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United Nations Office on Drugs and Crime



Myanmar Opium Survey 2020

Cultivation, Production, and Implications

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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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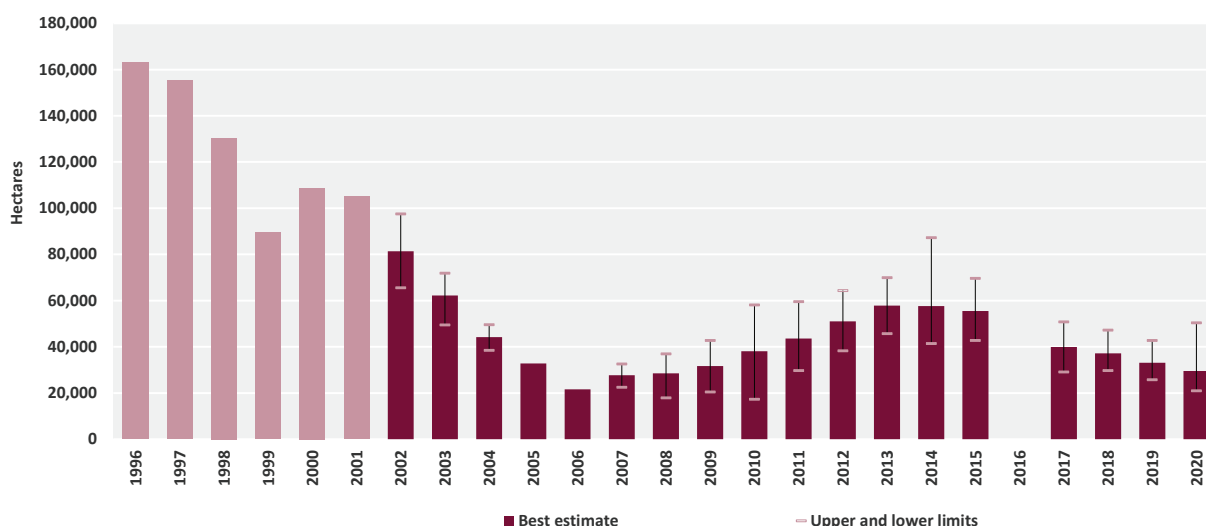
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Abbreviations

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

Key Findings

- In 2020, the area under opium poppy cultivation in Myanmar was estimated at 29,500 (21,000 to 50,400) hectares. In comparison to 2019, the area under opium cultivation has decreased by 11% or 3,600 hectares, which is a continuation of the downward trend that had started in 2014.¹



- Reductions have taken place in East, North and South Shan with respective decreases of 17%, 10% and 9% from 2019 levels. In Kachin State, the area under cultivation decreased by 6%.
- The average opium yield in 2019 was estimated at 13.7 kilograms per hectare.²
- Potential opium production was estimated at 405 metric tons in 2020. Shan State, which supplied 82% of the total, remained the main producing region with 331 tons.
- Eradication, as reported by the Government, showed a similar trend as opium poppy cultivation over the last nine years, with increases from 2010 to 2012-2014 and decreases from 2015 onwards. The eradication numbers for the 2020 growing season (from October 2019 to May 2020) were 18% lower than for the same period in 2019.
- For the period January to September 2020, the weight of seized opiates reported by GOUM/CCDAD increased significantly compared to 2019. This was the case for the weight of both opium (6,506 kg) and heroin (1,389 kg) seizures, which increased by 285% and 100% respectively.
- With an estimated gross value ranging from US\$ 0.5 to 1.6 billion, the illegal opiate market in Myanmar represented 0.7 – 2.1% of the GDP.
- Farmers cultivating opium earned between US\$ 58 - 98 million in 2020, which is approximately 6 - 12% of the overall value of the opiate economy or 0.4% of the agricultural sector's value.³
- The largest share of the 2020 opiate market value was generated by heroin consumption, manufacturing and trafficking. Domestic heroin consumption (6 tons of heroin) was valued between US\$ 144 - 315 million, whereas exports of heroin (13 - 53 tons) were worth between US\$ 299 - 1,205 million. Domestic opium consumption and exports accounted for a smaller share of the market value, US\$ 17 million and US\$ 42 respectively.
- Between 2015 and 2020, farm-gate prices of fresh and dry opium decreased by 52% and 61%, respectively.⁴ 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.⁵

¹ In 2020, the opium poppy cultivation survey covered Shan and Kachin States. Due to budget constraints 46 sample locations were available in Shan and Kachin States (compared to 84 locations in 2019), which increased uncertainty around area and production estimates. Chin and Kayah States were not covered in 2020 and latest available area estimates (2018) were used to calculate the total opium poppy cultivation area.

² Average regional opium yields weighted by cultivation.

³ The agricultural sector contributes 23.8% of the total GDP in Myanmar (World Bank 2019).

⁴ 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 2020 was linearly extrapolated from the 2004-2019 series.

⁵ The Southeast Asia region is almost exclusively supplied by heroin produced in Myanmar, and only marginal quantities of heroin originating in Afghanistan have been trafficked into the regional heroin market in recent years. Source: *Transnational Organized Crime in Southeast Asia: Evolution, Growth and Impact 2019* (TOCTA-EAP), (UNODC, 2019).

Fact Sheet

	Year 2019 (rounded numbers)	Year 2020 (rounded numbers)	Change 2019-2020
Total opium poppy cultivation (ha)^{6 7}	33,100 (25,800 to 42,800)	29,500 (21,000 to 50,400)	-11%
Opium poppy cultivation in Shan State (ha)	28,000 (21,000 to 37,100)	24,700 (16,400 to 36,600)	-12%
Opium poppy cultivation in Kachin State (ha)	3,900 (1,900 to 7,200)	3,600 (1,800 to 8,800)	-6%
Opium poppy cultivation in Chin State (ha)	630 (573 to 677)	630 (573 to 677)	Data from 2018
Opium poppy cultivation in Kayah State (ha)	570 (434 to 706)	570 (434 to 706)	Data from 2018
Total potential production of dry opium (mt)⁸	508 (380 to 672)	405 (289 to 685)	-20%
Potential dry opium production in Shan State (mt)	442 (316 to 599)	331 (219 to 598)	-25%
Potential dry opium production in Kachin State (mt)	48 (21 to 92)	58 (28 to 141)	+21%
Potential dry opium production in Chin State (mt)	9.6 (6.2 to 14.0)	8.6 (4.9 to 17.5)	-11%
Potential dry opium production in Kayah State (mt)	8.8 (5.1 to 13.2)	7.8 (4.0 to 16.1)	-11%
Average opium yield (kg/ha)⁹	15.4 (10.0 to 22.3)	13.7 (12.7 to 14.8)	-11%

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

	Year 2019 (rounded numbers)	Year 2020 (rounded numbers)	Change 2019-2020
Farm-gate price of fresh opium ¹⁰	145 US\$/kg (217,076 Kyat/kg)	131 US\$/kg (174,311 Kyat/kg)	-11% ¹¹
Farm-gate price of dry opium	160 US\$/kg (239,489 Kyat/kg)	144 US\$/kg (190,620 Kyat/kg)	-12%
Farm-gate value of opium in million US\$	61 - 107	42 - 98	-31% to -8%
Value of the opiate economy (gross) in million US\$	649 - 1,370	502 - 1,579	Stable
Value of the opiates economy (net) in million US\$	588 - 1,263	444 - 1,481	Stable
Total opium poppy eradication reported by the Government of Myanmar (ha)	2,460	2,023	-18%

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

6 The estimates may include areas eradicated after the acquisition date of the satellite images.

7 In 2020, the opium poppy cultivation survey covered Shan and Kachin States. Due to budget constraints 46 sample locations were available in Shan and Kachin States (compared to 84 locations in 2019), which increased uncertainty around area and production estimates. Chin and Kayah States were not covered in 2020 and latest available area estimates (2018) were used to calculate the total opium poppy cultivation area.

8 In 2020, for the first time since 2015, a yield survey was conducted in Kachin State and the updated yield estimates were used to estimate 2020 opium production in Kachin. In absence of yield surveys in Shan State in 2020, a multi-year average of all yield data from 2014 onwards was calculated for each Shan State region; percentage changes in production are therefore indicative only. It has not been possible to conduct yield surveys in Kayah State since 2014 and not at all in Chin State and, as in previous years, opium production was calculated based on latest available area estimates (2018) and the national average yield of the year under consideration (2020).

9 Average opium yield of Shan and Kachin States weighted by cultivation. Due to using a multi-year average of yields for Shan State, percentage changes are indicative only.

10 National average weighted by regional production estimates. For 2019 and 2020, exchange rates (<https://www.xe.com/>) on 20 December 2019 and 08 January 2021 were used, respectively.

11 Change calculated based US\$. Values without adjusting for inflation. Due to changes in the exchange rate, the decrease is larger in Kyat, with -18% and -20% for fresh and dry opium, respectively.

1. INTRODUCTION

1. Introduction

This report presents the results of the eighteenth opium survey in Myanmar. It has been conducted jointly by the Central Committee for Drug Abuse Control (CCDAC) of the Ministry of Home Affairs and UNODC, which has collected statistical information on illicit crop cultivation in Myanmar within the framework of its Illicit Crop Monitoring Programme (ICMP). The methodology used in this report combines satellite imagery and yield surveys to evaluate the extent of opium poppy cultivation and production in the country.¹² For this year, 46 sample locations in Shan and Kachin States were surveyed with satellite imagery to understand the area under cultivation and, as in the preceding year, Kayah and Chin States were not included in the survey.¹³ With that said, for the first time since 2015, the yield survey was conducted in Kachin in 2020 resulting in a potential opium production estimate for Kachin.

The 2020 report builds on years of data on illicit opium production in Myanmar, estimating and comparing the area under cultivation, and assessing yield and production. In 2020, the area under opium poppy cultivation in the country was estimated at 29,500 hectares (ha), declining by 11% from the 33,100ha recorded in 2019. It is important to note that the decreasing trend has persisted since 2014 when there were an estimated 57,600 ha of opium.

An estimated 405 metric tons of opium were produced in 2020, representing less than half of the estimate of 2013 (870 tons), corresponding to the regional drug market's continued shift to synthetic drugs. As in previous years, the majority of opium poppy continues being cultivated in Shan State, accounting for 84% (24,700 ha) of the total opium poppy cultivation area in 2020, followed by Kachin State at 12% (3,600 ha), with both decreasing by 12% and 6% respectively from 2019. Areas with opium cultivation in Kayah and Chin States (1,200 ha) accounted for 4% of the total based on the latest data available data (2018).

At the same time, the price for fresh opium has declined by more than 50% between 2015 and 2020 with the continued drop correlating with the decline in demand for opiates produced in Myanmar for the regional drug market. Compounded by the disruption of trade and a shortage of buyers in the wake of the COVID-19 pandemic, these trends signal that opium poppy farmers will continue facing downward pressures on income for their subsistence. According to UNODC estimates, farmers earned less than 10% of the money generated by the opiate economy in Myanmar prior to COVID-19.

While demand for opiates continues to decrease as the region's synthetic drug market expands and diversifies, organized crime groups that traffic heroin are still generating substantial profits, with heroin manufacturing and trafficking making up the vast majority of this value. In 2020, domestic heroin consumption of 6 tons was valued at US\$ 144 - 315 million, whereas the export of heroin from Myanmar to neighbouring countries was worth between US\$ 0.3 and 1.2 billion locally. Moreover, in addition to generating considerable illicit proceeds, heroin also continues to pose a significant public security and health challenge for neighbouring countries as Myanmar remains the major supplier of opium and heroin in East and Southeast Asia, as well as Australia. According to the latest available data, there are more than 3 million heroin users in the region who, together, consume roughly US\$10 billion worth of the drug annually and confirm that heroin remains an importance source of income for organized crime.¹⁴

Irrespective of the precise size of money flows, the interplay between opium cultivation, heroin production and the illicit drug economy has had a clear impact on the conflict situation in Myanmar and the establishment of peace and stability in the country. There has long been a connection between drugs and conflict in Myanmar, with the drug economy fueling the conflict, and conversely the conflict reinforcing the country's drug economy. Illicit drugs allow armed groups in Shan State and elsewhere to generate profits, while other groups that are less involved also manage to profit from "taxation" of the trade. This income underpins

12 In 2020 a socio-economic (village) survey could not be implemented due to the COVID-19 pandemic and was postponed to 2021. An in-depth analysis of the results will be presented in a separate report later in 2021.

13 Chin and Kayah States were not covered in 2020 and latest area estimates (2018) were used to calculate the total opium poppy cultivation area in order to maintain comparability with the previous surveys.

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

a corrosive political economy and facilitates continued militarization, ultimately helping sustain civil conflict. Any meaningful action to address the conflict will require breaking this cycle.

The influence of Myanmar's drug economy can be mitigated through alternative development programmes that provide assistance directly to opium-dependent communities on the ground, offering viable, sustainable sources of legitimate income. While related programmes are critical to the country's future, the drug economy must also be offset by addressing the escalating threat posed by transnational organized crime groups that continue producing and trafficking heroin while scaling-up the production of methamphetamine and other synthetic drugs for the regional drug market. It is necessary to counter drug production and organized crime networks in Myanmar in order to ensure safety, security and sustainable livelihoods for the people of Shan and Kachin, and border areas of the surrounding Mekong region.

