



UNODC
United Nations Office on Drugs and Crime



Central Committee for
Drug Abuse Control



Myanmar Opium Survey 2019

Cultivation, Production and Implications

In Southeast Asia, UNODC supports Member States to develop and implement evidence-based rule of law, drug control and related criminal justice responses through the Regional Programme 2014-2021 and aligned country programmes including the Myanmar Country Programme 2014-2021. This study is connected to the Mekong MOU on Drug Control which UNODC actively supports through the Regional Programme, including the commitment to develop data and evidence as the basis for countries of the Mekong region to respond to challenges of drug production, trafficking and use. UNODC's Research and Trend Analysis Branch promotes and supports the development and implementation of surveys globally, including through its Illicit Crop Monitoring Programme (ICMP).

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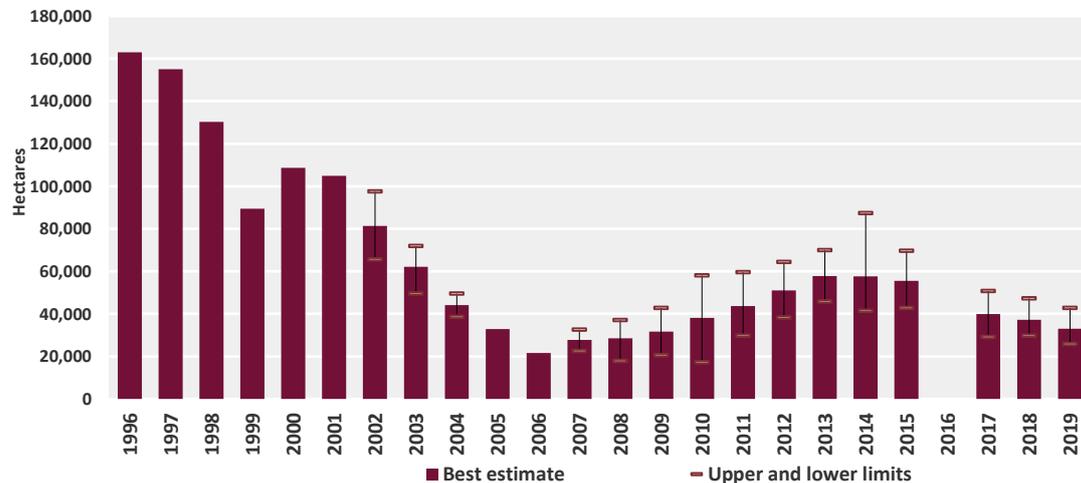
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Abbreviations

CCDAC	Central Committee for Drug Abuse Control
GOUM	Government of the Republic of the Union on Myanmar
HR	High Resolution
ICMP	UNODC Illicit Crop Monitoring Programme
LCLU	Land Cover Land Use
QA/QC	Quality Assurance/Quality Control
SR	Special Region
UNODC	United Nations Office on Drugs and Crime
USG	United States Government
VHR	Very High Resolution

Key Findings

- In 2019, the area under opium poppy cultivation in Myanmar was estimated at 33,100 hectares. In comparison to 2018, the area under opium cultivation decreased, which is a continuation of the downward trend that started in 2014. In comparison to 2018, the area under opium poppy cultivation in 2019 decreased by 11 per cent or 4,200 hectares from 37,300 hectares in 2018 to 33,100 hectares.¹



- Reductions have taken place in North, East and South Shan with decreases of 7%, 8% and 17% respectively. In Kachin State the cultivation increased by 15% from 2018.
- The average opium yield was estimated at 15.4 kilograms per hectare, with a 9% increase compared to 2018.
- Potential opium production was estimated at 508 metric tons (mt) in 2019. Shan State, which supplied 87% of the total, remained the main producing region with 442 mt, a decrease of 4% compared to last year.
- Eradication, as reported by the Government, showed a similar trend to opium poppy cultivation over the last nine years, with increases from 2010 to 2012-2014 and a decrease since 2015. The eradication numbers for the 2019 growing season (from September 2018 to March 2019) were 6% lower than for the same period in 2018.
- For the period January to September 2019, approximately 2,000 kg of seized opiates were reported; the total reported seizures for 2018 were 4,658 kg.
- With an estimated gross value ranging from 0.6 to 1.4 billion US\$, the illegal opiate market in Myanmar represented a notable share of the country's economy in 2019 (0.9 - 1.9% of the GDP in 2018).
- Of this total, 8 - 9%, corresponding to an estimated amount of 61 - 107 million US\$, or 0.5% of the agricultural sector's value², were earned by farmers cultivating opium.
- The largest share of the 2019 opiate market value was income generated by heroin manufacturing and trafficking. Domestic heroin consumption of 6 tons was valued at 152 - 290 million US\$, whereas the export of heroin (23 - 52 tons) was worth between 458 and 1,042 million US\$.
- Between 2015 and 2019, farm-gate prices³ of fresh and dry opium decreased by 63 and 51%, respectively. Decreasing prices together with a reduced supply of opium can be an indication of a decreased demand for opiates from Myanmar in the country and the region.

¹ The 2019 total area estimate uses latest available (2018) cultivation estimates in Chin and Kayah States.

² The agricultural sector contributes 25.7% of the total GDP in Myanmar (Source: World Bank 2018).

³ Average weighted based on production. Prices are inflation adjusted on the base of the Consumer Price Indices provided by the World Bank (base 2010=100) for the analysis of trends. The Index for 2019 was linearly extrapolated from the 2004-2018 series.

Fact Sheet

	Year 2018 (rounded numbers)	Year 2019 (rounded numbers)	Change 2018-2019 *
Total opium poppy cultivation (ha)⁴	37,300 (29,700 to 47,200)	33,100 ⁵ (25,800 to 42,800)	-11%
Opium poppy cultivation in Shan State (ha)	32,700 (25,300 to 42,400)	28,000 (21,000 to 37,100)	-14%
Opium poppy cultivation in Kachin State (ha)	3,400 (1,800 to 5,800)	3,900 (1,900 to 7,200)	+15%
Opium poppy cultivation in Chin State (ha)	630 (573 to 677)	630 (573 to 677)	Data from 2018 ⁶
Opium poppy cultivation in Kayah State (ha)	570 (434 to 706)	570 (434 to 706)	Data from 2018 ⁶
Total potential production of dry opium (mt)	520 (410 to 664)	508 ⁷ (380 to 672)	-2%
Potential dry opium production in Shan State (mt)	461 (348 to 605)	442 (316 to 599)	-4%
Potential dry opium production in Kachin State (mt) ⁸	42 (21 to 74)	48 (21 to 92)	+15%
Potential dry opium production in Chin State (mt)	8.7 (5.9 to 12.3)	9.6 ⁹ (6.2 to 14.0)	+10%
Potential dry opium production in Kayah State (mt)	8.0 (4.8 to 11.7)	8.8 ⁹ (5.1 to 13.2)	+9%
Average opium yield (kg/ha) ¹⁰	13.9 (9.5 to 19.7)	15.4 (10.0 to 22.3)	+11%

*Numbers in the table are rounded, percentage changes are calculated with exact estimates.

Chin and Kayah States were not surveyed in 2019 due to budget constraints. To maintain comparability with 2018 estimates, 2018 area estimates of Kayah and Chin were used to calculate totals of area under cultivation. Kayah and Chin yields of 2018 and 2019 are approximated by a weighted average of Shan State data of the respective years.

⁴ The estimates may include areas that were eradicated after the acquisition date of the satellite images.

⁵ The 2019 total area estimate uses latest available (2018) cultivation estimates in Chin and Kayah States.

⁶ Chin and Kayah States were not surveyed in 2019 due to budget constraints and therefore cultivation estimates for 2018 were used for 2019.

⁷ The total potential production in 2019 calculates production estimates for Chin and Kayah States with the latest available (2018) cultivation estimates and the 2019 weighted national average yield (15.4 kg/ha).

⁸ Yield data for Kachin State is from 2015 since the yield survey could not be implemented there after that year.

⁹ No yield survey was conducted in Chin and Kayah States in 2019. Production in these States was calculated the same way as in 2018 by applying a weighted average of Shan State yields of the current year (2019).

¹⁰ National average weighted by regional area estimates. National average in 2019 is based on yield and area data in Shan and Kachin States only. Yield data for Kachin State is from 2015.

	Year 2018 (rounded numbers)	Year 2019 (rounded numbers)	Change 2018-2019
Farm-gate price of fresh opium ¹¹	136 US\$/kg (216,166 Kyat/kg)	145 US\$/kg (217,076 Kyat/kg) ¹²	+7% ¹³
Farm-gate price of dry opium ¹¹	154 US\$/kg (243,783 Kyat/kg)	160 US\$/kg (239,489 Kyat/kg) ¹²	+4% ¹³
Farm-gate value of opium in million US\$	62 to 103	61 to 107	-2 to +4%
Value of the opiate economy (gross) in million US\$	718 to 1,488 ¹⁴	649 to 1,370	-10 to -8%
Value of the opiates economy (net) in million US\$	656 to 1,385 ¹⁴	588 to 1,263	-10 to -9%
Total opium poppy eradication reported by the Government of Myanmar (ha)	2,605	2,460	-6%

¹¹ National average weighted by regional production estimates.

¹² Exchange rate on 20 December 2019 (<https://www.xe.com/>)

¹³ Change calculated in US\$. Not adjusted for inflation. Due to changes in the exchange rate, the difference appears smaller in Kyat, for fresh and dry opium +0.4 % and -1.8% respectively. From 2018 to 2019, average farm-gate prices for fresh and dry opium decreased by 4% and 7%, respectively, taking inflation into account.

¹⁴ The values presented here are revised from the 2018 report (*Myanmar Opium Cultivation 2018 – Cultivation, Production and Implications*) based on updated price information from CCDAC in 2019. The values for 2018 were linearly interpolated from the 2010-2019 price series.

1. INTRODUCTION

1. Introduction

This report presents the results of the seventeenth opium survey in Myanmar. It was conducted jointly by the Central Committee for Drug Abuse Control (CCDAC) of the Ministry of Home Affairs and UNODC, which has been collecting statistical information on illicit crop cultivation in Myanmar within the framework of its Illicit Crop Monitoring Programme. The methodology used in this report combines satellite imagery, yield and village surveys to evaluate the extent of opium poppy cultivation and production in the country.

The 2019 report builds on years of data regarding illicit opium production in Myanmar, estimating and comparing the area under cultivation, and assessing yield and production. Although the area of opium cultivation experienced a considerable increase between 2006 and 2014 to just under 60,000 ha, it has been in sharp decline ever since. In 2019, the total area of opium poppy fell to 33,100 ha, declining by 11% from the 37,300 ha recorded in 2018, connected to the continuing shift of the regional drug market to synthetic drugs. As in previous years, the majority of opium poppy is again cultivated in Shan State, accounting for 85% (28,000 ha) of the total opium poppy area in 2019, followed by Kachin State 12% (3,900 ha), and Chin and Kayah States together accounting for 3% (1,200 ha).¹⁵

Prices for fresh and dry opium have also been decreasing in recent years. For instance, the price for fresh opium has declined by more than 60% between 2015 and 2019. The continuing drop in areas under opium poppy cultivation and prices point to decreasing demand for opiates produced in Myanmar for the regional drug market. This means opium poppy farmers now have less opportunities to earn necessary income for their subsistence. According to our estimates, opium farmers make less than 10 per cent of the money generated by the opiate economy in the country.

Despite decreasing demand for opiates, organised crime groups that traffic heroin continue to make substantial amounts of money. The market value for heroin manufacturing and trafficking makes up the vast majority of this value. Domestic heroin consumption of 6 tons was valued at 152 - 290 million US\$, whereas the export of heroin from Myanmar to neighbouring countries was worth around 1 billion US\$ locally.

In addition, despite of the downward trend in opium cultivation and related heroin production, the drug continues to pose a significant public health and security challenge throughout the region as the country remains the major supplier of opium and heroin in East and Southeast Asia, as well as Australia. There are more than 3 million heroin users in these regions who, together, consume about 10 billion US\$ worth of the drug annually, confirming heroin remains an importance source of income for organized crime.

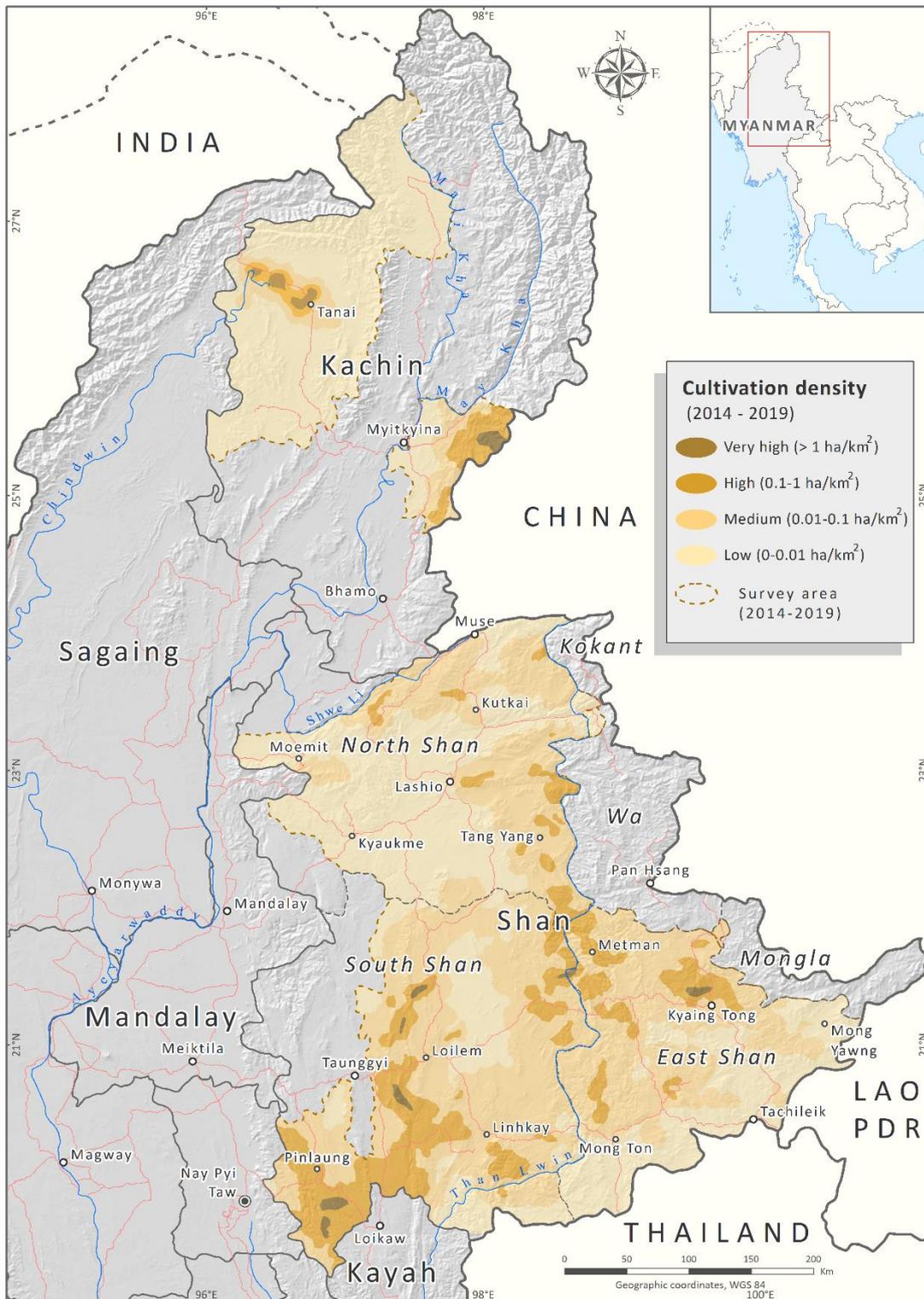
Opium cultivation, heroin manufacturing and the illicit drug economy itself are also important elements to consider in the context of the peace process and the establishment of long-term stability in Myanmar. There is a connection between drugs and conflict in Myanmar, with the drug economy supporting the conflict and in turn the conflict facilitating the drug economy. Providing solutions to the conflict requires breaking this cycle. The influence of the drug economy can be mitigated through alternative development programmes that provide viable sources of legitimate income, as well as by addressing the threat of transnational organised crime groups that continue to produce and traffic heroin and that have significantly scaled-up the production of methamphetamine and other synthetic drugs for the regional drug market.

