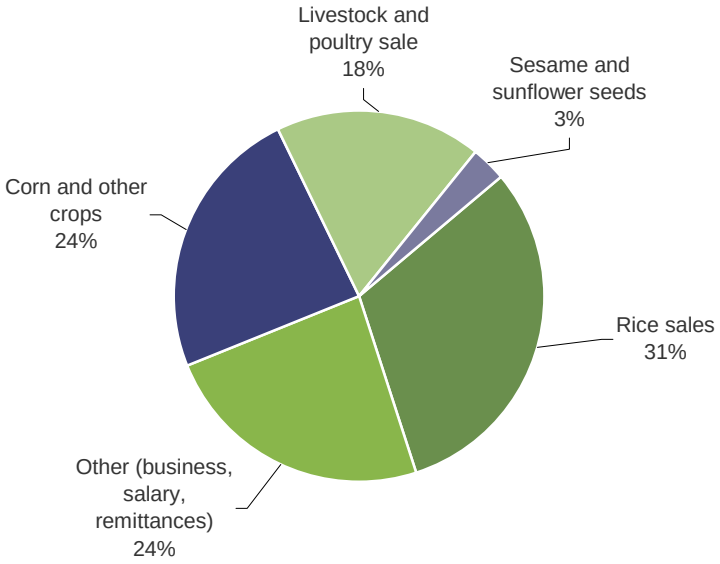
Opium poppy is by far the most lucrative crop for farmers. One hectare can generate a gross income of 5.5 millions kyats (US$ 6,300). In comparison, one hectare of rice, cultivated in low lands, yields about 2.3 mt and is sold for about 300,000 kyat per ton, which would give a potential income of 690,000 kyats per hectare i.e. 9 times less than opium. This ratio increases 15 fold for rice cultivated in the uplands. Significantly, in 2011, one hectare of poppy in Afghanistan yielded a gross income of US$ 10,700 which is more than double as compared to 2010.

In many townships in Myanmar, poppy cultivation is owned by farmers. However, large areas are not entirely controlled by the government but by armed groups, insurgents and militiamen who use cash income from opium as the main economic resource. The farmers in these regions typically act only as sharecroppers.

Figure 18: Sources of income in villages by opium poppy status in 2010 (include Shan and Kachin States)



Sources of income in poppy-growing villages



Sources of income in non poppy-growing villages

2.5 Opium use in opium-growing risk areas

Data on opium addiction was collected via interviews with village headmen. The headmen were asked to provide information on the number of drug users in their village. The addicts themselves were not interviewed and no data on their level of consumption was collected. Headmen were asked about the number of daily opium users and the number of regular users of other drugs without specifying the frequency of use.

According to the data reported by the headmen, daily opium use in Shan and Kachin State affects 0.7% of the population aged 15 years and above. This rate is similar as last year (0.8%). As in

previous years, the prevalence rate was higher in opium-growing villages (1.3%) compared to non-opium-growing villages (0.4%). The level of opium use found in Kachin was the highest (1.0%), followed by East Shan (0.8%) and North Shan (0.5%). Until a few years ago, opium production used to be highest in North Shan where the rate of addiction to opium remains high.

Heroin use affected 0.1% of the male population aged 15 and above. Although the number of amphetamine type stimulant (ATS) users is increasing, the prevalence rate was still low, affecting 0.2% of the population in the opium-growing risk areas (0.5% of the male population). As noticed in previous surveys, this type of drug use is at a low level in rural Myanmar. In urban areas, other sources indicate far higher rates of abuse.

In general, data on drug use must be interpreted with caution, as there may be reluctance on the part of respondents to report opium, heroin and ATS consumption in the context of the Government's efforts to curb such use.

Table 3: Opium, heroin and ATS addiction rates as reported by headmen in Shan state and Kachin in 2011 (population age 15 and above).

Description	Non-growing	Growing	Total
Opium addiction (men and women)	0.4%	1.3%	0.7%
Heroin addiction	0.1%	0%	0%
ATS addiction	0.2%	0.1%	0.2%

Equipment of the opium addict people

In Tanai (Kachin State) opium latex is naturally very liquid. After harvesting it is diluted in water, spread on a piece of cloth and finally dried under the sun. The piece of cloth will be sold to traffickers then purchased by opium addicted people.

Preparation of opium for consumption

Opium has been preserved and transported in a piece of cloth

. The opium gum is extracted from the cloth in boiling water

Minced young banana leaf to mix with liquid opium

Opium is mixed with the minced banana leaf

Small balls are formed ready to be smoked

Consumption of the opium-banana leaf balls with a hand-made pipe

2.6 Socio-economic characteristics of the population living in opium-growing risk areas

Food security

In 2011 the situation on food security (in this report defined as 'rice self sufficiency') was similar to last year, except for East Shan State and Kachin where the food security worsened. In non-poppy growing villages, 66% of households reported having sufficient rice over the last 12 months; whereas in households growing opium poppy, the rate is slightly lower (64%). This food gap could be, *inter alia*, a cause for the increased poppy cultivation in 2011.

Table 4: Food security (percent of households that had enough rice for 12 months*) in villages that *did not grow* opium poppy, for 2009 and 2010.

Region	In 2009	In 2010
Kachin	85%	56%
East Shan	79%	65%
North Shan	51%	76%
South Shan	69%	69%
Total	**63%**	**66%**

**Asked for the former year.*

Table 5: Food security (in percent of households that had enough rice for 12 months*) in villages that *did grow* opium poppy, for 2009 and 2010.