The annual opium survey report is an essential tool for assessing the extent of opium poppy cultivation in Myanmar, as well as understanding changes in cultivation and production 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 important 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: Opium poppy cultivation density in Myanmar (average over the period 2014-2020 in ha/km²)

Source: 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

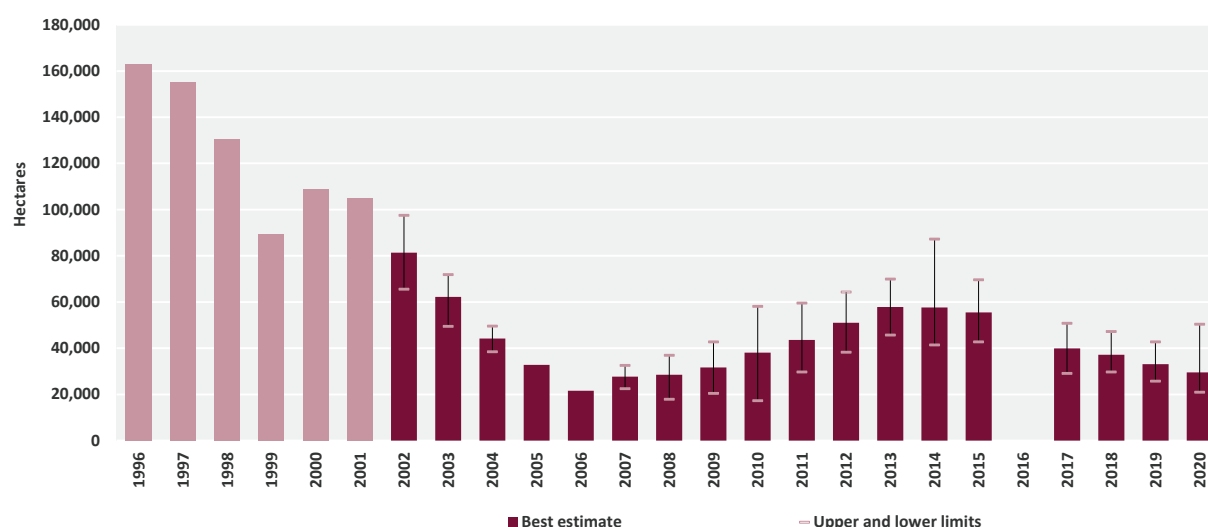
In 2020, the area under opium poppy cultivation in Myanmar was estimated at 29,500 (21,000 to 50,400) ha. This represents a decrease in cultivation of 11% from its 2019 level, 33,100 ha. The national trend has been declining since 2014 when area under cultivation was estimated at 57,600 ha (see figure 1).

The 2020 survey covered only the major producing States: Shan and Kachin. To maintain comparability with previous surveys, latest available area estimates (2018) of Chin and Kayah States were used to calculate the total area under cultivation.

Compared to 2019, decreases were observed in all surveyed regions. In Shan State, cultivation decreased by 3,300 ha (-12%): in East Shan cultivation reduced by 1,500 ha (-17%), in South Shan by 1,100 ha (-9%) and North Shan by 700 ha (-10%). In Kachin, a decrease of 200 ha (-6%) was observed.

Shan continued to be the major cultivating state in Myanmar, accounting for 84% (25,000 ha) of the overall opium poppy area (see table 1). The trend in Shan State has been declining since 2015 when the total cultivation area was estimated at 50,300 ha (see map 3). Within Shan State, the sub-regions of South, North and East Shan accounted for 37%, 25% and 22% of total cultivation in 2020, respectively. Kachin State accounted for 12% (3,600 ha), and Chin and Kayah States together for 4% (1,200 ha) (see figure 2).¹⁵

Figure 1: Opium poppy cultivation in Myanmar, 1996-2020 (ha)*



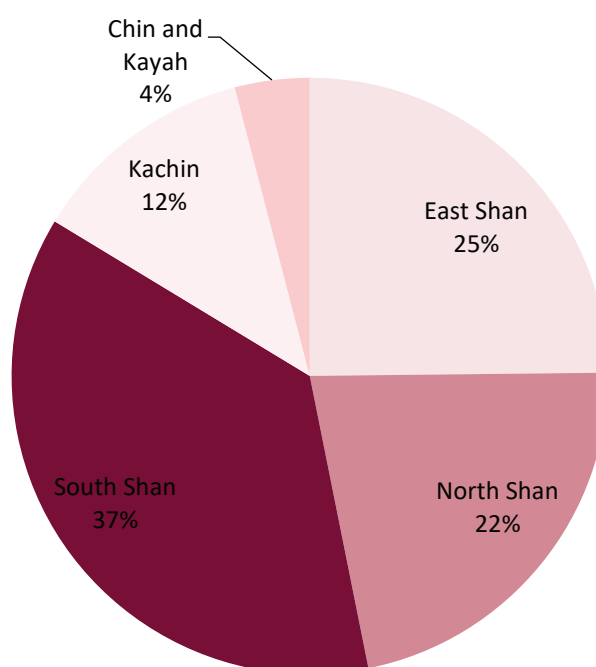
*Sources: from 1996 to 2001 USG, from 2002 to 2019 GOUM-UNODC. The surveys in 2014, 2015 and 2018 included cultivation estimates for Kayah and Chin States. In 2016 no survey was conducted. The surveys in 2019 and 2020 used latest available estimates (2018) for Kayah and Chin States. Due to budget constraints 46 sample locations were available in Shan and Kachin States (compared to 84 locations in 2019), which increased uncertainty around area and production estimates.

¹⁵ Chin and Kayah States were not covered in 2020 and latest available area estimates (2018) were used to calculate the total opium poppy cultivation area in order to maintain comparability with the previous surveys.

Table 1: Areas under opium poppy cultivation in Myanmar (ha), in 2019 and 2020

Region	Year 2019 (rounded numbers)	Year 2020 (rounded numbers)	Change 2019-2020
South Shan	12,000 (7,300 to 18,600)	10,900 (4,300 to 29,300)	-9%
East Shan	8,800 (5,800 to 12,300)	7,300 (4,000 to 12,600)	-17%
North Shan	7,200 (2,900 to 12,400)	6,500 (2,600 to 12,900)	-10%
Shan State total	28,000 (21,000 to 37,100)	24,700 (16,400 to 36,600)	-12%
Kachin	3,900 (1,900 to 7,200)	3,600 (1,800 to 8,800)	-6%
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	33,100 (25,800 to 42,800)	29,500 (21,000 to 50,400)	-11%

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

Figure 2: Regional distribution of opium poppy cultivation areas in Myanmar, 2020

*Chin and Kayah States were not surveyed in 2020 and 2019; therefore 2018 area estimates were used to calculate totals of area under cultivation and maintain comparability with 2018 estimates.

Opium poppy cultivation is concentrated in areas characterised by a combination of specific topographical conditions, challenging socio-economic circumstances and a precarious security situation. Map 1 gives an overview of the average density of opium poppy cultivation during 2014-2020. It shows high density opium poppy cultivation in the south-western mountains of South Shan and mostly medium cultivation levels in East Shan State. 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. 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 there are some areas with very high cultivation density.

In 2020, large areas with high to very high density of opium poppy cultivation were reported in the southwestern mountains of South Shan. Likewise, the eastern part of North Shan, bordering the Wa region, as well as Tanai and the border area east from Myitkyina city in Kachin State showed high concentrations of poppy.

Decreases in cultivation were observed in all major growing regions of Shan State regions in 2020. Most of the reductions in cultivation took place in areas well-suited for opium cultivation but which also exhibited a relatively stable security situation. However, armed incidents were reported by MIPS in all main producing areas of Kachin and Shan States, particularly in North Shan (see map 2). Poppy cultivation also decreased in Kachin State where cultivation had increased by 15% in 2019 (see figure 3).

Figure 3: A flowering-stage poppy field systematically cultivated with drainage groves in Kachin, 2020

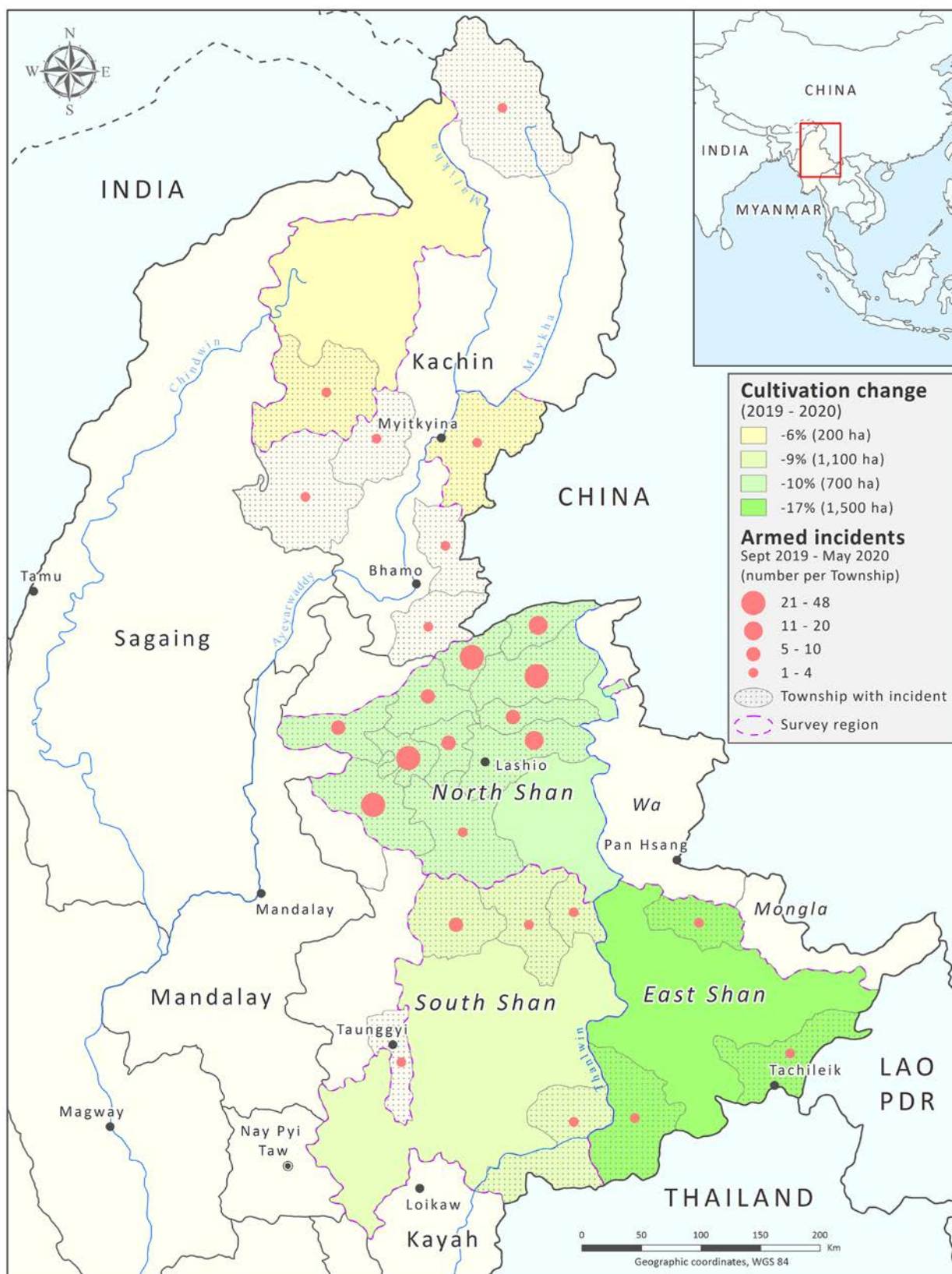


In addition to the core survey area, UNODC conducts risk assessments in areas where opium poppy cultivation has been reported by local communities. For example, in 2015, an assessment mission was conducted in three townships in the Sagaing region to establish the extent of opium poppy cultivation. In 2019, some local communities reported opium poppy cultivations in Putao and Sumprabum townships of Kachin where previous surveys (in 2014 and 2015) had only observed insignificant cultivation. For such areas, an assessment is planned to determine whether these areas need to be included in future surveys.

Figure 4: A poppy field cultivated by contour lines on a mountain flank in East Shan, 2020



Map 2: Opium poppy cultivation trends in Myanmar, 2015-2020



Source: National Monitoring System supported by UNODC; Myanmar Institute for Peace and Security (MIPS) - Monthly Peace and Security Brief.

