



**UNODC**

United Nations Office on Drugs and Crime



# Myanmar Opium Survey 2022

## Cultivation, Production, and Implications

January 2023



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 and aligned country programmes. 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).

The implementation of the Myanmar Opium Survey was made possible thanks to the financial support of the Governments of Japan and the United States of America.

**UNODC Regional Office for Southeast Asia and the Pacific**

Telephone: +6622882100

Fax: +6622812129

Email: [unodc-thailandfieldoffice@un.org](mailto:unodc-thailandfieldoffice@un.org)

Website: [www.unodc.org/roseap](http://www.unodc.org/roseap)

 Twitter: @UNODC\_SEAP

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of UNODC concerning the legal status of any country, territory or city, or its authorities, or concerning the delimitation of its frontiers or boundaries.

Cover photos: Benedikt Hofmann, UNODC.

## Contents

<b>Acknowledgements</b> .....	i
<b>Key Takeaways</b> .....	iii
<b>Introduction</b> .....	vii
<b>Fact Sheet</b> .....	ix
<b>1. Findings</b> .....	1
1.1 Estimated area under opium poppy cultivation.....	1
1.2 Opium yield and production estimates.....	8
1.3 Opium farm-gate price.....	10
1.4 Opium economy in Myanmar .....	10
<b>2. Eradication and Seizures</b> .....	15
2.1 Eradication .....	15
2.2 Seizures .....	17
<b>3. Methodology</b> .....	23
3.1 Area estimation.....	23
3.2 Yield and potential opium production estimation .....	35
3.3 Estimating the value of opium economy in Myanmar .....	40



## Acknowledgements

### UNODC Regional Office for Southeast Asia and the Pacific

Jeremy Douglas	Regional Representative, Southeast Asia and the Pacific
Inshik Sim	Programme Officer (Illicit Drugs Analyst)
Kavinvadee Suppamongtevasakul	Regional Synthetic Drugs Analyst
Akara Umapornsakula	Graphic Designer

### UNODC Myanmar

Benedikt Hofmann	Country Manager
San Lwin Htwe	GIS Specialist and Survey Coordinator
Naing Lin Aung	Data Analyst

### UNODC Headquarters

Angela Me	Chief, Research and Trend Analysis Branch
Anja Korenblik	Chief, Programme Development and Management Unit (PDMU)
Irmgard Zeiler	Programme Officer, PDMU
Coen Bussink	Remote Sensing & GIS Officer, PDMU
Leonardo Correa	Research Officer, PDMU
Bryce Pardo	Research Officer, PDMU
Lorenzo Vita	Geospatial Information Officer, PDMU



## Key Takeaways

### 2022 survey results point towards increased sophistication of farming practices and concentration of opium poppy cultivation

Typically, most of the opium poppy cultivation detected in Myanmar in the past was small, poorly organized plots with relatively low cultivation density when compared to most other licit cash crops. Fields were often found outside of main agricultural areas, away from villages and roads.

However, the evidence collected in 2022 points towards increasing sophistication in poppy cultivation practices. Newly sampled areas reveal greater opium poppy cultivation in high-density poppy cultivation hotspots. A general increase in poppy cultivation in some regions of the country is also evident with opium poppy fields becoming larger. In Shan State, field size increased by more than 30% compared to 2021 (from about 0.3 to 0.4 hectares on average).

Additionally, field research observed very well organized and high yielding opium poppy plots that had not been identified before. This was most evident in East Shan where substantial and significant increases in both opium poppy capsule number and volume were observed (the average number of observed capsules per plot increased by

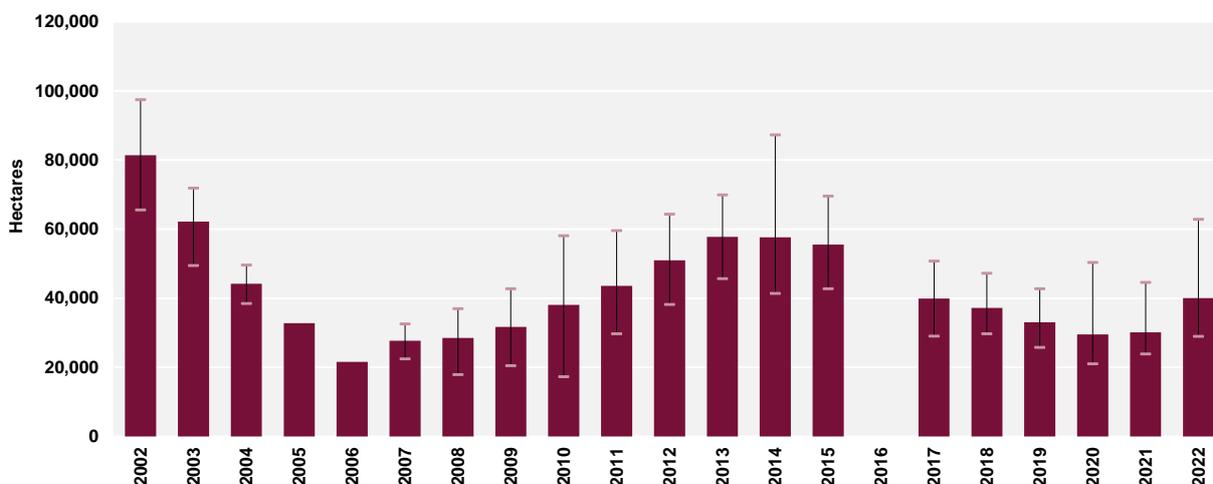
44% and their average volume more than doubled). This translated into higher overall yields. National yield estimates indicated an average of 19.8 kg of opium per hectare of poppy; levels that, while far below potential productivity in opium gum, are at the highest-ever estimated in Myanmar since UNODC started measuring.

### In the first full season opium survey after the military takeover, poppy cultivation is estimated to have increased by 33% compared to the previous season

In 2022, the area under opium poppy cultivation in Myanmar was estimated at 40,100 (29,000 to 62,900) hectares. This estimate is 33% greater, or about 10,000 more hectares than in 2021, reversing the downward trend that started in 2014. The increase was recorded against the backdrop of significant social, economic, security and governance disruptions in the course of 2021.

The increased estimate was likely due to two main factors: 1) increased size of fields; and 2) the detection of opium poppy hotspots. Together this translated into a higher overall area estimates under opium poppy cultivation. Furthermore eradication efforts appeared to have decreased substantially: 1,403 hectares were reported as eradicated in 2022, 70% less than in 2021.

### Area under opium poppy cultivation in Myanmar



Note: No survey was conducted in 2016. The error bars are the upper and lower limits of the confidence intervals of the sampling uncertainty.

## Declining trends in poppy cultivation and opium production ended around 2020

Estimates suggest that cultivation and total production has increased in 2022, reversing recent historic downward trends. Annual total opium production estimates hit a bottom in 2020 at around 400 metric tonnes following a downtrend after a recent peak in 2013 at 870 metric tonnes. Though 2022 estimates are still below this peak, national potential opium production was estimated to be nearly double the estimates for 2020 at about 790 (580 – 1,200) metric tonnes.

Likewise, the average opium yield in 2022 was estimated at 19.8 kilograms per hectare, representing an increase of 41% when compared to 2021, albeit remaining at a lower level than in other countries where poppy is cultivated. This is the highest yield value since the beginning of systematic yield surveys in 2002. The increase in production was most pronounced in North Shan, where field data confirmed very healthy, organized and dense poppy fields. In Shan State, which accounts for 84% of the total area of poppy cultivation estimates,

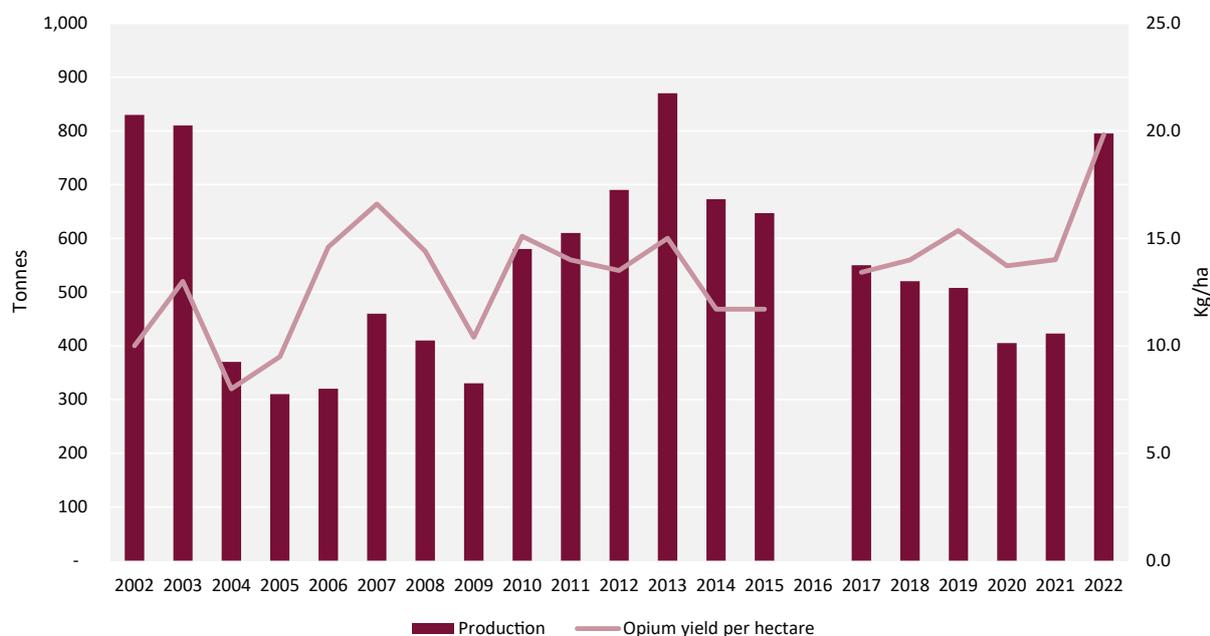
production approximately doubled to an estimated 670 tonnes when compared to 2021.

Taken together, it appears that year-over-year declines in poppy cultivation and opium production in Myanmar, which started in 2013, ended around 2020.

## While Myanmar’s licit economy remains fragile, the income from opiates gains importance

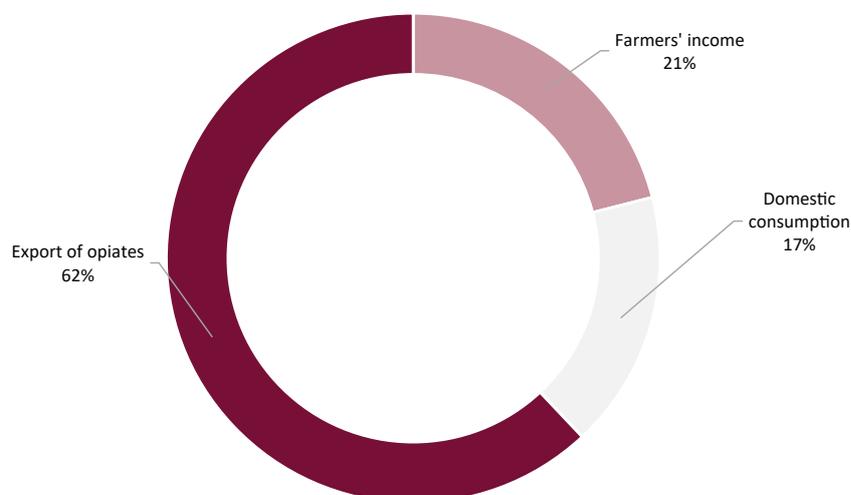
The average farm-gate prices of opium at harvest time increased from US\$166/kg in 2021 to US\$281/kg in 2022, a 69% increase. In combination with higher production, farmers earned more than twice as much from opium as in the previous year, between US\$ 160 – 350 million in 2022 (56 – 100 million in 2021). The farm-gate value only represents a small share of the overall income from opiate manufacture and export: the estimated value of the Myanmar opiate economy ranged between US\$ 660 million to 2.0 billion, representing 1 – 3% of the 2021 GDP.

### Opium production and yields in Myanmar



Note: No survey was conducted in 2016.

## Shares of the opiate economy, by component (approximation)



However, the increase in income did not necessarily translate directly into purchasing power as inflation and the costs of other agricultural inputs, fuel, and other transport costs have soared in Myanmar. Recent reports indicate that year-over-year inflation increased from 2.6% in 2021 to 17.3% in March 2022,<sup>1</sup> and prices for rice, an important staple crop, increased some 55% between November 2021 and November 2022.<sup>2</sup> Similarly, between July 2021 and July 2022, domestic prices of fertilizers and herbicides/pesticides have increased by 75% and 45%, respectively.<sup>3</sup> Agricultural traders have also reported a 74% increase in transportation costs between March 2021 and March 2022, driven by rising fuel costs and the nation's security situation.<sup>4</sup> Though higher input costs are likely to have contributed to higher farm-gate prices, there was a modest increase in trading volumes for many agricultural outputs, including maize and several other cereals, that are projected to result in above-average yields, which were grown under favourable weather conditions toward the end of 2022.<sup>5</sup>

### Implications and outlook

Poverty, lack of services, and insecurity are linked to poppy cultivation. The sharp economic contractions

that left a critically weak economy in the aftermath of the COVID-19 crisis, and the military takeover in early 2021 may have been among the determining factors that pushed rural households to rely more on opium, resulting in expanded and more intense poppy cultivation and reversing downward trends since 2014.

