UNODC
United Nations Office on Drugs and Crime

Islamic Republic of Afghanistan
Ministry of Counter Narcotics

Afghanistan

Survey of Commercial Cannabis Cultivation and Production 2012

SEPTEMBER 2013

ABBREVIATIONS

ANDS Afghanistan National Development Strategy

AOPS Annual Opium Poppy Survey

CNPA Counter Narcotics Police of Afghanistan

ICMP Illicit Crop Monitoring Programme (UNODC)

MCN Ministry of Counter-Narcotics

NDCS National Drug Control Strategy

UNODC United Nations Office on Drugs and Crime

ACKNOWLEDGEMENTS

The following organizations and individuals contributed to the implementation of the survey of commercial cannabis cultivation and production and to the preparation of this report:

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United Nations Office on Drugs and Crime (Vienna)

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The implementation of the survey would not have been possible without the dedicated work of the field surveyors, who often faced difficult security conditions.

The 2012 Survey of Commercial Cannabis Cultivation and Production was financed by the United States of America. The MCN/UNODC Illicit Crop Monitoring activities in Afghanistan were made possible by financial contributions from the Governments of Germany, Norway, the United Kingdom and the United States of America.

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2012 Survey of Commercial Cannabis Cultivation and Production

	2011	Change on 2011	2012
Commercial, mono-crop cannabis cultivation[1]	12,000 ha (8,000-17,000 ha)	-17%[2]	10,000 ha (7,000-14,000 ha)
Average cannabis resin powder (garda) yield from cannabis in mono-crop cultivation	First Garda: 51 kg/ha Second Garda: 36 kg/ha Third Garda: 25 kg/ha Total: 112 kg/ha	+21%	First Garda: 50 kg/ha Second Garda: 55 kg/ha Third Garda: 32 kg/ha Total: 136 kg/ha
Potential cannabis resin powder (garda) production[3]	1,300 tons (1,000-1,900 tons)	+8%	1,400 tons (900-1,900 tons)
Average farm-gate price of cannabis resin powder at time of resin processing (January), weighted by production	First Garda: US$ 95/kg Second Garda: US$ 63/kg Third Garda: US$ 39/kg		First Garda: US$ 68/kg Second Garda: US$ 41/kg Third Garda: US$ 26/kg
Total farm-gate value of cannabis resin production (all garda qualities) As percentage of GDP[4]	US$ 95 million (US$ 78-135 million) 0.6%	-32%	US$ 65 million (US$ 44-91 million) 0.3%
Cannabis growing households[5]	65,000		NA[6]
Average cannabis cultivated per cannabis growing household (all households)	0.29 ha		NA[6]
Proportion of cannabis farmers who also grew opium	58%		NA[6]
Average yearly gross income from cannabis of cannabis growing households[7]	US$ 2,400		NA[6]
Gross income from cannabis per hectare	US$ 8,100		US$ 6,400

[1] Refers to the area with commercial, mono-crop cultivation in the provinces covered by the survey (risk area). Small-scale cannabis cultivation in kitchen gardens, lines of cannabis around fields (bund cultivation) and fields of cannabis mixed with other crops are not considered in this area estimate.

[2] The area covered by the survey was reduced compared to 2011 (see "The scope of the survey"). The comparability of the two area estimates is therefore limited.

[3] Refers to air-dried cannabis powder (not adjusted for moisture).

[4] Nominal GDP for the respective year. Source: Government of Afghanistan.

[5] The estimate is based on headmen interviews from the village survey 2011. It comprises all cannabis-growing households reported by headmen, i.e. possibly also households with only small-scale cannabis cultivation. The contribution of such households to the total cannabis cultivation area and cannabis production could not be estimated.

[6] In the year 2012 no village survey was conducted; this indicator is therefore not available.

[7] Income figures are indicative only; they do not include all expenditure and income components associated with cultivation.