¹⁵ Chin and Kayah States were not surveyed in 2019 but 2018 area estimates were used to calculate totals of area under cultivation and maintain comparability with 2018 estimates.

Countering drug production and organised crime networks is vital for providing peace and security in Kachin and Shan.

The annual opium survey report remains an essential tool for assessing the extent of opium poppy cultivation in Myanmar, as well as understanding changes in cultivation patterns and the links between drugs and the rural economy. This information is useful for understanding cultivation techniques, rural livelihoods and for designing effective alternative development options. It is also essential for supporting decision makers to develop effective strategies to sustain the transition from an illicit to a licit economy, and as a basis for understanding the connection between the drug economy and ongoing conflict.

Map 1: Cultivation density map (2014-2019) in Myanmar, October 2018 - March 2019



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.

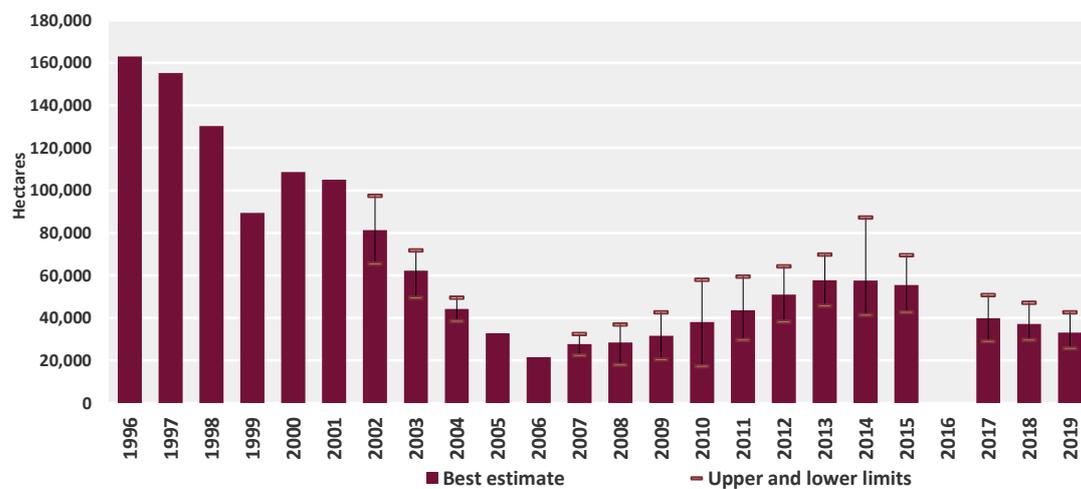
2. FINDINGS

2. Findings

2.1 Estimated area under opium poppy cultivation

In 2019, the total amount of opium poppy cultivation area in Myanmar was estimated at 33,100 ha. Contrary to the survey in 2018 when all four producing States were covered, this year's survey covered only the major producing States, Shan and Kachin similar to the survey in 2017. Chin and Kayah States were not surveyed in 2019 but the 2018 area estimates were used to calculate totals of area under cultivation to maintain comparability with 2018 estimates. A decrease in cultivation of 11% was recorded, from 37,300 ha in 2018 to 33,100 ha in 2019. The national trend has been declining since 2014 when the total cultivation was estimated at 57,600 ha (Figure 1:).

Figure 1: Opium poppy cultivation in Myanmar, 1996-2019 (ha)*



*Sources: from 1996 to 2001 USG, from 2002 to 2019 GOUM-UNODC. The surveys in 2014, 2015 and 2018 included satellite image estimates for Kayah and Chin States. In 2016 no survey was conducted. The survey in 2019 uses latest available (2018) estimates for Kayah and Chin States.

Compared to 2018, moderate decreases were observed in all surveyed regions except in Kachin State where cultivation increased (Table 1). In Shan State alone, cultivation decreased by 4,700 hectares (-14%). In South Shan the reduction was of 1,900 hectares (-14%). Decreases of 1,300 ha (-12%) and 1,500 ha (-17%) were also observed in East and North Shan, respectively. The only increase was observed in Kachin State amounting to 500 hectares (+15%).

All in all, Shan continued to be by far the major cultivating State in Myanmar, accounting for 85% (28,000 ha) of the total opium poppy area (Table 1:). The trend in Shan State has been declining since 2015 when the total cultivation area was estimated at 50,300 ha (Map 3:). Within Shan State, the sub-regions of South, East and North Shan accounted for 36%, 27% and 22% of total cultivation in 2019, respectively (Figure 2:). Kachin State accounted for 12% (3,900 ha), and Chin and Kayah States together for 3% (1,200 ha).¹⁶

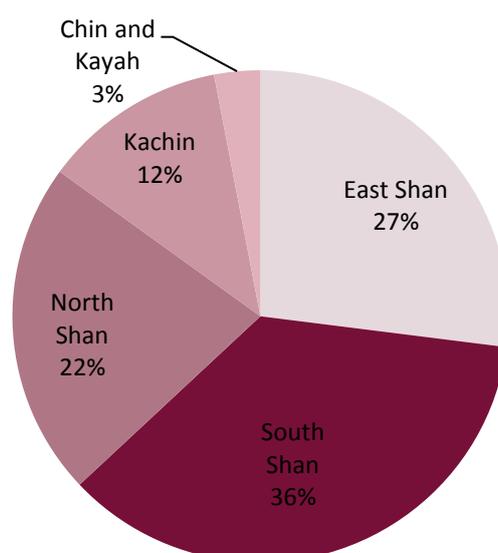
¹⁶ Chin and Kayah States were not surveyed in 2019 but 2018 area estimates were used to calculate totals of area under cultivation and maintain comparability with 2018 estimates.

Table 1: Areas under opium poppy cultivation in Myanmar (ha), 2018 and 2019*

Region	Year 2018 (rounded numbers)	Year 2019 (rounded numbers)	Change 2018-2019
South Shan	13,900 (8,800 to 20,900)	12,000 (7,300 to 18,600)	-14%
East Shan	10,100 (6,900 to 14,000)	8,800 (5,800 to 12,300)	-12%
North Shan	8,700 (4,400 to 14,200)	7,200 (2,900 to 12,400)	-17%
Shan State total	32,700 (25,300 to 42,400)	28,000 (21,000 to 37,100)	-14%
Kachin	3,400 (1,800 to 5,800)	3,900 (1,900 to 7,200)	+15%
Chin	630 (573 to 677)	630 (573 to 677)	Data from 2018
Kayah	570 (434 to 706)	570 (434 to 706)	Data from 2018
National total	37,300 (29,700 to 47,200)	33,100 (25,800 to 42,800)	-11%

* Values in brackets indicate the 95% confidence interval. Numbers in the table are rounded, percentage changes are calculated with exact estimates.

Chin and Kayah States were not surveyed in 2019 due to budget constraints. To maintain comparability with 2018 estimates, 2018 area estimates of Kayah and Chin were used to calculate totals of area under cultivation.

Figure 2: Regional distribution of opium poppy cultivation areas in Myanmar, 2019*

*Chin and Kayah States were not surveyed in 2019 but 2018 area estimates were used to calculate totals of area under cultivation and maintain comparability with 2018 estimates.

Opium poppy cultivation is now concentrated in areas characterised by a combination of specific topographical conditions, socio-economic circumstances and security. For example, from a geographic perspective the south-western mountains in South Shan provide a good environment for opium poppy cultivation (Figure 3: & Figure 4: & Figure 5:). In this region large areas with high to very high density of opium poppy cultivation has been reported in 2019 (see Map 1:). The majority of East Shan State present areas with medium cultivation levels. The northern area of Kyaing Tong city in East Shan and the areas near the boundaries of East and South Shan, on both sides of the Than Lwin river, also present some extensive areas of poppy, although the cultivation is dispersed, and the density is slightly lower than in South Shan region.

Most of the reduction in cultivation between 2018 and 2019 took place in areas well-suited for opium cultivation but with a relatively good security situation (see Map 2:). Decreases were also observed in major growing regions with security incidents. The only increase in cultivation this year was observed in Kachin State, where only a very few conflicts were reported during the opium poppy cultivation period. It should be noted, however, that no field survey to provide ground truthing of satellite image analysis has been conducted in Kachin since 2015, due to security concerns.

Until 2005, Special Region 2 - or Wa region - showed high levels of poppy cultivation, but after 2005 there has been hardly any poppy fields due to the ban on opium poppy cultivation. In 2019, the eastern part of North Shan, bordering the Wa region, showed high concentrations of poppy. The majority of North Shan region presents areas with medium cultivation levels. In Kachin State, the north-western zone of Tanai town and the area east from Myitkyina city next to the international border with China present some areas with very high cultivation density.

In the past surveys, UNODC conducted risk assessments to the areas with opium poppy cultivation reported by local communities in order to establish the cultivation status of that area, for example, the assessment mission to Naga in three townships in Sagaing region during 2015 survey. In 2019, some local communities reported opium poppy cultivations in Putao and Sumprabum townships of Kachin where the past UNODC surveys in 2014 and 2015 observed insignificant cultivation in that areas. For such areas, an assessment is planned in order to establish the cultivation status in future surveys.

Figure 3: Poppy field in South Shan, 2019



Map 2: Cultivation change map (2018-2019) with reported conflicts in Myanmar, October 2018 - March 2019

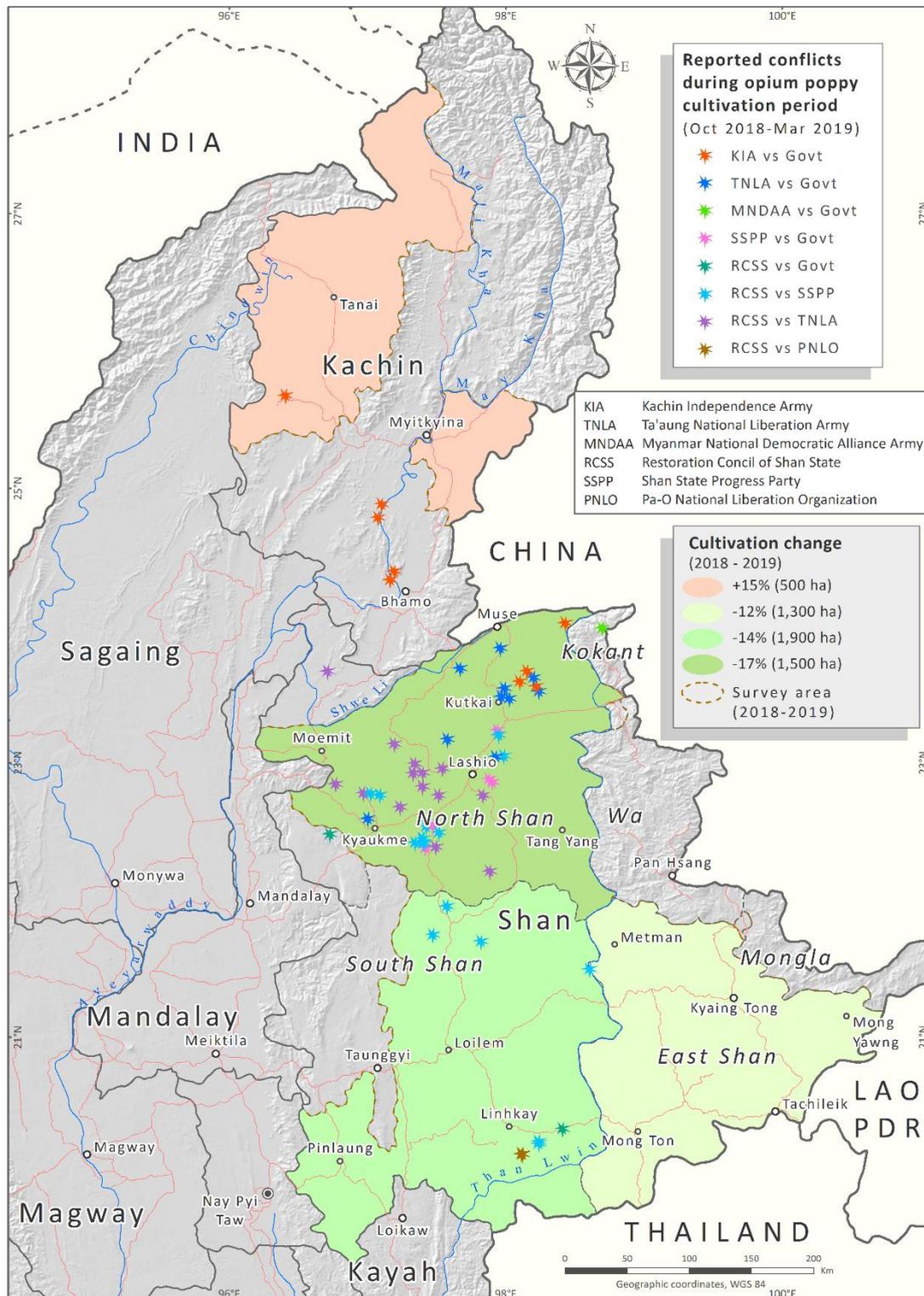


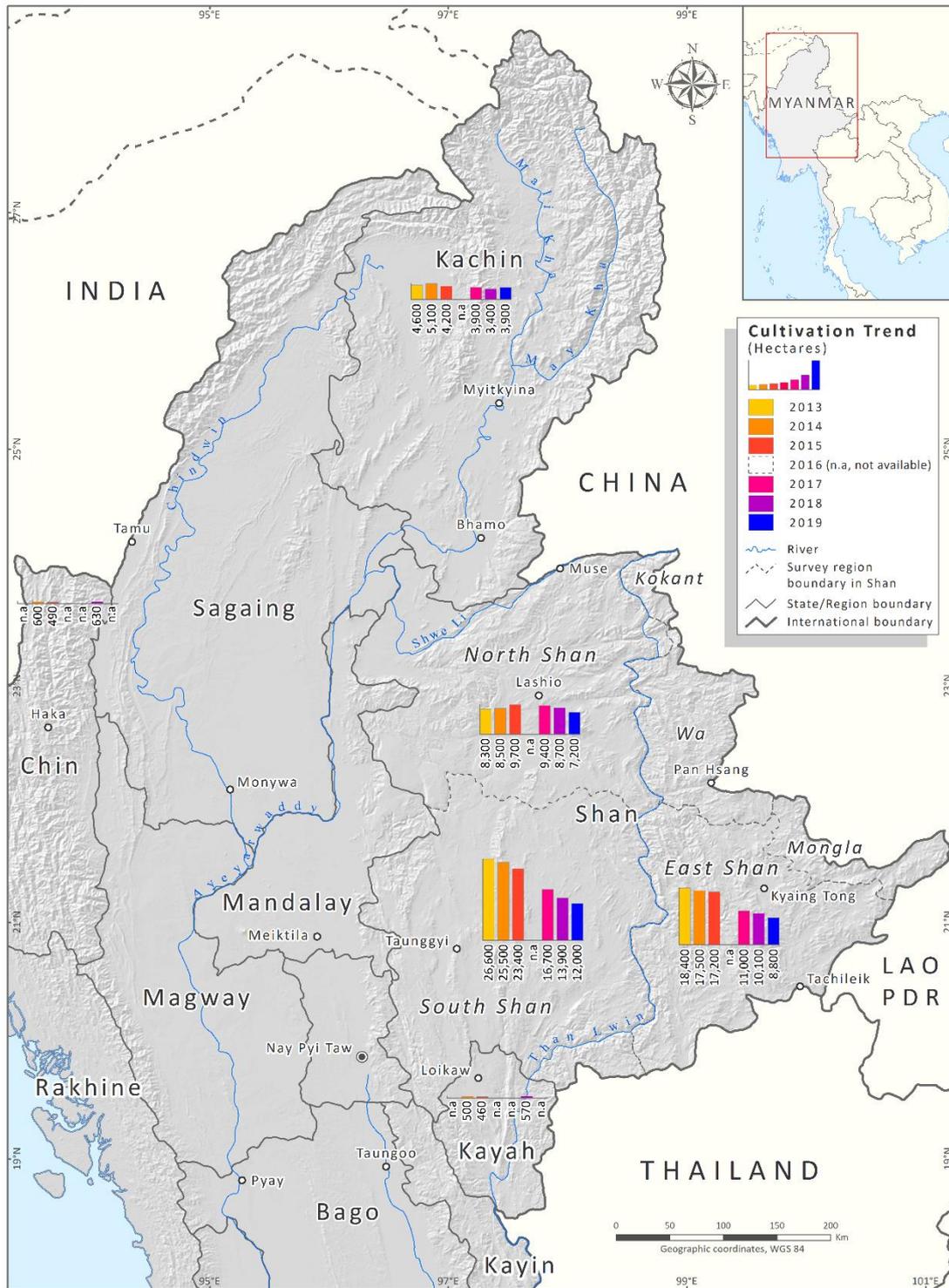
Figure 4: Poppy field in North San, 2019