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

Figure 5: Inter-cropping poppy field with maize (top), and young poppy plants under silver oak plantation (bottom) in South Shan, 2020



Figure 6: Weeding in a young stage poppy field by round 2 cultivation (staggered planting at different fields) in East Shan, 2020



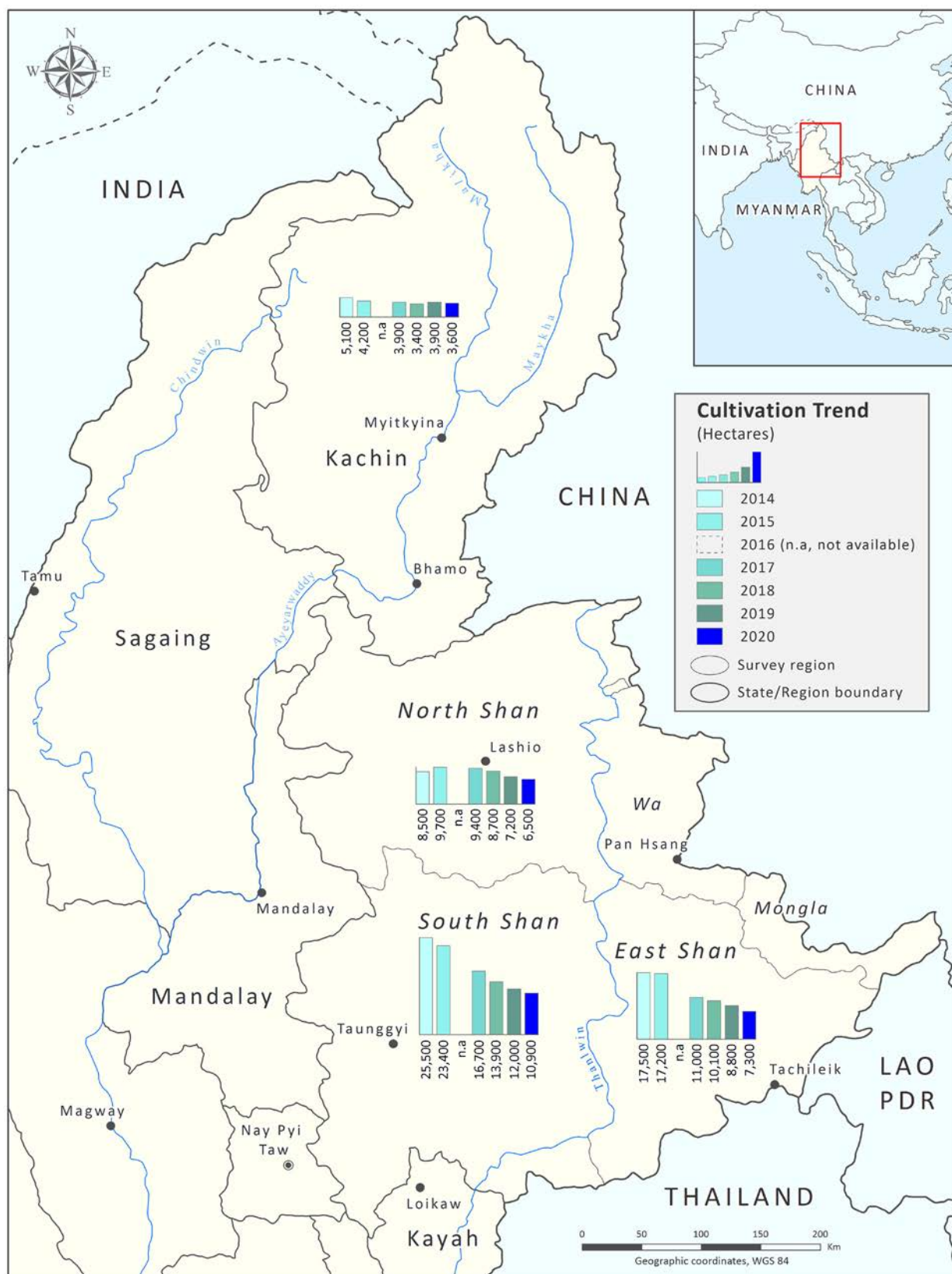
Figure 7: A rain-fed poppy field cultivated naturally in East Shan, 2020



Figure 8: A harvested dry poppy field by round 1 cultivation (staggered planting at different fields) in East Shan, 2020



Map 3: Cultivation change and reported armed incidents during the 2019-2020 opium poppy growing season



Source: National Monitoring System supported by UNODC.

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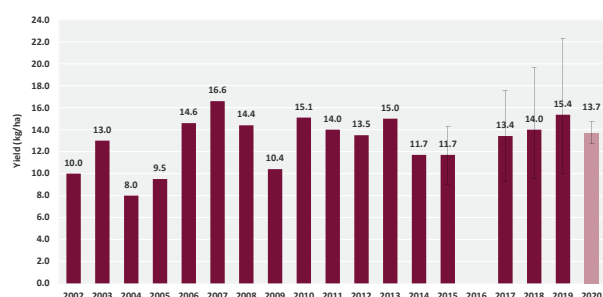
2.2 Opium yield and production estimates

In 2020, for the first time since 2015, a yield survey was carried out in Kachin State and yield estimates based on field measurements were used to calculate the 2020 potential opium production in Kachin (see figure 10). Yields in Kachin State were estimated at 16.0 kg/ha, an increase of 28% compared to the last field survey in 2015.

In the absence of yield surveys in Shan in 2020, a multi-year average of all yield data from 2014 onwards was calculated for each Shan State region. The calculated multi-year average yield was the highest in North Shan (14.7 kg/ha) followed by South Shan (13.0 kg/ha) and East Shan (12.8 kg/ha) (see table 2). It has not been possible to conduct yield surveys in Kayah State since 2014 and not at all in Chin State due to budget constraints.

The national average yield 2020 was estimated at 13.7 kg/ha (see figure 9).¹⁶

Figure 9: Average opium yield in Myanmar, 2002 – 2020



Average weighted by regional area estimates. In 2016 no survey was conducted. In 2020, a multi-year average was used to estimate yields in Shan State regions, which reduced the uncertainty ranges around the average yield, as a much larger sample size was available.

Figure 10: Yield survey measurements in Kachin, 2020



16 Average opium yield of Shan and Kachin States weighted by cultivation. See Methodology section for details.

Table 2: Potential opium yield by region (kg/ha), in 2019 and 2020

Region	2019	2020	Change
Kachin	12.5 * (9.7 to 15.3)	16.0 (14.1 to 17.9)	28%
South Shan	13.8 (12.8 to 14.8)	13.0 (12.5 to 13.6)	-6%
East Shan	13.0 (12.4 to 13.7)	12.8 (12.3 to 13.4)	-1%
North Shan	22.4 (19.1 to 25.8)	14.7 (12.9 to 16.6)	-35%
Average yield **	15.4 (10.0 to 22.2)	13.7 (12.7 to 14.8)	-11%

* Estimate is from 2015 since the yield survey could not be implemented there in 2016-2019.

** Average of Shan and Kachin States weighted by cultivation.

Values in brackets indicate the 95% confidence interval. Numbers in the table are rounded, percentage changes are calculated with exact estimates. Due to using a multi-year average, a different methodology than in 2019, percentage changes for Shan State are indicative only.

For calculating the 2020 potential opium production in Kachin State, the updated yield estimate (16.0 kg/ha) was used. Multi-year average yield estimates were used to calculate production in each Shan State region. As in previous years, the potential opium production estimates for Chin and Kayah were calculated based on latest available area estimates (2018) and the 2020 average national yield estimate.

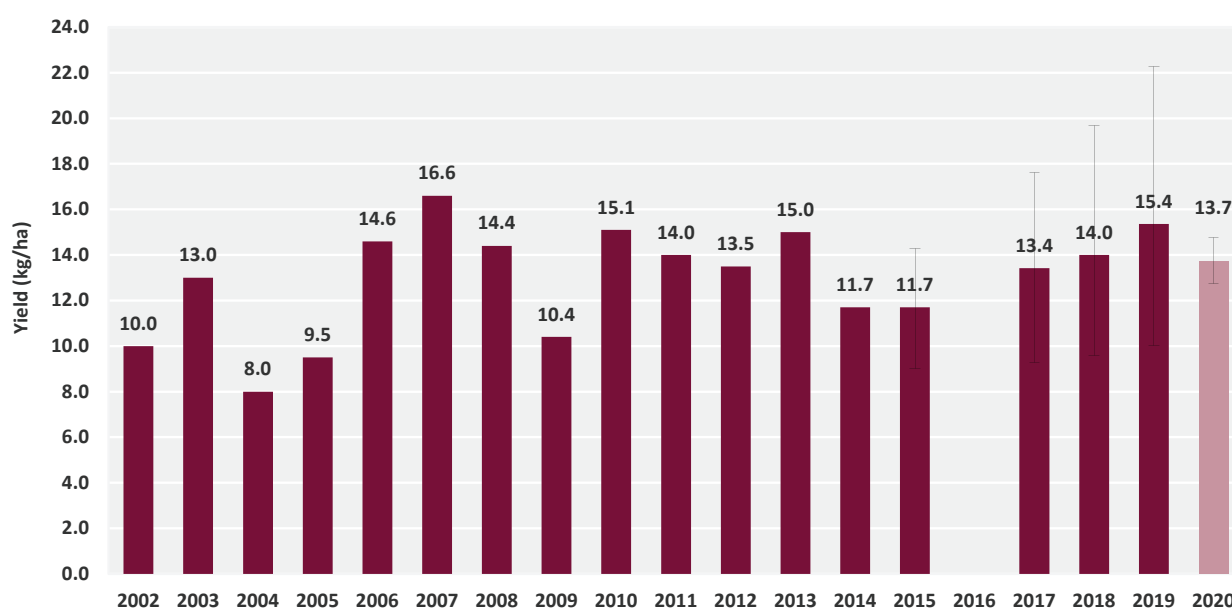
The resulting estimate of potential dry opium production in Myanmar in 2020 was 405 metric tons (see table 3). Production decreased from 2014 onwards and more than halved when directly compared to the production in that year (870 tons) (see figure 11).

Table 3: Potential opium production by region and State (metric tons), in 2019 and 2020

Region	Potential production 2019	Potential production 2020	Change 2019-2020	2020 proportion by State
South Shan	165 (100 to 257)	142 (56 to 382)	-14%	35%
East Shan	115 (76 to 160)	94 (52 to 162)	-18%	23%
North Shan	161 (62 to 282)	95 (37 to 190)	-41%	24%
Shan State total	442 (316 to 599)	331 (219 to 598)	-25%	82%
Kachin State	48 (21 to 92)	58 (28 to 141)	+21%	14%
Chin State	9.6 (6.2 to 14.0)	8.6 (4.9 to 17.5)	-11%	2%
Kayah State	8.8 (5.1 to 13.2)	7.8 (4.0 to 16.1)	-11%	2%
Total (rounded)	508 (380 to 672)	405 (289 to 706)	-20%	100%

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

In 2020, for the first time since 2015, the yield survey was conducted in Kachin State and the updated yield figures were used to estimate Kachin opium production in 2020. In absence of yield surveys in Shan in 2020, a multi-year average of all yield data from 2014 onwards was calculated for each Shan State region; percentage changes are therefore indicative only. Chin and Kayah were not surveyed in 2020 and as in the previous years, latest available area estimates (2018) and the national average yield of the year under consideration (2020) were used to calculate the total cultivation area, in order to maintain comparability with 2019 estimates.

Figure 11: Potential opium production in Myanmar, 1996-2020 (metric tons)

Source: from 1996 to 2001 USG, from 2002 to 2020 GOUM-UNODC.

In 2016 no survey was conducted. In 2020, a different yield methodology was used than in 2019; a multi-year average (2014-2019) yield estimates were calculated in Shan State regions. Due to budget constraints 46 cultivation area sample locations were available in Shan and Kachin States (compared to 84 locations in 2019), which increased uncertainty around area and thus production estimates.

Figure 12: Lancing poppy capsules in a very healthy poppy field, Kachin, 2020



Figure 13: Lancing poppy capsules in a healthy poppy field, Kachin, 2020



Figure 14: Harvesting in an unhealthy poppy field, South Shan, 2020



Figure 15: Unhealthy rain-fed poppy field suffering from lack of water, East Shan, 2020



2.3 Farm-gate price of opium

In 2020, a village survey was not implemented due to the COVID-19 pandemic, and only a limited number of fresh opium price data were collected in connection of the yield survey in Kachin and ground truthing in South and East Shan regions.¹⁷

The average farm-gate prices¹⁸ at harvest time of fresh and dry opium were assessed at 174,311 Kyat (US\$ 131) and 190,620 Kyat (US\$ 144) per kilogramme, respectively. In 2019, average farm-gate prices of fresh and dry opium were estimated at 217,076 Kyat (US\$ 145) and 239,489 Kyat (US\$ 160) per kg, respectively.

From 2019 to 2020, average farm-gate prices for fresh and dry opium decreased by 11% and 12%, respectively, not taking inflation into account. When considering inflation, the corresponding prices decreased 22% and 21%, respectively.¹⁹

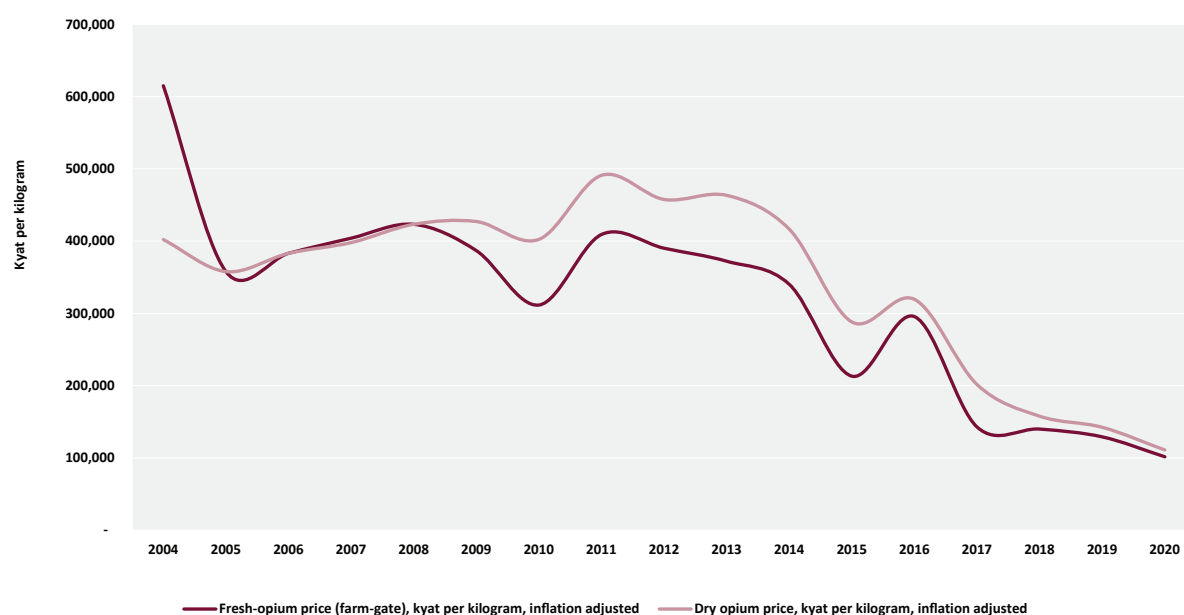
Since 2015, the corresponding farm-gate prices of fresh and dry opium have dropped significantly by 52% and 61%, respectively (see figure 16). Decreasing prices together with a reduced supply of opium can be an indication of a decreased demand for opiates from Myanmar, both in the country and throughout the region. At the same time, lower prices make opium cultivation less attractive, which might be contributing to the declining area under cultivation.