KEY FINDINGS

- The 2012 Survey of Commercial Cannabis Cultivation and Production estimated the total area under cultivation in 2012 at 10,000 hectares and a potential production of 1,400 tons. These figures only include commercial, mono-crop cannabis cultivation as the survey tool cannot capture small-scale "kitchen garden" cultivation of cannabis, which is often for localized and/or personal use and is thought to account for only a small percentage of total production.
- In contrast to previous surveys, the 2012 survey consisted of only two instead of three components: an area survey using satellite imagery and a yield survey. There was no socioeconomic village survey and the survey area was reduced.
- In 2012, the estimated area under commercial cannabis cultivation declined by 17% compared to 2011; however, the area covered by the survey was reduced compared to 2011, which reduces the comparability of the two area estimates.
- Due to higher per-hectare yields, production increased by 8% compared to 2011.
- The decrease in cultivation is mainly attributed to lower levels of cannabis cultivation in Uruzgan province. The area under cannabis cultivation in Uruzgan decreased drastically from more than 1,000 hectares in 2011 to less than 100 hectares in 2012. According to reports from the field, the reason for the reduction was a strictly enforced ban by provincial authorities, which was imposed because cannabis fields seemed to have been used by insurgent groups as hiding places.
- In the remaining 15 provinces surveyed, no major changes in cannabis cultivation were observed in 2012 and the 2012 levels of cultivation in these provinces are considered to be stable compared to 2011.
- The main reason for the increase in potential production in spite of a decline in cultivation is the better yield of cannabis garda compared to 2011. In 2012, the national average of garda yield (all qualities) was 136 kg/ha, an increase by 21% when compared to 2011 (112 kg/ha). Levels of cannabis garda yield are nearly as high as they have been in 2009 (145 kg/ha).
- The MCN/UNODC price monitoring showed that the cannabis prices have declined in 2012 after a price hike in 2011, in parallel to the opium price trends. Despite this, cannabis cultivation is still financially very attractive. In 2012, farmers potentially achieved a gross income[8] of US$ 6,400 per hectare from cannabis resin, which was higher than the gross income from opium (US$ 4,600 per hectare) in the same year.

[8] The gross income from cannabis resin does not take into account the potential value of cannabis by-products such as cannabis seeds or stalks.