Region	In 2009	In 2010
Kachin	83%	88%
East Shan	60%	53%
North Shan	52%	73%
South Shan	60%	61%
Total	**61%**	**64%**

**Asked for the former year.*

In order to overcome the lack of food, the most frequent strategies across all regions were assistance from friends and loans for food. Contrary to previous years, farmers were more inclined to utilize rice banks to overcome their food deficits. Rice banks are village committees that, on behalf of member farmers, receive paddy or seeds from farmers with surpluses and lend them to needy farmers at an appropriate interest rate. The collected interest is used as a village fund.

55% of households that could not afford to buy food bought food on credit or got an advance of food (rice) from friends and relatives. This percentage is the same if the villages grew poppy or not. In the villages growing poppy, 21% bought cheaper or lower quality food versus 10% in villages that do not grow poppy. In all surveyed villages, about 10% got some food by hunting or foraging.

Table 6: Coping strategies in households that did not have enough food in 2011

Strategy	In growing poppy villages	In non-growing poppy villages	In all surveyed villages
Foraging and hunting	9%	11%	10%
Rely on less preferred or less expensive food	10%	21%	13%
Borrow food, rely on friends or relatives	25%	31%	27%
Purchase food on credit	30%	24%	28%
Other stategy	25%	20%	24%

Table 7: Average cultivated land in the village per household in 2011 (in hectare)

Villages in surveyed area	Rice	Wheat and corn	Mustard and sunflower	Vegetable	Long term (rubber, fruit tree)	Other	Poppy	TOTAL
Not growing poppy	0.57	0.16	0.04	0.06	0.01	0.19		1.05
Growing poppy	0.48	0.14	0.04	0.04	-	0.11	0.17	1.0

The crops cultivated by opium and non-opium poppy producing villages are much the same. Rice remained the most important crop in all villages, and the cultivated area remained the same as last year. The households in non-poppy growing villages use about 16% more of their land for rice than the villages growing poppy.

Irrigation

Only 15% of the total cultivated land was reported to be irrigated. This percentage is almost the same in villages cultivating poppy (15.5%) and in villages not cultivating poppy (15%). The same percentage of poppy cultivation is irrigated. This in contrast with Afghanistan where the majority of the opium poppy fields are irrigated and where significantly higher yields are obtained.

Watering is mostly done by transporting water in containers and pouring the water directly on to the poppy plants, or by diverting a river through furrows in the ground across the fields.

This field, which is in the process of eradication, is crossed by furrows that distribute the water diverted from the lake near-by (Inlay lake).

Assistance

The proportion of villages that received assistance was about 6% regardless of their opium poppy cultivation status. The highest proportion of assistance was reported in villages in East Shan States where villages received some improved seeds and in Kachin States where villages received assistance from international organizations.

Table 8: Percentage of villages that received assistance in 2010-2011 (n = 735)

Region	Never received assistance	Received assistance
In villages not growing poppy		
Kachin	83%	17%
East Shan	93%	7%
North Shan	98%	2%
South Shan	99%	1%
Total in villages not growing poppy	**95%**	**5%**
In villages growing poppy		
Kachin	93%	7%
East Shan	74%	26%
North Shan	100%	-
South Shan	100%	-
Total in villages growing poppy	**92%**	**8%**
Total in all surveyed villages	**94%**	**6%**

2.7 Reported eradication

The opium survey did not monitor or validate the results of the eradication campaign carried out by the Government of Myanmar. According to the Government of Myanmar, a total of 7,058 ha were eradicated in the 2010-2011 opium season. This is a significant decrease compared to the area reported as eradicated in 2009-2010, which was 48,268 hectares. Most of the eradication continued to take place in Shan State (87% of the total), notably in South Shan (51%) where three townships recorded an amount of 44% alone (almost half the eradication of the Shan States). These townships cultivate opium poppy from June to March and are know to plant a first opium crop during the rainy season. Likely the eradication figures given by the Government of Myanmar also include the monsoon poppy crop.

Eradication amounted to 14% of the area under poppy cultivation in 2011, which was still a far higher proportion than in Afghanistan (3%).