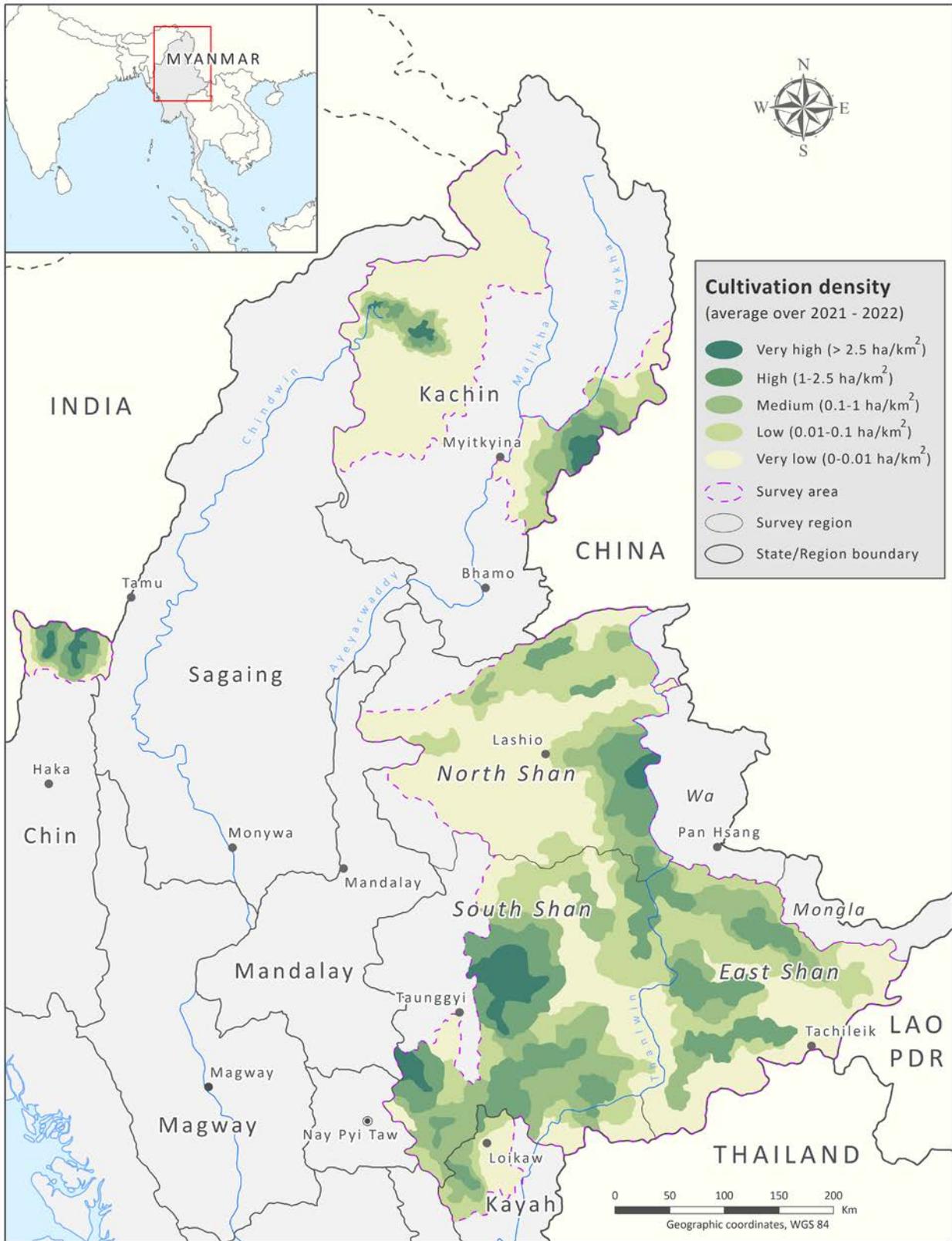
Myanmar's economy in 2022 faced a series of external and domestic shocks. The war in Ukraine has caused steep increases in global prices of fuel and fertilizer, disproportionately affecting Myanmar's poor and rural populations.<sup>6</sup> Continued political instability in the post-coup environment, a weak economy, inflation, and very high farm-gate prices for opium are shaping household decisions. Taken together, these economic signals can provide a strong incentive for farmers to take up or expand opium poppy cultivation.

A continued resurgence of opium poppy cultivation in Myanmar will have significant impact on the wider drug economy centred around the lower Mekong region. Strengthening the socio-economic resilience and basic livelihoods of farming communities will be critical to countering the renewed momentum in poppy cultivation, and support farmers living at the nexus of a humanitarian, development, and conflict crises. It will be critical to continue monitoring the opiate economy to ensure they can be factored into broader policy discussions within the region and beyond.

1 Central Statistical Organization of Myanmar, 2022. <https://www.csostat.gov.mm/Content/pdf/SMEI/s3.1MA02.htm>  
2 Food and Agriculture Organisation (FAO), Food Price Monitoring and Analysis Tool.  
3 Food and Agricultural Organization (FAO), GIEWS Country Brief, Myanmar October 18, 2022.  
4 International Food Policy Research Institute (IFPRI), Myanmar, Strategy Support Program Research Note 79, May 2022.  
5 Ibid.

6 The World Bank 2022, "Myanmar Economic Monitor July 2022".

**Map 1: Opium poppy cultivation density in Myanmar<sup>7</sup>**



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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

<sup>7</sup> To have a more comprehensive visualisation of cultivation density UNODC uses data from both 2021 and 2022.

## Introduction

This report presents the results of the twentieth Myanmar opium survey, examining the 2021/2022 opium growing season. As the first cultivation season after the military takeover on 1 February 2021, the data was collected against the backdrop of the prolonged COVID-19 pandemic, and the far-reaching social, economic, security and governance disruptions that have defined the country since then.

Using a mix of local and global expertise of the UNODC's Illicit Crop Monitoring Programme (ICMP), the methodology used in this report combines the use of satellite imagery and, when the situation on the ground allowed, field verification and yield surveys to evaluate the extent of opium poppy cultivation and production. This included a total of 92 sample locations and three target areas in Shan and Kachin States, as well as, for the first time since 2018, cultivation sites in Kayah and Chin, to understand the area under cultivation.<sup>8</sup>

The present survey compares cultivation levels to the preceding years to observe long-term trends. While the 2021 survey – covering the 2020/2021 season using data collected during the first year of the COVID-19 pandemic – had shown a moderate increase at the national level in both areas under opium poppy cultivation (2%) and opium production (4%), this survey sees a substantial expansion of the cultivation area during the 2021/2022 season. With a total cultivation area estimated at 40,100 hectares, this is an increase of approximately 33% as compared to the past season, reversing the downward trend that had started in 2014. The 2022 survey detected the existence of poppy cultivation “hotspots”. Due to the randomized sampling nature of the survey, observed hotspots can vary from year to year. Thus, it may be possible that increasing cultivation in some areas started earlier.

The survey shows increases in cultivation area across all geographic areas (except for the Tanai region of Kachin, where cultivation area decreased). Most increases were observed in Shan State, which continues to be the centre of opium production in

Myanmar at 84% of total cultivation area. With a combined cultivation area estimated at 34,600 ha, North, South and East Shan showed a year-on-year increase of 39%. Cultivation in Kachin saw a moderate increase of 3% and can be considered stable, especially when compared to previous years where Kachin had seen above-average increases. Estimates for Chin and Kayah States, where the overall area remained small in comparison to other states, showed increases of 14% and 11%, respectively, and will require further monitoring.

The increase is even more pronounced for overall potential opium production due to a combination of increased cultivation area and increased opium yields. Production was estimated at 790 (580 – 1,200) metric tonnes, or 88% more than in 2021. Production is at its highest estimated levels since 2013 (870 tonnes). Opium yields depend on many factors, including timing and amount of precipitation, plant diseases and pests, and changes in agricultural practices. The increase in yield was most pronounced in North Shan, where field data confirmed very healthy and dense poppy fields.

The increase in cultivation coincided with a major increase in farm-gate prices of both fresh and dry opium, by 62% and 69%, respectively. In combination with higher production, farmers earned more than twice as much as in the previous year, between US\$ 160 - 350 million in 2022. The farm-gate value only represents a small share of the overall income from opiate manufacture and export: the estimated value of the overall opiate economy ranged between US\$ 0.66 to 2 billion, representing 1 – 3% of the 2021 GDP. However, the increase in income did not necessarily translate into purchasing power as inflation has soared in Myanmar. Recent reports indicate that overall inflation increased from 2.6% in March 2021 to 17.3% in March 2022.<sup>9</sup>

## Implications and regional context

Opium poppy cultivation in Myanmar is closely linked to multi-dimensional poverty, lack of services, and insecurity. Households and villages involved in opium poppy cultivation face a significant development gap when compared to non-poppy villages. For the 2022 season, which started in

<sup>8</sup> Chin and Kayah States had last been included in the 2018 survey. Past surveys had utilized the 2018 estimates to calculate the total opium poppy cultivation area in order to maintain comparability with the earlier surveys. The current survey results should also be compared to the 2018 estimates for these two States.

<sup>9</sup> Central Statistical Organization of Myanmar, 2022. <https://www.csostat.gov.mm/Content/pdf/SMEI/s3.1MA02.htm>

November 2021, farmers may have decided to start cultivating or cultivate poppy more intensely due to a variety of factors, including sharp economic contractions that left a critically weak economy in the aftermath of the COVID-19 crisis, and the military takeover in early 2021. Strengthening the socio-economic resilience and basic livelihoods of farming communities will be critical to countering the renewed momentum in poppy cultivation, and support farmers living at the nexus of a humanitarian, development, and conflict crises. Similarly, effective local governance mechanisms will be key to developing long-term sustainable solutions to the opium issue in Myanmar.

Myanmar's drug economy is not only shaped by opiates. It is important to note that the surge in synthetic drug production of recent years, which has coincided with the past downwards trend in opium cultivation since 2014, continues to accelerate, with reported regional seizures, especially for methamphetamine, reaching record levels. While increased seizures do not necessarily equate to increased production, the volume and changes in the geographic pattern of seizures, combined with falling prices and stable or increasing purities of drugs available in consumer markets, point towards an increased sophistication in production, trafficking and availability of synthetic drugs, especially methamphetamine. Combined with renewed expansion of opium cultivation in Myanmar, East and Southeast Asia – fanning out from the upper Mekong region across ASEAN countries, to Australia and New Zealand, Japan and the Republic of Korea, as well as India and Bangladesh – is set to continue to face a significant expansion in the illicit supply of drugs.

Only small part of the proceeds from the illicit trade in drugs is generated within Myanmar – this report estimates the local opiate economy at around US\$ 660 million to US\$ 2.0 billion, while 2019 estimates put the regional market for heroin at US\$ 8.7 to US\$ 10.3 billion – but proceeds in Myanmar are closely linked to insecurity and conflict in the country.<sup>10</sup> An increasing trend in drug production and trafficking can further accelerate and reinforce these linkages, particularly in light of the current environment of increased insecurity, absence of the rule of law, and a weak economy.

---

10 UNODC, 2019. "Transnational Organized Crime in Southeast Asia: Evolution, Growth and Impact."

Myanmar's economy faced a series of external and domestic shocks. The war in Ukraine has caused steep increases in global prices of fuel and fertilizer, which spilled over into Myanmar, and disproportionately affect the poor and rural populations.<sup>11</sup> Next year's outlook for cultivators is thus being shaped by political instability, a weak economy, high inflation rates, and very high farm-gate prices for opium. Taken together, these economic signals can provide a strong incentive for farmers to take up or expand cultivation.

A continued resurgence of opium cultivation in Myanmar will affect the local, national and regional levels, and interact with the dynamics of the wider drug economy centred around the lower Mekong region. It will be critical to continue monitoring these developments, including the synthetic drug markets, to ensure they can be factored into broader policy discussions within the region and beyond. In this context, 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 the illicit trade in drugs, security, the rural economy, the livelihoods of farmers and their communities, and the regional and international illicit markets.

---

11 The World Bank 2022, "Myanmar Economic Monitor July 2022".

## Fact Sheet

	Year 2021 (rounded)	Year 2022 (rounded)	Change 2021-2022
<b>Total opium poppy cultivation (ha)<sup>12</sup></b>	30,200 (23,900 to 44,600)	40,100 (29,000 to 62,900)	33%
Opium poppy cultivation in Shan State	24,900 (18,900 to 32,500)	34,600 (23,700 to 45,500)	39%
Opium poppy cultivation in Kachin State	4,200 (2,400 to 9,000)	4,400 (2,500 to 10,900)	3%
Opium poppy cultivation in Chin State	560 (520 to 610)	640 (310 to 970)	14%
Opium poppy cultivation in Kayah State	450 (440 to 470)	500 (280 to 720)	11%
<b>Total potential production of dry opium (metric tonnes)<sup>13</sup></b>	420 (330 to 630)	790 (580 to 1200)	88%
Potential dry opium production in Shan State	340 (220 to 600)	670 (460 to 1090)	96%
Potential dry opium production in Kachin State	68 (38 to 140)	100 (58 to 260)	52%
Potential dry opium production in Chin State	7.9 (7.0 to 8.8)	13 (6.1 to 19)	61%
Potential dry opium production in Kayah State	6.3 (5.8 to 6.8)	10 (5.7 to 14)	58%
<b>Average opium yield (kg/ha)<sup>14</sup></b>	14.0 (13.1 to 15.0)	19.8 (18.5 to 21.3)	41%
Farm-gate price of fresh opium <sup>15</sup>	153 US\$/kg (219,000 Kyat/kg)	248 US\$/kg (370,000 Kyat/kg)	62% <sup>16</sup>
Farm-gate price of dry opium <sup>15</sup>	166 US\$/kg (238,000 Kyat/kg)	281 US\$/kg (418,000 Kyat/kg)	69% <sup>16</sup>
Farm-gate value of opium in million US\$	56 - 100	160 - 350	193 - 237%
Value of the opiate economy (gross) in million US\$	460 - 1,100	660 - 2,000	44 - 78%
Value of the opiate economy (after the farm-gate) in million US\$	410 - 1,000	500 - 1,600	23 - 62%
Total opium poppy eradication reported by the CCDAC (ha)	4,633	1,403	-70%

Numbers in the table are rounded, percentage changes are calculated with exact estimates. The value of the Kyat was calculated at the time of drafting.

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

13 In 2022, for Shan and Kachin states a multi-year average was applied, using data from 2020 to 2022. For Chin and Kayah States the national average yield was applied (see methodology chapter for further details).

14 Opium yields weighted by cultivation. In Kayah and Chin, the national average has been applied, since no yield measurements were available.

15 National average weighted by regional production estimates. For 2021 and 2022, the applied exchange rates MMK/US\$ are the 2020 and 2021 DCE alternative conversion factors provided by the World Bank (<https://data.worldbank.org/indicator/PA.NUS.ATLS?locations=MM>).

16 Change calculated based on US\$ without adjusting for inflation. Due to changes in the exchange rate, the increase is slightly larger in Kyat, with 69% and 76% for fresh and dry opium, respectively.