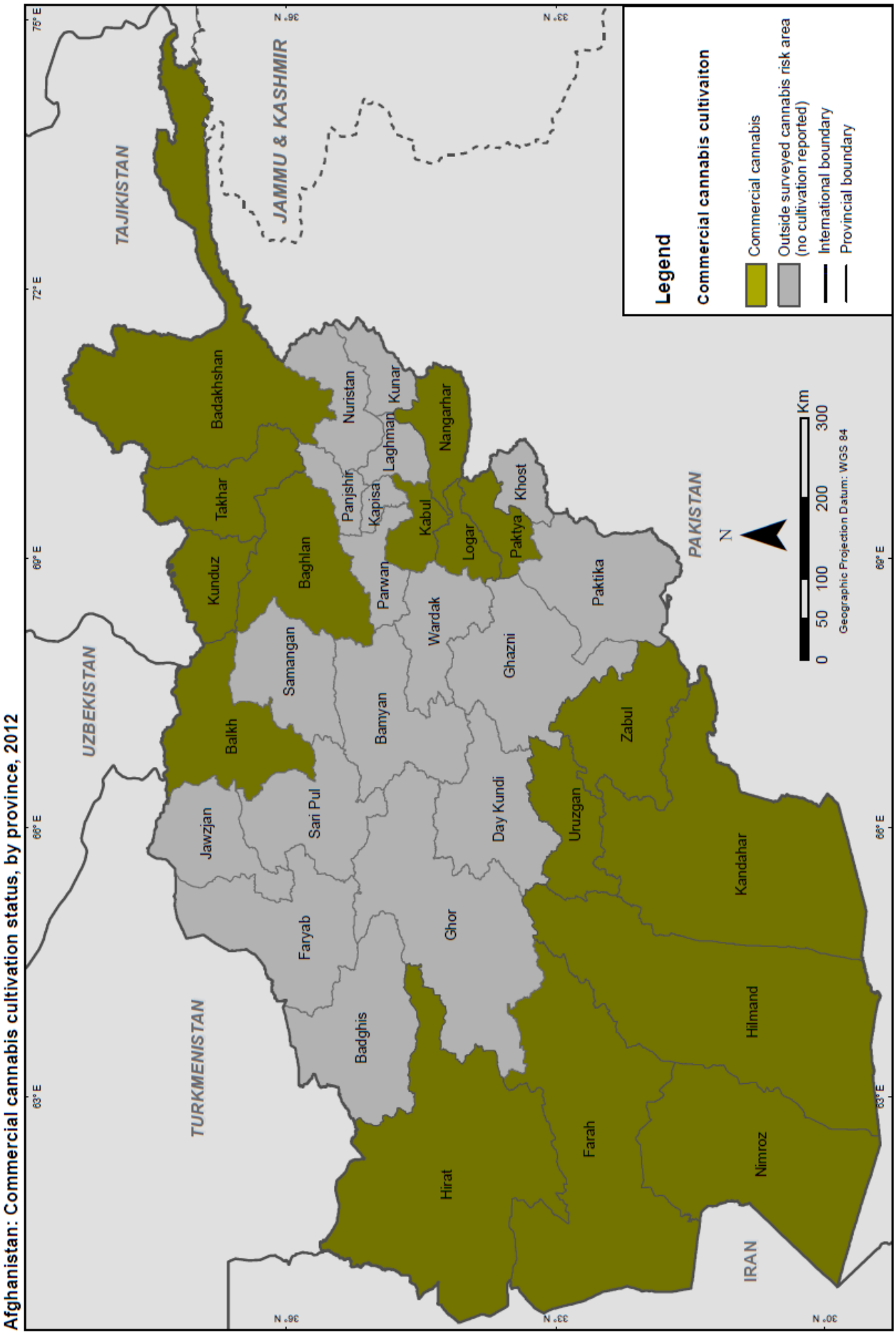
1 INTRODUCTION

This report presents the results of the fourth *Afghanistan Cannabis Survey* implemented by the Ministry of Counter Narcotics (MCN) with support from UNODC. The first survey was carried out in 2009, as evidence from cannabis resin seizures had long pointed to Afghanistan as one of the world's main producers of this cannabis product.

In 2012, the survey consisted of yield studies and satellite image interpretation, only. In contrast to previous years no socioeconomic village survey was conducted; therefore several indicators could not be provided. The cannabis production estimation was based on a yield observation study undertaken in October 2012 -January 2013, when the harvest and processing of cannabis resin took place. The overall cannabis area estimate is based on the interpretation of 160 high-resolution satellite images in 16 provinces.

The 2012 Survey of Commercial Cannabis Cultivation and Production was implemented within the technical framework of UNODC's Illicit Crop Monitoring Programme (ICMP) under the project AD/AFG/F98. The objective of ICMP is to assist the international community in monitoring the extent and evolution of illicit crops within the context of the Political Declaration and Plan of Action on International Cooperation towards an Integrated and Balanced Strategy to Counter the World Drug Problem, adopted by Member States in 2009[9].

[9] E/2009/28, E/CN.7/2009/12, Political Declaration and Plan of Action on International Cooperation towards an Integrated and Balanced Strategy to Counter the World Drug Problem.


Afghanistan: Commercial cannabis cultivation status, by province, 2012
Legend
Commercial cannabis cultivaiton
Commercial cannabis
Outside surveyed cannabis risk area (no cultivation reported)
International boundary
Provincial boundary
TAJIKISTAN
JAMMU & KASHMIR
UZBEKISTAN
PAKISTAN
TURKMENISTAN
IRAN
Badakhshan
Takhar
Kunduz
Baghlan
Nuristan
Kunar
Laghman
Nangarhar
Panjshir
Kapisa
Kabul
Logar
Khost
Paktya
Parwan
Paktika
Wardak
Ghazni
Samangan
Balkh
Bamyan
Zabul
Jawzjan
Sari Pul
Day Kundi
Uruzgan
Faryab
Ghor
Kandahar
Badghis
Hilmand
Hirat
Farah
Nimroz
0 50 100 200 300 Km
N
Geographic Projection Datum: WGS 84
Source: MCN - UNODC Afghanistan Cannabis Survey, 2012(http://www.unodc.org/unodc/en/crop_monitoring.html)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