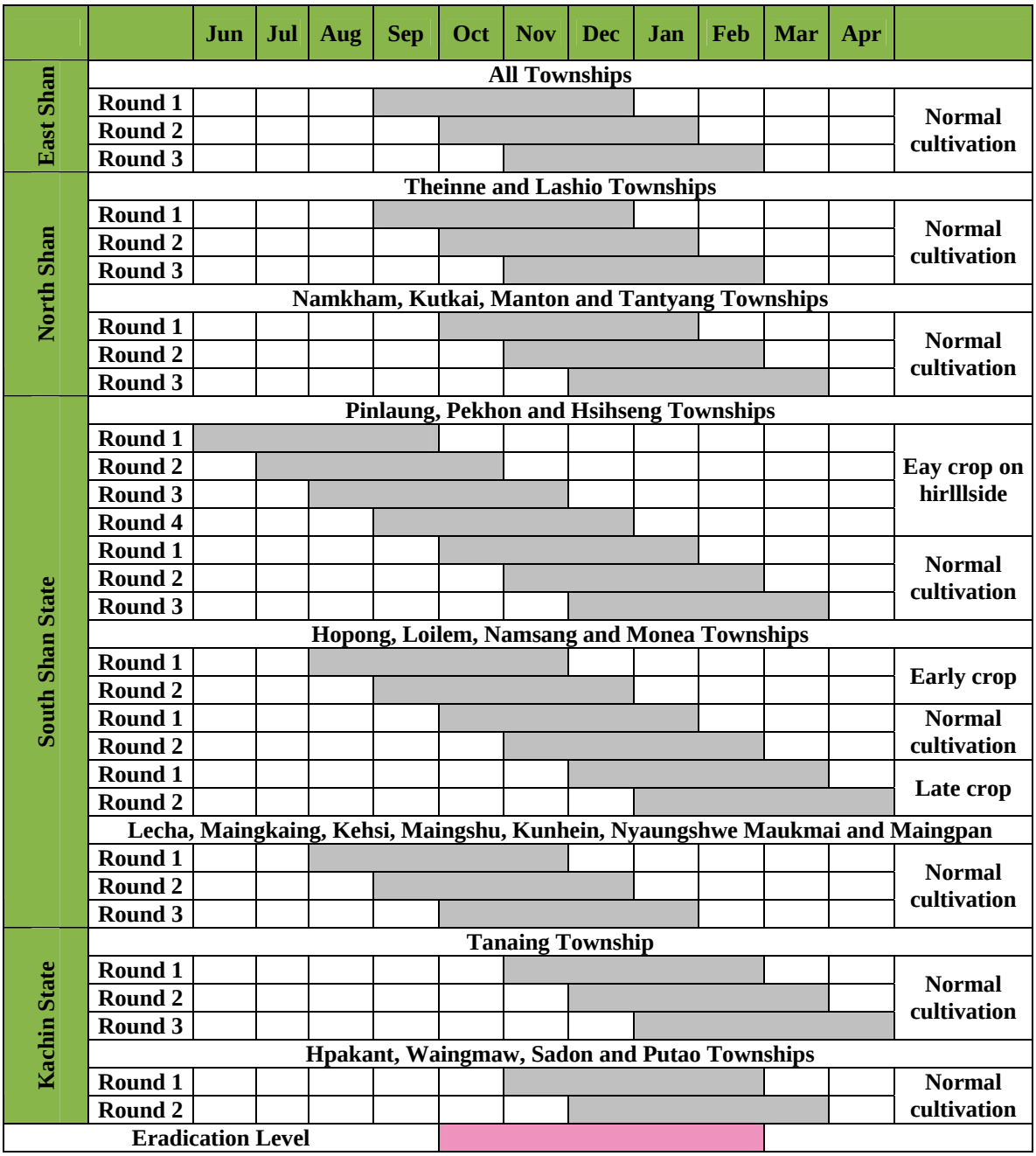
Table 9: Eradication by region (in ha) from 2005 to 2011

Region	2005	2006	2007	2008	2009	2010	2011
East Shan	124	32	1,101	1,249	702	868	1,230
North Shan	1,211	76	916	932	546	1,309	1,315
South Shan	1,203	3,175	1,316	1,748	1,466	3,138	3,579
Shan State Total	**2,538**	**3,283**	**3,333**	**3,929**	**2,714**	**5,316**	**6,124**
Kachin	1,341	678	189	790	1,350	2,936	847
Kayah	8	0	12	12	14	13	-
Total within the surveyed area	**3,887**	**3,961**	**3,534**	**4,731**	**4,078**	**8,265**	**6,971**
Kayah(*)	-	-	-	-	-	-	38
Magwe	0	0	45	0	1	1	0
Chin	3	0	10	86	5	2	10
Mandalay	0	9	0	3	2	0	39
Sagaing	17	0	9	0	1	0	0
Other States	20	9	64	0	0	0	0
All surveyed villages	**3,907**	**3,970**	**3,598**	**4,820**	**4,087**	**8,268**	**7,058**

(*) Kayah State was not part of the survey in 2011

Manual eradication campaign.

Figure 19: **Opium poppy cultivation calendar in Shan State (2010-2011)**



2.8 Clandestine laboratories and trafficking

In Myanmar, opium is transformed into heroin within clandestine laboratories, often hidden in remote areas. These laboratories are very difficult to find but a few are dismantled and destroyed every year by law enforcement agencies. For the transformation of opium into heroin, chemicals are required such as ammonium chloride, acetic anhydride, sodium carbonate, acetone and hydrochloric acid. These chemicals are typically imported from neighbouring countries in the region and are smuggled across borders that Myanmar shares with Laos and Thailand. Most of these laboratories are found in Shan State. Heroin is easier to transport and easier to hide. It also sells for considerably higher prices.

-1-

-2-

-3-

-4-

-5-

-6-

-7-

-8-

-9-

-10-

-11-

-12

Photo 1 and 2: Laboratories for processing opium into morphine/heroin are carefully hidden, camouflaged with the means at hand.

Photo 3: A laboratory inside showing household goods used for the processing.

Photo 4: All the seized equipment inside the laboratory does not represent a large monetary value

Photo 5 and 6: The opium gum come into the laboratory bundled into simple balls wrapped in banana leaves and “shan paper” (home made and water proof paper).

Photo 7 and 8: To transform opium into morphine/heroin, ammonium chloride (6) and lime powder are needed. Lime is extracted from small local quarries that are found throughout the Shan State.