Figure 5: Irrigated young-stage poppy field in South Shan, 2019. Irrigated late cultivation (after monsoon cultivation) was observed in southern townships of South Shan (See also Table 12 for opium cultivation calendar 2018-2019)



Map 3: Opium poppy cultivation trends in Myanmar, 2013-2019

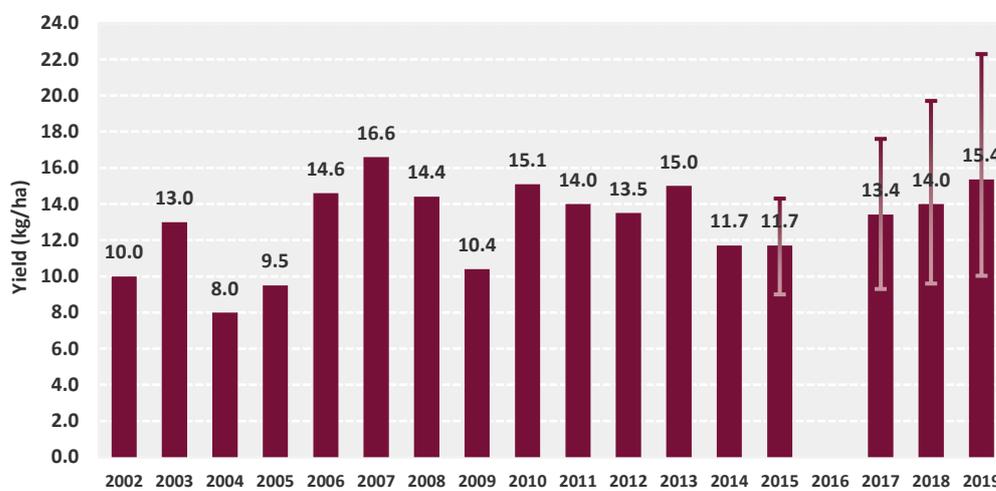


Source: Government of Myanmar - National Monitoring System supported by UNODC
 The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

2.2 Opium yield and production estimates

In 2019, the field work was carried out in Shan State only due to security constraints in Kachin, Chin and Kayah States were not surveyed in 2019 due to budget constraints. Several field studies were carried out to measure opium yields in three different regions of Shan State. North Shan was the region with highest yield values (22.4kg/ha) followed by South Shan (13.8 kg/ha) and East Shan (13.0 kg/ha) (Table 2:). It should be noted, however, that the number of villages and fields visited in North Shan was rather low compared to South and East Shan due to security constraints.¹⁷ The national average yield was estimated at 15.4kg/ha¹⁸, a 9% increase compared to 2018 (Figure 6:). For the opium production calculation in Kachin State the 2015 yield estimate (12.5kg/ha) was used, similarly to the previous years' surveys. The total potential production estimates for Chin and Kayah were calculated with the latest available (2018) cultivation estimates and the 2019 weighted national average yield.

Figure 6: Average opium yield in Myanmar, 2002 – 2019



National average weighted by regional area estimates. In 2016 no survey was conducted.

Table 2: Potential opium yield by region (kg/ha), 2018 and 2019*

Region	2018	2019	Change 2018-2019
South Shan	13.3 (12.3 to 14.3)	13.8 (12.8 to 14.8)	+3%
East Shan	13.5 (12.3 to 14.6)	13.0 (12.4 to 13.7)	-4%
North Shan	16.1 (14.7 to 17.5)	22.4 (19.1 to 25.8)	+28%
Average yield	14.0 (9.5 to 19.7)	15.4 (10.0 to 22.2)	+9%

*Values in brackets indicate the 95% confidence interval. Numbers in the table are rounded, percentage changes are calculated with exact estimates.

¹⁷ In 2019, 118 fields were surveyed in 40 villages in East Shan, 93 fields in 31 villages in South Shan, and 21 fields in 7 villages in North Shan.

¹⁸ National average weighted by regional area estimates. National average in 2019 is based on yield and area data in Shan and Kachin States only. Yield data for Kachin State is from 2015.

The resulting estimate of potential dry opium production in 2019 was 508 metric tons. Shan State, with 442mt accounted for 87% of the total production. However, the estimates for this State are not equally distributed and a trend similar to 2018 continued also in 2019; whilst the South and East Shan regions showed moderate decreases of 11% (-11mt) and 15% (-21mt), North Shan showed an increase of 15% (+21mt), even though the greatest percentage decrease (-17%) in the cultivation area of all Shan regions was observed in North Shan (Table 3:). The increase of production in North Shan can be explained by the yield which increased by more than 6 kg/ha (+28%) compared to the value of 2018. The production in Kachin State increased by 15% (+6mt)¹⁹ which can be explained by the 500ha increase in the cultivation area, +15% respectively. The total potential production estimates for Chin and Kayah were calculated with the latest available (2018) cultivation estimates and the 2019 weighted national average yield (15.4kg/ha). The total potential opium production in Myanmar resulted in a decrease of 2%, from 520mt to 508mt (Figure 7:).

Table 3: Potential opium production by region (mt), 2018 and 2019*

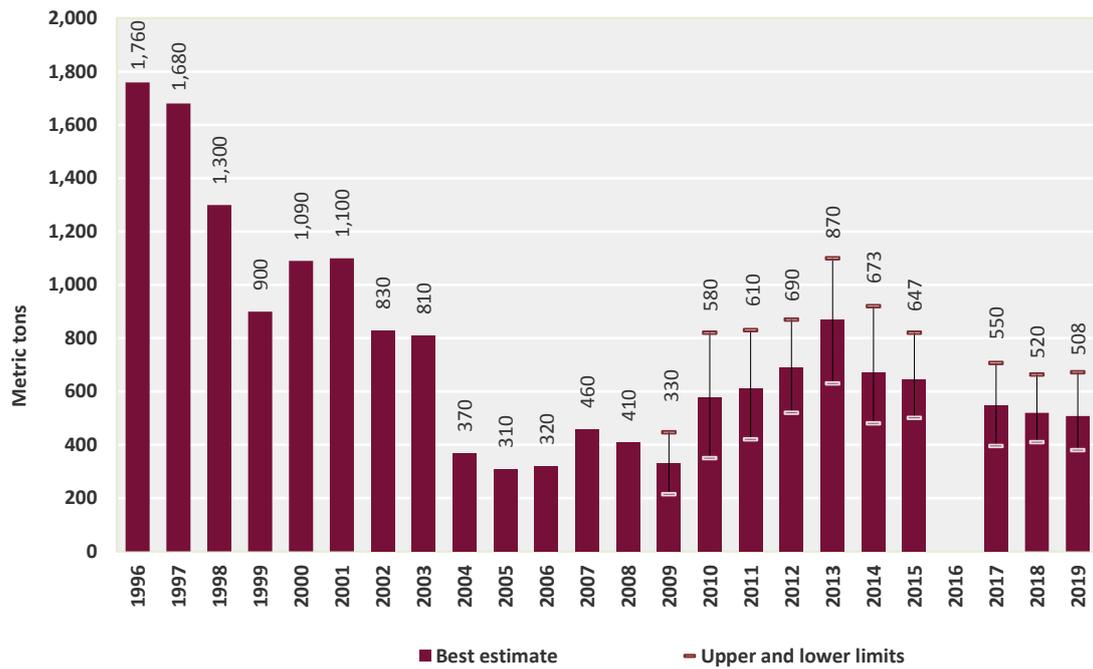
Region	Potential production 2018	Potential production 2019	Change 2018-2019	2019 proportion by State
South Shan	185 (116 to 279)	165 (100 to 257)	-11%	33%
East Shan	136 (91 to 189)	115 (76 to 160)	-15%	23%
North Shan	140 (70 to 231)	161 (62 to 282)	+15%	32%
Shan State total	461 (348 to 605)	442 (316 to 599)	-4%	87%
Kachin State	42 (21 to 74)	48 (21 to 92)	+15%	9%
Chin State	8.7 (5.9 to 12.3)	9.6 (6.2 to 14.0)	+10%	2%
Kayah State	8.0 (4.8 to 11.7)	8.8 (5.1 to 13.2)	+9%	2%
Total (rounded)	520 (410 to 664)	508 (380 to 672)	-2%	100%

*Values in brackets indicate the 95% confidence interval. Numbers in the table are rounded, percentage changes are calculated with exact estimates.

Chin and Kayah States were not surveyed in 2019 due to budget constraints. To maintain comparability with 2018 estimates, the total potential production in 2019 calculates production estimates for Chin and Kayah States with the latest available (2018) cultivation estimates and the 2019 weighted national average yield (15.4 kg/ha). Yield data (12.5kg/ha, 95% confidence interval: 9.7 -15.3kg/ha) for the production calculation of Kachin State is from 2015 since the yield survey could not be implemented there after that year.

¹⁹ Yield data for Kachin State is from 2015 since the yield survey could not be implemented there after that year.

Figure 7: Potential opium production in Myanmar, 1996-2019 (mt)



Source: from 1996 to 2001 USG, from 2002 to 2019 GOUM-UNODC. In 2016 no survey was conducted.

Figure 8: Lancing poppy capsules, South Shan, 2019



Figure 9: Lancing poppy capsules, East Shan, 2019



Figure 10: Harvested fresh opium gum, East Shan, 2019**Figure 11: Dried opium poppy capsules to extract seed for next cultivation season, South Shan, 2019**

2.3 Opium farm-gate price

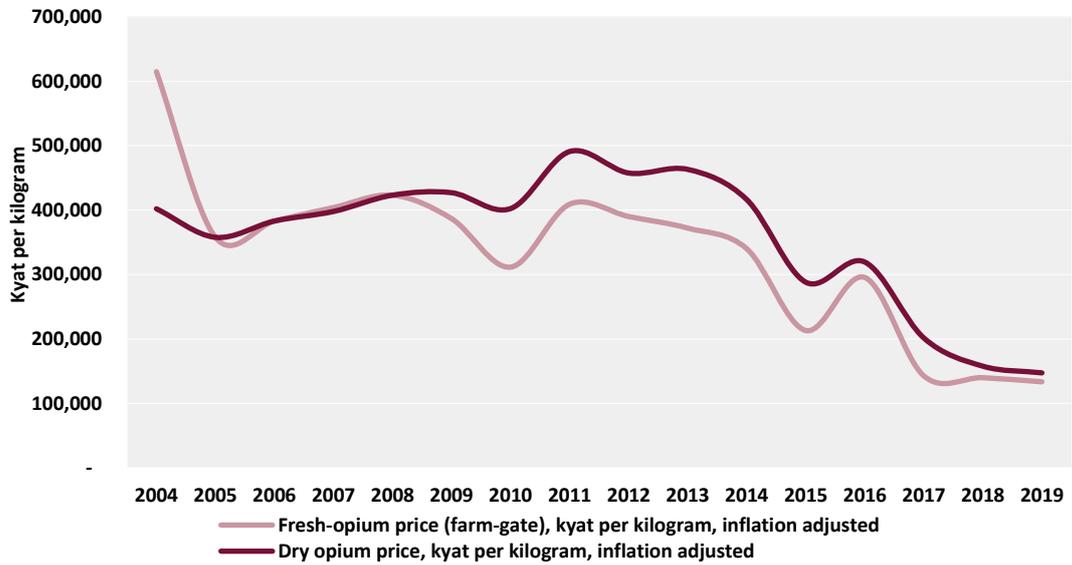
In 2019, a village survey was implemented, and opium price data were collected.²⁰ The average farm-gate prices²¹ at harvest time of fresh and dry opium were assessed at 217,076 Kyat (145 US\$) and 239,489 Kyat (160 US\$) per kilogramme, respectively. In 2018, average farm-gate prices of fresh and dry opium were estimated at 216,666 Kyat (136 US\$) and 243,783 Kyat (154 US\$) per kg, respectively. From 2018 to 2019, average farm-gate prices for fresh and dry opium decreased by 4% and 7%, respectively, taking inflation into account.²² Over the four years span from 2015, the corresponding farm-gate prices of fresh and dry opium dropped significantly by 63% and 51%, respectively (Figure 12:). The fact that farm-gate opium prices fell strongly, despite the concurrent reduction of opium supply, suggests that the demand for opiates in Myanmar may be lower than before and supports the hypothesis that the heroin market has declined in the region. At the same time, lower prices make opium cultivation less attractive, which might be contributing to the declining area under cultivation.

²⁰ The socio-economic report will be published later in 2020.

²¹ Weighted average based on opium production, see Methodology chapter.

²² Change calculated in Kyat. Prices were adjusted for inflation on the basis of the Consumer Price Index information provided by the World Bank (base 2010=100). The Consumer Price Index for 2019 was linearly extrapolated from the 2004-2018 series.

Figure 12: Inflation-adjusted farm-gate prices (weighted average) of fresh and dry opium in poppy-growing villages, Myanmar, 2004-2019, (Kyat per kilogram)*



*Prices were adjusted for inflation on the basis of the Consumer Price Index information provided by the World Bank (base 2010=100). The Consumer Price Index for 2019 was linearly extrapolated from the 2004-2018 series.

Figure 13: Weighting fresh opium gum in poppy field, Easth Shan, 2019



2.4 Opium economy in Myanmar

Every year, hundreds of tons of opium are harvested in Myanmar and further commercialised. Opium can be either consumed as raw opium or further processed into heroin. Both raw opium and heroin reach the end-consumer markets in and outside Myanmar (Table 4:).

Table 4: Estimated quantities of the different opiate market's components

Opium production 2019	Domestic demand for unprocessed opium	Domestic demand for heroin	Unprocessed opium for consumption potentially available for export	Heroin potentially available for export
508 (380 to 672)	5.1 tons	6.1 tons	75 tons	23 - 52 tons

Note: A ratio of 10:1 is used for converting opium to heroin of unknown purity.