2 CANNABIS IN AFGHANISTAN 2012: FACTS & FIGURES

The scope of the survey

The 2012 cannabis survey covered 16 provinces where commercial cannabis cultivation had been observed or reported in past surveys. These 16 provinces formed the so-called "risk area" for the 2012 survey, i.e. the area to be surveyed. On the basis of reports and observations from regional and provincial survey coordinators it was concluded that in the other 18 provinces commercial, large-scale cannabis cultivation either did not exist, was negligible or cannabis was limited to kitchen gardens or other forms of small-scale, non-commercial cultivation.

Out of the nine provinces in 2011 that were covered by the village survey only and not by satellite imagery, three were added to this year's satellite image-based survey (Kabul, Kunduz and Takhar), because of strong indications from field reports and previous surveys that significant commercial cannabis cultivation existed. The remaining six provinces (Badghis, Faryab, Jawzjan, Kapisa, Paktika and Sari Pul) were excluded from the survey area as field reports and previous survey results indicated that commercial cannabis cultivation was negligible or not present. This was also true for Day Kundi province which was covered by satellite imagery in 2011 but excluded from the 2012 survey[10].

This overall reduction of number of provinces surveyed limits the direct comparability of the 2012 area estimate with previous years, since the existence of commercial cannabis cultivation cannot be completely excluded in those provinces. However, the expansion of the satellite-based survey to additional provinces in 2012 and the reliance on only one survey tool for the area estimate – the interpretation of very high resolution satellite imagery – instead of a combination of village and satellite surveys allowed more robust estimates.

The main components of the survey were a satellite based cannabis cultivation survey in all provinces in the survey area and a cannabis yield survey. The "satellite survey" covered only fields with mono-crop cannabis. In some provinces, cannabis is intercropped with licit crops, making the identification of cannabis fields on satellite images difficult. Such mixed fields, which do not show a typical cannabis reflectance pattern in images, cannot be identified with current remote-sensing methodology. Thus, the area estimate from the remote sensing survey refers only to mono-crop cannabis fields and does not consider cannabis in kitchen-gardens, along field boundaries and in mixed fields. In addition to this survey a cannabis yield survey was conducted in 41 villages at the end of 2012 and beginning of 2013, when farmers actually processed the harvested and dried cannabis plants to obtain cannabis resin.

The extent of commercial cannabis cultivation in 2012

The area under cannabis cultivation in Afghanistan in 2012 was estimated to be 10,000 hectares (7,000 – 14,000 hectares). The area under cannabis cultivation decreased by 17% in 2012, from 12,000 hectares in 2011 to 10,000 hectares. The decrease in cultivation is mainly attributed to lower levels of cannabis cultivation in Uruzgan province: the area under cannabis cultivation in Uruzgan decreased drastically from more than 1,000 hectares in 2011 to less than 100 hectares in 2012. According to reports from the field, the reduction was caused by a strictly enforced ban by provincial authorities, which was imposed because cannabis fields seemed to have been used by insurgent groups as hiding places.

For the overall levels of cultivation in the remaining 15 provinces, no major changes were observed. The levels of cultivation in these provinces are therefore considered to be stable when compared to 2011.