Photo 9 and 10: The raw opium is mixed with lime powder in boiling water in a old recycled oil drum serving as container. The result will give a white organic precipitate (morphine/heroin)

Photo 11: Liquid morphine after boiling together with lime powder.

Photo 12: Brown paste (morphine/heroin base) before being filtered. The morphine/heroin is boiled with acetic anhydride for several hours to produce heroin.

METHODOLOGY

3.1 Introduction

This is the ninth year that the Central Committee for Drug Abuse Control (CCDAC) of the Republic of the Union of Myanmar collaborated with the United Nations Office on Drugs and Crime to implement the annual Myanmar Opium Survey.

The pattern of opium poppy cultivation continued to change in Myanmar: Some areas became opium-free while others increased their level of cultivation. In South Shan State, the opium poppy crop calendar changed and new patterns such as multi-cropping were observed. Opium fields generally moved further away from the villages and, in certain regions, were subject to eradication. In addition, cultivation possibly shifted to areas already considered opium-free or to climatically less favourable regions. In 2011, all these considerations, combined with reduced accessibility and the expected change in cropping pattern, influenced the survey methodology and the sampling procedure for the estimation of the planted area and other socio-economic indicators.

Considerable efforts have been made over the last four years to improve various methodological details and to adapt to the evolving conditions of cultivation. This survey integrated the ground data collection component and combined the use of satellite remote sensing with field surveys and interviews.

The 2011 opium poppy survey was composed of three parallel components:

1. A cultivation estimation survey throughout the two regions of Shan State (North, South, East) and Kachin State. The survey was based on the use of satellite remote sensing as the primary source of data for Shan State and Kachin State. In these two States, satellite remote sensing was supplemented by field surveys to provide ground truthing and to support the interpretation of opium poppy fields.;
2. An opium yield survey in the two regions of Shan State, and Kachin;
3. A socio-economic survey in 800 villages in Shan State and Kachin State. Large part (750) of the villages was selected randomly, and 50 additional villages were selected within the sites of the satellite images in order to provide extra groundtruth information. The surveyors conducted interviews with village headmen and other people who play an independent role in the life of the villages.

Sampling procedure for village survey

The planning of the surveys started with the definition of the sampling frame. The sampling frame is composed of an updated village listing provided by the Central Committee for Drug Abuse Control in Myanmar. The village listing includes names of villages, regions, township names and codes, village tract codes and, in some cases, opium poppy growing history. This listing is regularly updated with information obtained through previous surveys to reflect changes in village location or name, village mergers and relocations, and to delete double entries. For many village entries, GPS positions have been added, which facilitates the unique identification of each village.

From the sampling frame, villages are excluded from townships where there are known security issues or those that have been declared to be poppy-free on the basis of local expert knowledge.

The sample size was influenced by a number of requirements and constraints. The main requirement was the level of accuracy considered acceptable for the estimates, whereas the constraints were either economical or logistical.

The socio-economic survey was conducted in 800 villages, which is approximately 8% of the 9,677 villages from the sampling frame.

Table 10: Composition of the sample of the village survey

Particulars	North Shan	South Shan	East Shan	Kachin	Total
Projected number of villages to be surveyed	250	250	150	101	750
Actual number of villages that were surveyed	250	236	148	101	735

The ethnic composition of the regions of Shan State is possibly the most diverse in the whole of the Republic of the Union of Myanmar. The villages surveyed this year reflect the major ethnic groups present in each surveyed region.

3.2 Survey organization

The surveys were coordinated by the UNODC/ICMP office in Yangon and, as in previous years, operationally implemented in close collaboration with Myanmar official institutions.

The ground survey to measure opium yield and socio-economic indicators were supervised and implemented by CCDAC, while UNODC/ICMP provided technical support, coordination and supervision with national and international staff throughout the survey. No rapid assessment survey or assessment of the opium ban in Shan Special Region 2 (Wa) was implemented directly by UNODC/ICMP/CCDAC since Wa local authorities did not allow any authorisation. UNODC/ICMP conducted a rapid assessment survey in Kokang Special Region (Shan Special Region 1) in collaboration with CCDAC. According to the observations and ground information in the survey, there was no evidence of opium poppy cultivation in these areas this year.

The area estimation was conducted in collaboration with the Remote Sensing and GIS Section of the Forest Department, Ministry of Environmental Conservation and Forestry. Four teams from the Forest Department conducted ground verification in Shan and Kachin States. Three teams, each comprising of two surveyors from the Remote Sensing and GIS section of Forest Department, visited each region of Shan State. One team comprising of one surveyor from Forest Department and one officer from CCDAC visited Kachin State. Two teams from UNODC/ICMP, each collaborating with a CCDAC officer conducted monitoring for ground verification in Shan and Kachin States. Ground verification teams visited the field with printouts (large size) of the satellite images. Once they reached the area represented in each single scene, they annotated the print with the land use classes and relative boundaries proceeding with specific transect itineraries. Back in the office, the ground truth data were used to classify the satellite images combining digital and visual interpretations. The UNODC/ICMP office in Yangon monitored the image interpretations of Forest Department. The results were subject to quality control by an international remote sensing expert at UNODC Headquarters.

3.3 Field operations

Field operations for the village survey started in the third week of December 2010 and continued until mid-February 2011 for Shan State and up to March 2011 for Kachin State. Field surveyors visited 6.7% of all villages in Shan and 19.3% in Kachin States.