The farm-gate value of opium is an important measure of the gross income of farmers generated by opium poppy cultivation and it was estimated to range between 61 to 107 million US\$ (mid-point 81 million US\$). These values were calculated using information on farm-gate prices collected in the 2019 socio-economic survey²³ and the amount of potential opium production which ranged between 380 and 672 tons (mid-point 508 tons).

Table 5: Estimated values of the opiates economy, 2019

	Gross value Millions of US\$	Value in relation to GDP* %
Value of the opiates economy (gross)**	649 – 1,370	0.9 - 1.9
Value of opiates potentially available for export	490 - 1,073	0.7 - 1.5
Raw opium	31	
Heroin	458 - 1,042	
Value of the opiates market for domestic consumption	159 - 297	0.2 - 0.4
Raw opium	7	
Heroin	152 - 290	
Farm-gate value of opium	61 - 107	0.1 - 0.2
Value of the opiates economy after farm-gate to the border	588 – 1,263	0.8 - 1.8

Numbers in the table are rounded, sums and percentages are calculated with exact estimates. Ranges are calculated based on lower and upper bounds of opium production and on assumptions about the different purities of exported and domestic heroin. See more details in the Methodology chapter.

*Source: World Bank.

**The sum of the value of the domestic market and the value of opiates believed to be exported.

²³ The socio-economic report was published in November 2019.

After deducting the seizures of opiates reported by relevant law enforcement agencies²⁴, it can be estimated that 80 tons of raw opium and some 30 to 59 tons of heroin reached the illicit market.²⁵ Out of these 80 tons of opium, 5 tons were destined for domestic consumption, with a market value of 7 million US\$; the remaining 75 tons of opium were exported with a revenue of 31 million US\$. The main value of the opiate market is generated by the manufacturing and trafficking of heroin. In 2019 domestic consumption of 6 tons of heroin led to an income between 152 and 290 million US\$, whereas the export of heroin (23 - 52 tons) was deemed to be worth between 458 million and 1.04 billion US\$ for Myanmar traffickers.

The overall gross value of the Myanmar opium economy for the year 2019 ranged between 649 and 1,370 million US\$, equivalent to 0.9 - 1.9% share of the 2018 national GDP.²⁶ The value of manufacturing and trafficking after farm-gate up to the border of Myanmar ranges between 588 and 1,263 million US\$ (0.8 - 1.8% of the GDP). These values represent the income generated by the traffickers after deducting the costs of buying the dry opium from the farmers.

These estimates have some limitations. There is great uncertainty around the conversion ratio of opium to heroin, which depends on three main factors: the morphine content of opium, the efficiency of traffickers to extract morphine from opium and convert morphine to heroin, and the purity of the heroin estimated.²⁷ None of these factors are well researched in the context of Myanmar but can have a strong impact on the estimated values of the opiate economy. Estimates on demand in the region are based on 2011 data and may have changed since then. Moreover, the estimates presented are gross estimates before deducting any cost, e.g. costs for precursor substances, such as acetic anhydride, which can substantially reduce the profits of manufacturers and traffickers of heroin. To assess the profits made, other cost components such as transportation, labour costs and costs of bribery also need to be considered.

The estimates presented here need to be understood as an indication of the order of magnitude rather than as precise measurements. UNODC, in collaboration with CCDAC of Myanmar, are working on improving the accuracy of the estimates.

²⁴ HONLEA by October 2019 reported the seizure of 1.381 tons of opium and 0.6471 tons of heroin. The quantities of opiates seized in the whole year 2019 was extrapolated based on these figures, 1.537 and 0.777 tons respectively.

²⁵ See more in Methodology chapter.

²⁶ Source: World Bank.

²⁷ For a detailed description of the calculation of conversion ratios see “UNODC/MCN Afghanistan opium survey 2014” and “UNODC/MCN Afghanistan opium survey 2017 – Challenges to sustainable development, peace and security”.

3. ERADICATION AND SEIZURES

3. Eradication and Seizures

As in former years, the Government of the Republic of the Union of Myanmar (GOUM) provided the data on eradication of opium poppy and seizures of opium in 2019.

3.1 Eradication

By the end of the 2019 growing season (March 2019), a total amount of 2,460 ha of opium poppy eradication was reported by GOUM/CCDAC, representing a decrease of 6% compared to 2018 (Table 6:). As in previous years, most of the eradication, 2,144ha (87%) occurred in Shan State and in particular in South Shan region (2,000ha, 81%), followed by Kachin State, Sagaing region and East Shan State with 126ha (5%), 118ha (5%) and 100ha (4%), respectively. The decline in eradication started in 2015 and shows a similar trend as the area under opium poppy cultivation (Figure 14:).

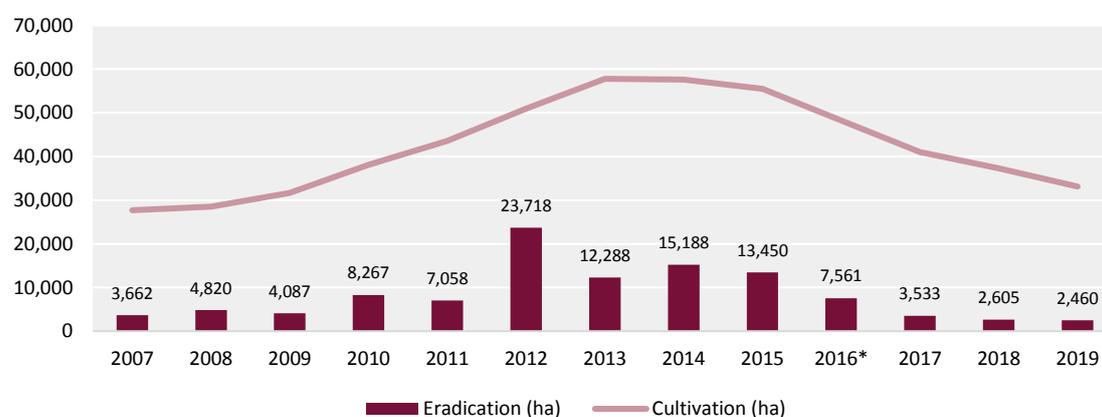
Table 6: Reported eradication in Myanmar (ha), 2007-2019

Region	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
East Shan	1,101	1,249	702	868	1,230	1,257	537	356	378	482	264	224	100
North Shan	916	932	546	1,309	1,315	977	532	337	532	69	97	29	44
South Shan	1,316	1,748	1,466	3,138	3,579	21,157	10,869	13,696	10,715	4,947	3,019	2,209	2,000
Shan State total	3,333	3,929	2,714	5,315	6,124	23,391	11,939	14,389	11,625	5,498	3,381	2,462	2,144
Kachin	189	790	1,350	2,936	847	83	250	395	1,495	1,504	28	65	126
Kayah	12	12	14	13	38	84	59	67	54	16	47	12	3
Magway	45		1	1		4	7	60	8	9	47	44	19
Chin	10	86	5	2	10	110	32	277	267	534	28	22	50
Mandalay		3	2		39	45					1		
Sagaing	9		1				2	1					118
Other States	64												
National total	3,662	4,820	4,087	8,267	7,058	23,718	12,288	15,188	13,450	7,561	3,533	2,605	2,460

Source: GOUM/CCDAC

Figures for 2019 are partial and refers to the period September 2018 – March 2019

Figure 14: Eradication versus opium poppy cultivation in Myanmar, 2007-2019



*Opium poppy cultivation for the year 2016, when survey was not conducted, was plotted with linear interpolation.

Most of the locations in South Shan where eradication took place overlapped with areas with high to very high opium poppy density. Map 4: shows eradication patterns in South Shan which principally follow the high to very high density cultivation in mountainous areas. On the contrary, eradication activities in East Shan presented a more irregular and dispersed pattern, covering different density levels, from low to very high. In North Shan only very little eradication was reported, equivalent to 44ha. This was concentrated in the south, near the border with Wa State and in the north next to Shwe Li river.

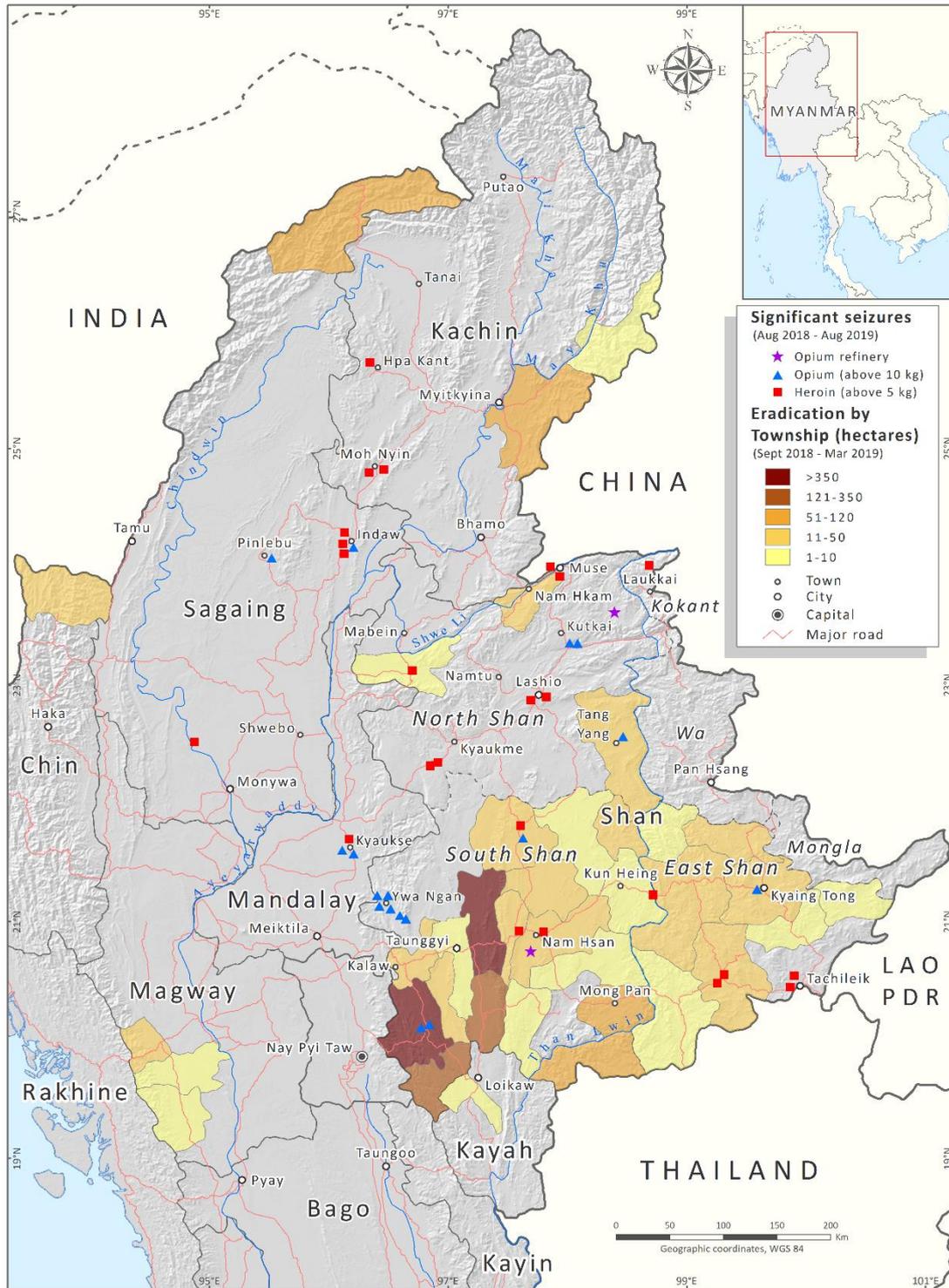
In Kachin State, eradication was reported at the border with China whilst there was no reporting from other medium to high density areas such as the region surrounding Tanai town. In the Sagaing region 118ha eradication was reported in the north next to the border with India. Finally, in the north of Chin State 50ha eradication was reported, located at the eastern side of the Manipur River.

Figure 15: GOUM eradication in South Shan, 2019



The opium poppy cultivation estimates presented in this report refer to the fields that were identified at the time that the satellite images were taken. Therefore, if any effective eradication was carried out after the satellite image acquisition date, it is not reflected in the presented cultivation figures. Besides, data provided by GOUM may include eradication implemented during the monsoon poppy season, prior to the main growing season when the remote sensing survey was implemented. The eradication figures reported by GOUM were not verified by UNODC.

Map 4: Reported eradication of opium poppy and seizures of opium products in Myanmar (2018-2019)



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

3.2 Seizures

Similarly, to the eradication figures, the seizures of different opium products reported by GOUM showed decreases in all opiate types. Most of the opium and heroin seizures took place near the larger towns, such as Muse, Lashio, Tachileik, and the other towns along trafficking routes, such as Moh Nyin, Indaw, Kyaukse, Ywa Ngan, and Kutkai, as shown in Map 4:

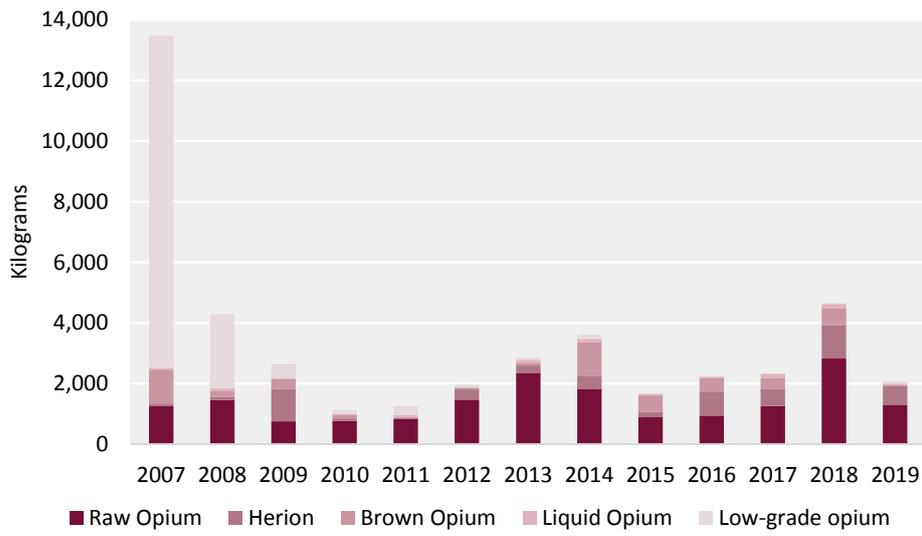
Table 7: Seizures of drugs (opiates) in Myanmar (kg), 1988-2019*

Year	Raw Opium	Heroin	Brown Opium	Liquid Opium	Low-grade opium
1988-1997	22992	3722	186	118	306
1998	5394	404	96	206	312
1999	1473	245	24	333	314
2000	1528	159	23	16	245
2001	1629	97	7	19	142
2002	1863	334	314	18	126
2003	1482	568	156	52	204
2004	607	974	59	39	396
2005	773	812	44	21	128
2006	2321	192	1371	29	6154
2007	1274	68	1121	56	10972
2008	1463	88	206	80	2453
2009	752	1076	326	27	465
2010	765	89	98	35	147
2011	828	42	37	60	282
2012	1470	336	46	29	81
2013	2357	239	72	115	66
2014	1828	435	1109	102	134
2015	889	186	539	38	35
2016	944	769	472	47	22
2017	1256	754	348	146	6
2018	2829	1099	554	146	30
2019 (Sep)	1299	633	5	58	64

Source: GOUM/CCDAC

* Figures for 2019 correspond to January – September only.