# 1. FINDINGS



## 1. Findings

### 1.1 Estimated area under opium poppy cultivation

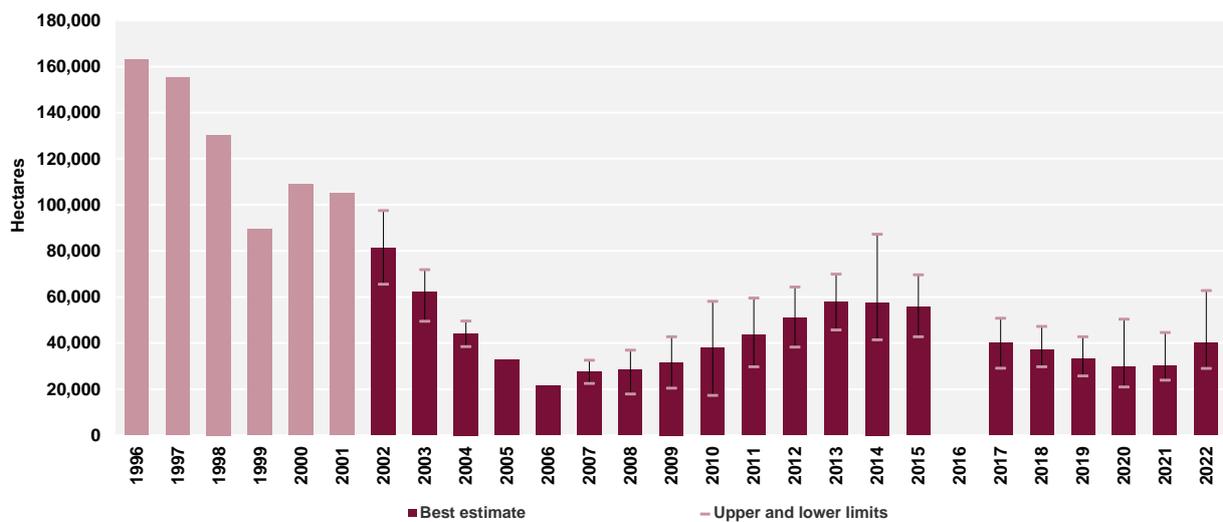
In 2022, the area under opium poppy cultivation in Myanmar was estimated at 40,100 (29,000 to 62,900) ha. That is a 33% increase from the 30,200 hectares estimated to be under cultivation in 2021. The national trend of reductions in poppy cultivation starting in 2014, when area under cultivation was estimated at 57,600 ha, levelled off in 2020 and has risen since then. The 2022 survey covered Shan, Kachin, Chin and Kayah states.

Poppy cultivation increased across all states. Compared to 2021, the Shan state showed the largest increase in absolute terms of cultivated hectares (increase of some 10,000 hectares, or

39% from the previous year). Major increases were observed in North and South Shan (57% and 50%, respectively). Increases in East Shan (11%), Chin (14%) and Kayah (11%) regions were less pronounced. In Kachin State, a 3% increase was detected, which can be considered as a substantial stability. Within Kachin State, the Tanai region declined by 13% in cultivation, being the only area where a decrease was observed.

Shan continued to be the major cultivating state in Myanmar, accounting for about the 84% (34,600 ha) of the overall opium poppy area. The trend inversion is particularly sharp in Shan State. Within Shan State, the sub-regions of South, North and East Shan accounted for 42%, 21% and 23% of total cultivation in 2022, respectively. Kachin State accounted for 11% (4,400 ha), and Chin and Kayah States together for 3% (1,100 ha).

Figure 1: Opium poppy cultivation in Myanmar, 1996-2022 (ha)



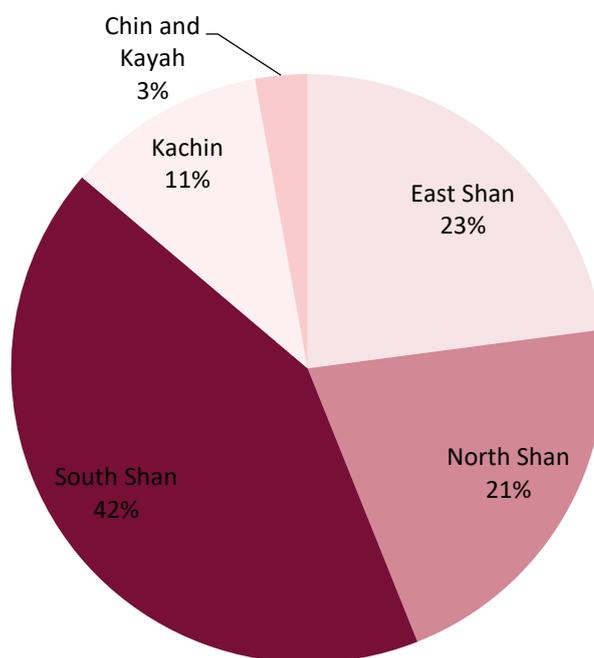
Sources: from 1996 to 2001 USG, from 2002 to 2020 CCDAC-UNODC, in 2021 and 2022 UNODC. In 2016 no area survey was conducted.

**Table 1: Areas under opium poppy cultivation in Myanmar (ha), in 2021 and 2022**

Region	Year 2021 (rounded)	Year 2022 (rounded)	Change 2021-2022
South Shan	11,300 (7,100 to 22,100)	16,900 (7,900 to 34,500)	50%
East Shan	8,200 (5,000 to 14,600)	9,200 (5,700 to 15,800)	11%
North Shan	5,400 (2,600 to 14,600)	8,400 (3,300 to 19,500)	57%
<b>Shan State total</b>	<b>24,900</b> <b>(18,900 to 32,500)</b>	<b>34,600</b> <b>(23,700 to 45,500)</b>	<b>39%</b>
Kachin	4,200 (2,400 to 9,000)	4,400 (2,500 to 10,900)	3%
Chin	560 (516 to 610)	640 (310 to 970)	14%
Kayah	450 (440 to 470)	500 (280 to 720)	11%
<b>National total</b>	<b>30,200</b> <b>(23,900 to 44,600)</b>	<b>40,100</b> <b>(29,000 to 62,900)</b>	<b>33%</b>

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

**Figure 2: Regional share of opium poppy cultivation areas in Myanmar, 2022**



Opium poppy cultivation is concentrated in areas characterised by a combination of specific topographical conditions, challenging socio-economic circumstances and a precarious security situation. Additionally, poppy cultivation can be found in high density near some international borders. Map 1 above gives an overview of the average density of opium poppy cultivation during the 2021 and 2022 growing seasons.

South Shan showed high density opium poppy cultivation in the southwestern mountains and the mountain ranges in the eastern part of Taunggyi city. Medium cultivation levels were observed in southern part of South Shan region. The areas near the boundaries of South, East and North Shan regions, on both sides of the Than Lwin River, presented several extensive areas of poppy cultivation, while cultivation is dispersed in the areas along the southern boundaries of South Shan

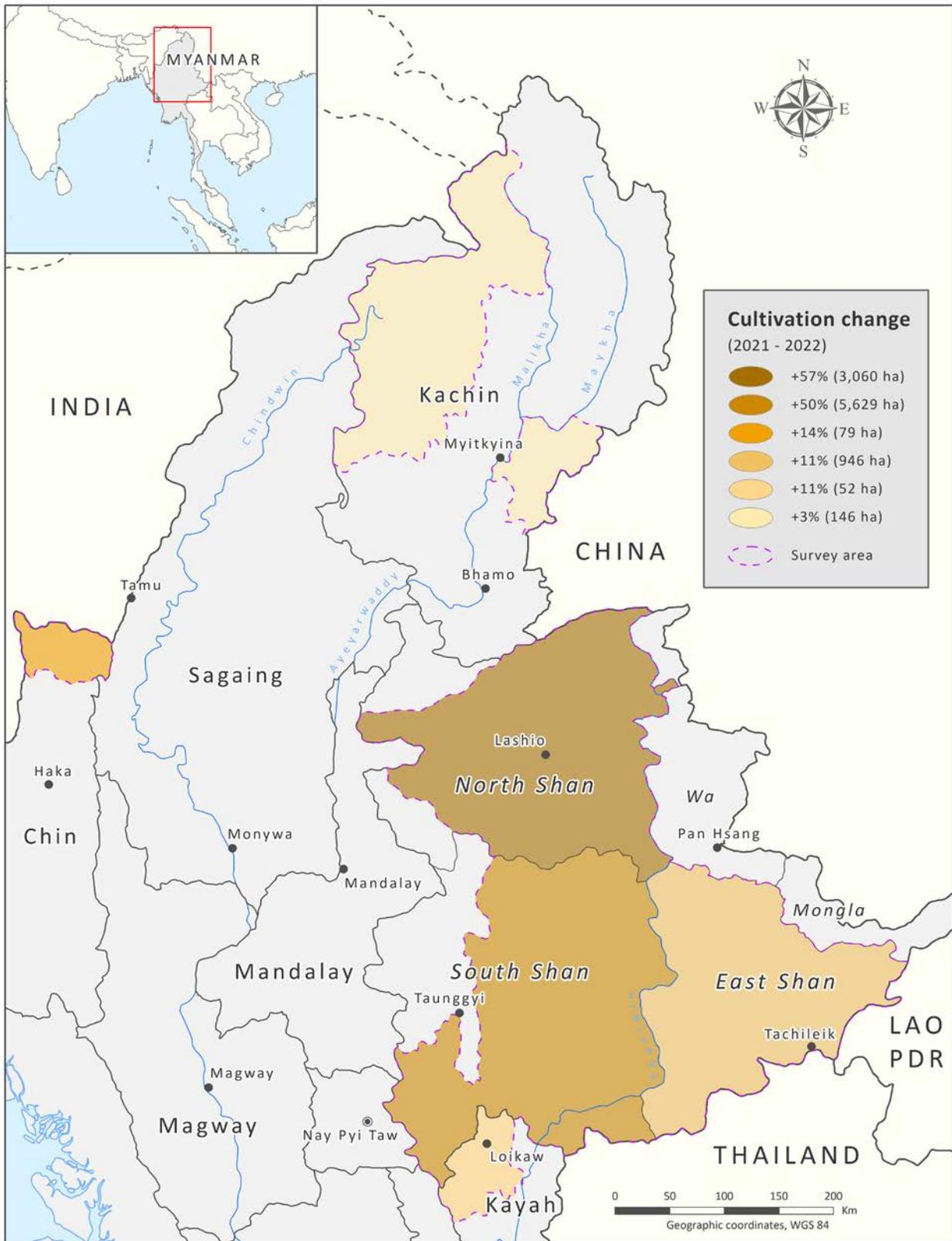
and East Shan. Overall, East and North Shan present areas with medium cultivation levels. The northern part (close to the border with Mongla region) and the mountain areas in the southwestern part of East Shan included some extensive area of poppy. Cultivation is dispersed in the southeastern and southern areas along the international border with Thailand. High-density cultivation areas were detected in the southeastern mountains bordering the Wa region. Very high cultivation levels were observed in the northwestern part of Kachin State and the areas east of Myitkyina city, next to the international boundary with China. Chin State showed high poppy cultivation density in the mountains north of Tonzang town, near to the international border with India. In Kayah State, poppy cultivation is mainly dispersed.

Map 2 and 3 show cultivation trends in the major producing states/regions.

#### **Young-stage poppy seedlings planted in a terrace field, East Shan 2022**



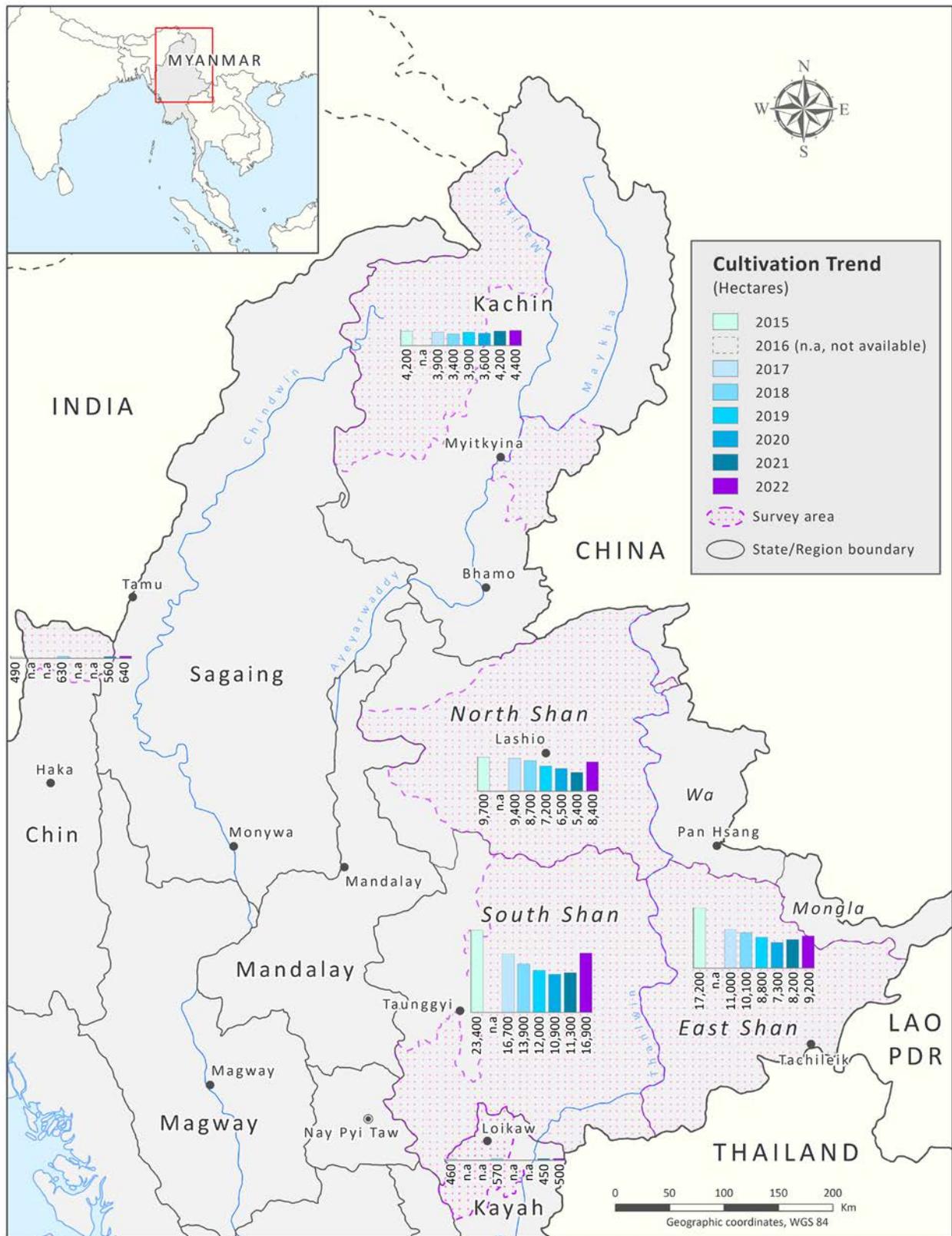
Map 2: Cultivation changes between 2021 and 2022



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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

Map 3: Opium poppy cultivation trends in Myanmar, 2015-2022



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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

**Well organized poppy fields in a hot spot area in South Shan, 2022**



**Sprinkler irrigation of a young poppy field in South Shan, 2022**



**Lancing stage of a poppy field in North Shan, 2022**



**Multi-stage poppy fields observed in South Shan, 2022**



**Poppy field in Kachin State, 2022**



## 1.2 Opium yield and production estimates

In 2022, the yield survey was carried out in Shan and Kachin States. In general, poppy fields were found to be particularly healthy and higher capsule volumes were measured compared with previous years. To avoid the possibility of the opportunistic nature of the sample biasing the final estimates, a three-year average was calculated. For Chin and Kayah States, the national average yield was applied (see methodology chapter for further details).