A total 38 satellite image locations ground truth data out of 54 were collected. For the village and field surveys, 147 surveyors carried out the field work from 21 December, 2010 to mid-February, 2011. In Kachin State, where opium is harvested later, the date was extended to the end of March, 2011. The surveyors were organized in 48 teams (15 teams for North Shan, 17 teams for South Shan, 10 teams for East Shan and 6 teams for Kachin State). In each team,

there was one surveyor from the Myanmar Police Force, one from the General Administrative Department and one from the Settlement and Land Records Department or the Myanmar Agriculture Service from each township. A head supervisor and three regional national supervisors coordinated the work. Additionally, one UNODC international officer monitored the entire field work. The survey teams were all involved in interviews with the village headmen and heads of households, as well as in field measurements for the collection of yield estimation variables.

Two survey teams were assigned to each of the two townships with a heavier workload (Pinlaung in South Shan State and Waingmaw in Kachin State), and two teams were assigned to another five townships (Lashio, Tant Yang and Thibaw in North Shan State, Kyaingtong in East Shan State). One survey team was assigned to each of the rest of the townships.

The supervision teams met with all teams during the field survey to assess the progress of the survey and ensure quality control. The duration of the main ground survey was 8 weeks, and operations were wrapped up with a debriefing by the end of March, 2011.

As the majority of opium gum collection takes place between early September and late December, it was of vital importance that surveyors commence their work as early as possible, so that they had the opportunity to measure the opium poppy capsules.

Table 11: Socio economic survey fact for the 2010 opium poppy survey

	North Shan	South Shan	East Shan	Kachin	Total
Start Date	29-Dec 2010	17-Dec 2010	29-Dec 2010	16-Feb 2011	17-Dec 2010
End Date	15-Feb 2011	15-Feb 2011	15-Feb 2011	31-Mar 201	31-Mar 2011
Survey Teams	15	17	10	6	48
Targeted Villages	250	250	150	101	750
Surveyed Villages	250	236	148	101	735
% of Villages	100%	94%	99%	100%	94%
Households covered	11,360	14,193	5,481	11,991	43,025
Rual population covered	54,109	68,695	39,581	157,867	395,594

3.4 Area estimation procedures

For the second time, Waingmaw township of Kachin State was added to the area where the poppy cultivation estimate is performed with remote sensing techniques. In this region and in the South, North and East Shan very high-resolution satellite images were purchased after a random selection throughout the study area.

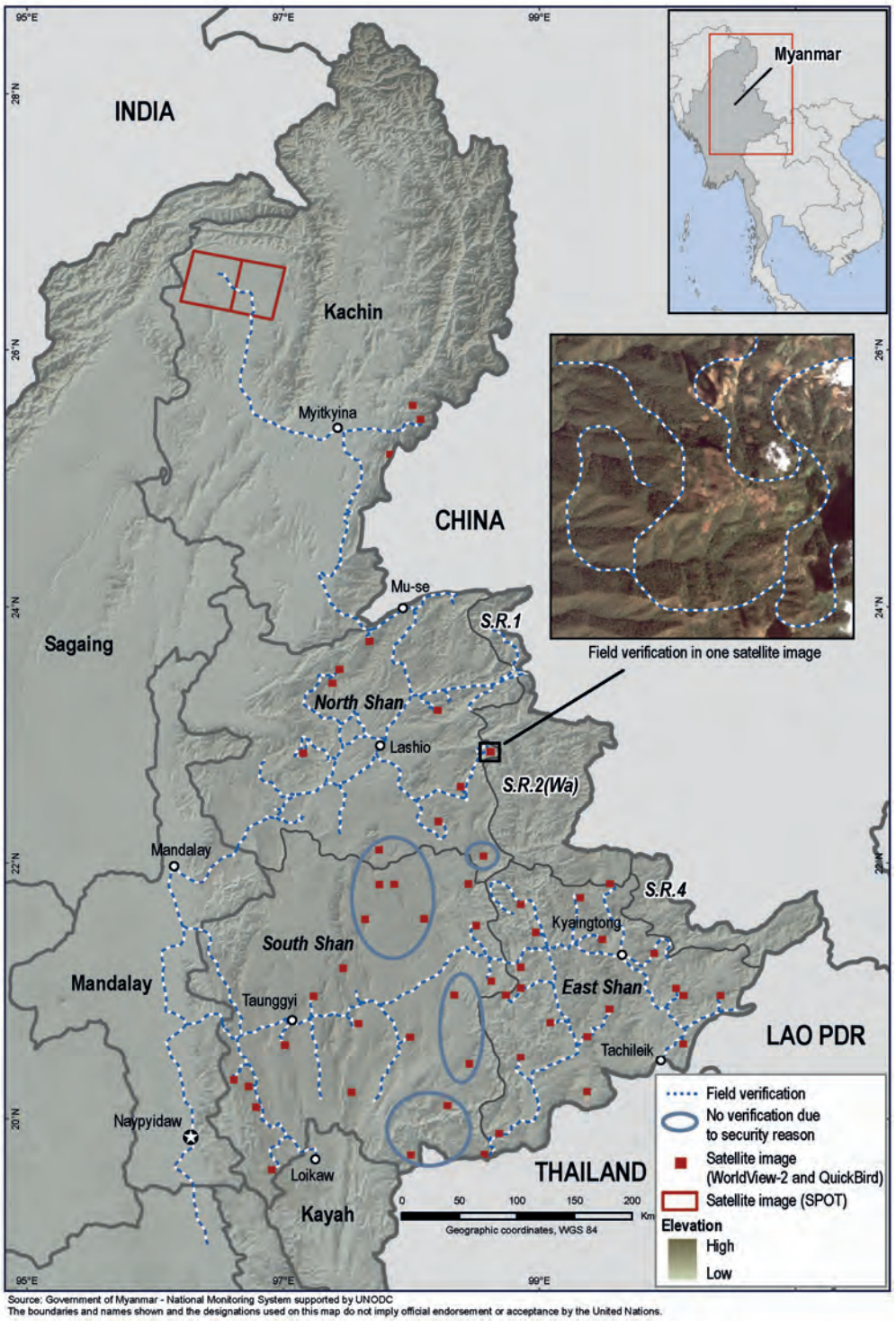
At 54 selected locations, very high-resolution images (Quickbird with 2.8-meter resolution (4 bands) and WorldView-2 images with 2-meter resolution (4 bands)) were acquired. The number of images was defined by the availability of the budget and the total area surveyed. For 2011, this was the highest number of sample locations of the last 5 surveys, mainly by reducing the size of the sample locations. For every location, images at two different dates were purchased with a 5 week interval (December/January and February/March). Two date images facilitated the identification of the opium poppy, taking into account the different crop calendars for every region obtained from the former surveys.