Figure 16: Seizures of drugs (opiates) in Myanmar (kg), 2007-2019*



Source: GOUM/CCDAC

* Figures for 2019 correspond to January – September only

Figure 17: Opium process refinery and mixer, North Shan, 2018



4. METHODOLOGY

4. Methodology

The 2019 opium survey included three components:

1. Estimation of opium poppy cultivation area throughout North Shan, East Shan, South Shan, and Kachin. The area estimation survey was based on the use of satellite images as the primary source of data, which was supplemented by field surveys to provide ground-truthing that supports the interpretation of opium poppy fields;
2. Crop yield estimation survey throughout South Shan, North Shan and East Shan. Due to insecure situation crop yield measurements could not be conducted in Kachin State;
3. A socio-economic (village) survey in poppy growing areas of North Shan, East Shan and South Shan. An in-depth analysis of the results will be presented in a separate report, expected to be ready later in 2020.

4.1 Area estimation

Remote sensing imagery

The area estimation to monitor the extent of opium poppy cultivation in Myanmar was carried out by means of remote sensing techniques. North, East and South Shan regions in Shan State, and Tanai area and the eastern zone of Kachin State were surveyed. Satellite imagery were acquired following two approaches (Map 5):

1. A sampling approach with a selection of randomly selected squared segments; this was used for the three Shan regions and the south-eastern part of Kachin (see *Sample approach* section);
2. A full coverage approach with larger, targeted images; this was applied for the Tanai area of Kachin State (see *Target area selection and interpretation* section).

The images used for the sampling areas were very high resolution (VHR) satellite images, whilst a combination of VHR and high resolution (HR) images were used for the targeted areas.

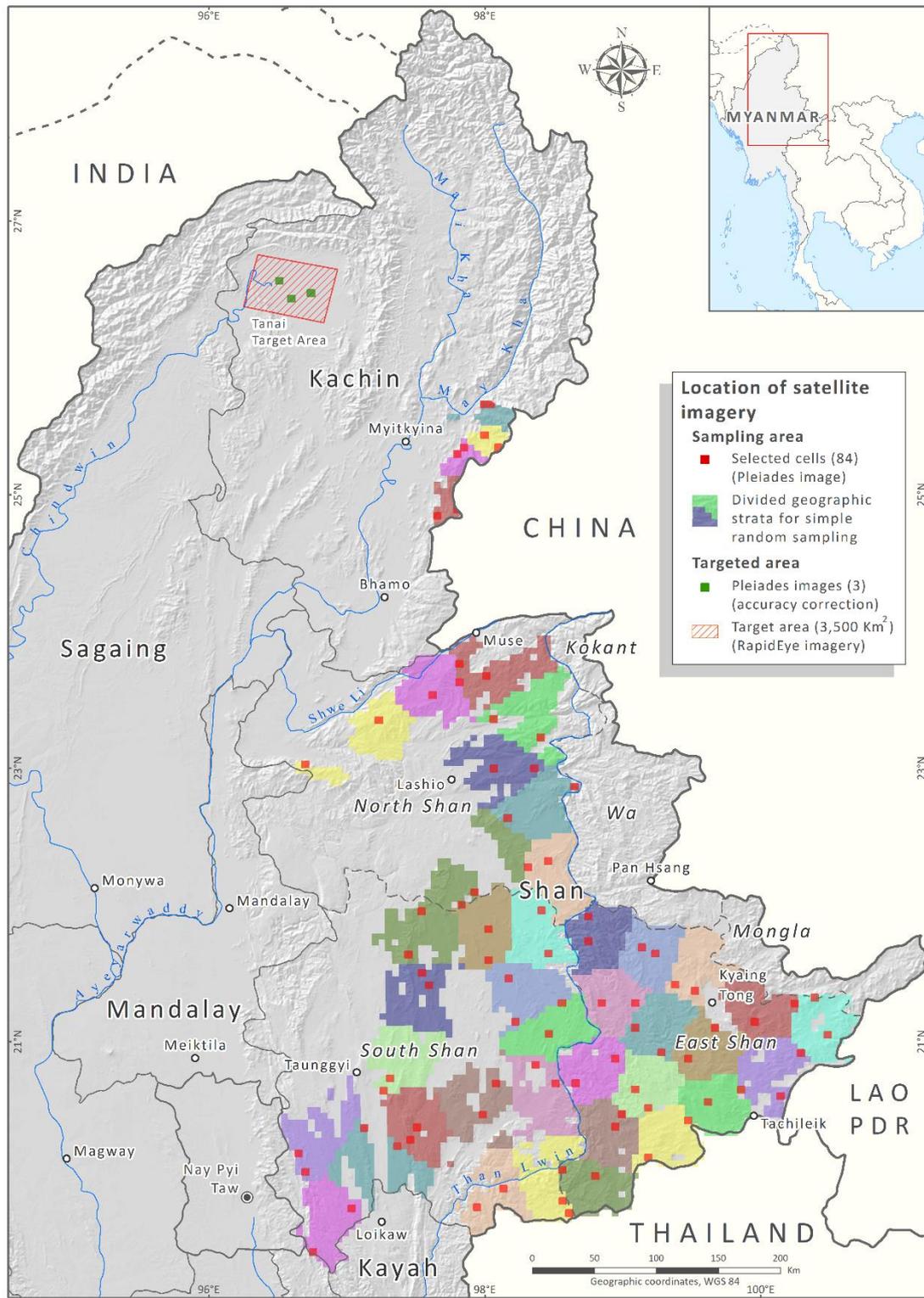
The VHR images at the sample locations were acquired by Pleiades satellites, which provides images of 2 metre ground resolution with four spectral bands (blue, green, red and infra-red) and a 50 centimetre panchromatic band. For every location (sample segment), two images were acquired with an approximate five-week interval; one image was taken in December or January and the other one between February and March. These two dates correspond to the pre- and post-harvest periods of poppy, thus facilitating the identification and discrimination from other land cover classes. To determine the image acquisition dates, the regional differences between the crop calendars were considered.

Figure 18: VHR image (Pleiades) on the left vs. HR image (RapidEye) on the right



The images covering the Tanai area in Kachin State were acquired by RapidEye satellites, with 6.5 metre nominal ground resolution or 5 metre resolution for orthorectified products. It provides five spectral bands, ranging from blue to near infrared colours. A few VHR Pleiades images were acquired for the same areas, to correct for interpretation errors caused by the lower spatial resolution of the RapidEye images. By interpreting both image types independently, a factor was determined that provides the difference in area estimates from a RapidEye image compared to Pleiades images. This factor was applied to the fields that were only covered by the RapidEye images, to correct for the differences in spatial resolution.

Map 5: Different types of satellite imagery approaches used for the survey, 2019.



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.

Risk area and sampling frame for the selection of satellite image locations

A risk area describes the geographic area considered in the area estimation survey. Basically, the risk area for the opium survey was developed by the combination of the following factors:

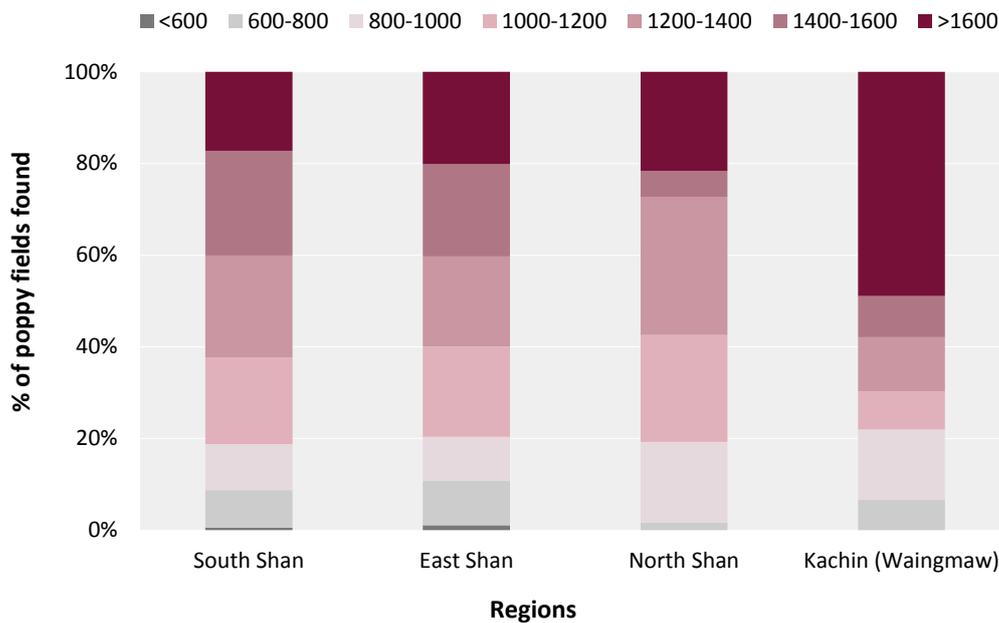
- 1) Land Cover;
- 2) Altitude;
- 3) Opium poppy free²⁸ areas according to ground information.

Land cover was the first important factor in defining the sampling frame. From the 2012 survey onwards, a land cover map, which was developed by classifying 5 DMC images with 22 metre resolution, acquired in February 2011, was used. From this map, large agricultural areas were extracted and considered to be poppy-free, since the cultivation of opium poppy was practised in small agricultural areas, often surrounded by natural vegetation. Wetlands and settlements were also excluded. Other classes of land use were considered to have the potential for opium poppy cultivation.

Prior to 2013, only altitudes between 800 and 1,800 metres were to be considered within the risk area. This was based on survey findings which had revealed that 95% of opium poppy was cultivated at such altitudes. However, later evidence showed the existence of poppy fields at 600 metre altitude and above, without a specific higher limit. Consequently, the sampling frame for the selection of the sample locations was updated since 2013 using this finding. Several opium poppy-free areas were identified based on ground information. The special regions; Wa (former S.R.2), Mongla (former S.R.4), and Kokant (former S.R.1); were excluded from the sampling frame. The townships; Mabein, Kyaukme, Nawng Hkio and Kunlon in North Shan; and Kalaw, Pindaya, Yak Sauk and Ywa Ngan in South Shan; were excluded from the sampling frame for the same reason. A 10-km buffer zone along the border with Thailand, which were considered opium poppy-free in earlier surveys, was included again in sampling frame since 2013 because ground information from the 2012 survey indicated a certain poppy risk.

The above-mentioned factors were combined in a Geographic Information System (GIS) to calculate the sampling frame in Shan State. The sampling frame for Waingmaw Township in Kachin State was developed only considering an altitude factor of more than 800 metres.

²⁸ Opium poppy free in the sense of no indication for significant levels of opium poppy cultivation.

Figure 19: Altitude ranges (metres) of poppy fields detected in satellite images, 2018/2019

Sampling approach, sample size and sample selection

Because of the dispersed distribution of poppy cultivation in the North, East and South Shan regions and in southern Kachin, a sampling approach is the most cost-efficient method given the required accuracy.

The sampling frame for this survey was a set of 5x5 km segments used to select the locations for obtaining satellite imagery. For that purpose, a 5x5 km regular grid was superimposed on the risk area. To increase the efficiency of the sample (thus to reduce the number of images purchased that only cover a small part of the risk area), a threshold of a minimum of 30% of risk area was set: if a segment contained less than 30% of risk area (e.g. is a cell at the boundary of the risk area), it was not included in the sampling frame. Nevertheless, in the extrapolation, the whole risk area is considered, with the underlying assumption that the area outside of the frame behaves on average as the area inside the sampling frame.

In 2019, the same samples were used as selected for survey of 2018, totalling 84 segments (Table 8:). Since the same samples are used in 2018 and 2019, the 2018 selection method is explained. Firstly, the frame was separated by region. Here, each segment had to be assigned to exactly one per region: if the majority of the risk area is within that region, the segment was assigned to that region. Therefore, regional boundaries were in some sense generalised to fit the 5x5 km grid. Secondly, each sub frame (region) was divided into compact geographical strata of approximately equal area. In former surveys the definition of the strata was done manually but a clustering algorithm (“k-means”) in the statistical software R29 package *Spcosa* was applied since the 2014 survey. In each stratum, two sampling locations were selected by simple random sampling. This sampling method provides a geographically well distributed sample and allowed the variance (uncertainty) to be estimated in an unbiased manner. See for more details the Myanmar Opium Survey of 2015.³⁰

²⁹ <http://www.r-project.org/> and package <http://cran.r-project.org/web/packages/spcosa/index.html>

³⁰ https://www.unodc.org/documents/crop-monitoring/sea/Southeast_Asia_Opium_Survey_2015_web.pdf

Table 8: Sample size allocation in 2019

Region	Sample size 2019	Sample size 2019	Number of geo-strata 2018	Number of geo-strata 2019
East Shan	30	30	15	15
South Shan	30	30	15	15
North Shan	16	16	8	8
Kachin	8	8	4	4
Total	84	84	42	42

Ground truth data collection

In previous surveys, the ground truth data collection was conducted in collaboration with the Remote Sensing and GIS Section of the Forest Department, Ministry of Natural Resources and Environmental Conservation. Each year, field teams organized by the Department carried out ground truthing at the selected sample locations. In 2019, the Forest Department was not involved in the opium survey activities. A technical team from UNODC Myanmar office, including four members, visited 32 satellite image sites out of target 36 locations and collected ground truth data (Table 9:). The team, in collaboration with the local drug enforcement police, visited selected satellite sample sites during the period of December 2018 to March 2019.

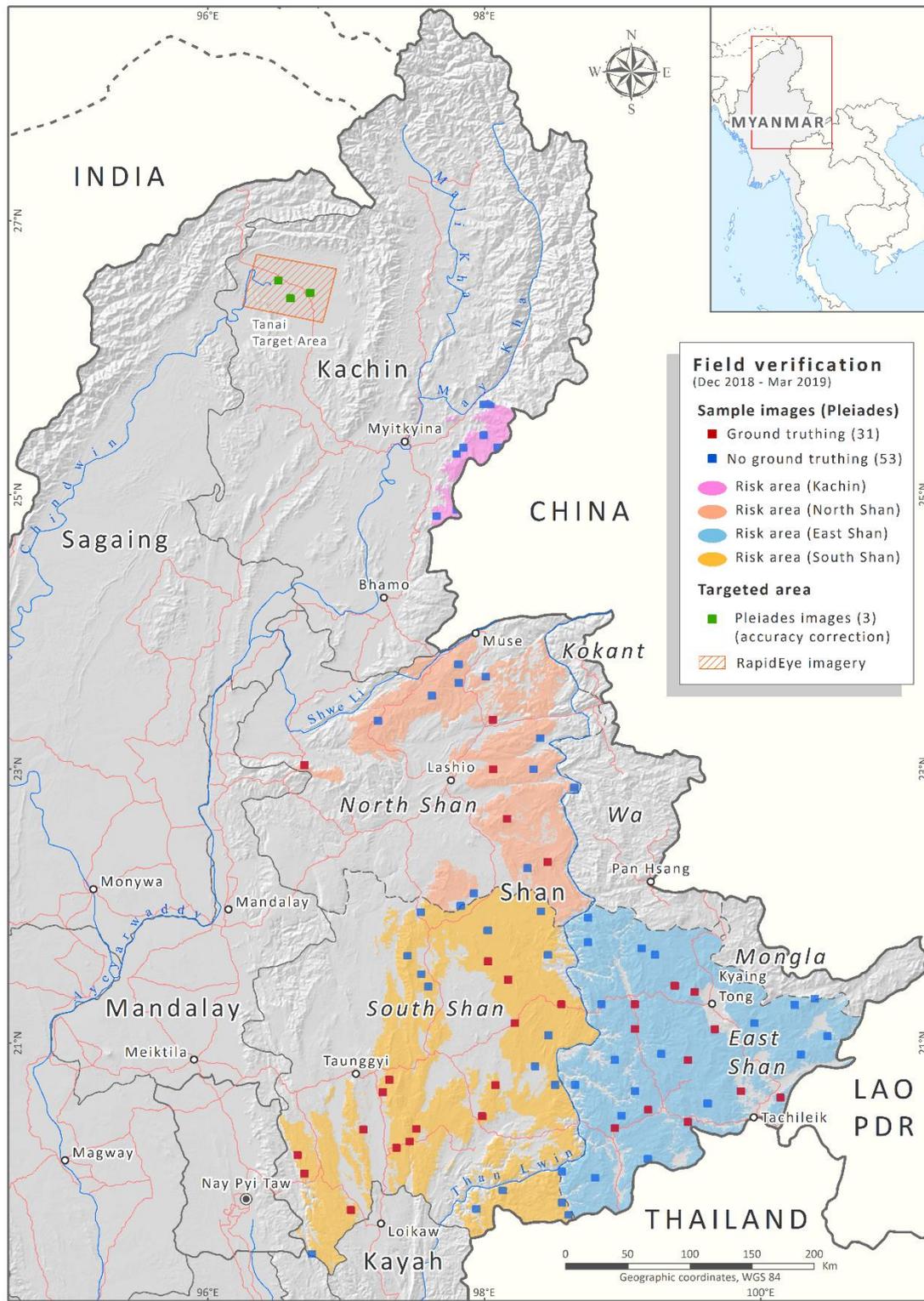
Figure 20: “Ground truthing” in South Shan, 2019

The ground verification teams visited selected sites with printouts of the satellite images (see Map 6:). Once they reached the area represented in each single scene, they annotated the printouts with the land use classes and relative boundaries proceeding with specific transect itineraries. They collected GPS coordinates taking field photos from 32 selected satellite image sites in Shan State. Back in the office, poppy fields were visually interpreted by an UNODC national expert from the Myanmar office. The results were assessed, and quality control procedures were applied by international experts at UNODC Headquarters, Vienna.