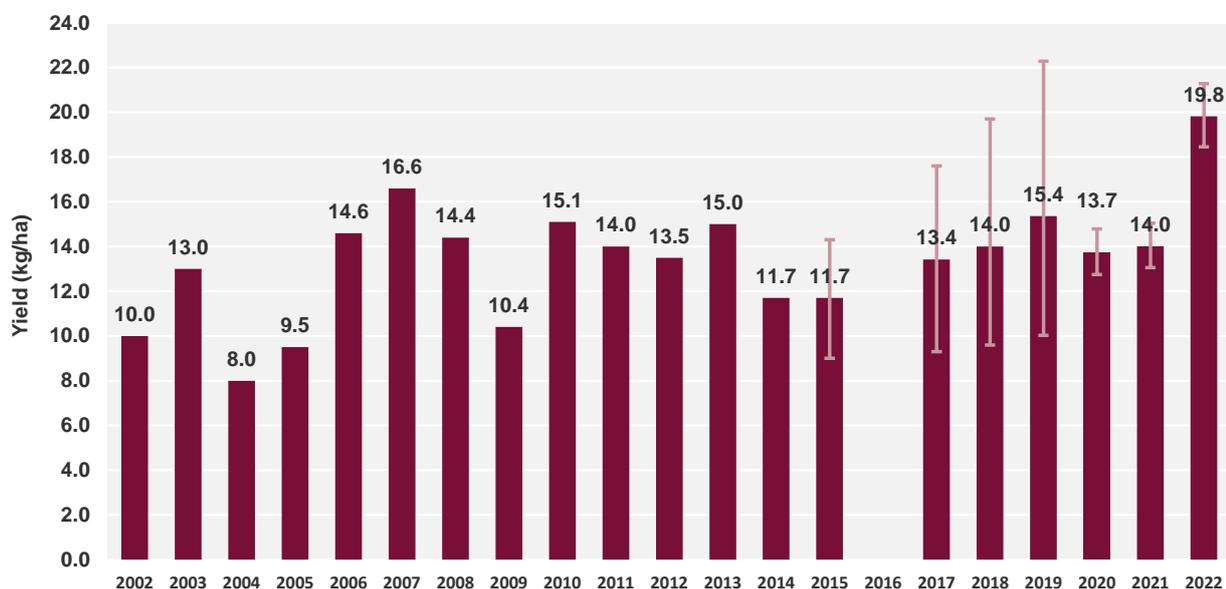
Compared to 2021, increases in yield were observed in all surveyed regions: 46% in East Shan (18.6 kg/ha in 2022), 22% in South Shan (17 kg/ha in 2022), 70% in North Shan (24.9 kg/ha in 2022, and 47% in Kachin (23.6 kg/ha in 2022).

The national average yield in 2022 was estimated at 19.8 kg/ha, 41% higher than in the previous year.

### Lancing stage of healthy poppy capsules in Kachin State, 2022



Figure 3: Average opium yield in Myanmar, 2002-2022



Average weighted by regional area estimates. In 2016 no survey was conducted. In 2021 and 2022, 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 (see the methodology section for further details).

Table 2: Potential opium yield by region (kg/ha), in 2021 and 2022

Region	2021	2022	Change
Kachin	16.0 (14.1 to 17.9)	23.6 (21.9 to 25.3)	47%
South Shan	13.9 (13.3 to 14.5)	17.0 (16.1 to 17.9)	22%
East Shan	12.8 (12.3 to 13.3)	18.6 (17.1 to 20.3)	46%
North Shan	14.7 (12.9 to 16.6)	24.9 (22.9 to 27.0)	70%
<b>Average yield</b>	<b>14.0</b> <b>(13.1 to 15.0)</b>	<b>19.8</b> <b>(18.46 to 21.29)</b>	<b>41%</b>

Average weighted by cultivation. Values in parentheses indicate the 95% confidence interval. Numbers in the table are rounded, percentage changes are calculated with exact estimates. In Kayah and Chin, the national average has been applied since no yield measurements were available.

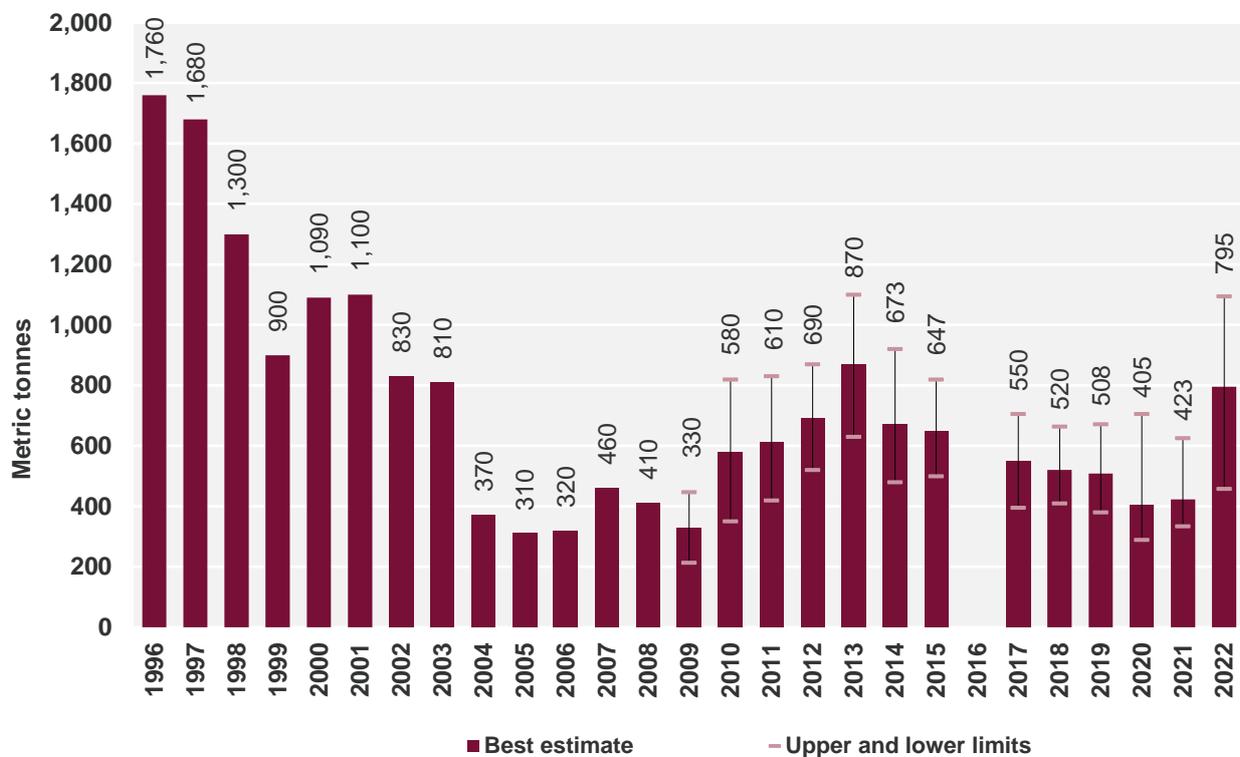
The resulting estimate of potential dry opium production in Myanmar in 2022 was 790 (580-1,200) metric tonnes, the highest since 2013. This represents a substantial increase of 88% compared with the 2021 estimate. Growth was estimated in all states, with a near doubling in Shan State. The highest increase was observed in North Shan (167%).

Shan State continues to be by far the dominant opium producing State, accounting for more than the 84% of the national total.

**Table 3: Potential opium production by region and State (metric tonnes) in 2021/2022**

Region	Potential production 2021	Potential production 2022	Change 2021-2022	2022 proportion by State
South Shan	157 (99 to 307)	288 (134 to 587)	83%	36%
East Shan	105 (64 to 186)	170 (104 to 295)	62%	21%
North Shan	79 (35 to 157)	210 (82 to 488)	167%	26%
<b>Shan State total</b>	<b>340</b> <b>(257 to 528)</b>	<b>670</b> <b>(460 to 1100)</b>	<b>96%</b>	<b>84%</b>
Kachin State	68 (38 to 140)	100 (58 to 260)	52%	13%
Chin State	7.9 (4.9 to 17.5)	13 (6.1 to 19)	61%	2%
Kayah State	6.3 (4.0 to 16.1)	10 (5.7 to 14)	58%	1%
<b>Total</b>	<b>420</b> <b>(330 to 630)</b>	<b>790</b> <b>(580 to 1,200)</b>	<b>88%</b>	<b>100%</b>

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

**Figure 4: Potential opium production in Myanmar, 1996-2022 (metric tonnes)**

Source: from 1996 to 2001 USG, from 2002 to 2020 CCDAC-UNODC, in 2021 and 2022 UNODC only. In 2016 no survey was conducted.

### Lancing poppy capsules in a very healthy poppy field in North Shan, 2022



### A lanced capsule oozing opium latex in Kachin, 2022



## 1.3 Farm-gate price of opium

Opium gum price data were collected in the framework of the village survey implemented in May 2022 in the three regions of Shan State.

The average farm-gate prices<sup>17</sup> at harvest time of fresh and dry opium were assessed at 370,000 Kyat (US\$ 248)<sup>18</sup> and 418,000 Kyat (US\$ 281) per kilogramme, respectively.

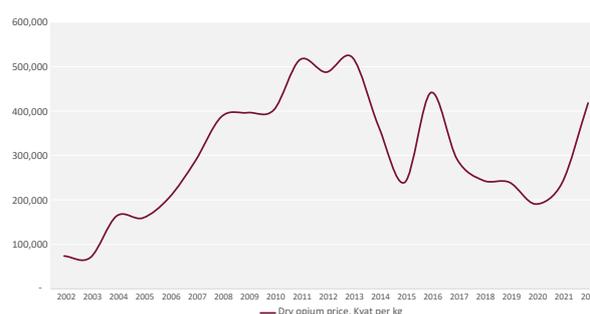
In 2022, the farm-gate price continued its upward trend starting the year before but also rose sharply. However, because of the small amount of price data collected in 2021, it is difficult to explain why prices are increasing alongside increased levels of opium

<sup>17</sup> Weighted by opium production in the respective regions.

<sup>18</sup> Applied MMK/USD exchange rate is the 2020 DEC alternative conversion factor provided by the World Bank (<https://data.worldbank.org/indicator/PA.NUS.ATLS>).

production. Contributing factors are inflationary pressures from COVID-19 and the economic crisis after the military takeover. Additionally, farmers may seek to recoup increased production costs (e.g., rising prices of fertilizer and pesticides). Another explanation may be a perception of opium as a safe insurance crop amidst the growing political and economic insecurity unfolding in 2021.

**Figure 5: Farm-gate prices of dry opium in poppy-growing villages in Myanmar (Kyat/kg), 2002-2022**



Without inflation adjustment.

## 1.4 Opium economy in Myanmar

In 2022, the role of opiates in the Myanmar economy grew in importance. The farm-gate value of opium is an important measure of the gross income of farmers generated by opium poppy cultivation. In 2022, it was estimated to range between US\$160 to 350 million, representing between 0.25 and 0.54% of the 2021 national GDP, and between 1 and 2% of the agricultural, forestry and fishing component of the 2021 GDP, which was estimated at US\$15 billion.<sup>19</sup>

The harvested opium is either consumed raw or further processed into heroin. Both raw opium and heroin reach the end-consumer markets in Myanmar and are exported outside Myanmar – or are seized by law enforcement.

After deducting the seizures of opiates in Myanmar reported by relevant law enforcement agencies,<sup>20</sup> it was estimated that 287 tonnes of raw opium and between 28 to 95 tonnes of heroin reached the illicit markets in the country and outside.<sup>21</sup> Out of these

<sup>19</sup> Source: World Bank.

<sup>20</sup> CCDAC reported between 1 of January and 31 October 2022 the seizures of 1,094 kg of opium and 1,249 kg of heroin. The quantities of opiates seized in the whole year 2022 were extrapolated based on these figures, 1,313 and 1,500 kg respectively.

<sup>21</sup> See more in Methodology chapter.

287 tonnes of opium, 22 tonnes were destined for domestic consumption, with a value of US\$ 13 million; the remaining 265 tonnes of opium were exported with an export value of US\$ 160 million. The gross value of the entire opiate economy – comprising both the value of domestic consumption and exports of opium and heroin – in Myanmar in 2022 was estimated to be between US\$660 million and 2 billion, accounting for 1-3% of the national GDP in 2021.

The value of manufacturing and trafficking after farm-gate up to the border of Myanmar ranged between US\$ 0.5 and 1.6 billion. This value represents the income generated by traffickers after deducting the cost of buying raw opium from the farmers.

**Table 4: Estimated values of the opiates economy, 2022**

	Gross value Millions of US\$	Value in relation to GDP* (%)
Value of the opiates economy (gross)	660 – 2,000	1 – 3
Value of opiates potentially available for export	540 – 1,720	0.8 – 2.6
Raw opium	160	
Heroin	380 – 1,560	
Value of the opiates market for domestic consumption	120 – 260	0.2 – 0.3
Raw opium	13	
Heroin	110 – 250	
Farm-gate value of opium	160 – 350	0.3 – 0.5
Value of the opiate economy after farm-gate to the border	500 – 1,600	0.8 – 2.5

Source: World Bank.