In Tanai township in Kachin, the area estimate was based on a targeted high resolution image (SPOT5, 10 meter resolution). In this township, the opium poppy cultivation was concentrated in one region that could be measured with the SPOT5 satellite image.

Impact of eradication on the cultivation figures

In none of the surveys performed until now the cultivation figures were adjusted for the eradication that had taken place after the acquisition of the satellite images. So if poppy cultivation was observed in the images but these fields were eradicated afterwards it was not accounted for. However, the timing of the images targets the flowering time when most of the eradication campaigns have been finalized which minimizes the potential error. Nevertheless, the actual area harvested and opium production could be slightly smaller than stated in this report. This applies to the current and past figures for cultivation and production.

Map 4: Routes of field verification for the survey with satellite images, 2011



Sampling frame

To select the sample locations of the satellite images, the sampling frame of last year's survey was improved and adjusted with new information. The sampling frame was developed by the combination of the following factors:

- Land cover map
- Altitude/slope
- Opium poppy-free areas according to ground information.

The *land cover map* was developed by classifying 6 Landsat-5 satellite images taken in February/March 2005. From this map, the large agricultural areas were extracted and considered as poppy-free, since the cultivation of opium poppy is practised in small agricultural areas, often surrounded by natural vegetation. Wetlands and settlements were also excluded. The other land use classes were considered as potential for opium poppy growing. The land cover map is still valid for this survey since only the class with large agricultural areas were used.

Altitude was taken as a factor since former surveys had revealed that 95% of the opium poppy was cultivated at altitudes between 800-1800 meters. However, for East Shan the lower altitude was adjusted to 600 meters based upon the former survey. Some large, flat areas were excluded, since the accessibility of these areas is very high, with a very low chance of finding poppy cultivation.

Figure 20: Altitude ranges (meters) of the opium poppy fields found in the satellite images 2010

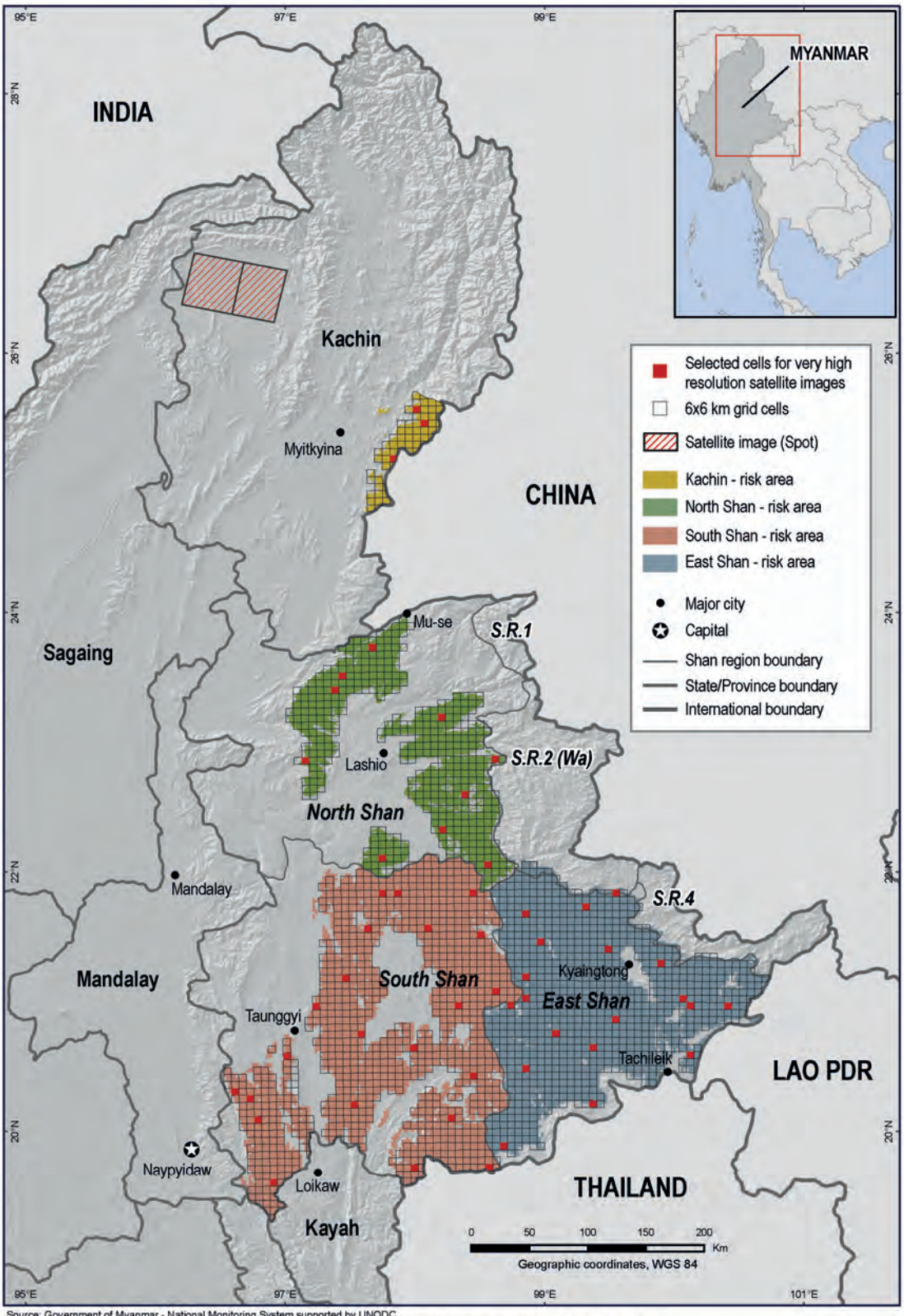
From information on the ground, several *opium poppy-free areas* were identified: Special Region 4 and the townships Maingyang, Kalaw, Pindaya, Taunggyi and Ywangan as well as a 10-km buffer zone along the border with Thailand. These areas were excluded from the sampling frame.