¹⁷ Prices of dry opium were estimated on the basis of collected price data for fresh opium and the ratio between the fresh and dry opium prices collected in 2019 survey.

¹⁸ Weighted average based on opium production, see Methodology chapter.

¹⁹ 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 2020 was linearly extrapolated from the 2004-2019 series.

Figure 16: Inflation-adjusted farm-gate prices (weighted average) of fresh and dry opium in poppy-growing villages, Myanmar, 2004-2020 (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 2004-2019 series.

Figure 17: Opium poppy capsule lancing tools and fresh opium gum on the harvesting tools, Kachin, 2020



Figure 18: Harvested fresh opium gum and collected big opium poppy capsules to extract the seeds for next cultivation season, Kachin, 2020



Figure 19: Drying poppy capsules for collecting the seeds for next cultivation season, East Shan, 2020



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 (see table 4).

The farm-gate value of opium is an important measure of the gross income of farmers generated

by opium poppy cultivation. In 2020, it was estimated to range between US\$ 58 to 98 million (mid-point US\$ 42 million) (see table 5). These values were calculated using information on farm-gate prices collected in South Shan and East Shan regions, and in Kachin State during yield survey and ground truthing activities.²⁰ The amount of potential opium production which ranged between 289 and 685 tons (mid-point 405 tons).

Table 4: Estimated quantities of the different opiate market components, 2020

Opium production 2020	Domestic demand for unprocessed opium	Domestic demand for heroin	Unprocessed opium for consumption potentially available for export	Heroin potentially available for export
405 (289 to 685)	22 tons	5.8 tons	55 tons	13 - 53 tons

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

Table 5: Estimated values of the opiates economy, 2020

	Gross value Millions of US\$	Value in relation to GDP (%)
Value of the opiates economy (gross) **	502 – 1,579	0.7 - 2.1
Value of opiates potentially available for export	341 - 1,247	0.4 - 1.6
Raw opium	42	
Heroin	299 - 1,205	
Value of the opiates market for domestic consumption	161 - 332	0.2 - 0.4
Raw opium	17	
Heroin	144 - 315	
Farm-gate value of opium	58 - 98	0.1
Value of the opiate economy after farm-gate to the border	444 – 1,481	0.6 - 1.9

GDP 2019. Source: World Bank.

The gross value of opiates is the sum of the value of the domestic market and the value of opiates believed to be exported. Numbers in the table are rounded, 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.

²⁰ Information on fresh opium prices was collected in South Shan and East Shan between December 2020 and January 2021, and in Kachin in March.

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.²⁴ 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.

After deducting the seizures of opiates reported by relevant law enforcement agencies,²¹ it was estimated that 77 tons of raw opium and some 19 to 60 tons of heroin reached the illicit market.²² Out of the 77 tons of opium, 22 tons were destined for domestic consumption, with a value of US\$ 17 million; the remaining 55 tons of opium were exported with a value of US\$ 42 million.

The main value of the opiate market was generated by consumption, manufacturing and trafficking of heroin. In 2020 domestic consumption of 6 tons of heroin led to an income between US\$ 144 - 315 million, whereas the export of heroin (13 - 53 tons) was deemed to be worth between US\$ 299 million - 1.21 billion for Myanmar traffickers.

The overall gross value of the Myanmar opium economy for the year 2020 ranged between US\$ 502 and 1.58 billion, equivalent to a 0.7 - 2.1% share of the 2019 national GDP.²³ The value of manufacturing and trafficking after farm-gate up to the border of Myanmar ranged between US\$ 444 and 1.48 billion (0.6 - 1.9% of the GDP). These values represent the income generated by traffickers after deducting the costs of buying raw opium from the farmers.

21 GOU/CCDAC reported by 7 October 2020 the seizure of 6,506 tons of opium and 1,389 tons of heroin. The quantities of opiates seized in the whole year 2020 were extrapolated based on these figures, 7,801 and 1,666 tons respectively.

22 See more in Methodology chapter.

23 Source: World Bank.

24 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 previous years, the Government of the Republic of the Union of Myanmar (GOURM) provided data on eradication of opium poppy and seizures of opium and heroin in 2020.

3.1 Eradication

By the end of May 2020, GOURM/CCDAC, reported that 2,023 ha of opium poppy had been eradicated,

representing a decrease of 18% compared to 2019 (see table 6). As in previous years, most of the eradication, 1,856 ha or 92%, occurred in Shan State and particularly in the South Shan region (1,571 ha, 78%), followed by North Shan (179 ha, 9%), East Shan (106 ha, 5%), and Kachin (75 ha, 4%). The decline in eradication started in 2015 and shows a trend similar to the area under opium poppy cultivation (see figure 20).

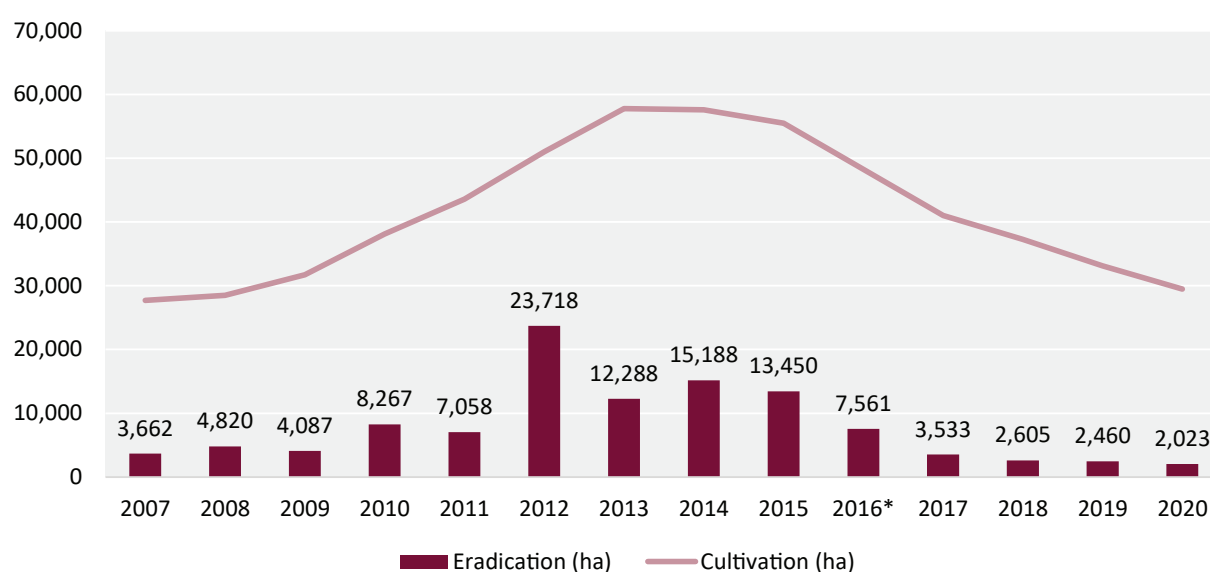
Table 6: Reported eradication in Myanmar (ha), 2007-2020

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	2019-2020
East Shan	1,101	1,249	702	868	1,230	1,257	537	356	378	482	264	224	100	106
North Shan	916	932	546	1,309	1,315	977	532	337	532	69	97	29	44	179
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	1,571
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	1,856
Kachin	189	790	1,350	2,936	847	83	250	395	1,495	1,504	28	65	126	75
Kayah	12	12	14	13	38	84	59	67	54	16	47	12	3	0
Magway	45		1	1		4	7	60	8	9	47	44	19	25
Chin	10	86	5	2	10	110	32	277	267	534	28	22	50	35
Mandalay		3	2		39	45					1			
Sagaing	9		1				2	1					118	31
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	2,023

Source: GOURM/CCDAC.

Figures for 2020 are partial and refers to the period October 2019 – May 2020.

Figure 20: Eradication versus opium poppy cultivation in Myanmar (ha), 2007-2020



*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 (see map 1 and 4). In East Shan, eradication activities had a more irregular and dispersed pattern, covering different density levels, from low to very high. In North Shan significantly more eradication was reported in 2020, 179ha, when compared to 44ha in 2019. Eradication was concentrated in the south, near the border with the Wa special region and in the north next to Shwe Li river.

In Kachin State, eradication was reported at the border with China while there was no reporting from other medium to high density areas such as the region surrounding Tanai town. In Chin State and the Magway and Sagaing Regions, a total of less than one hundred ha of eradication was reported, 25 ha, 31 ha, 35 ha, respectively.

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 dates, it is not reflected in the estimated cultivation figures. Additionally, Data provided by GOUM may include eradication activities 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.

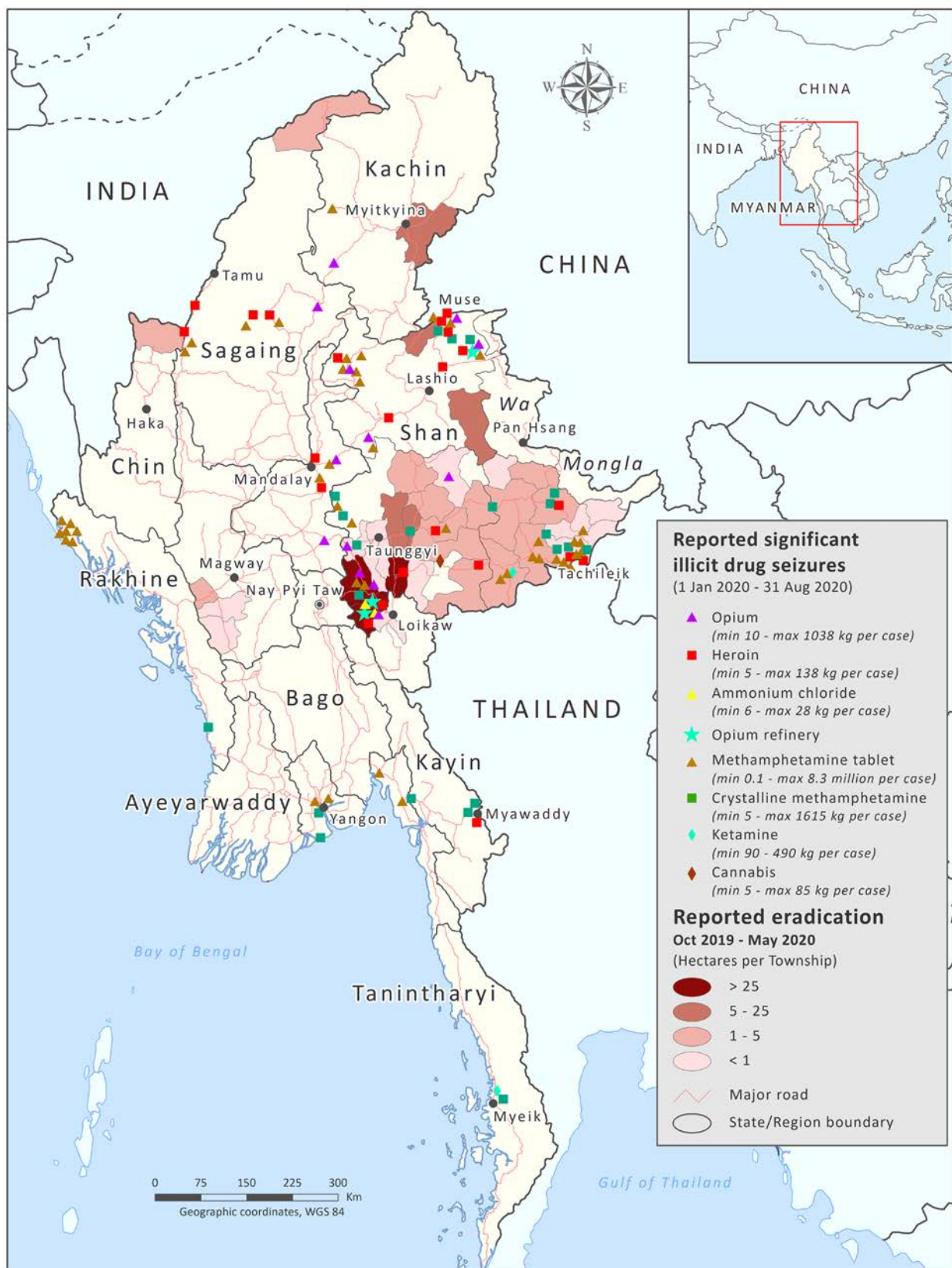
Figure 21: GOUM poppy eradication in South Shan, 2020



Figure 22: GOUM poppy eradication in East Shan, 2020



Map 4: Reported eradication of opium poppy 2019-2019 and seizures of all drug types in Myanmar, January 2020 to August 2020²⁵



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.