\* GDP 2021.

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.

### Limitations of estimating the value of the opiate economy

The estimates presented here 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.<sup>22</sup> 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 2010 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 is working on improving the accuracy of the estimates.

<sup>22</sup> 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





## 2. Eradication and Seizures

### 2.1 Eradication

By the end of 2022, the Central Committee for Drug Abuse Control (CCDAC) reported that 1,403 ha of opium poppy had been eradicated, a decrease of 70% compared to 2021, with most of the eradication activities implemented in South Shan (91% of the eradicated area). It is noteworthy that the decrease in eradication coincided with increasing cultivation levels.

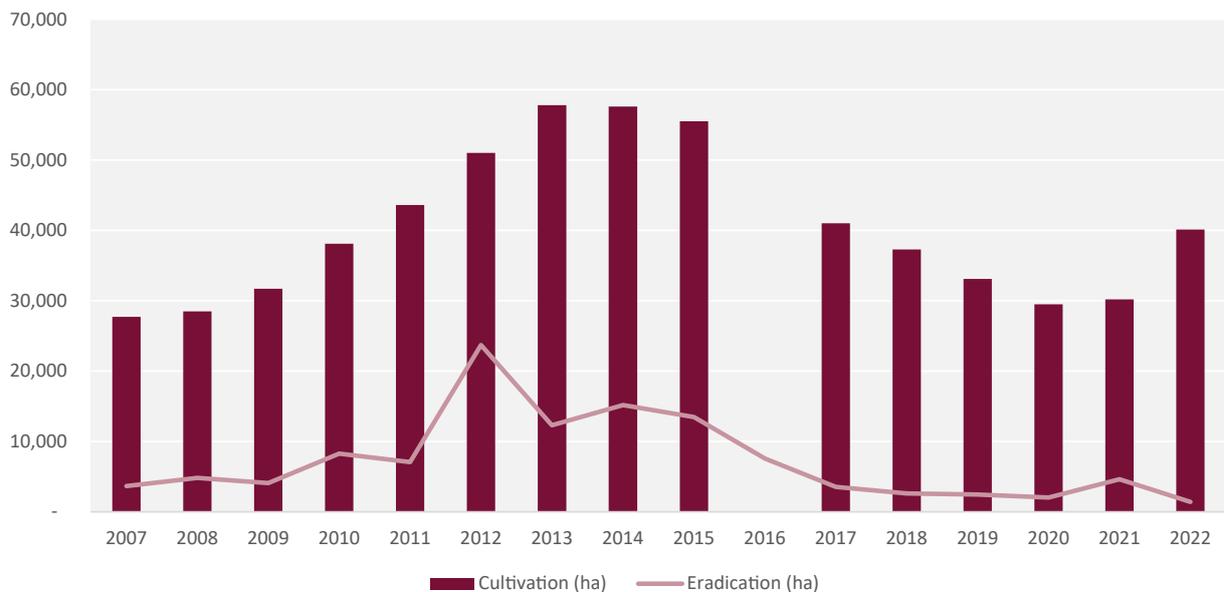
The opium poppy cultivation estimates presented in this report refer to the fields that were identified at the time that the satellite images were taken. Therefore, if any effective eradication was carried out after the satellite image acquisition dates, it is not reflected in the estimated cultivation figures. Data provided by CCDAC 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 CCDAC were not verified by UNODC.

**Table 5: Reported eradication in Myanmar (ha), 2006-2022**

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	2020-2021	2021-2022
East Shan	1,101	1,249	702	868	1,230	1,257	537	356	378	482	264	224	100	106	85	55
North Shan	916	932	546	1,309	1,315	977	532	337	532	69	97	29	44	179	127	34
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	1,575	4,226	1,282
<b>Shan State total</b>	<b>3,333</b>	<b>3,929</b>	<b>2,714</b>	<b>5,315</b>	<b>6,124</b>	<b>23,391</b>	<b>11,939</b>	<b>14,389</b>	<b>11,625</b>	<b>5,498</b>	<b>3,381</b>	<b>2,462</b>	<b>2,144</b>	<b>1,861</b>	<b>4,438</b>	<b>1,370</b>
Kachin	189	790	1,350	2,936	847	83	250	395	1,495	1,504	28	65	126	75	90	19
Kayah	12	12	14	13	38	84	59	67	54	16	47	12	3	0	0	0
Magway	45	0	1	1	0	4	7	60	8	9	47	44	19	25	18	15
Chin	10	86	5	2	10	110	32	277	267	534	28	22	50	35	81	0
Mandalay	0	3	2	0	39	45	0	0	0	0	1	0	0	0	0	0
Sagaing	9	0	1	0	0	0	2	1	0	0	0	0	118	31	5	0
Other States	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>National total</b>	<b>3,662</b>	<b>4,820</b>	<b>4,087</b>	<b>8,267</b>	<b>7,058</b>	<b>23,718</b>	<b>12,288</b>	<b>15,188</b>	<b>13,450</b>	<b>7,561</b>	<b>3,533</b>	<b>2,605</b>	<b>2,460</b>	<b>2,027</b>	<b>4,633</b>	<b>1,403</b>

Source: CCDAC.

**Figure 6: Eradication versus opium poppy cultivation in Myanmar (ha), 2007-2022**



**Poppy seed extraction in North Shan, 2022**



**Opium gum harvesting tools in North Shan, 2022**



**Clandestine opium processing lab, Myanmar 2022**



## 2.2 Seizures

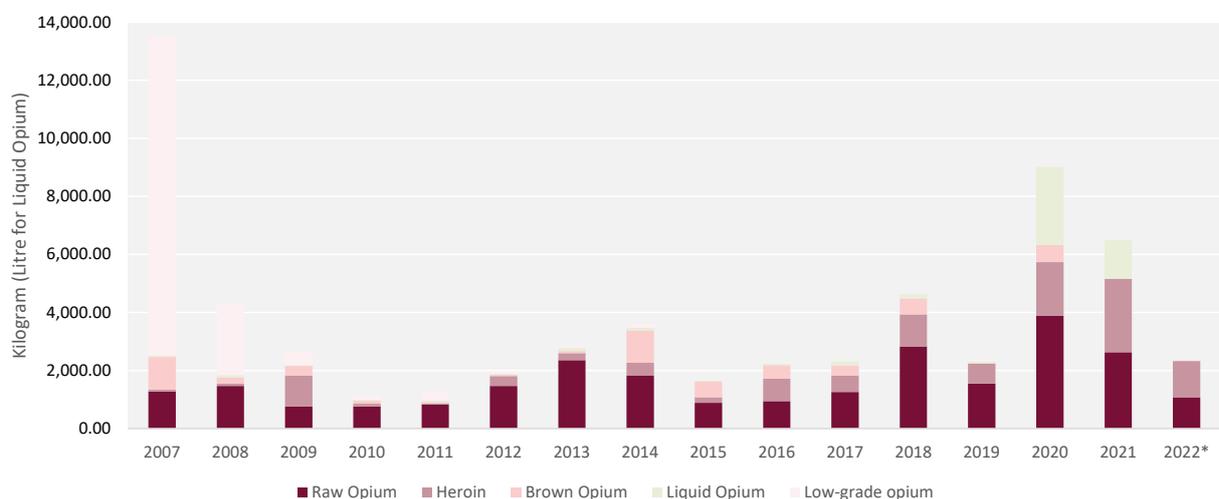
**Table 6: Reported opiates seizures in Myanmar (kg), 1998-2022**

Year	Raw Opium	Heroin	Brown Opium	Liquid Opium	Low-grade Opium
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	3,883	1,853	523	2,694	22
2021	2,110	2,003	0	1,334	21
2022*	1,078	1,249	1	2	13

Source: CCDAC

\* Figures for 2022 correspond to the period 1 January – 31 October.

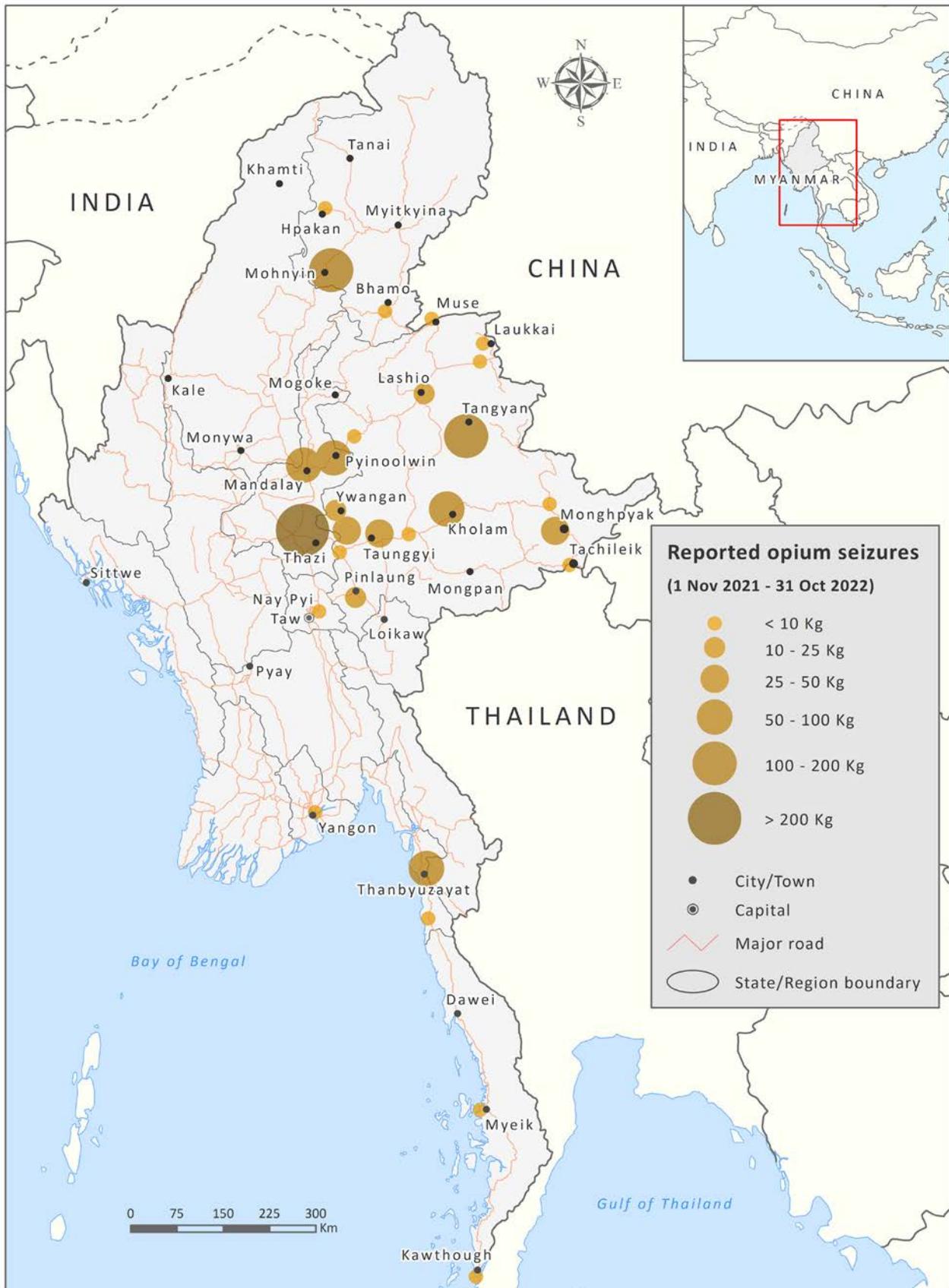
**Figure 7: Seizures of opiates in Myanmar (kg), 2007-2022**



Source: CCDAC.

\* Figures for 2022 correspond to 1 January – 31 October only.

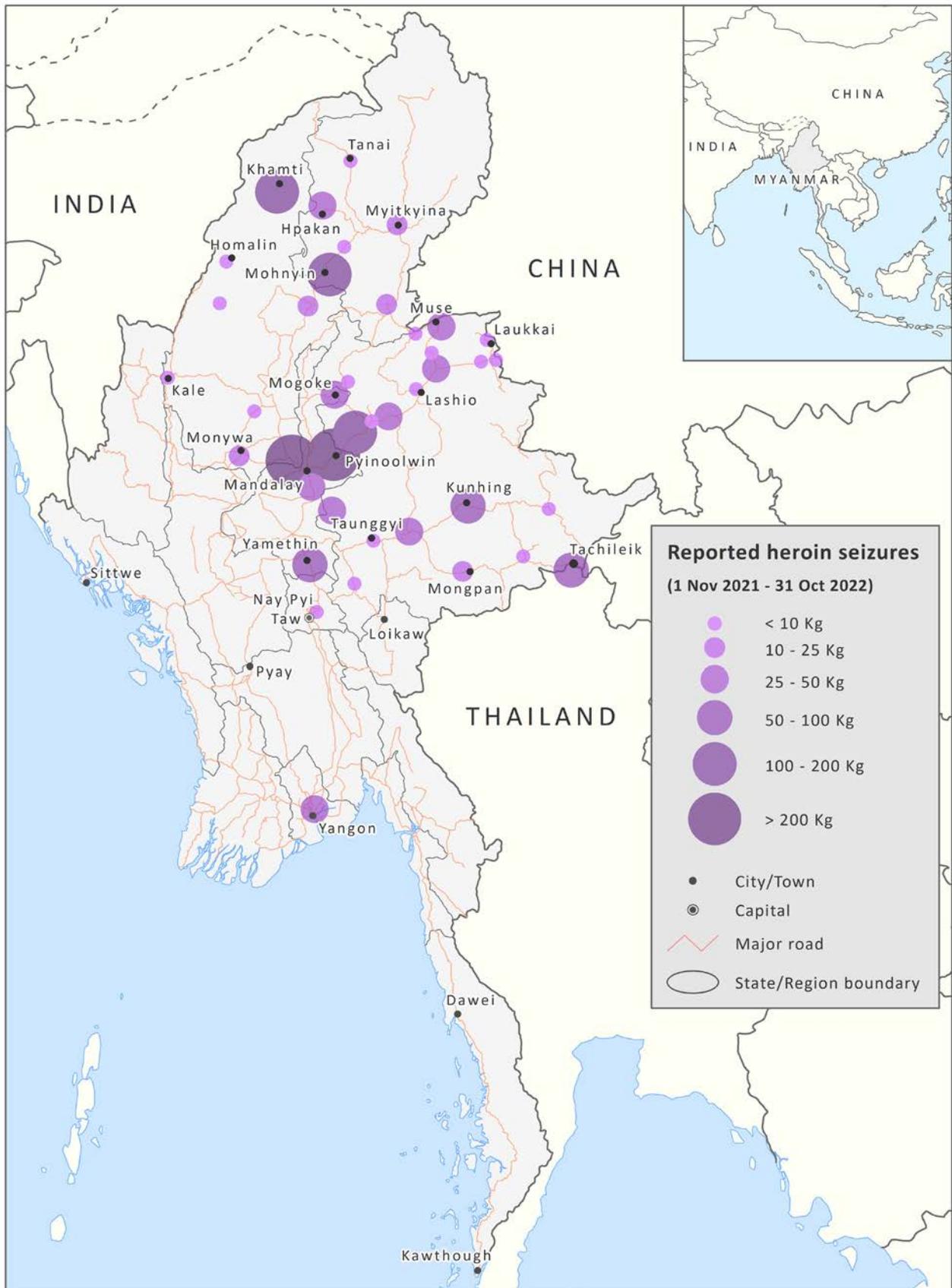
Map 4: Seizures of opium in Myanmar, 1 November 2021 to 31 October 2022



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.