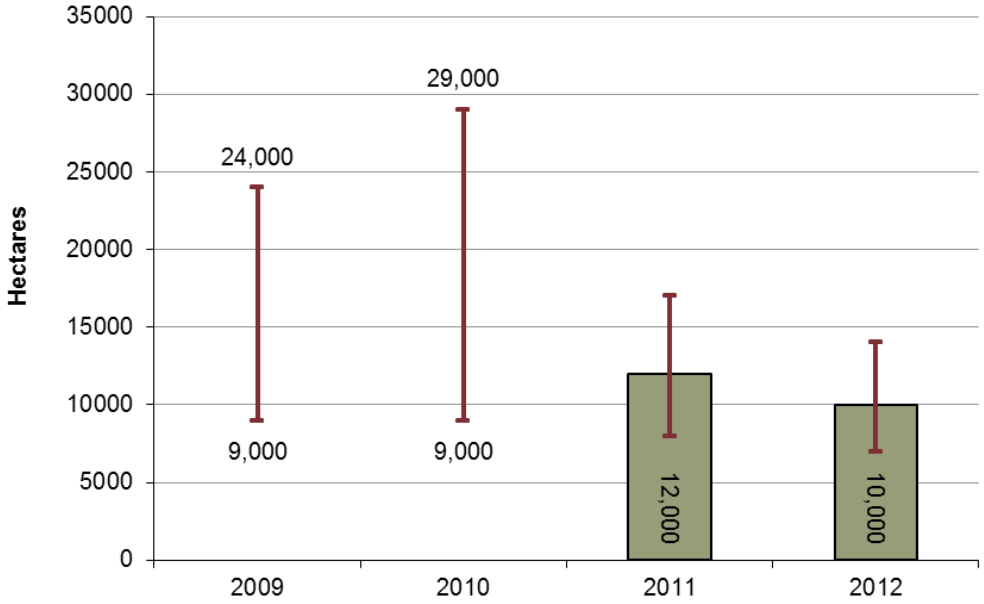
The area estimate covers only fields with mono-crop cannabis and is therefore an estimate of large-scale, "commercial" production. That is to say that small-scale cultivation, such as in kitchen gardens, flower pots, along the walls of compounds, along the boundaries of fields, "wild cannabis" or cannabis inter-cropped with other crops in the same field at the same time, is not part of the area estimates of this survey.

The survey found that roughly 54% of cannabis cultivation in 2012 was in the Southern region (a separate estimate cannot be provided because the survey was not designed for providing estimates with sufficient accuracy at the provincial level), a regional disparity that, by and large, reflects the current pattern of

[10] The comparability of the 2011 and 2012 estimates is therefore limited. The provinces exlcuded in 2012 contributed about 6% to the 2011 area estimate.

opium cultivation, though cannabis was also found in several poppy-free provinces. However, there is a clear geographic association between opium and cannabis cultivation at the provincial level.

Figure 1 Estimated levels of cannabis cultivation in Afghanistan, 2009 - 2012



Source: MCNUNODC: Annual Cannabis Surveys 2009-2012.
The high-low bars represent the upper and lower bounds of the estimates.

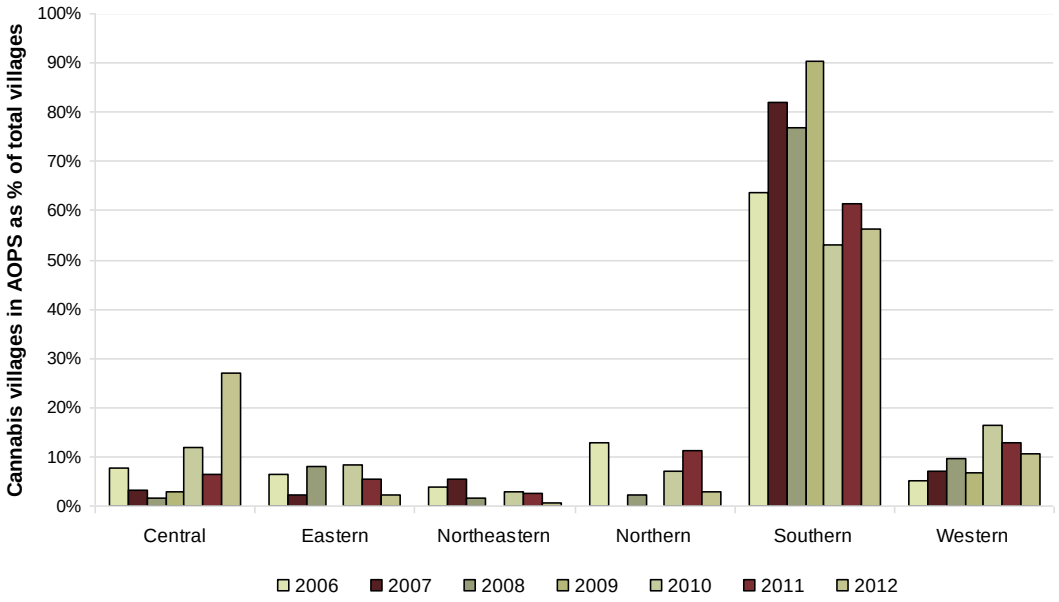
Regional trends in commercial cannabis cultivation