²⁵ The map does not depict all reported seizures by CCDAD but major seizures only.

3.2 Seizures

Unlike eradication, seizures of different opium products reported by GOUM/CCDAC increased in all opiate types except low-grade opium which

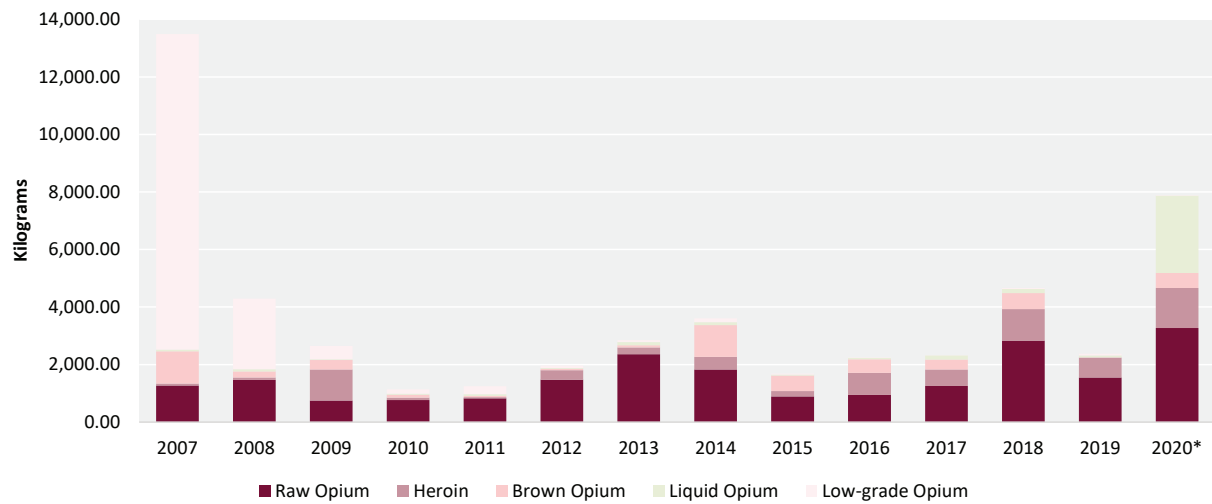
decreased (see figure 23). Most of the opium and heroin seizures took place near border cities, such as Muse, Tachileik, Myawaddy, and other cities along trafficking routes, such as Lashio, Mandalay, and Kyaing Tong as shown in Map 4.

Table 7: Seizures of drugs (opiates) in Myanmar (kg), 1988-2020*

Year	Raw Opium	Heroin	Brown Opium	Liquid Opium	Low-grade opium
1988-1997	22,992	3,722	186	118	306
1998	5,394	404	96	206	312
1999	1,473	245	24	333	314
2000	1,528	159	23	16	245
2001	1,629	97	7	19	142
2002	1,863	334	314	18	126
2003	1,482	568	156	52	204
2004	607	974	59	39	396
2005	773	812	44	21	128
2006	2,321	192	1,371	29	6,154
2007	1,274	68	1,121	56	10,972
2008	1,463	88	206	80	2,453
2009	752	1,076	326	27	465
2010	765	89	98	35	147
2011	828	42	37	60	282
2012	1,470	336	46	29	81
2013	2,357	239	72	115	66
2014	1,828	435	1,109	102	134
2015	889	186	539	38	35
2016	944	769	472	47	22
2017	1,256	754	348	146	6
2018	2,829	1,099	554	146	30
2019	1,553	690	6	65	66
2020*	3,269	1,389	523	2,694	20

Source: GOUM/CCDAC.

* Figures for 2020 correspond to 1 January – 7 October only.

Figure 23: Seizures of opiates in Myanmar (kg), 2007-2020*

Source: GOUN/CCDAC.

* Figures for 2020 correspond to 1 January – 7 October only.

Figure 24: GOUN seized methamphetamine and heroin labs in Shan State, 2020**Figure 25: GOUN seized 108 kg of heroin together with 9 kg of crystal methamphetamine in Kayin State, 2020****Figure 26: GOUN seized 138 kg of heroin together with 1599 kg of crystal methamphetamine in Kayin State, 2020**

4. METHODOLOGY

4. Methodology

The 2020 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 Kachin State. Due to insecurity in the area, crop yield measurements could not be conducted in Kachin during the past four years (2016-2019). Additionally, the crop yield data collection has been conducted throughout North Shan, South Shan and East Shan in the past three years (2017-2019) but not in 2020;
3. Small-scale data collection for price information on fresh poppy was implemented in conjunction with ground truthing activities in South Shan and East Shan regions and yield survey activities in Kachin, instead of the socio-economic (village) survey.²⁶

4.1 Area estimation

Remote sensing imagery

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

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

of Kachin State (see *Target area interpretation and correction factors* section).

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

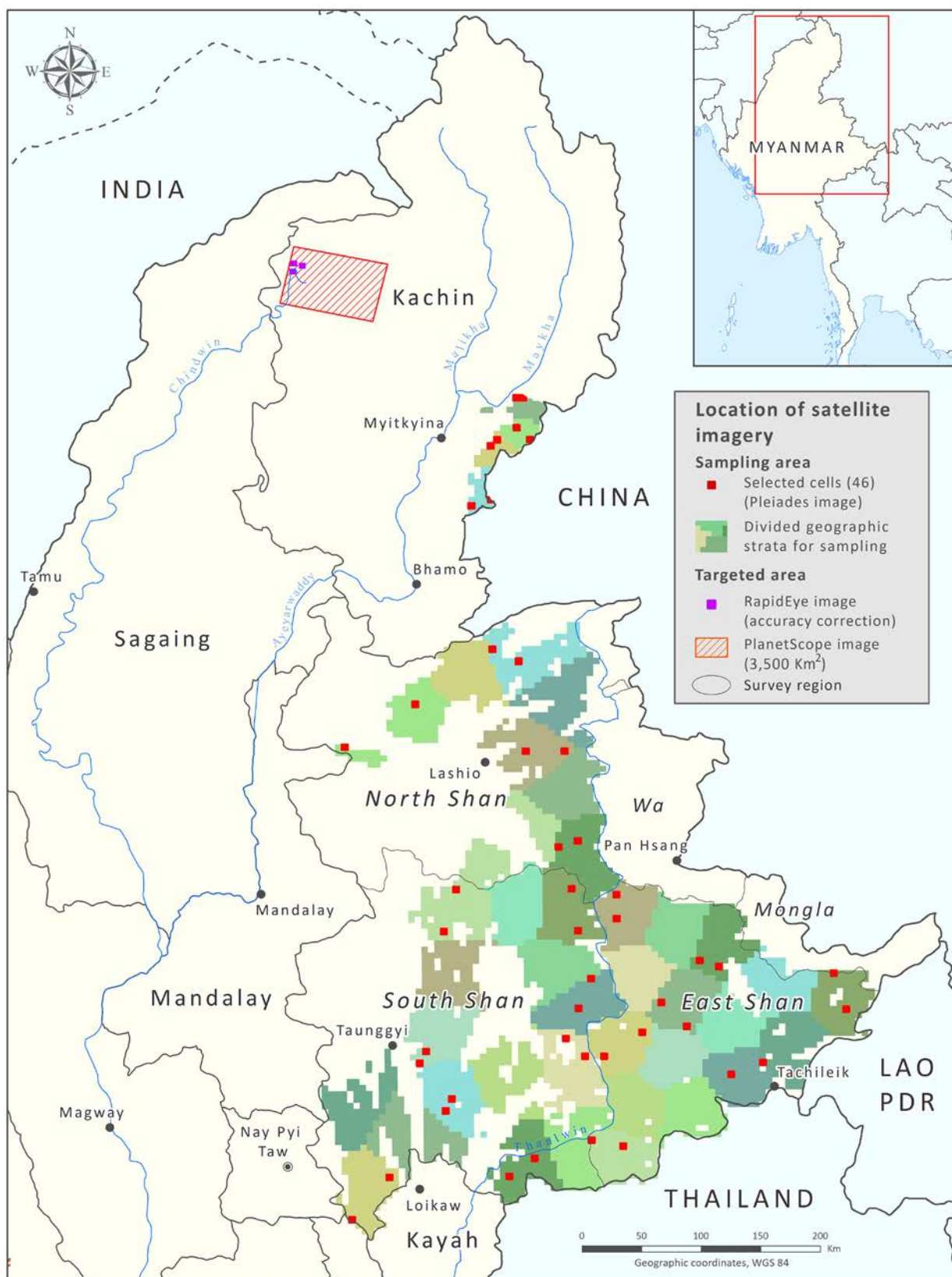
The VHR images at the sample locations were acquired by Pleiades satellites, which provide images of 2 metre ground resolution with four spectral bands (blue, green, red and infra-red) and a 50 centimetre panchromatic band. For each location (sample segment), two images were acquired with an approximate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

The imagery covering the Tanai area in Kachin State was acquired by PlanetScope satellites, with 3 metre (approx.) ground resolution for orthorectified products. It provides four spectral bands, ranging from blue to near infrared bands. PlanetScope imagery was used for the first time to identify and interpret opium poppy in the context of the Myanmar Opium Survey 2020, whereas RapidEye images have been used in several previous opium surveys.²⁷ Therefore, a few HR RapidEye images with 5 metre resolution were acquired as orthorectified products for selected location in the Tanai area to evaluate the quality of the interpretation results derived from the PlanetScope imagery for the first time. Unlike in 2019, no VHR Pleiades images were acquired for Tanai in 2020 due to budget constraints.

²⁶ Due to an unprecedented situation and required restrictions of the COVID-19 pandemic, the scheduled socio-economic survey in poppy growing areas of Kachin State was postponed to the first quarter of 2021, before monsoon rains. An in-depth analysis of the results will be presented in a separate report, expected to be published later in 2021.

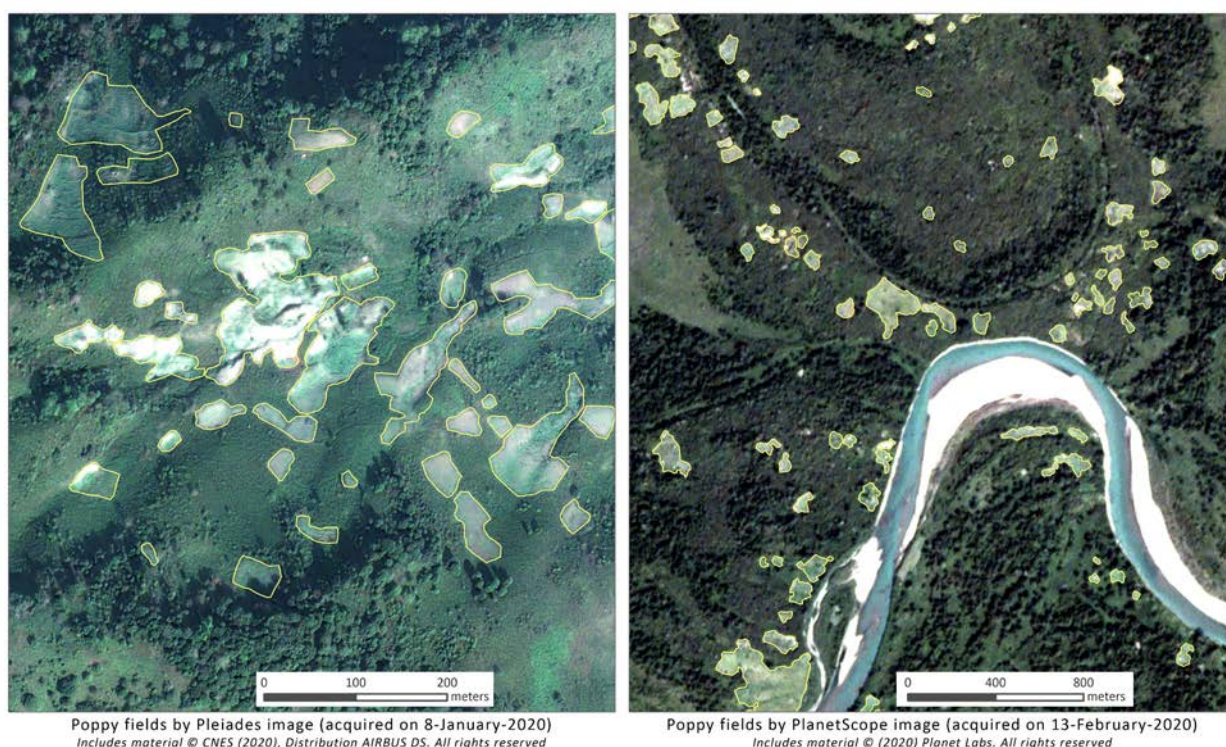
²⁷ RapidEye satellite constellation was decommissioned in March 2020 and thus imagery could no longer be acquired from the sensor.

Map 5: Different satellite imagery and approaches used for the survey, 2020



Source: 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.

Figure 27: VHR image (Pleiades) on the sampling area vs. HR image (PlanetScope) on the targeted area

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. The risk area for the opium survey was developed by the combination of the following factors:

- 1) Land Cover;
- 2) Altitude; and
- 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.