Map 5: Heroin seizures in Myanmar, 1 November 2021 to 31 October 2022



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. METHODOLOGY





### 3. Methodology

The 2022 cultivation and production survey included:

1. Estimation of opium poppy cultivation area throughout North, East and South Shan, Kachin, Chin, and Kayah States. The area estimation survey was based on the use of satellite imagery 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 North, East and South Shan and Kachin States.

#### 3.1 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 State, Tanai area and the eastern part of Kachin State, poppy cultivation areas of Chin and Kayah States were surveyed. Satellite imagery was acquired following two approaches:

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

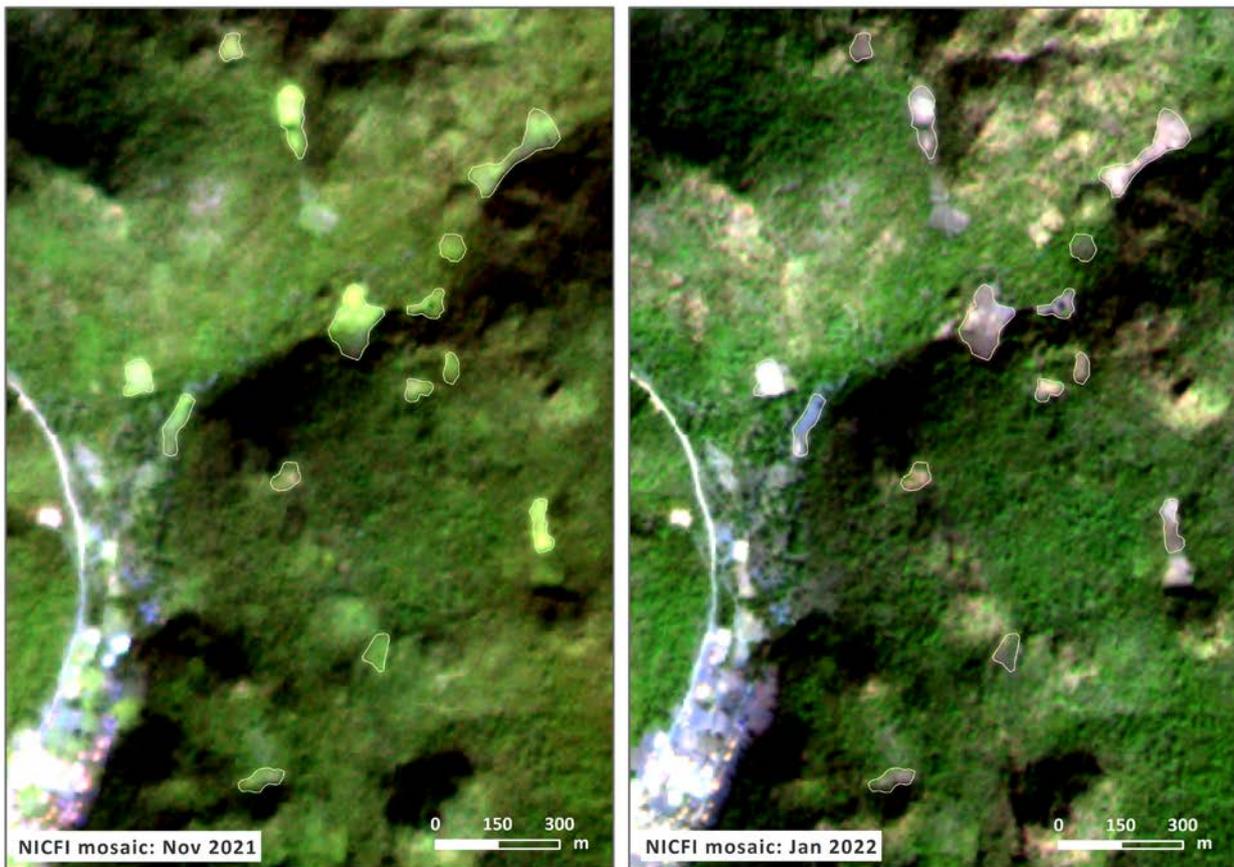
The satellite images used for the sampling areas were very high-resolution (VHR) images, whilst both VHR and high-resolution (HR) images were used for the targeted areas.

The VHR images at the sample locations were acquired by Pleiades satellites, which provide images of 2 metre ground resolution with four spectral bands (blue, green, red, and infra-red) and a 50-centimetre panchromatic band. In previous surveys, two images were acquired

with an approximate five-week interval for each location (sample segment); the first image was taken in December/January and the second one in February/March. In 2022, one VHR image and a second HR image were acquired for the segments that kept the same location as in 2021. For the segments that were new locations, two VHR images were acquired. The two acquisition dates correspond to the poppy pre- and post-harvest time, thus facilitating the identification of poppy fields and their discrimination from other land cover classes. To determine the image acquisition dates, the regional differences between the crop calendars were considered.

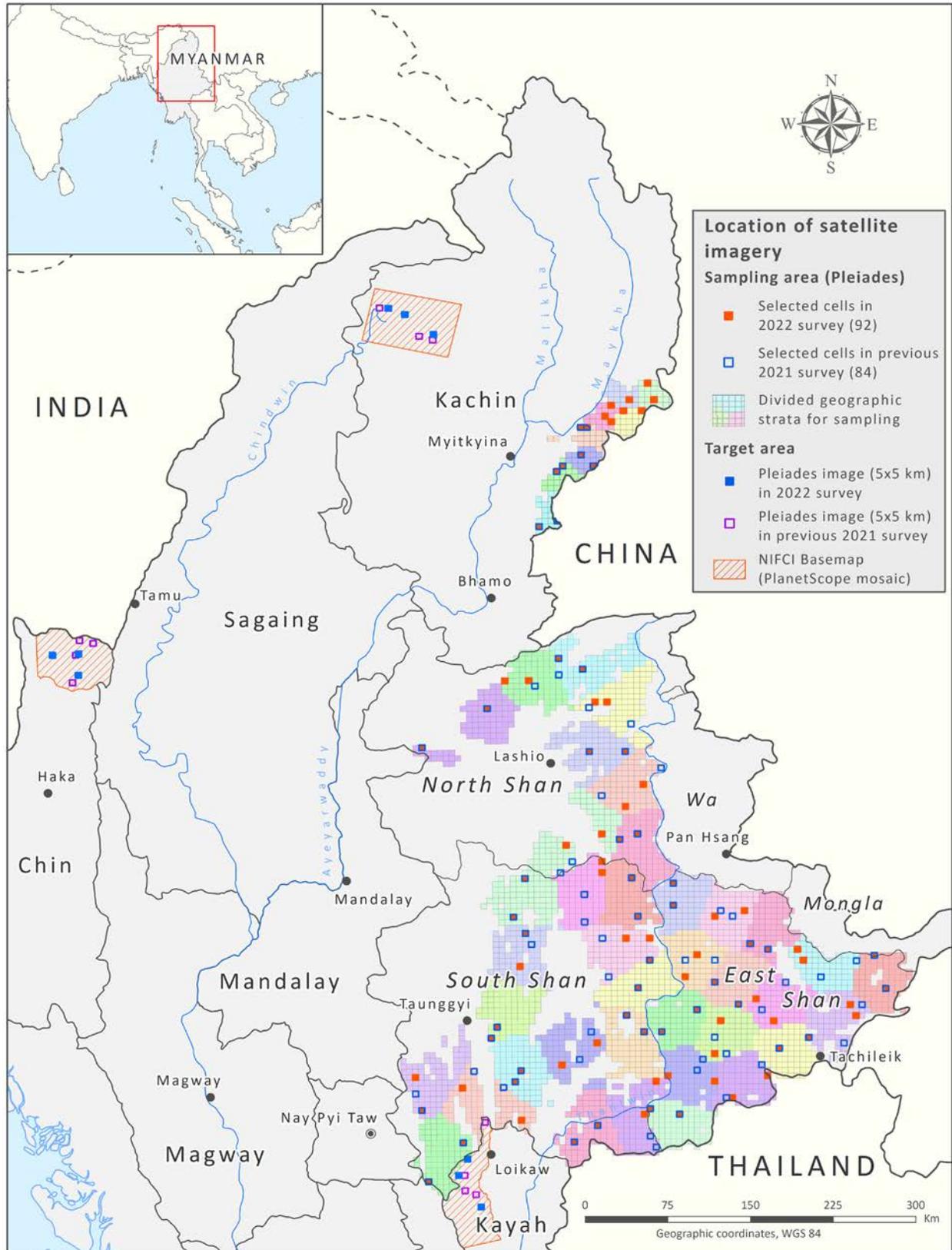
The images covering the Tanai area in Kachin State, the target areas in northern part of Chin State and north-western part of Kayah State were acquired by Planet-NICFI monthly mosaic images, with 4.77 metre (approx.) ground resolution for analysis-ready products. They consist of four spectral bands, ranging from blue to near-infrared wavelength. A set of three 5x5 km segments with Pleiades VHR images were acquired within each target area, (i.e. Tanai area in Kachin, Chin, and Kayah), to evaluate for interpretation results by the Planet-NICFI mosaic data. By interpreting both image types independently, a factor was determined that provides the difference in area estimates from the mosaic images compared to Pleiades VHR images. This factor was applied to the fields that were only covered by the Planet-NICFI images, to correct for the differences in spatial resolution.

Poppy fields observed on HR images (Planet-NICFI monthly mosaics), Kayah State 2022



Use of Planet-NICFI monthly mosaic images for opium poppy field interpretation in Kayah State  
*Includes material © Planet-NICFI programme, all rights reserved*

Map 6: Different satellite imagery and approaches used for the survey, 2022



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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 in Myanmar was developed by the combination of the following factors:

- 1) Land cover;
- 2) Altitude;
- 3) Opium poppy-free<sup>23</sup> 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 practiced 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 metres 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 areas were considered to be poppy-free 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 was considered opium poppy-free in earlier surveys, was included again in the sampling frame since 2013 because ground information from the 2012 survey indicated a certain risk of poppy cultivation.

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

The sampling area in the eastern part of Kachin State was analysed separately. In previous surveys, only Waingmaw township was considered in defining the sampling frame as the significant poppy growing area. However, field evidence in previous surveys showed the existence of several poppy fields in Chipwe township. Therefore, the sampling frame for the selection of the sample locations in Kachin was updated in the 2022 survey using this field evidence. The frame was developed including part of Chipwe township by considering an altitude factor of more than 800 metres and the village tract-level administrative boundary based on field information.

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 8: Altitude ranges (metres) of area of poppy fields detected in satellite images, 2021/2022

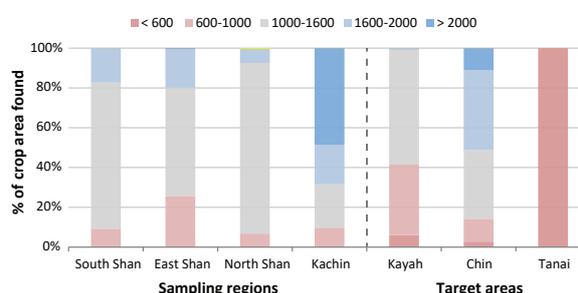
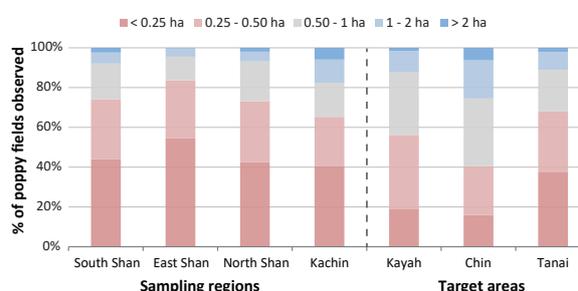


Figure 9: Field size distribution of poppy fields detected in satellite images, 2021/2022



### **Updated 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 eastern 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.

Since 2010, a simple random sampling within geo-strata has been applied. First, the frame was separated by region. Here, each segment had to be assigned to exactly one per region: if most 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*<sup>24</sup> *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.<sup>25</sup>

In 2022, the total number of satellite images chosen was set to 92. In Kachin, the sampling frame was extended by 115%, due to the emergence of

new cultivation areas. Therefore, the number of samples in Kachin state was set at 16, double the previous year’s sample number because of the extended sampling frame. Half of the samples were kept as in the previous year’s location and another half were new locations in the extended sampling frame. In all of Shan, 76 sample locations were selected, keeping the same number of samples as the previous 2021 survey. Among them, 40 samples (18 in South Shan, 14 in East Shan, and 8 in North Shan) out of 76 were kept as in the previous year’s location and another 36 samples were in new locations.

Opium poppy cultivation in Myanmar is done clandestinely, often in small plots in remote and rugged areas. Measuring such activity presents different challenges compared to using satellite imagery for estimating poppy cultivation in places like Afghanistan where most cultivation occurs in flatter terrain under less cloud cover. Sampling methods in Myanmar over time remain constant, allowing for temporal comparability. This includes resampling with replacement periodically to determine changes in plot sizes, density, and cultivation areas that can occur in the country.