Table 9: Ground truth data collection, 2007-2019

Survey Year	Satellite image VHR	No. of segments in Shan	Segment size (km)	No. of segment visited (ground truth)	Ground truth %	No. of segments in Kachin	VHR images area (km ²)
2007	Ikonos	22	8x8	17	77%		2,816
2008	Ikonos	28	8x8	19	68%		3,584
2009	Ikonos	40	8x8	34	85%		5,120
2010	GeoEye, WorldView	40	6.5 x 6.5	32	80%	3	3,634
2011	WorldView, QuickBird	51	6 x 6	40	78%	3	3,888
2012	GeoEye, WorldView	58	5x5	47	81%	8	3,300
2013	GeoEye, WorldView	66	5x5	46	70%	8	3,700
2014	GeoEye, WorldView, QuickBird	76	5x5	49	64%	8	4,200
2015	Pleiades	76	5x5	47	62%	8	4,200
2016	No survey	--	--	--	--	--	--
2017	Pleiades	38	5x5	3	8%	8	4,200
2018	Pleiades	76	5x5	30	39%	8	4,200
2019	Pleiades	76	5x5	32	42%	8	4,200

Map 6: Field verification status of the survey with satellite images, 2019

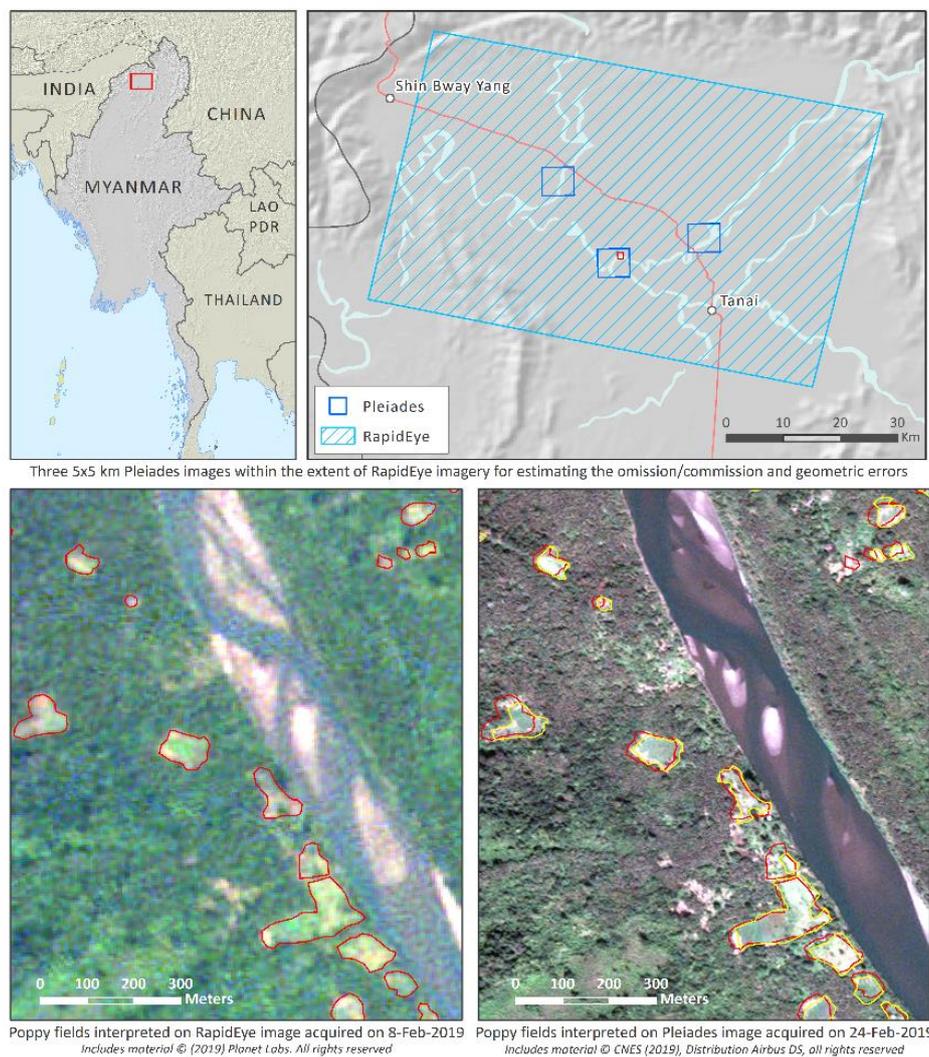


Target area selection and interpretation

The area estimates for Tanai area in Kachin State were based on a so-called target approach.³¹ These areas were fully covered by high resolution (HR) satellite imagery (RapidEye). In addition to the HR images, very high resolution (VHR) images (Pleiades) were acquired (Map 5: & Map 6:), which allowed for an estimation of the omission/commission and geometric errors that stem from the use of lower resolution imagery.

To that end, the area of opium poppy fields was first interpreted on the lower resolution imagery (full coverage) and then on the VHR images (three selected locations) (Figure 21:), the latter producing more accurate interpretations. The difference between the areas of the two interpretations was used to calculate a correction factor that was applied subsequently to the estimates interpreted with the HR images (Table 11:).³²

Figure 21: Poppy fields interpreted on Pleiades and RapidEye satellite imagery



³¹ The target areas were defined based on information on poppy cultivation from previous surveys. Three VHR images were acquired for Tanai in Kachin State.

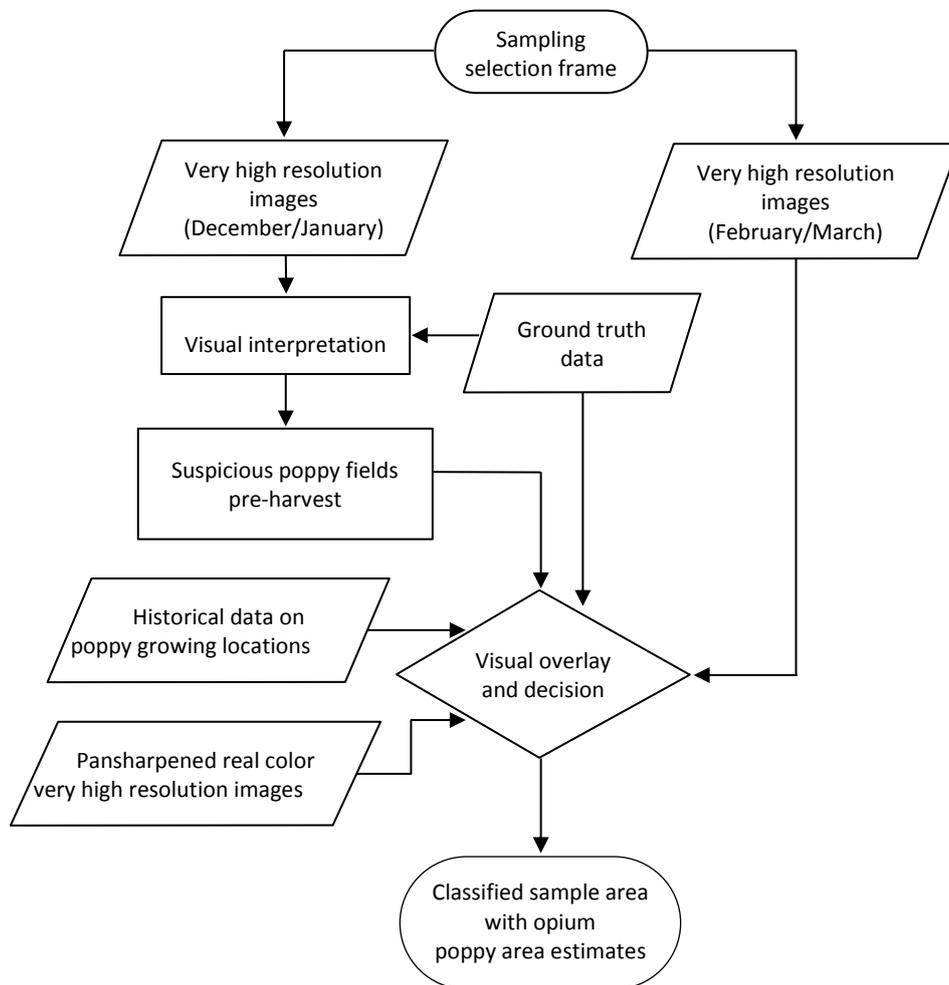
³² 95% confidence intervals for each targeted area were calculated assuming a t-student distribution and two degrees of freedom. See <https://www.itl.nist.gov/div898/handbook/mpc/section5/mpc552.htm> for further information on the method to calculate the standard deviation.

Satellite image processing and interpretation

The collected ground truth data, namely the geotagged field photos, were used as reference information to visually identify, interpret and delineate poppy fields. This task was conducted by a UNODC national experts in the Myanmar office, with a long-time experience in poppy detection and interpretation of the fields.

The classification procedure of the very high resolution images is illustrated in the flowchart below (Figure 22:). Before the interpretation phase, the acquired imagery is pre-processed through a number of steps into a stable, uniform format for the visual analysis. The main pre-processing step is pansharpening (merging) of the Pleiades multispectral image with the panchromatic image resulting in a pansharpened VHR imagery with the spatial resolution of the panchromatic band (50 cm) and with all multispectral bands. This is a fundamental step to better discriminate poppy fields from other landcover classes. In addition, visual enhancement procedures are applied, when appropriate.

Figure 22: Satellite image interpretation flowchart



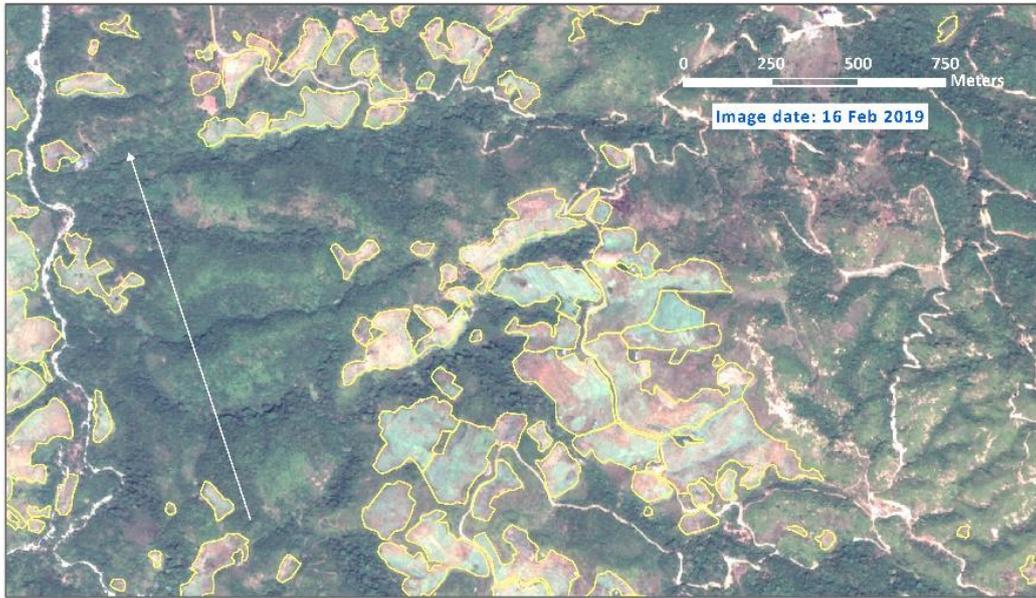
The satellite image interpretation was conducted in a visual manner. The latest ground truth data, historical ground truth data, data collected from the yield measurements and eradication activities were used as reference material during the interpretation process. In visual interpretation, accuracy and precision of the result vary with the experience and the skills of those conducting the interpretation. Therefore, interpretation keys (decision rules) were used that bring the interpreters to a comparable level of knowledge, experience and

notion of the topic. The interpretation keys use features of poppy fields such as tone, colour, shape or texture, in addition to context information and knowledge about the area.

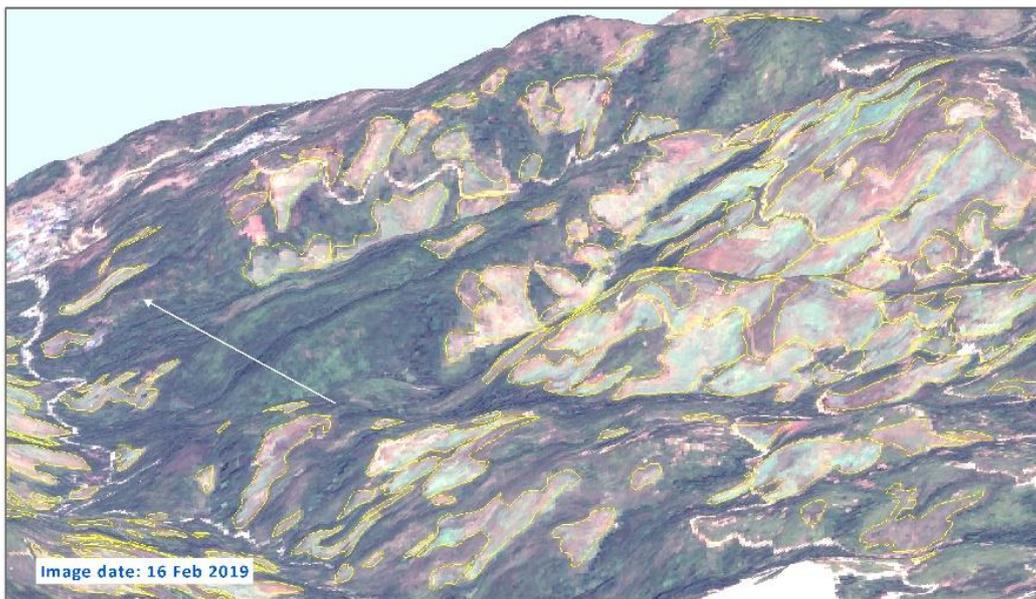
The images acquired in the second phase were used to observe changes in possible poppy-growing fields. If there was an apparent change that corresponded to the harvesting of the poppy, it was used to confirm that the field was indeed a poppy field. Since the images were not geometrically corrected an automated classification and change detection process was not possible due to the possible displacements of the fields in question.