These factors were combined in a Geographic Information System to calculate the sampling frame. North, East and South Shan were analyzed separately.

Selection of satellite image locations

A grid with 6 by 6 kilometer cells was put on top of this sampling frame to select the image locations. The number of images in Shan state was determined according to the size of the risk area in each region, i.e. the more risk area the more images. Half of the locations that were selected for last year's survey were selected again. The rest of the images were selected in a systematic random way. This was done by creating clusters of cells in which a random selection was made. In total, 54 locations were selected out of 2,534. Those locations represent 2.3% of the total risk area in the sampling frame. From the selected locations, 39 images were successfully acquired for both dates, the rest was acquired with only one date.

Map 5: Sampling frame area and satellite image locations in Myanmar, 2011

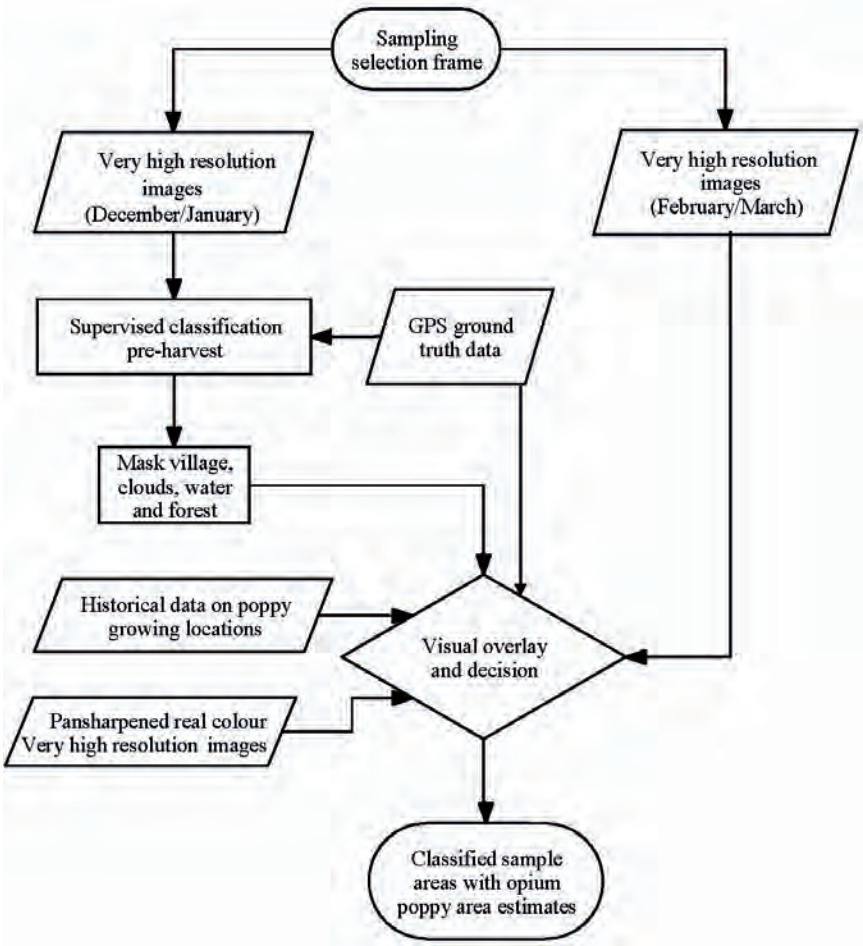


Source: Government of Myanmar - National Monitoring System supported by UNODC
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Processing of the satellite images

The classification procedure of the Very High Resolution images is illustrated in the following flow chart.