A dedicated annual survey for measuring the extent of cannabis cultivation and production in Afghanistan was undertaken by UNODC in each of the four years, 2009-2012. However, information on cannabis cultivation was also collected during the Annual Opium Surveys from 2005 to 2012 in which information was collected on farmers' intentions to cultivate cannabis in each of those years, with some limitations. The village level interviews undertaken during the opium survey were conducted during the opium cultivation period (spring) before cannabis, a summer crop, was planted. Thus, reporting was based on farmers' intentions rather than actual cannabis cultivation as farmers could subsequently change their decision on which crop to plant in the summer season. Furthermore, the existence of cannabis cultivation could not be verified by the surveyors during the opium surveys since the crop was not yet visible in fields. Within those limitations and considering that a separate, interview-based survey on cannabis was not conducted in 2012, some conclusions can still be drawn :

- During the period 2005 to 2012, the proportion of villages reporting the intention to cultivate cannabis was always much smaller than the proportion of opium-cultivating villages. Typically, the samples showed about two to four times more opium-cultivating than cannabis-cultivating villages.
- The lower proportion of cannabis-cultivating villages and the smaller area of cannabis cultivated per village compared to opium cultivation, reflect that the levels of cannabis cultivation in the years 2009 to 2012 was well below the level of opium cultivation in the same period.
- The proportion of villages in the sample reporting the intention to cultivate in the Southern region dramatically increased between 2005 and 2009 and decreased in 2010, from where on it stabilized. Due to the low number of cannabis villages found in all of those years, it is difficult to assess whether such proportional changes indicate a change in cannabis cultivation in absolute terms in those regions.

The information on cannabis collected through the Annual Opium Surveys cannot be directly compared with the information collected during the cannabis surveys as the opium surveys cover all provinces of Afghanistan, whereas the cannabis surveys cover only provinces identified as the cannabis risk area. In addition, only a small proportion of villages included in the opium surveys reported cannabis cultivation and that limited the reliability of the information collected on cannabis.

Figure 2 Regional shares of villages reporting the intention to cultivate cannabis, 2006-2012



Source: MCNUNODC: Annual Opium Surveys 2006-2012

Table 1: Commercial cannabis cultivation by province, 2009 – 2012

PROVINCE	Cannabis cultivation 2009	Cannabis cultivation 2010	Cannabis cultivation 2011	Cannabis cultivation 2012
Ghazni	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Kabul	Not in risk area*	Not in risk area*	Yes	Yes
Khost	Not in risk area*	Yes	Not in risk area*	Not in risk area*
Logar	Yes	Yes	Yes	Yes
Paktika	Not in risk area*	Not in risk area*	Yes	Not in risk area*
Paktya	Yes	Yes	Yes	Yes
Panjshir	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Parwan	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Wardak	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Central Region	**Yes**	**Yes**	**Yes**	**Yes**
Kapisa	Not in risk area*	Not in risk area*	Yes	Not in risk area*
Kunar	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Laghman	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Nangarhar	Yes	Yes	Yes	Yes
Nuristan	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Eastern Region	**Yes**	**Yes**	**Yes**	**Yes**
Badakhshan	Yes	Yes	Yes	Yes
Kunduz	No	Yes	Yes	Yes
Takhar	Yes	Yes	Yes	Yes
North-eastern	**Yes**	**Yes**	**Yes**	**Yes**
Baghlan	Yes	Yes	Yes	Yes
Balkh	Yes	Yes	Yes	Yes
Bamyan	No	No	Not in risk area*	Not in risk area*
Faryab	Insignificant	Yes	Yes	Not in risk area*
Jawzjan	Yes	No	No	Not in risk area*
Samangan	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Sari Pul	No	No	No	Not in risk area*
Northern	**Yes**	**Yes**	**Yes**	**Yes**
Day Kundi	Not in risk area*	Yes	Yes	Not in risk area*
Hilmand	Yes	Yes	Yes	Yes
Kandahar	Yes	Yes	Yes	Yes
Uruzgan	Yes	Yes	Yes	Yes
Zabul	Yes	Yes	Yes	Yes
Southern	**Yes**	**Yes**	**Yes**	**Yes**
Badghis	Yes	Yes	Yes	Not in risk area*
Farah	Yes	Yes	Yes	Yes
Ghor	Not in risk area*	Not in risk area*	Not in risk area*	Not in risk area*
Hirat	Yes	Yes	Yes	Yes
Nimroz	Yes	Yes	Yes	Yes
Western	**Yes**	**Yes**	**Yes**	**Yes**
Total	**10,000-24,000**	**9,000-29,000**	**12,000**	**10,000**