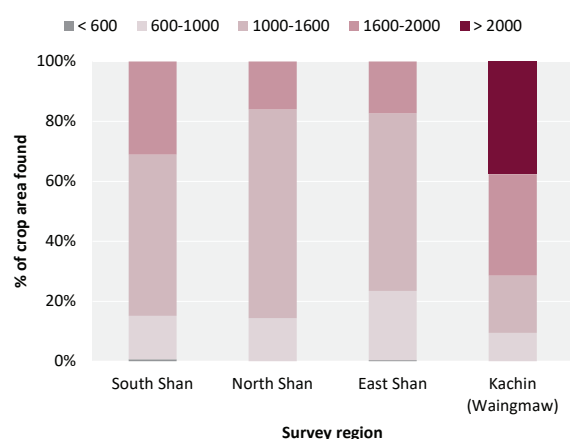
Several opium poppy-free areas were identified based on ground information. The special regions; Wa (former S.R.2), Mongla (former S.R.4), and Kokant (former S.R.1); were excluded from the sampling frame. The townships; Mabein, Kyaukme, Nawngkhioand Kunlong in North Shan; and Kalaw, Pindaya, Lawksawk, 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, has been included again in sampling frames since 2013 because ground information from the 2012 survey indicated a certain poppy risk.

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

Table 8: Sample size allocation in 2020

Region	Sample size 2019	Sample size 2020	Number of geo-strata 2019	Number of geo-strata 2020
East Shan	30	14	15	7
South Shan	30	16	15	8
North Shan	16	8	8	4
Kachin	8	8	4	4
Total	84	46	42	23

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.

Figure 28: Altitude ranges (metres) of area of poppy fields detected in satellite images, 2019/2020

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.

The 2020 sample locations were chosen on the 2019 sample which used the following method. 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 was 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 *R*²⁹ package *Spcosa* has been 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. For more details, see the Myanmar Opium Survey of 2015.³⁰

In 2020, the total number of satellite images chosen was set to 46. In Kachin, the same number of samples and sample locations were kept as in the previous year. In Shan, a sub-sample of 38 sample locations was selected, halving the number of samples in comparison to 2019. These numbers were mainly defined by the available budget. A potential bias in the area estimates due to the reduced sample size was considered in the area estimation methodology.

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.

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. From 2019 onwards, the

Forest Department was not involved in the opium survey activities. A technical team from UNODC Myanmar office, including four members, visited 12 satellite image sites in Shan and 3 sites in Kachin to collect ground truth data (see table 9). The team, in collaboration with the local drug enforcement police, visited selected satellite sample sites during the period of December 2019 to February 2020 (see figure 29 and 30).

Figure 29: “Ground truthing” in South Shan and East Shan, 2020



Figure 30: “Ground truthing” in Kachin, 2020

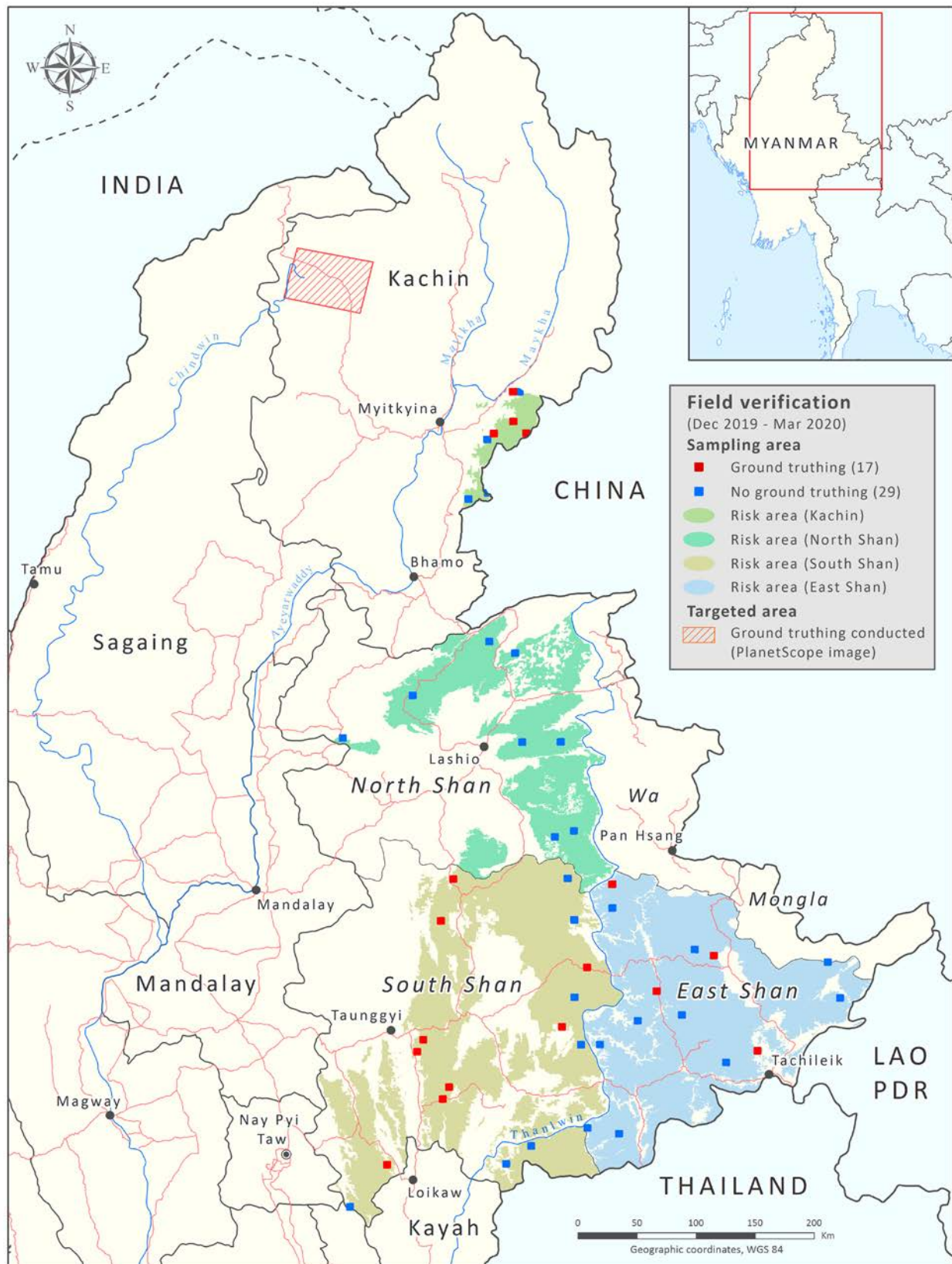


The ground verification teams visited selected sites with printouts of the satellite. Once the teams reached the area represented in each single scene, they annotated the printouts with the land use classes and relative boundaries proceeding with specific transect itineraries. They collected GPS coordinates taking field photos from 12 selected

satellite image sites in Shan State and 3 sites in Kachin State. Additionally, poppy fields were visually interpreted by an UNODC national expert from the Myanmar office. The results were verified, and standard quality control procedures were applied by international experts at UNODC Headquarters, Vienna.

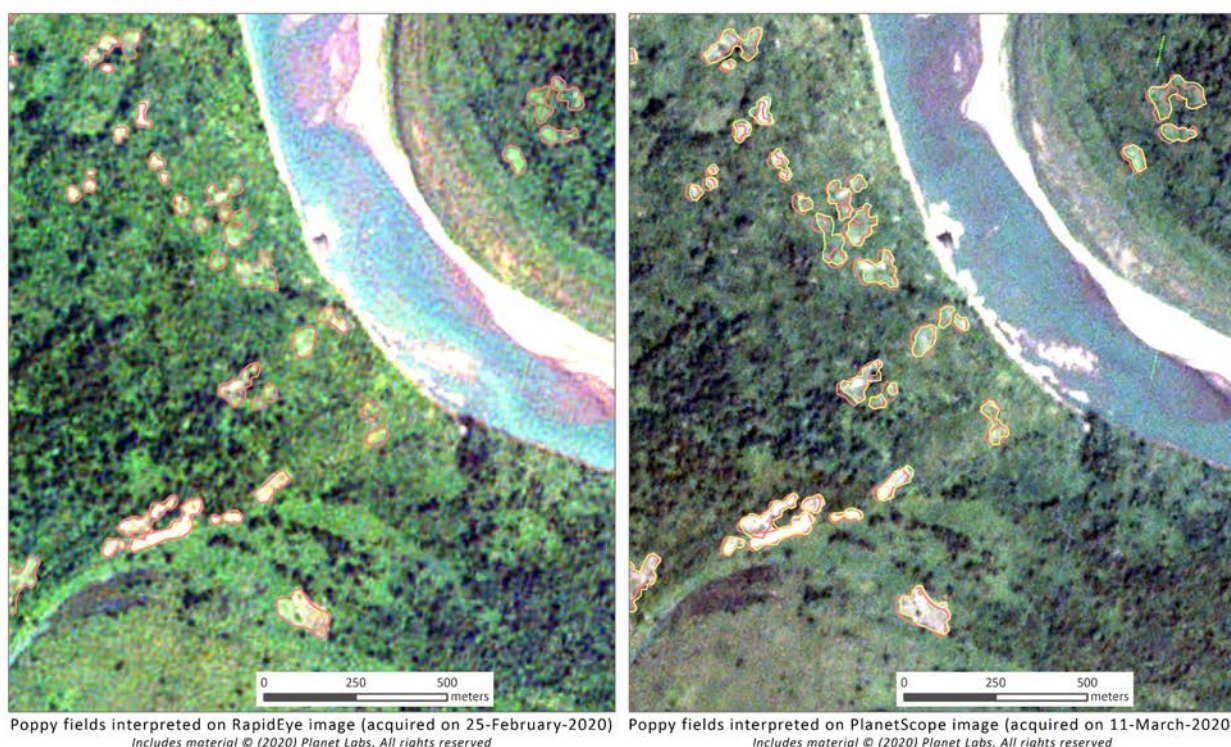
Table 9: Ground truth data collection, 2007-2020

Survey Year	Satellite image VHR	No. of segments in Shan	Segment size (km)	Segments visited in Shan (ground truth)	Ground truth % in Shan	No. of segments in Kachin	Segments visited in Kachin (ground truth)	Ground truth % 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, World-View	40	6.5 x 6.5	32	80%	3	--	--	3,634
2011	World-View, QuickBird	51	6 x 6	40	78%	3	--	--	3,888
2012	GeoEye, World-View	58	5x5	47	81%	8	--	--	3,300
2013	GeoEye, World-View	66	5x5	46	70%	8	--	--	3,700
2014	GeoEye, World-View, 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	--	--	2,300
2018	Pleiades	76	5x5	30	39%	8	--	--	4,200
2019	Pleiades	76	5x5	32	42%	8	--	--	4,200
2020	Pleiades	38	5x5	12	32%	8	3	38%	2,300

Map 6: Field verification status of the survey with satellite images, 2020

Source: 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.

Figure 31: Poppy fields interpreted on RapidEye and PlanetScope satellite imagery**Target area interpretation and correction factors**

The area estimate for Tanai area in Kachin State was based on a ‘target approach’ (full coverage survey).³¹ The Tanai area was fully covered with high resolution (HR) PlanetScope satellite imagery. In addition, RapidEye (HR) satellite images were acquired to cover three selected locations within the Tanai area, i.e. the area also covered with PlanetScope (see map 5). The imagery acquired by RapidEye allowed to calibrate the poppy interpretations made with the PlanetScope imagery, since the accuracy of interpretations made from RapidEye was generally known from the previous survey, while the PlanetScope was used for the first time to analyse poppy fields in Myanmar. No very high resolution (VHR) images were acquired for Tanai in 2020.

The area of opium poppy fields was first interpreted on the PlanetScope and then on the RapidEye images (see figure 31). By interpreting poppy fields from both sensors’ imagery independently, a correction factor was determined that provides the difference in the interpreted area from PlanetScope compared to RapidEye in the same extent. Subsequently, this factor was applied to the

fields that were only covered by PlanetScope (i.e. the entire extent of the Tanai area) to adjust the area interpreted from PlanetScope (3m resolution) to the resolution of the RapidEye imagery (5 m resolution). Here, it should be noted that, in fact, the method did not correct the interpretation to a higher resolution but vice versa: adjusted the result to a lower resolution. This approach, however, was necessary as part of the two-step approach to make the results comparable with surveys from previous years, when RapidEye imagery was used as the main dataset in the Tanai area. This was referred to as the first correction factor in 2020 (see table 11).

In the previous 2019 survey, the Tanai area was fully covered with RapidEye satellite imagery. VHR Pleiades imagery was acquired in three locations to estimate the omission/commission and geometric errors that stem from the use of RapidEye imagery with lower spatial resolution. The area of opium poppy fields was interpreted on the RapidEye imagery and on the Pleiades images independently from each other. The difference between the areas of the two interpretations was used to calculate a correction factor. For more details, see the Myanmar Opium Survey of 2019.³²

31 The target area was defined based on information on poppy cultivation from previous surveys since 2009.

32 https://www.unodc.org/documents/crop-monitoring/Myanmar/Myanmar_Opium_Survey_2019.pdf.

The second step of the approach in 2020 was to correct the interpretation results from RapidEye (the outcome of the first step) to the accuracy of the VHR imagery using the correction factor from 2019 (see table 12). This second correction factor was applied to all interpreted fields to define the final area estimate for the Tanai area, which is comparable to the surveys of previous years.³³

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 long-time experience in poppy detection and interpretation of the fields.