This year’s survey sample included an increased number of dense hotspots, as well as minor increases in poppy density more generally in other areas of the country. These hotspot observations contributed to increased estimates for the year; however, it is possible that the increasing trend started earlier. Confidence intervals for poppy cultivation in Myanmar for prior years capture this uncertainty. Taken together with other recent drug market data for the region (e.g., numbers and weights of heroin seizures, retail prices of heroin, and levels of consumption derived from population estimates), it is more than likely that poppy cultivation in Myanmar has been increasing in recent years.

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

25 [https://www.unodc.org/documents/crop-monitoring/sea/Southeast\\_Asia\\_Opium\\_Survey\\_2015\\_web.pdf](https://www.unodc.org/documents/crop-monitoring/sea/Southeast_Asia_Opium_Survey_2015_web.pdf).

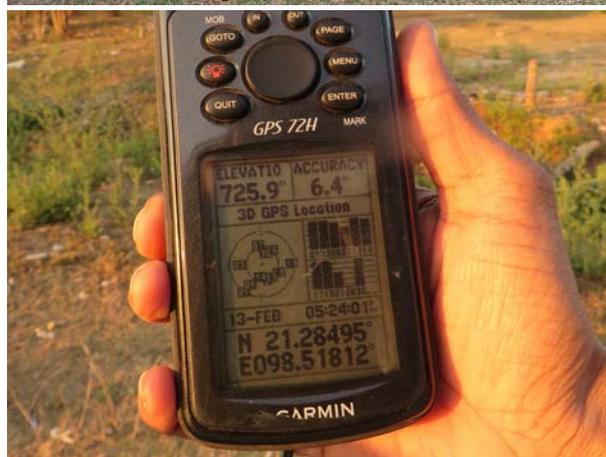
**Table 7: Sample size allocation in 2022**

Region	Sample size 2021	Sample size 2022	Number of geo-strata 2021	Number of geo-strata 2022
East Shan	30	30	15	15
South Shan	30	30	15	15
North Shan	16	16	8	8
Kachin	8	16	4	8
<b>Total</b>	<b>84</b>	<b>92</b>	<b>42</b>	<b>46</b>

**Ground truth data collection**

Before 2019, 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. Since 2019, the Forest Department has not been involved in the opium survey activities. In the 2022 survey, a technical team from UNODC Myanmar office, composed of four members, visited 4 sites in South Shan, 4 sites in East Shan, and 5 sites in Kachin to collect ground truth data. The team visited areas corresponding to the sample satellite images footprint, during the period of December 2021 to February 2022, although field visits were limited due to COVID-19 mobility restrictions and security situations. The field team could not conduct ground truth data in North Shan due to security issues.

**“Ground truthing” in South Shan, East Shan, and Kachin, 2022**



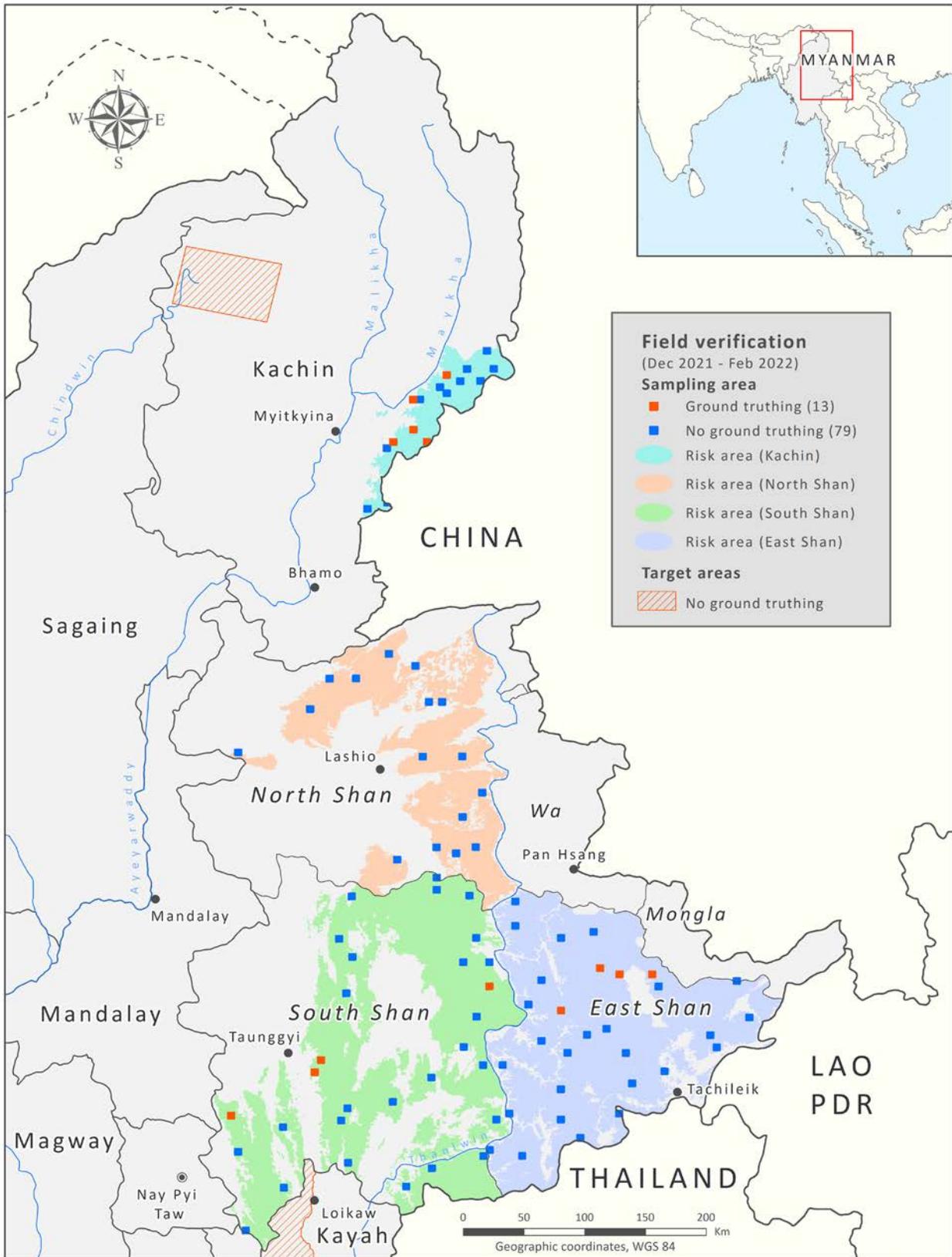
The ground verification team visited locations selected in an opportunistic manner, with printouts of the corresponding satellite images (see Map 7). They collected GPS coordinates, taking field photos from 8 selected satellite image sites in Shan and 5 sites in Kachin State. Subsequently,

the collected field data was complemented by the visual interpretation of poppy fields, executed by a national expert in the UNODC Myanmar Office. The results were verified, and standard quality control procedures were applied by international experts at UNODC Headquarters, Vienna.

**Table 8: Ground truth data collection, 2007-2022**

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 <sup>2</sup> )
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	--	--	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
2021	Pleiades	76	5x5	8	11%	8	--	--	4,200
2022	Pleiades	76	5x5	8	11%	16	5	31%	4,600

Map 7: Field verification status of the survey with satellite images, 2022



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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

### Target area interpretation and correction factors

The area estimates for Tanai area in Kachin, the northern part of Chin and the north-western part of Kayah States were based on a so-called target approach (full coverage survey).<sup>26</sup> All target areas were fully covered by high resolution (HR) Planet-NICFI mosaic images. In addition to the Planet-NICFI images, very high resolution (VHR) images were acquired for each target area (Map 5).

In the 2022 survey, a set of 5x5 km segments with very high resolution (VHR) Pleiades images were acquired for target areas in Kachin, Chin, and Kayah to estimate the omission/commission and geometric errors that stem from the use of lower-resolution imagery. Three 5x5 km segments were selected based on previous year's poppy occurrence in each target area. To that end, the area of opium poppy fields was first interpreted on the Planet-NICFI mosaic images (full coverage) and then on the Pleiades images (three selected locations in each target area). 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 Planet-NICFI images.<sup>27</sup>

### 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 expert in the Myanmar office, with a long-time experience in poppy detection and interpretation of the fields.

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

The main pre-processing step is pan-sharpening (merging) of the Pleiades high resolution panchromatic and lower resolution multispectral

<sup>26</sup> The target area was defined based on information on poppy cultivation from previous surveys since 2009.

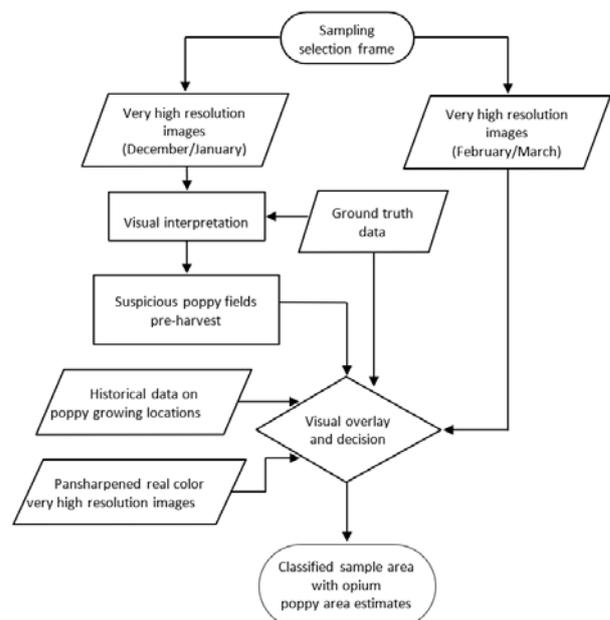
<sup>27</sup> 95% confidence intervals for each targeted area were calculated assuming a t-student distribution and two degrees of freedom. See <https://www.itl.nist.gov/div898/handbook/mpc/section5/mpc552.htm> for further information on the method to calculate the standard deviation.

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.

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.

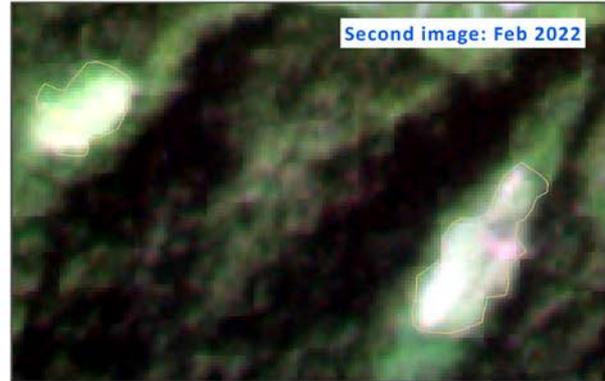
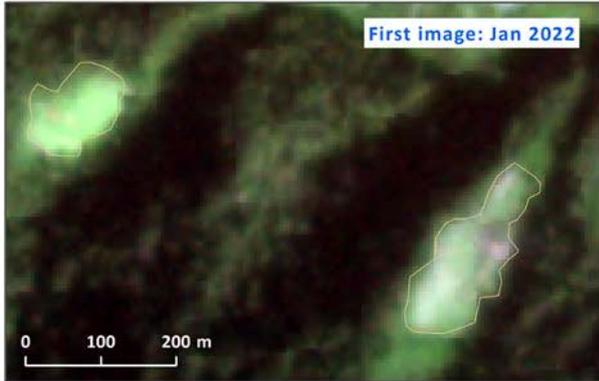
### Satellite image interpretation flowchart



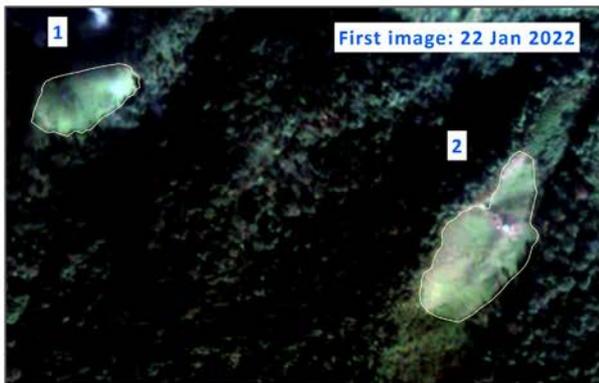
The decision rules can vary by region and stage of poppy cultivation. However, the most commonly applied rule was that potential poppy in the first image, when classified as bare soil in the second image, meant that it was opium poppy. Historical

data on poppy cultivation, three-dimensional (3D) terrain visualisation and real colour pansharpned VHR images were used to facilitate the decision-making.