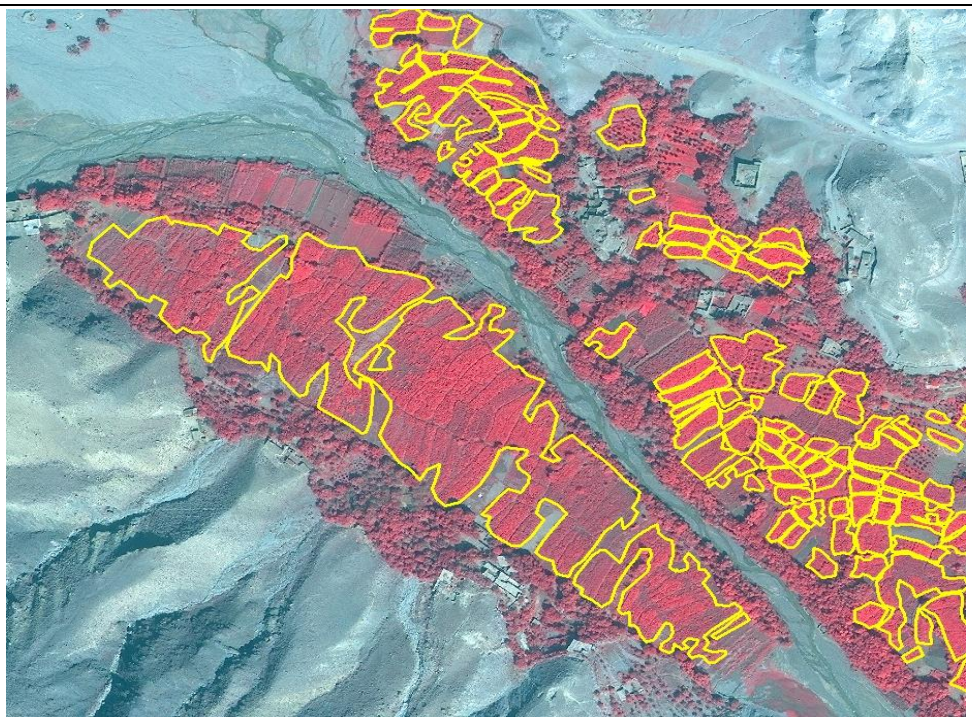
** The province is not in the cannabis risk area as it was defined for the cannabis survey of the given year.*