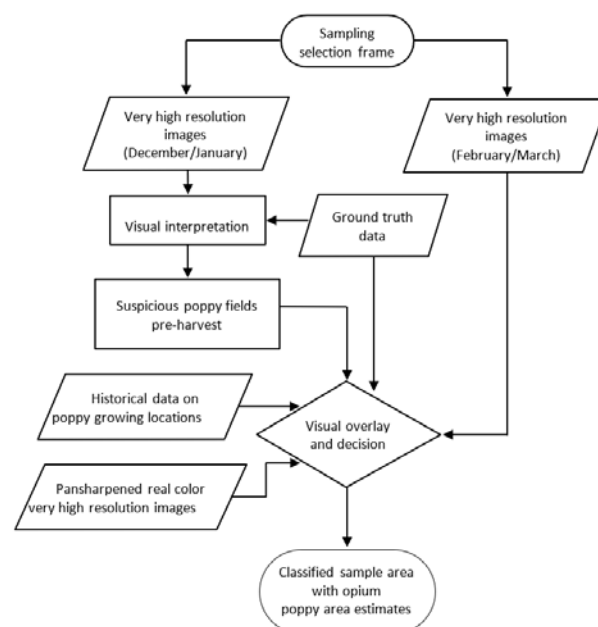
The classification procedure of the VHR images is illustrated in the flowchart below (see figure 32). Before the interpretation phase, the acquired imagery is pre-processed through a number of steps into a stable, uniform format for the visual analysis.

The main pre-processing step is pansharpening (merging) of the Pleiades high resolution panchromatic and lower resolution multispectral imagery 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.

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.

Figure 32: Satellite image interpretation flowchart

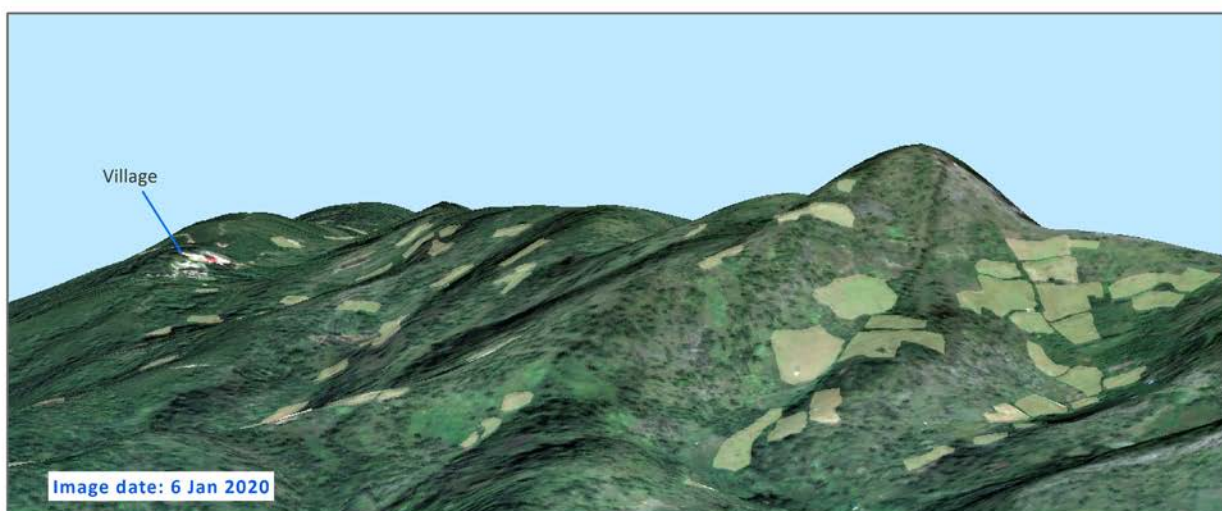


The images acquired in the second phase were used to observe changes in possible poppy-growing fields. If there was an apparent change that corresponded to the harvesting of the poppy, it was used to confirm that the field was indeed a poppy field. Since the images were not geometrically corrected an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

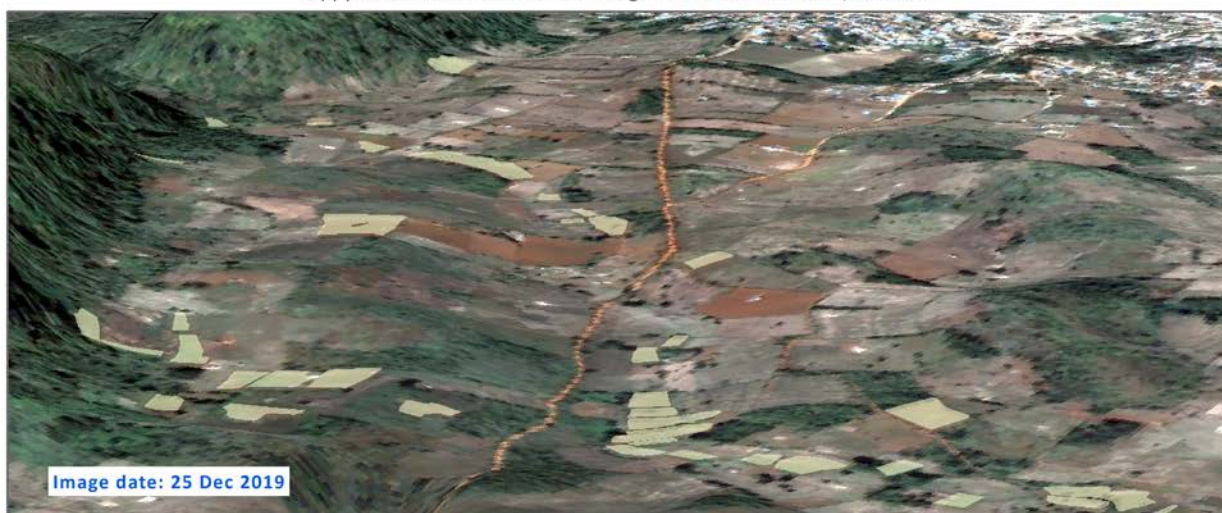
The decision rules can vary by region and stage of poppy cultivation. However, the most commonly applied rule was that potential poppy in the first image, when classified as bare soil in the second image, meant that it was opium poppy. Historical data on poppy cultivation, three-dimensional (3D) terrain visualisation and real colour pansharpened VHR images were used to facilitate the decision-making (see figure 33).

³³ 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.

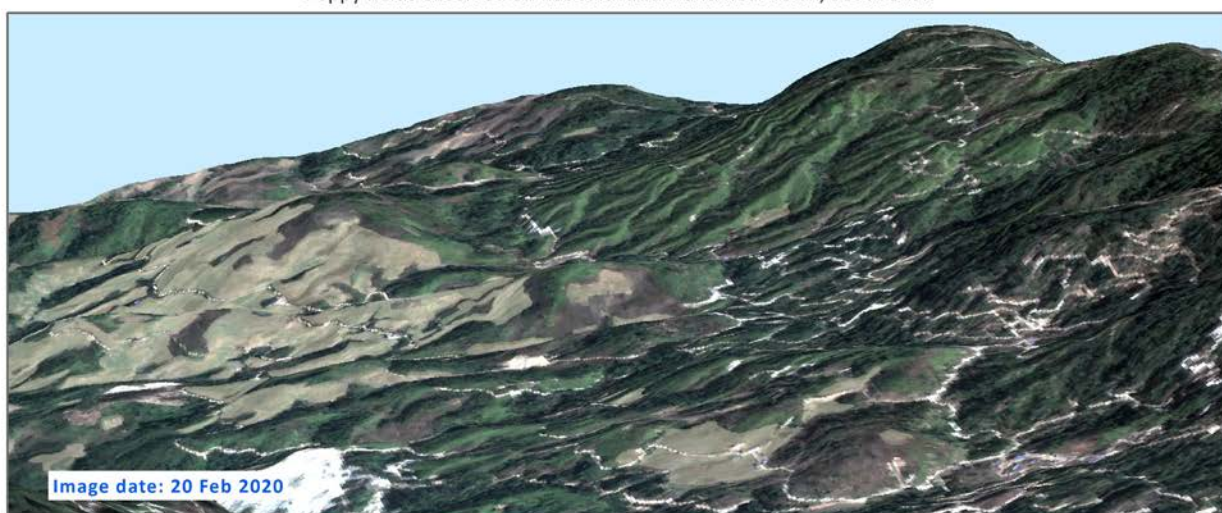
Figure 33. Poppy interpretations on Pleiades imagery and visualised in 3D



Poppy fields observed around a village on remote mountains, East Shan



Poppy fields observed on flat cultivation land near Town, South Shan



Complicated route network near a poppy cultivation hotspot area, Kachin

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3D visualization of interpreted poppy fields on Pleiades image draped on SRTM Digital Elevation Model (DEM)

Figure 34. Changes of poppy field observations between 2019 and 2020



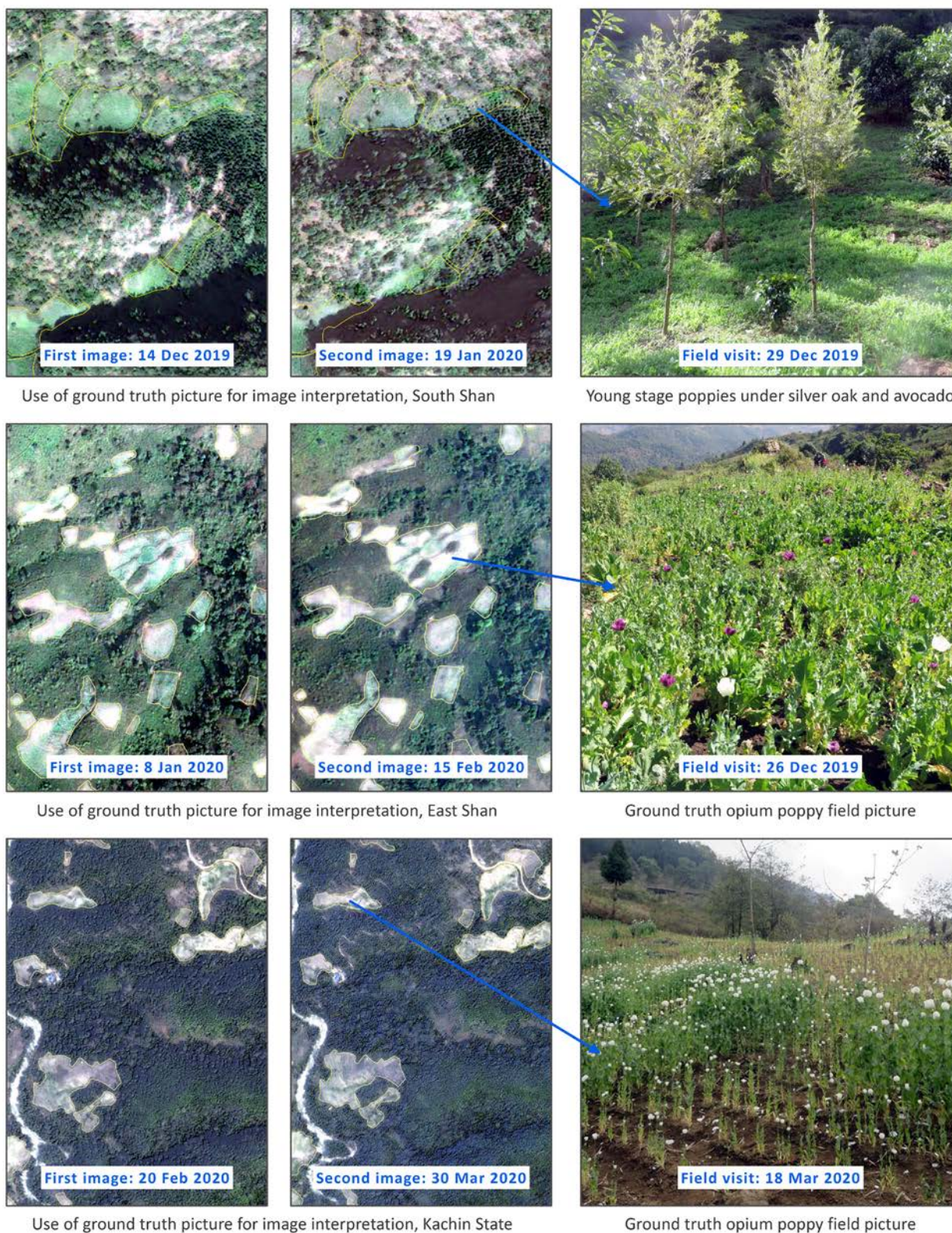
RapidEye satellite images (true colour composite)

Includes material © (2019, 2020) Planet Labs, all rights reserved



If compare to 2019, significantly decrease quantity of poppy fields in 2020, with developing new agricultural land
Tanai area, Kachin

Figure 35. Satellite image interpretations with the corresponding ground truth data



Very high-resolution, PLEIADES satellite images (pansharpened, true colour composite)
Includes material © CNES (2019, 2020), Distribution Airbus DS, all rights reserved

Area estimation methods in 2020

The area estimation consisted of a sampling estimate and a target area estimate (see table 10). The final national estimate is the exact sum of the regional estimates – in other words, poppy estimated in the sample regions of Shan and Kachin States and the estimate obtained from the target areas of Tanai in Kachin.³⁴ 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 regional level, a simple combined ratio estimate was calculated. The ratios were then extrapolated to risk area outside the frame. In 2020, 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.

In 2020, only a sub-sample of the 2019 sample was available. Using less samples may lead to a bias of the estimates, as it is possible, that by chance, samples with on-average higher or lower levels of cultivation have been chosen rather than the overall average of samples.

To correct for such a potential bias, the trend 2019-2020 was estimated. In practice this meant that the change between the two ratio estimators in 2019 and 2020 (using the images that were selected

for the 2020 half sample) was applied to the area estimation in 2019 to calculate the 2020 area.

By adjusting for the bias in the half sample, the estimates are comparable, under the assumption that the observed and unobserved samples behaved the same way.