The decision rules can vary by region and stage of poppy cultivation. However, the most commonly applied rule was that potential poppy in the first image, when classified as bare soil in the second image, meant that it was opium poppy. Historical data on poppy cultivation, 3D terrain visualisation and real colour pansharpened VHR images were used to facilitate the decision-making (See Figure 23: & Figure 24:).

Figure 23: Poppy interpretations on Pleiades imagery and visualised in 3D

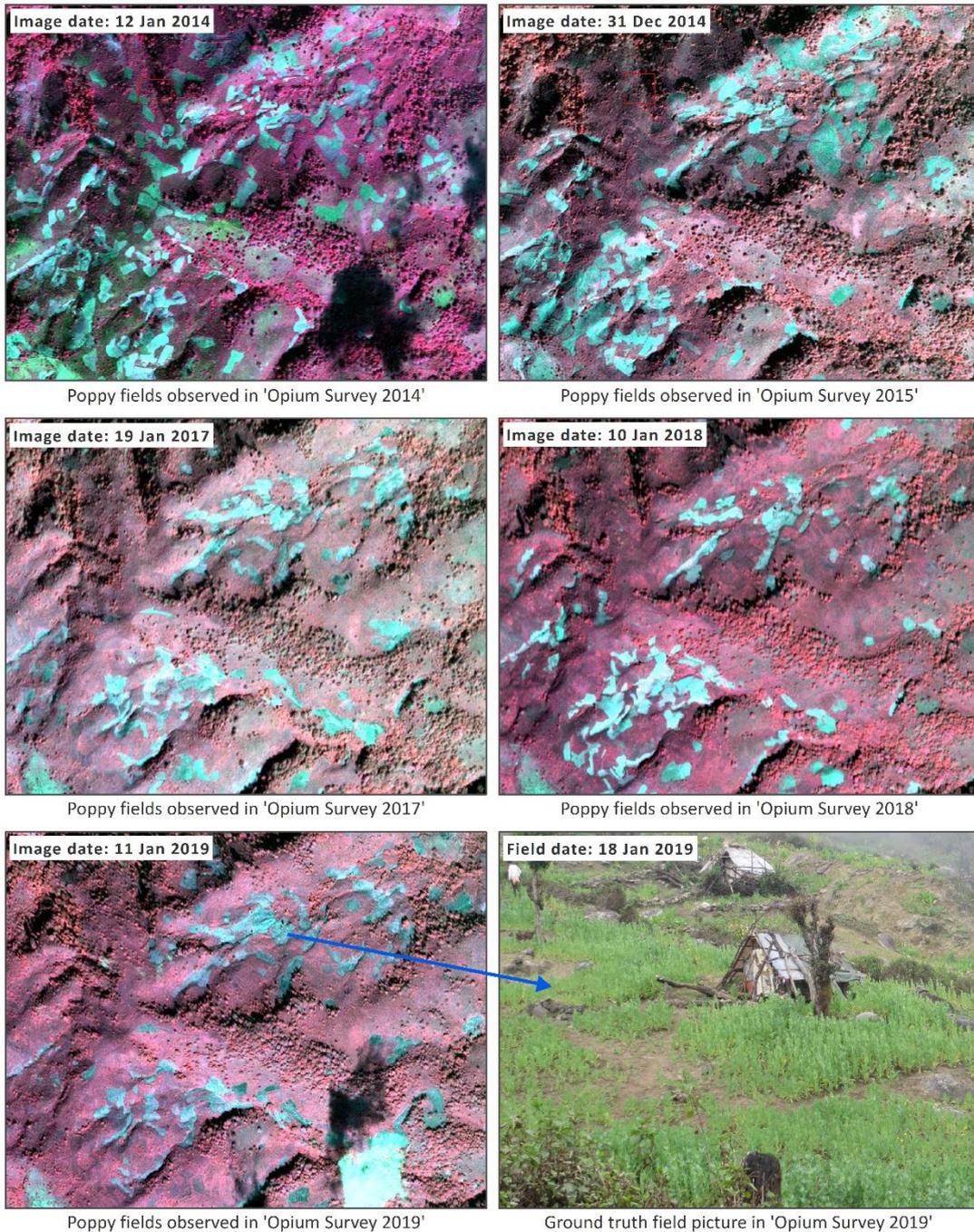


Interpretation of poppy fields in Kachin state on Pleiades image



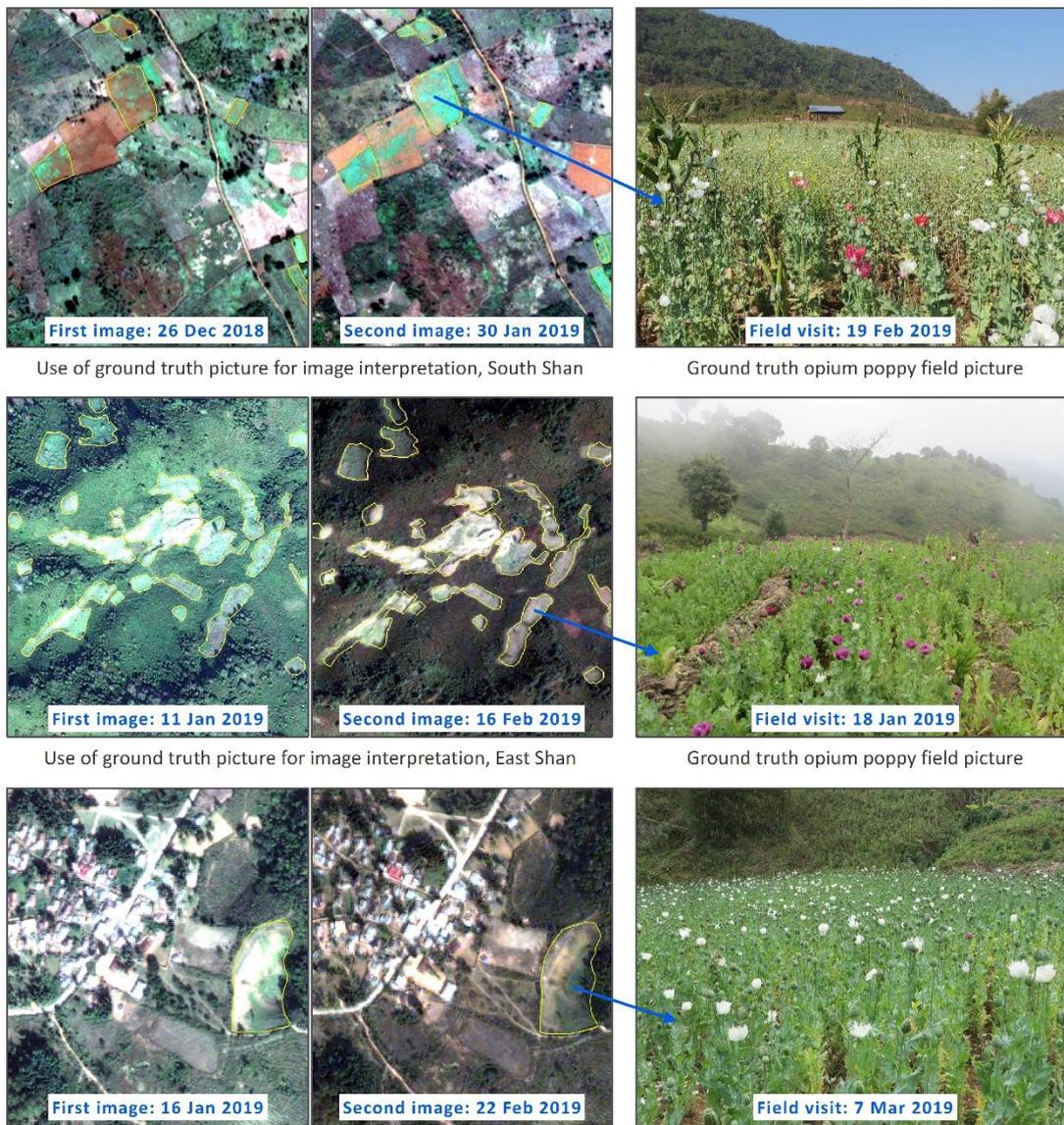
3D visualization of interpreted poppy fields on Pleiades image draped on SRTM Digital Elevation Model (DEM)
Includes material © CNES (2019), Distribution Airbus DS, all rights reserved

Figure 24: Time series of poppy field observations with a ground truth photo, 2014-2019



Very high-resolution, PLEIADES satellite images (pansharpened, false colour composite)
Includes material © CNES (2014, 2017, 2018, 2019), Distribution Airbus DS, all rights reserved

Figure 25: Satellite image interpretations with the corresponding ground truth data



Use of ground truth picture for image interpretation, South Shan

Ground truth opium poppy field picture

Use of ground truth picture for image interpretation, East Shan

Ground truth opium poppy field picture

Use of ground truth picture for image interpretation, North Shan

Ground truth opium poppy field picture

*Very high-resolution, PLEIADES satellite images (pansharpened, true colour composite)
Includes material © CNES (2018, 2019), Distribution Airbus DS, all rights reserved*

Area estimation methods in 2019

The area estimation consisted of a sampling estimate and a target area estimate depending on the area (See Table 10: & Table 11:). The final national estimate is the sum of poppy estimated in the sample region and the estimate obtained from the target areas. The following section describes the sampling estimation method. The sample area estimation of the extent of opium poppy cultivation at the national level is a combined ratio estimate using risk area as an auxiliary variable. The estimation was done separately for the strata containing segments where opium poppy was identified in the past and for the strata that were free of opium poppy (but containing risk area because of their biophysical features). The total is a sum of these two separate estimates. At the provincial level, a simple combined ratio estimate was calculated. The ratios were then extrapolated to risk area outside the frame. The sample mean was calculated as

$$\bar{y}_{st} = \sum_{h=1}^k \frac{N_h}{N} \bar{y}_h; \bar{x}_{st} = \sum_{h=1}^k \frac{N_h}{N} \bar{x}_h.$$

where k is the number of stratum, \bar{y}_h is the sample mean of poppy in stratum h ; \bar{x}_h is the sample mean of the risk area in stratum h ; N_h is the number of sampling units in stratum h , and N is the population size.

The combined ratio estimate of the area under poppy cultivation then is given by

$$\bar{Y}_{RC} = \frac{\bar{y}_{st}}{\bar{x}_{st}} \bar{X}$$

where \bar{X} is the total risk area in the sampling frame.

The confidence intervals for the national estimate were calculated by using standard statistical methods for combined ratio estimators.

Bootstrapping³³ was performed to estimate the confidence intervals of the regional estimates. This was necessary as the heavily skewed distribution of opium poppy in the samples led to unrealistic confidence intervals when applying the standard methods. Although bootstrapping is considered to be an appropriate choice in such situations, UNODC is undertaking further research to assess if this is the case in all situations.

Table 10: Estimated poppy cultivation areas for the sampled areas in 2018 and 2019

Region	2018	2019	Difference 2018-2019
South Shan	13,880	12,002	-14%
East Shan	10,095	8,844	-12%
North Shan	8,691	7,186	-17%
Kachin	2,417	2,618	+8%
Total	35,083	30,650	-13%

Table 11: Estimated poppy cultivation areas for the target area in 2019

Target area	Interpreted poppy area (ha) before correction factor	Correction factor 2019	Interpreted poppy area (ha) after correction factor
Tanai (Kachin State)	1,420	-12.74%	1,238

4.2 Yield and potential opium production estimation

Collection of yield data

The 2019 yield data collection was conducted by opportunistic manner in Shan State³⁴ (Map 7:). In the past surveys, crop yield data collection was accompanied with the village socio-economic survey which was run by local survey teams organized by CCDAC. In this year, similarly as previous the 2018 survey, the crop yield data collection was implemented by

³³ <http://cran.r-project.org/web/packages/boot/index.html>.

³⁴In 2019, 118 fields were surveyed in 40 villages in East Shan, 93 fields in 31 villages in South Shan, and 21 fields in 7 villages in North Shan.

UNODC with supporting of local Drug Enforcement Units (former Anti-Narcotic Task Forces). A field team which included three UNODC national staff from UNODC Myanmar office, incorporated with one officer from the local Drug Enforcement Unit conducted collection of yield data in South Shan, East Shan and North Shan.

In South Shan, data collection was conducted in 31 poppy growing villages in 7 townships (Hopong, Hsi Hseng, Pinlaung, Pekon, Mawkmai, Monae and Loilem townships) from 4 to 26 December 2018. The villages were selected by opportunistic-based according to accessibility and security. Field measurements were normally taken from three poppy fields in each village. The field team followed the UNODC Guidelines for yield assessment. The team selected mature opium poppy fields close to the village and selected a good, an average and a bad field from those mature fields. Once a field is selected, a transect was drawn through the field, along which three 1 m² sample plots were defined. In each plot, the numbers of flowers buds, flowers, immature capsules and mature capsules expected to yield opium were counted, and the diameter and height of 10 to 14 lanced capsules were measured with a digital calliper (Figure 26). All the measurements were recorded by digital cameras to check for data quality assurance. Yield data was taken from 93 poppy fields in South Shan.

Figure 26: Measuring poppy capsule in South Shan, 2019



In East Shan, yield data was collected in 40 poppy growing villages in 7 townships (Kyaing Tong, Mong Hpyat, Mong Khat, Metman, Mong Hsat, Mong Ton and Mong Pyin townships) from 14 January 2019 to 16 February 2019. Same as South Shan, villages were selected according to accessibility and security. Field measurement was taken from 122 poppy fields as the guidelines. Eventually, only 118 fields were used for the estimates after the quality control process.