**Poppy interpretations on HR and VHR, Chin State 2022**



Poppy field interpretation in Planet-NICFI monthly mosaic images

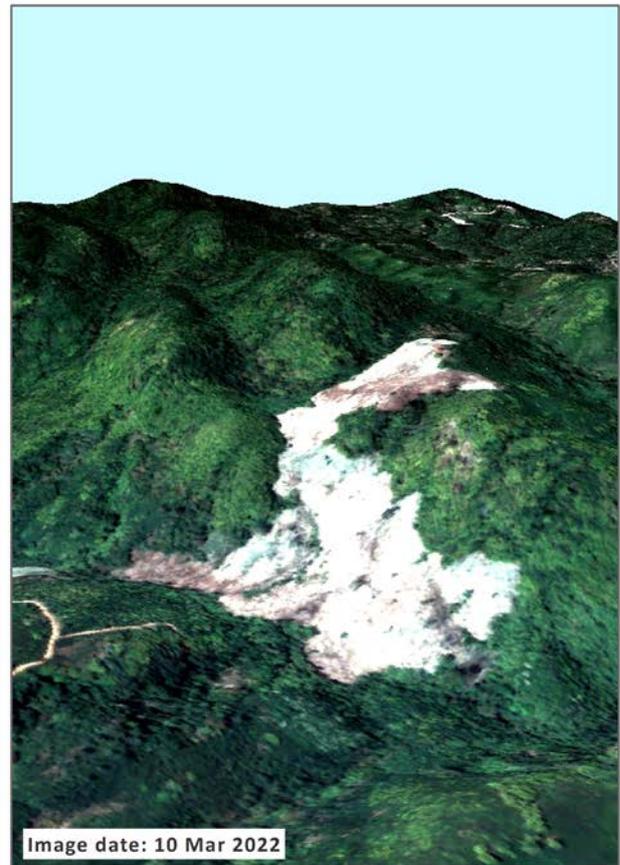
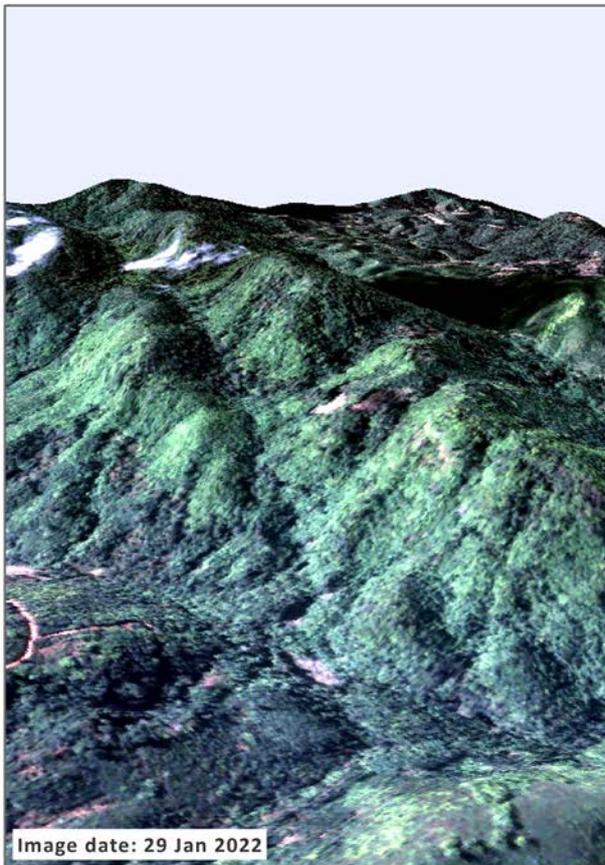


Poppy field interpretation in Pleiades VHR images



3D visualization of interpreted poppy fields on NICFI mosaic image draped on SRTM Digital Elevation Model (DEM)  
Includes material © CNES (2022), Distribution Airbus DS, and Planet-NICFI programme, all rights reserved

Forest clearance observation for poppy cultivation between the first and second images, North Shan 2022



Clearing forest for poppy cultivation in North Shan, Pleiades images draped on SRTM Digital Elevation Model (DEM)  
*Includes material © CNES (2022), Distribution Airbus DS, all rights reserved*

Satellite image interpretations with the corresponding ground truth data, poppy fields, 2022



Use of ground truth picture for image interpretation, South Shan



Flowering-stage poppy field with stony surface



Use of ground truth picture for image interpretation, East Shan



Ground truth flowering-stage poppy field picture



Use of ground truth picture for image interpretation, Kachin State



Ground truth flowering-stage poppy field picture

Very high-resolution, PLEIADES satellite images (pansharpened, true colour composite)  
Includes material © CNES (2021, 2022), Distribution Airbus DS, all rights reserved

### Area estimation methods in 2022

The area estimation consisted of a sampling estimate and a target area estimate. 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, northern Chin, and north-western part of Kayah. 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 2022, 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 strata,  $\bar{y}_h$  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. Bootstrapping<sup>28</sup> 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.

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

**Table 9: Estimated poppy cultivation areas for the sampled areas in 2021 and 2022**

Region	2021	2022	Difference 2021-2022
South Shan	11,315	16,944	50%
East Shan	8,229	9,175	11%
North Shan	5,381	8,441	57%
Kachin	2,716	3,064	13%
<b>Total</b>	<b>28,091</b>	<b>37,625</b>	<b>34%</b>

**Table 10: Estimated poppy cultivation areas for the target areas in 2022**

Target area	Interpreted poppy area (ha) before correction factor	Correction factor 2022	Interpreted poppy area (ha) after correction factor
Tanai (Kachin State)	1,501	-7.07%	1,303
Chin	720	-5.77%	642
Kayah	577	-6.86%	503

## 3.2 Yield and potential opium production estimation

### Collection of yield data

The 2022 yield data collection was conducted by opportunistic manner in North, South and East Shan, and Kachin (Map 7). A field team, composed of four technical staff from the UNODC Myanmar Office, collected yield data in 44 poppy growing villages in Pinlaung, Hsihseng, Hopong, and Loilen Townships in South Shan; 25 poppy growing villages in Kengtung and Mongping Townships in East Shan; 17 poppy growing villages in Tangyan Township in North Shan; and 38 poppy growing villages in Waingmaw Township in Kachin during the period of 24 December 2021 to 22 March 2022.

The villages were selected opportunistically, according to accessibility and security. Field measurements were normally taken from three poppy fields in each village. In 2022, a total 370 fields were surveyed in 124 villages through Shan and Kachin States. Out of 370 fields visited, about 340 had capsule measurements, since the remaining 30 poppy fields were not at the capsule stage yet. The total number of measured capsules was 11,214.

The field team followed the UNODC Guidelines for yield assessment.<sup>29</sup> 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 m<sup>2</sup> 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. All the measurements were recorded by digital cameras to check for data quality assurance.

**Fresh and harvested opium gum at a first-time lanced capsule in Kachin, 2022**



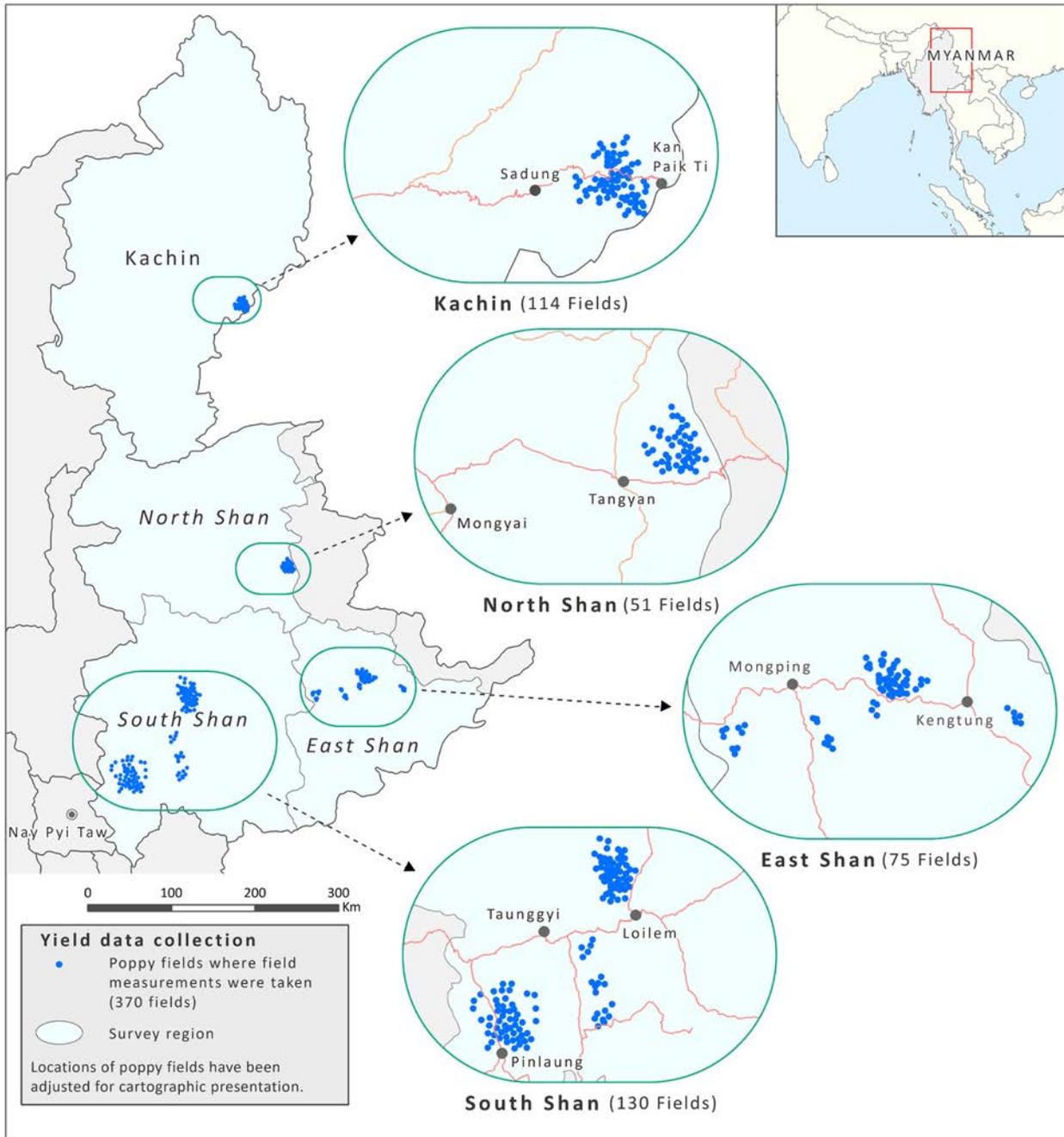
**Yield data collection in South Shan and Kachin, 2022**



<sup>29</sup> <https://www.unodc.org/unodc/en/scientists/guidelines-for-yield-assessment-of-opium-gum-and-coca-leaf.html>.



**Map 8: Location of fields visited in the yield surveys in Shan and Kachin States, 2022**



Source: UNODC Illicit Crop Monitoring Programme in Myanmar.

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

Table 11: Opium cultivation calendar Myanmar, 2020-2021\*

Region	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Kayah											
South Shan											
East Shan											
North Shan											
Kachin											
Chin											

	Monsoon cultivation
	Normal cultivation
	Late cultivation

Source: Illicit Crop Monitoring Programme in Myanmar

\* Monsoon cultivation observed in Kayah and southern South Shan refer to early planting before end of rainy season and Late cultivation refer to staggered planting after normal time to spread the harvest over a longer period.

### Estimating potential opium yield

The capsule volume per square metre is derived from field measurements and entered into the formula for the yield calculation. Each plot thus provides one yield observation. The simple average of the three plots in a field is considered the field yield. The yield by State is 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 (cm<sup>3</sup>/m<sup>2</sup>).

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 cm<sup>3</sup>/m<sup>2</sup>.

However, high volumes exceeding 900 cm<sup>3</sup>/m<sup>2</sup> 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.<sup>30</sup>

In 2022, yield data were collected in 124 villages of Shan and Kachin States. A total of 370 fields were visited. A three-year (2020 – 2022) average was applied to calculate yield figures for North, East, South Shan regions and Kachin State.

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 (see following section).

### Estimating national average yield

In 2022, 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.

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

### 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.

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 ( $\Delta p$ ), resulting from uncertainty in the estimates for cultivation area and yield.

The 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.

### 3.3 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. 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. 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 consumed either 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 region<sup>31</sup> and the comparison of the opium production levels between Myanmar and Laos,<sup>32</sup> which are supposedly the only opium providing countries in the region.<sup>33</sup> The remaining

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

32 *Southeast Asia Opium Survey 2015 – Lao PDR, Myanmar* (UNODC, 2015).

33 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.

opium, after discounting opium seizures,<sup>34</sup> is deemed to be processed into heroin. A ratio of 10:1 is used for converting opium to heroin of unknown purity,<sup>35</sup> and, after subtracting the reported heroin seizures,<sup>36</sup> 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:

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

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

- The prevalence of opiates use<sup>37</sup> in the country
- The respective proportions of opium and heroin users<sup>38</sup>
- The Myanmar population between 15 and 64 years old<sup>39</sup>
- The annual heroin<sup>40</sup> and opium<sup>41</sup> average consumption rates

The retail price of opium and the retail price of heroin were provided by the CCDAC.<sup>42</sup> 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.<sup>43</sup>

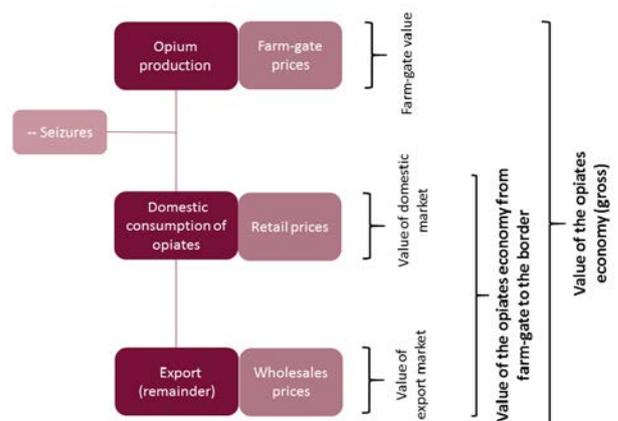
**The value of opiates potentially available for export**

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 prices<sup>44</sup> 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.<sup>45</sup> 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 needs 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 12: Workflow diagram of the analysis of the opiates economy’s components**



34 CCDAC by October 2021 reported the seizure of 2,110 kg of opium. The quantities of opium seized in the whole year 2020 was linearly extrapolated based on this figure.

35 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).

36 CCDAC by October 2021 reported the seizure of 2,003 kg of heroin. The quantities of heroin seized in the whole year 2021 was linearly extrapolated based on this figure.

37 Annual prevalence for opiates is 0.8%. Source: UNODC, 2010 (<https://dataunodc.un.org/data/drugs/Prevalence-general>).

38 Heroin users represent the 90.5% of opiates users, opium users the 9.5%. Derived from 2020 treatment data at the 2021 SMART Regional Workshop.

39 Source: World Bank.

40 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](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.

41 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).

42 CCDAC, at the 2020 SMART Regional Workshop.

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

44 Wholesale opium and heroin prices were reported by CCDAC at the 2021 SMART Regional Workshop.

45 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.

### ***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 heroin<sup>46</sup> 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.

---

46 The amount of raw opium needed for producing 1 kg 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.





# UNODC

United Nations Office on Drugs and Crime

## Regional Office for Southeast Asia and the Pacific

United Nations Building, 3<sup>rd</sup> floor B Block, Secretariat Building, Raj Damnern Nok Avenue, Bangkok 10200, Thailand

Tel. (66-2) 288-2100 Fax. (66-2) 281-2129 E-mail: [unodc-thailandfieldoffice@un.org](mailto:unodc-thailandfieldoffice@un.org)

Website: <http://www.unodc.org/roseap>

 Twitter: @UNODC\_SEAP