Bootstrapping³⁵ 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. The confidence interval of the national estimate combines the uncertainty of the regional estimates.

The reduced number of samples available in 2020 has led to an increased confidence interval around area and production estimates.

Table 10: Estimated poppy cultivation areas for the sampled areas in 2019 and 2020

Region	2019	2020	Difference 2019-2020
South Shan	12,002	10,867	-9%
East Shan	8,844	7,327	-17%
North Shan	7,186	6,497	-10%
Kachin	2,618	2,503	-4%
Total	30,650	27,194	-11%

Table 11: Estimated poppy cultivation areas for the target area in 2020, 1st correction factor (from PlanetScope to RapidEye)

Target area	Interpreted poppy area (in PlanetScope imagery) (ha) before correction factor	Correction factor 2020	Interpreted poppy area (ha) after correction factor (RapidEye)
Tanai (Kachin State)	1,227	4.68%	1,284

³⁴ Chin and Kayah States were not covered in 2020 and latest available area estimates (2018) were used to calculate the total national estimate.

³⁵ <http://cran.r-project.org/web/packages/boot/index.html>.

Table 12: Final estimated poppy cultivation areas for the target area in 2020, 2nd correction factor (From RapidEye to Pleiades VHR)

Target area	Interpreted poppy area (ha) after 1 st correction factor	Correction factor 2019*	Interpreted poppy area (ha) after correction factor
Tanai (Kachin State)	1,284	-12.77%	1,120

* 2019 correction factor was applied as no VHR imagery was acquired in 2020 due to budget constraints.

4.2 Yield and potential opium production estimation

Collection of yield data

In 2020, for the first time since 2015, the yield survey was conducted in Kachin State. The 2020 yield data collection was conducted by opportunistic manner in Kachin (see map7).³⁶ No yield data was collected in the Shan State regions, the main poppy cultivating areas in Myanmar.

This year, similarly to previous surveys (from 2017 onwards) the crop yield data collection was implemented by UNODC together with the support of local Drug Enforcement Units (former Anti-Narcotic Task Forces). A field team which included three UNODC national staff from UNODC Myanmar office, together with one officer from the local Drug Enforcement Unit, conducted collection of yield data in Kachin. Data collection was conducted in 41 poppy growing villages in Tanai, Waingmaw, Chipwi Townships and Sadung, Kan Paik Ti Sub-Townships during the period of 26 February to 30 March 2020. The villages were selected opportunistically 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.³⁷ 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 was 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 (see figure 35). All the measurements were recorded by digital cameras to check for data quality assurance.

In total, field data of 117 poppy fields were collected and 3,409 poppy capsules were measured in the 2020 yield survey.

Figure 35: Measuring poppy capsule in Kachin, 2020

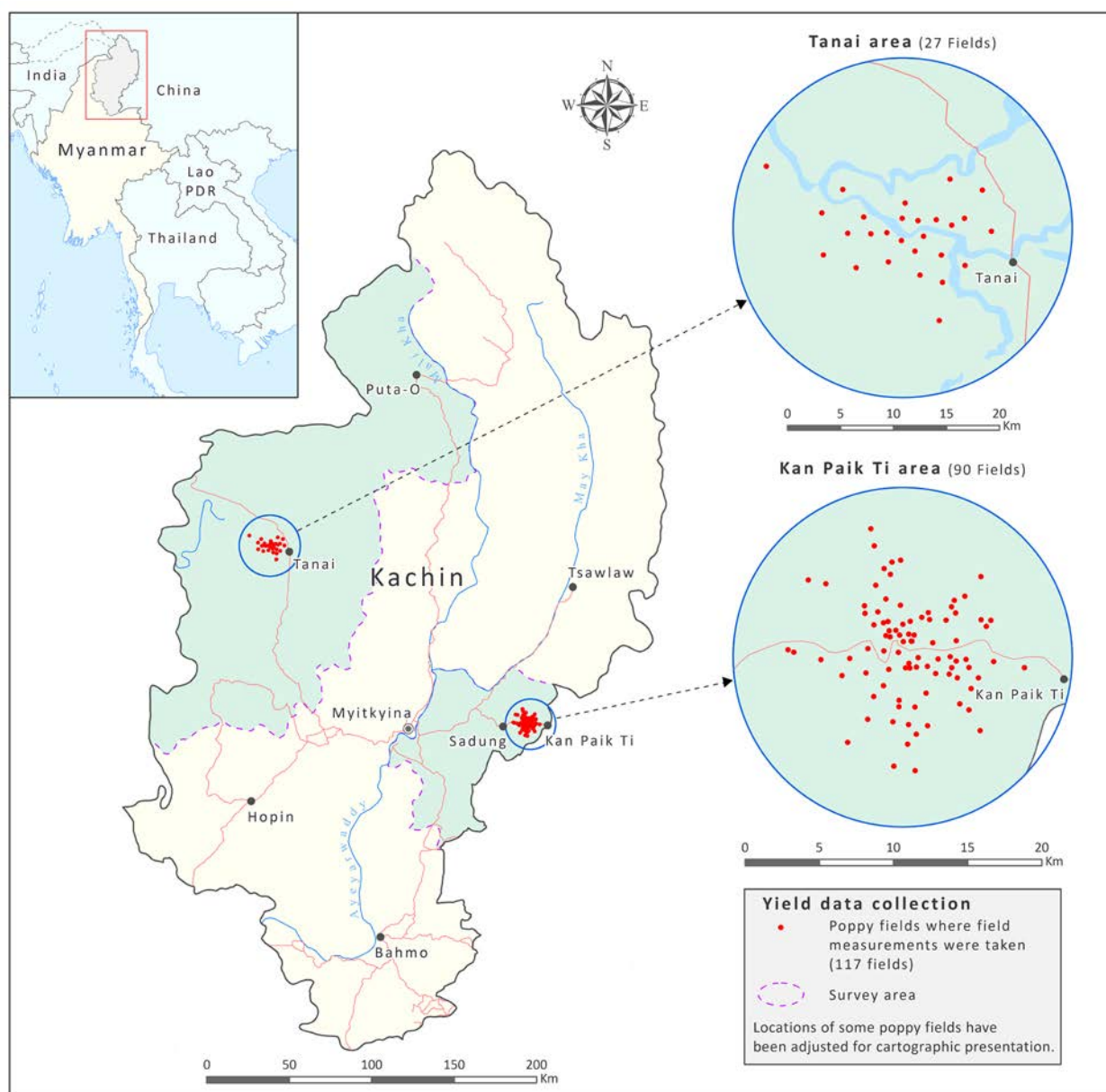


³⁶ In 2019, 118 fields were surveyed in 40 villages in East Shan, 93 fields in 31 villages in South Shan, and 21 fields in 7 villages in North Shan.

³⁷ <https://www.unodc.org/unodc/en/scientists/guidelines-for-yield-assessment-of-opium-gum-and-coca-leaf.html>.

Figure 36: Yield data collection in the field, 2020



Map 7: Location of fields visited in the yield surveys in Kachin State, 2020

Source: 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 13: Opium cultivation calendar Myanmar, 2019-2020*

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								
	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.Kutkai, 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 in Kachin

For the 2020 survey in Kachin, 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 was 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.³⁸

Estimating potential opium yield in Shan State regions

In 2020, no yield data was collected in the Shan State regions, the main poppy cultivating areas in Myanmar where yield data collection was conducted in the previous years. To impute the missing data and maintain the comparability with the previous estimates, a multi-year average yield of data from 2014 onwards was calculated.

38 $Y \pm 1.96 \frac{\sigma}{\sqrt{n}}$, where Y is the point estimate, n is the number of samples and σ is the standard deviation.

The time frame for calculating the multi-year average was based on data quality. Starting from 2013, thorough data quality measures were introduced, and the yield survey methodology was adapted to be in line with international data quality assurance measures, applied in other countries, too (e.g. in Afghanistan). From 2014, photo evidence was collected in the fields, which allowed to accurately verify measurements. Data from 2014 onwards fulfilled all data quality measures³⁹ and was thus used to calculate a multi-year average for each Shan State region.

Due to the change in methodology, the percentage changes of yields are only indicative.

Estimating national average yield

In 2020, national average yield was calculated based on the average yield of Shan and Kachin States and then weighed by cultivation estimate of the respective States. Hence, the national average yield is a combination of estimates derived from the yield measurement data collected in Kachin in 2020, and multi-year average estimates for each Shan State region.

It has not been possible to conduct yield surveys in Kayah State since 2014 and not at all in Chin State and hence, yield values were derived from the national average yield (of Shan and Kachin States) and were weighted by production of the two main producing States.

Estimating opium production

Opium production was calculated by region/state as the result between the estimated area under opium cultivation and the corresponding opium yield. The total national potential opium production is a sum of regional estimates, weighted by cultivation. The national estimated also includes Chin and Kayah States, as in the previous years, for which the opium production figures were calculated based on latest available area estimates (2018) and the national average yield of the year under consideration (2020).

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

39 See Afghanistan opium survey report 2012, <https://www.unodc.org/unodc/en/crop-monitoring/index.html>.

“normal” conditions as traded) would be higher as such air-dry opium contains some moisture.

The uncertainties of the opium production estimate in 2020 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.

The 2020 ranges around average national yield were calculated by using the uncertainty around yield estimates, that is the national lower/upper bounds are the averages of the regional lower/upper bounds weighted by the point estimates of the area estimates.

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; and
- 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.⁴⁰ 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 two main producing regions of Shan State and Kachin State.⁴¹ The lower and upper bounds of the farm-gate value reflect the range of the potential 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 region⁴² and the comparison of the opium production levels between Myanmar and Laos,⁴³ which are supposedly the only opium providing countries in the region.⁴⁴ The remaining opium, after discounting opium seizures,⁴⁵ is deemed to be processed into heroin. A ratio of 10:1 is used for converting opium to heroin of unknown purity⁴⁶ and, after subtracting the reported heroin

40 In this survey, price information was collected on fresh opium only. Farm-gate prices, however, were calculated for both fresh and dry opium to maintain comparability with the previous surveys. Farm-gate prices for dry opium were calculated on the basis of the ratio between fresh and dry opium prices of collected data in 2019.

41 Farm-gate prices at harvest time of fresh opium in East Shan and South Shan regions and Kachin State were collected during the ground truthing and yield surveys.

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

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

44 The assumption is that the ratio between total opium production and unprocessed opium is the same for the two countries. Sources: *World Drug Report 2020* (UNODC, 2020), *Transnational Organized Crime in East Asia and the Pacific – A Threat Assessment* (UNODC, 2013) and *Transnational Organized Crime in Southeast Asia: Evolution, Growth and Impact 2019*, UNODC.

45 GOUM/CCDAC by October 2019 reported the seizure of 6,506 tons of opium. The quantities of opium seized in the whole year 2020 was extrapolated based on this figure, 7,806 tons respectively.

46 For countries other than Afghanistan, a traditional conversion ratio of opium to heroin of 10:1 is used. Source: *World Drug Report 2020, Booklet 3*, p.79 (UNODC, 2020).

seizures,⁴⁷ the amount of heroin reaching the end-consumer markets is obtained.

The value of opiates market for domestic use

The value of the domestic opiates market is given by:

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

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

- The prevalence of opiates use⁴⁸ in the country
- The respective proportions of opium and heroin users⁴⁹
- The Myanmar population between 15 and 64 years old⁵⁰
- The annual heroin⁵¹ and opium⁵² average consumption rates

The retail price of opium and the retail price of heroin were provided by the Central Committee on Drug Abuse control of Myanmar (CCDAC).⁵³ 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.⁵⁴

47 GOU/CCDAC by October 2020 reported the seizure of 1,389 tons of heroin. The quantities of heroin seized in the whole year 2020 was extrapolated based on this figure, 1,666 tons respectively.

48 Annual prevalence for opiates is 0.8%. Source: *World Drug Report 2020* (UNODC, 2020).

49 Heroin users represent the 90.5% of opiates users, opium users the 9.5%. Derived from 2019 treatment data reported by the CCDAC at the 2020 SMART Regional Workshop.

50 Source: World Bank.

51 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.

52 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).

53 CCDAC, at the 2020 SMART Regional Workshop.

54 Due to the lack of data on street heroin's purity in Myanmar, Thailand 2020 figure, reported at the 2020 SMART Regional Workshop, was used, which recorded a retail purity ranging from 42 to 92%.

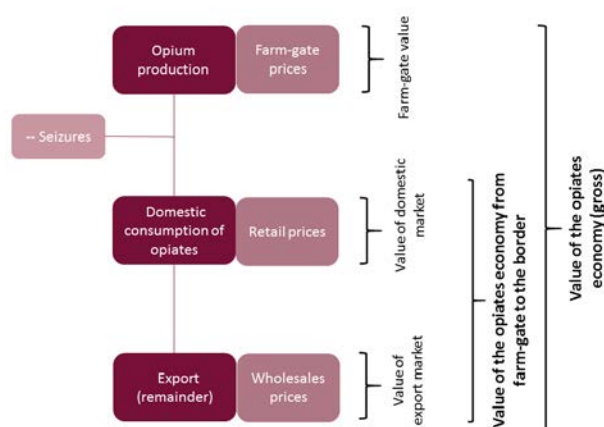
The value of opiates potentially available for export

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 prices⁵⁵ 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.⁵⁶ 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.

Table 14: 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

55 Wholesale opium and heroin prices were reported by CCDAD at the 2020 SMART Regional Workshop.

56 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.

production estimates is high, uncertainties around the conversion ratio from opium to heroin⁵⁷ 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.

57 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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