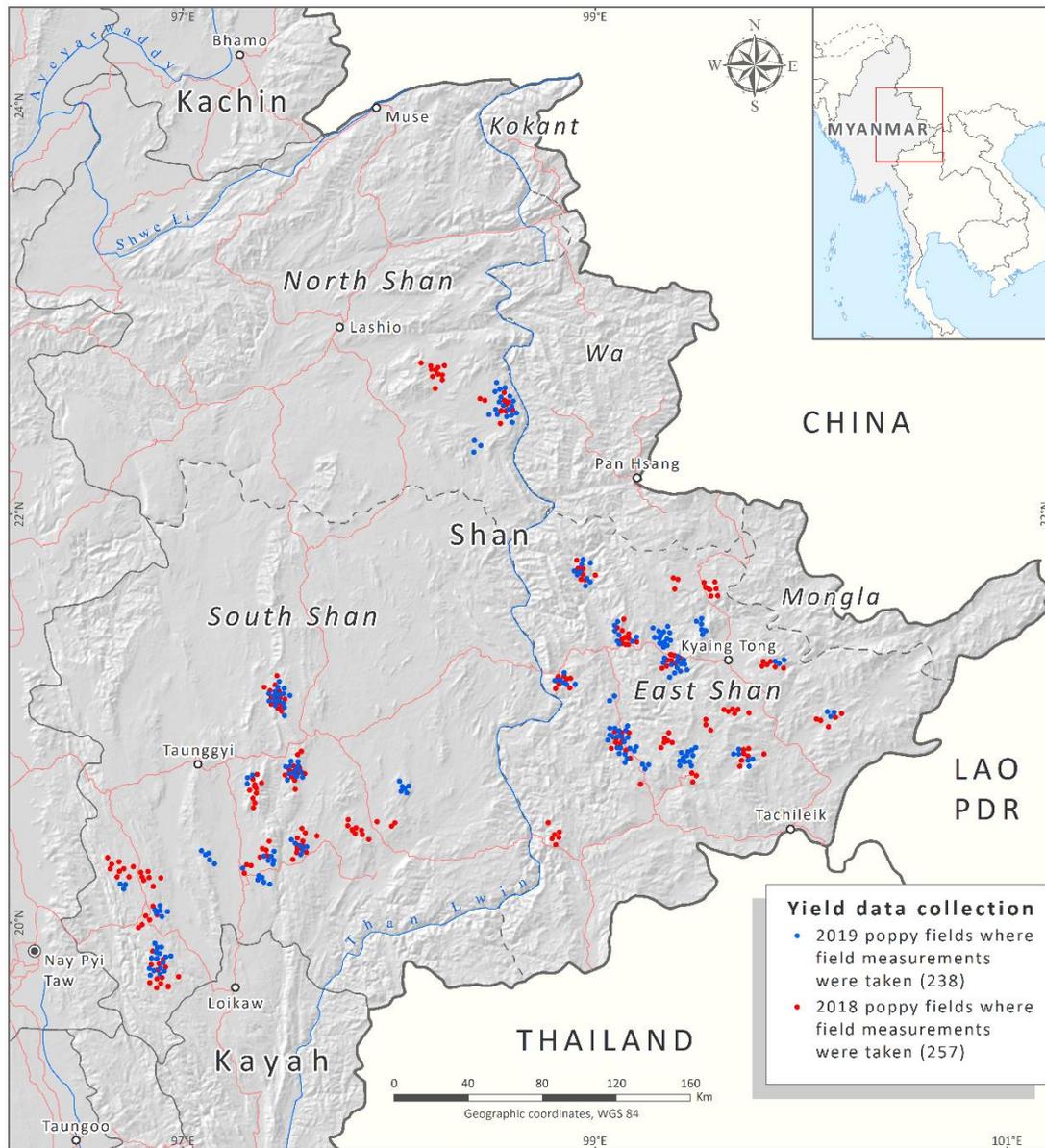
Due to armed conflict issues in North Shan, the field team collected yield data in one township only. Field measurement was taken from 21 poppy fields of 7 poppy growing villages in Tang Yang township from 20 February 2019 to 6 March 2019.

In total, field data of 236 poppy fields were collected and 7,164 poppy capsules were measured in the 2019 yield survey.

Figure 27: Yield data collection in the field, 2019



Map 7: Location of fields visited in the yield surveys in Shan State, 2018 and 2019



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.

Table 12: Opium cultivation calendar Myanmar, 2018-2019*

Region	Township	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Kayah	1.Loikaw, 2.Demawso, 3.Fruso	Monsoon cultivation												
		Round 1												
		Round 2												
South Shan	1. Pekon, 2. Pinlaung, 3.Hsi Hseng, 4.Nyaung Shwe	Monsoon cultivation												
		Round 1												
		Round 2												
		Irrigated late crop												
	5.Maukmai, 6.Hopong, 7.Monae, 8.Nam Sang, 9.Linkhay	Round 1												
		Round 2												
		Irrigated late crop												
	10.Mong Pan, 11.Loilem, 12.Kun Heing, 13.Leicha, 14.Mong Shu, 15.Kyae Thee, 16.Mong Kaing	Round 1												
		Round 2												
Round 3														
East Shan	1.Mong Ton, 2.Mong Hsat, 3.Tachileik, 4.Mong Hpyat	Round 1												
		Round 2												
		Irrigated late crop												
	5.Kyaing Tong, 6.Mong Yawng, 7.Mong Pyin, 8.Mong Hkat, 9.Metman	Round 1												
		Round 2												
		Round 3												
North Shan	1.Tang Yang, 2.Mong Yai, 3.Thibaw, 4.Kyaukme, 5.Lashio, 6.Theinne	Round 1												
		Round 2												
		Round 3												
	7.Moemit, 8.Nam Hsang, 9.Namtu, 10.Kutai, 11.Manton, 12.Kunlon, 13.Muse, 14.Nam Hkam	Round 1												
		Round 2												
		Round 3												
Kachin	1.Waingmaw	Round 1												
		Round 2												
	Round 3													
	2.Tanai	Round 1												
Round 2														
Chin	1.Tunzan	Round 1												
		Round 2												

* Round 1, 2 and 3 refer to staggered planting on different fields at different times to spread the harvest over a longer period. Since the opium poppy plants are growing at different stages, at the time of gum collection in the first field, the second fields will not yet be at flowering stage. Therefore, labours needs are better distributed.

Estimating potential opium yield

For the 2019 survey, the capsule volume per square metre was calculated and entered into the formula for the yield calculation. Each plot thus provided one yield observation. The simple average of the three plots in a field was the field yield. The yield by State was calculated as the simple average of all fields in a State.

For estimating potential opium yield, a relationship between poppy capsule volume per square metre and dry opium yield is used. The relationship is based on extensive field research and is described as:

$$Y = 1.89 + 0.0412 V$$

where Y is dry opium weight (kg/ha) and V is the mature capsule volume (cm³/m²).

This formula has been developed based on data collected in Thailand and emphasizes the lower end of observed capsule volume. It is based on data varying between 0 and 900 cm³/m².

However, high volumes exceeding 900 cm³/m² were observed (particularly in Kachin). The formula was not validated for these ranges and would supposedly overestimate yields. To avoid overestimation, an alternative formula was used for fields where at least one plot exceeded said volume. This formula was calibrated with combined data from Pakistan and Thailand, and reads as

$$Y = \frac{[(V + 1,495) - ((V + 1,495)^2 - 395.259 V)^{0.5}]}{1.795}$$

A range was calculated to express the uncertainty of the yield estimate due to sampling with the 95% confidence interval.³⁵

Estimating opium production

Opium production was calculated by Region/State as the product between the estimated area under opium cultivation and the corresponding opium yield.

All opium estimates in this report are expressed in oven-dry opium equivalent, i.e. the opium is assumed to contain 0% moisture. The same figure expressed in air-dry opium, i.e. opium under “normal” conditions as traded, would be higher as such air-dry opium contains some moisture.

The uncertainties of the opium production estimate combine those due to sampling for the area under poppy cultivation and those related to the yield estimate. These uncertainties were calculated by using the standard method for error propagation. The point estimates and uncertainties of the area under poppy cultivation and yield can be expressed as $a_p \pm \Delta a$ and $y_p \pm \Delta y$ respectively, where the uncertainty is determined from the 95% confidence intervals. These uncertainties will impact on the estimate of production ($p_p \pm \Delta p$, or equivalently expressed as the range [$p_p - \Delta p$, $p_p + \Delta p$]), where the best estimate is $p_p = a_p y_p$. Therefore,

$$\frac{\Delta p}{p_p} = \sqrt{\left(\frac{\Delta a}{a_p}\right)^2 + \left(\frac{\Delta y}{y_p}\right)^2}$$

expresses the error in production (Δp), resulting from uncertainty in the estimates for cultivation area and yield.

³⁵ $Y \pm 1.96 \frac{\sigma}{\sqrt{n}}$, where Y is the point estimate, n is the number of samples and σ is the standard deviation.

4.3 Estimating the value of opium economy in Myanmar

Estimating the value of Myanmar opium economy implies evaluating the amounts of raw opium and heroin which are used either for the domestic consumption or for export, along with their prices at every link of the chain. This means estimating and then combining multiple factors, using the best available data.

Due to the scarcity of reliable and/or updated data, especially on purity and conversion factor, the degree of uncertainties is significant and infers the use of range rather than point estimates.

The key components of the opium economy which have been estimated to derive the gross and net values of the opium economy in Myanmar are:

- The farm-gate value;
- The amounts of raw opium and heroin reaching the illicit end-consumer markets;
- The value of opiates market for domestic use;
- The value of opiates potentially available for export.

The farm-gate value

The farm-gate value is derived directly from the potential production of dry opium.³⁶ The national price per kilogram of dry opium used for the calculation is the weighted average of the farm-gate prices at harvest time of the three main producing regions of Shan State.³⁷ The lower and upper bounds of the farm-gate value reflect the range of the opium production estimate.

The amounts of raw opium and heroin reaching the illicit end-consumer markets

Opium can be either consumed as raw opium or further processed into heroin. Starting from the production figures, the estimate of the share of unprocessed opium entering the illicit markets is based on the direct opium consumption in the Southeast Asia region³⁸ and the comparison of the opium production levels between Myanmar and Laos³⁹, which are supposedly the only opium providing countries in the region⁴⁰. The remaining opium, after discounting opium seizures⁴¹, is deemed to be processed into heroin. A ratio of 10:1 is used for converting opium to heroin of unknown purity⁴² and, after subtracting the reported heroin seizures⁴³, the amount of heroin reaching the end-consumer markets is obtained.

³⁶ Farm-gate prices, however, were calculated for both fresh and dry opium to maintain comparability with the previous surveys where both prices were presented.

³⁷ Farm-gate prices at harvest time of dry opium in North, East and South Shan were collected during the 2019 socio-economic survey.

³⁸ Source: *Transnational Organized Crime in Southeast Asia: Evolution, Growth and Impact 2019* (TOCTA-EAP), (UNODC, 2019).

³⁹ Source: *Southeast Asia Opium Survey 2015 – Lao PDR, Myanmar* (UNODC, 2015).

⁴⁰ See *World Drug Report 2019*. The assumption is that the ratio between total opium production and unprocessed opium is the same for the two countries.

⁴¹ HONLEA by October 2019 reported the seizure of 1.381 tons of opium. The quantities of opium seized in the whole year 2019 was extrapolated based on this figure, 1.537 tons respectively.

⁴² For countries other than Afghanistan, a traditional conversion ratio of opium to heroin of 10:1 is used (cfr. *World Drug Report 2019, Booklet 1, p.41*).

⁴³ HONLEA by October 2019 reported the seizure of 0.6471 tons of heroin. The quantities of heroin seized in the whole year 2019 was extrapolated based on this figure, 0.777 tons respectively.

The value of opiates market for domestic use

The value of the domestic opiates market is given by:

$$\begin{aligned} & (\text{annual estimated domestic opium consumption} \times \text{typical retail opium price}) \\ & \quad + \\ & (\text{annual estimated domestic heroin consumption} \times \text{typical retail heroine price adjusted} \\ & \quad \text{for purity}) \end{aligned}$$

The estimates of opium and heroin consumed in Myanmar are based on:

- The prevalence of opiates use⁴⁴ in the country
- The respective proportions of opium and heroin users⁴⁵
- The Myanmar population between 15 and 64 years old⁴⁶
- The annual heroin⁴⁷ and opium⁴⁸ average consumption rates

The retail price of opium⁴⁹ is taken from the Myanmar Annual Reports Questionnaire (ARQ) and the retail price of heroin⁵⁰ was provided by the Central Committee on Drug Abuse control of Myanmar (CCDAC). Heroin's street price has been adjusted for purity, resulting in a range due to the uncertainties related to the purity of the retail market's heroin.⁵¹

The value of opiates potentially available for export

The amounts of opiates potentially available for export are derived by subtracting the domestic consumption from the opiates reaching the illicit market. The obtained opium and heroin quantities are then multiplied by the respective wholesale prices⁵² and summed to each other to find the value of the opiates export.

Gross and net values of opiates economy in Myanmar

The gross value of the opiates economy is the sum of the value of the domestic market and the value of opiates believed to be exported.⁵³ The estimate of the value of manufacture and trafficking of opiates to the border excludes the farm-gate value, which is paid by first level traffickers to the farmers. A detailed analysis of the profits made at each stage need to consider other costs associated to the illicit drug business, for instance those related to manufacture and distribution, most importantly precursor substances. Due to lack of data it was not possible to include the above-mentioned components in this analysis.

⁴⁴Annual prevalence for opiates is 0.8%. Source: *World Drug Report 2019* (UNODC, 2019).

⁴⁵ Heroin users represent the 97.7% of opiates users, opium users the 2.3%. Derived from 2018 treatment data reported by the CCDAC at the 2019 SMART Regional Workshop, Singapore, August 2019.

⁴⁶ Source: World Bank.

⁴⁷ The global annual average value of 22g of heroin is used, obtained from data from Australia's wastewater analysis (Source: https://www.unodc.org/documents/southeastasiaandpacific/Publications/2019/SEA_TOCTA_2019_web). The value was used to calculate the heroin market size in the region.

⁴⁸ A value of 770g of opium for yearly consumption is used. Source: *Drug Use in Afghanistan* (Afghanistan Ministry of Counter-narcotics/ Afghanistan Ministry of Health/ UNODC, 2009).

⁴⁹ Source: ARQ 2010.

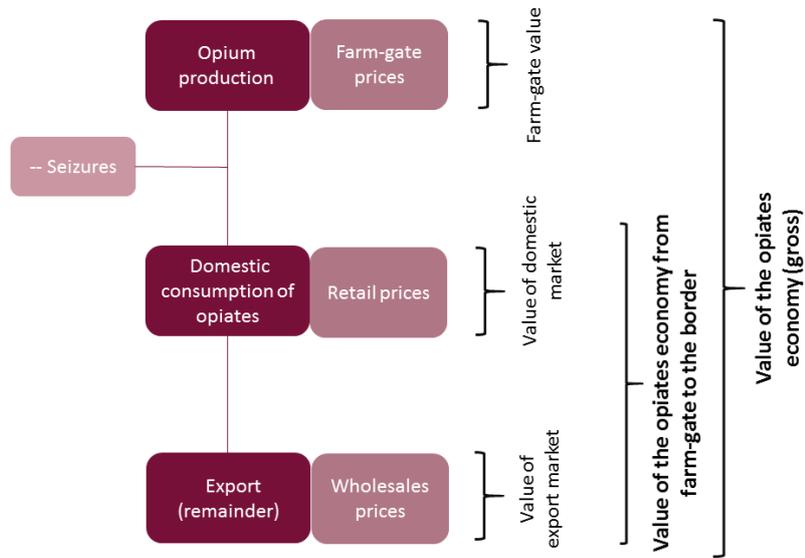
⁵⁰ CCDAC, "Synthetic drug situation in Myanmar", presented at the 2019 SMART Regional Workshop, Singapore, August 2019.

⁵¹ Due to the lack of data on street heroin's purity in Myanmar, Cambodia 2016 ARQ data are used, which recorded a retail purity ranging from 42 to 80%.

⁵² Wholesale opium price is derived from the Myanmar 2014 ARQ. Wholesale heroin price was reported by CCDAC in 2019 ("Synthetic drug situation in Myanmar", presented at the 2019 SMART Regional Workshop, Singapore, August 2019).

⁵³ The gross value of opiates economy includes several components (e.g., costs associated to precursor substances, transports, processing, etc.), which are not considered in this analysis.

Table 13: Workflow diagram of the analysis of the opiates economy’s components



Uncertainties

There is a significant uncertainty around these estimates. While confidence in the opium production estimates is high, uncertainties around the conversion ratio from opium to heroin⁵⁴ stem mainly from the wide range of possible purities of the product and from the lack of data on the efficiency of the conversion from opium to heroin (i.e., how much opium is needed to produce 1kg of heroin). Uncertainties around the demand estimate are mainly associated with the assumptions around annual opium consumption per user.

⁵⁴ The amount of raw opium needed for producing 1kg of heroin depends on two main factors: i) the average morphine content of opium and ii) the efficiency of the heroin labs. To date there are no available studies that focus on opium’s morphine content and/or heroin labs efficiency in Myanmar.



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