Figure 21: Flow chart of the satellite images processing steps in the Shan state and Kachin (Maingwaw township)



The satellite images were classified with the ground truth data collected by the ground control teams. For the first collected images, supervised classifications with maximum likelihood rules were applied to obtain maps that identified different land cover as forest, scrubs, grass, agricultural land and possible poppy areas. The second collection images were used to observe changes in the possible poppy areas. If there was an apparent change that corresponded to the harvesting of the poppy, it was used to confirm that the field was indeed a poppy field. This was done in a visual manner, since the images were not geometrically corrected and automation was not possible due to the displacements of the fields. The rules can vary by region and stage of the poppy crop, however the most commonly applied rule was that potential poppy in the first classification, when classified as bare soil in the second classification meant that it was opium poppy. Historical data on poppy cultivation and real colour, pansharpened (very high resolution images) visualization was used to facilitate the decision-making.

Formulae used for the area estimation with satellite imagery

A ratio estimate approach was used in order to provide the most accurate approximation of the extent of the opium poppy cultivation in North Shan State, East Shan State and South Shan State.

The estimation of the area under opium poppy cultivation was based on the information collected from the satellite imagery.

An estimate of the extent of the opium poppy cultivation was made using the equations described next page.

a. Average ratio of opium poppy cultivation within region, *k*:

$$\bar{y}_k = \frac{1}{n_k} \sum_{i=1}^{n_k} P_i / R_i$$

where n_k is the number of satellite image locations within the region, P_i is the area of poppy in segment *i* and R_i is the risk area in segment *i*.

b. Estimate of area of opium cultivation in each region, *k*:

$$A_k = \bar{y}_k R_k$$

where R_s is the total risk area in the sampling frame in region *k*.

The confidence intervals were calculated using the bootstrap method with 100,000 iterations. The 2011 area estimates and confidence intervals for Myanmar are presented in the table below. It should be noted that the upper and lower estimates do not lie symmetrically between the mean estimates because of the different statistical tools used to arrive at the most robust regional estimates.

Bootstrapping consists of sampling with replacement from the original sample with multiple iterations, composed in this case of the total poppy areas of the selected segments. After each iteration, a mean value is estimated and scored. At the end, a distribution of means can be observed, producing a mean estimate and a 95% confidence interval for the mean.

Kachin State

The Kachin estimate was not based on ratio estimate since there were only 3 images obtained, which resulted too few to make a reliable estimate. Here the estimation was based on the change in an overlapping satellite image from 2010 and 2011. There was one image that made this overlap and the absolute difference in poppy could be calculated from the satellite image interpretation results. This resulted in a 4% increase of the absolute figure for the same area. This factor of increase was applied to the Kachin figure to get the 2011 figure and does not have an estimation interval.

Table 12: Area estimates with 95% confidence interval (in ha), 2011

Region	Area estimate	Lowest estimate	Upper estimate
East Shan State	12,200	6,700	18,300
North Shan State	4,300	1,700	7,200
South Shan State	23,300	11,500	37,400
Kachin	3,800	-	-
Total	**43,600**	**29,700**	**59,600**

Opium poppy cultivation status by townships

The table below indicates the poppy-growing status according to different sources, either from the remote sensing analysis, and/or from the socio-economic survey and/or from the eradication campaign.

Table 13: Poppy growing status in 2011 by township and source

Region	In Satellite image location	During the socio-economic survey	Eradication campaign
East Shan			
Mong Yawng			X
Tachileik	X	X	X
Mongkhat	X	X	X
Mongpyat	X	X	X
Metmong	X	X	X
Mongpyin	X	X	X
Mongsat	X	X	X
Mong Tong	X	X	X
Kyaing Tong	X	X	X
Total	8	8	9
North Shan			
Kyaukme			X
Lashio	X	X	X
Mongyai	X		
Theinne			X
Thibaw	X		
Moemeik			X
Muse			
Naungcho			
Manton	X	X	X
Tant Yang	X	X	X
Kutkai		X	X
Namkham	X	X	X
Namtu			X
Kunlon			X
NamSam(N)			X
Mabein			
Total	7	5	11
South Shan			
Kalaw			X
Maukmai	X	X	X
Mongpan	X	X	X
Hopong	X	X	X
Kyaethi	X	X	
Leacha			
Linkhay			X
Kunhein	X	X	X
Loilem	X	X	X
Hsihseng		X	X
Namsang(S)	X		X
Pinlaung	X	X	X
Pekhon	X	X	X
Monea	X	X	X
Mong Kaing	X	X	
Mongshu	X	X	X
Nyaung Shwe		X	X
Taunggyi			X
Total	12	13	15
Kachin			
Moenyin			
Pharkant			X
Putao			X
Waing Maw	X	X	X
Tanai	X	X	X
Total	2	2	4
Grand total	29	28	39

Information on poppy cultivation in Special Region 1 (Kokang) and Special Region 4 (Monglar)

For various reasons, it was not possible to do a rapid assessment in these regions but information obtained from diverse sources indicates that there was no evidence of opium poppy cultivation in these areas this year. Special Region 4 has been opium poppy-free since 1997, Kokang since 2003, and Special Region 2 (Wa) since 2005.

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