Table 2: Cannabis and opium cultivation, by province, 2012

PROVINCE	Opium cultivation 2012 (hectare)**	Commercial cannabis cultivation 2012
Ghazni	Poppy-free	Not in risk area*
Kabul	120	Yes
Khost	Poppy-free	Not in risk area*
Logar	Poppy-free	Yes
Paktika	Poppy-free	Not in risk area*
Paktya	Poppy-free	Yes
Panjshir	Poppy-free	Not in risk area*
Parwan	Poppy-free	Not in risk area*
Wardak	Poppy-free	Not in risk area*
Central Region	**120**	**Yes**
Kapisa	290	Not in risk area*
Kunar	1,279	Not in risk area*
Laghman	877	Not in risk area*
Nangarhar	3,151	Yes
Nuristan	Poppy-free	Not in risk area*
Eastern Region	**5,596**	**Yes**
Badakhshan	1,927	Yes
Kunduz	Poppy-free	Yes
Takhar	Poppy-free	Yes
North-eastern Region	**1,927**	**Yes**
Baghlan	177	Yes
Balkh	Poppy-free	Yes
Bamyan	Poppy-free	Not in risk area*
Faryab	Poppy-free	Not in risk area*
Jawzjan	Poppy-free	Not in risk area*
Samangan	Poppy-free	Not in risk area*
Sari Pul	Poppy-free	Not in risk area*
Northern Region	**177**	**Yes**
Day Kundi	1,058	Not in risk area*
Hilmand	75,176	Yes
Kandahar	24,341	Yes
Uruzgan	10,508	Yes
Zabul	424	Yes
Southern Region	**111,507**	**Yes**
Badghis	2,363	Not in risk area*
Farah	27,733	Yes
Ghor	125	Not in risk area*
Hirat	1,080	Yes
Nimroz	3,808	Yes
Western Region	**35,109**	**Yes**
Total (rounded)	**154,000**	**10,000**

** Provinces not in the cannabis risk area as defined for the 2012 cannabis survey.*
**Source: Afghanistan Opium Survey 2012*

Photo 1: Cannabis fields at flowering stage, as seen on a false-colour satellite image in Nangarhar province, 2012



Cannabis fields at the flowering stage, as seen on a false-colour satellite image

Cannabis fields at the flowering stage, as seen on heli-picture

Photo 2: Cannabis at flowering stage, Panjway district, Kandahar province, 2012

Cannabis yield and potential production

The product sold by cannabis farmers is a powdery substance called "garda" obtained by threshing and sieving dried cannabis plants. In a process of repeated sieving, farmers produce graded qualities that contain different concentrations of cannabis resin (first, second and third garda). Research indicates that regional differences exist in processing cannabis into garda, which are also reflected in the prices of its different qualities.

Previous surveys showed that processing methods used in the Northern and North-eastern region resulted in a better quality but smaller quantity of first garda, whereas in the Southern, Eastern, Western and Central regions a larger proportion of first garda was obtained but of a poorer quality (less resin and more other plant material). Garda from the Northern and North-eastern regions (Mazari or Balkhi garda) contained more resin and no cannabis leaves, in contrast to garda from other regions where farmers mixed the resin with cannabis leaves during the processing of first garda.

In 2011 and 2012, the regional differences in garda yield and quality were much less pronounced than in 2009 and 2010. There seemed to have been shifts in the different garda qualities on the market. However, yield data continues to show regional differences in garda quality between the North and North-Eastern regions and the rest of the country. In 2012, per-hectare yields in the Northern and North-Eastern regions were on average much smaller than in the Central, Eastern, Southern and Western regions. Thus, for calculating the yield, the provinces were grouped into a Northern/North-eastern (N/NE) yield region and a Southern, Eastern, Western and Central (S-E-W-C) yield region, similar to the regional grouping in previous surveys.

The yield survey is statistically not representative and based on observations rather than measurements. MCN/UNODC are currently exploring methods for more systematically assessing cannabis yields.

Photo 3 Cannabis garda processing, 2012

Table 3: Average cannabis garda yield, by region (kg/ha), 2012

Region	1st garda (kg/ha)	2nd garda (kg/ha)	3rd garda (kg/ha)	Total yield (kg/ha)
N/NE (n=31)	26	32	20	79
S-E-W-C (n=37)	52	57	33	144
National average*	**50**	**55**	**32**	**136**

** Weighted by cannabis area, n refers to number of surveyed fields.*

The cannabis survey 2011 showed that cannabis cultivation on the boundaries of fields and mixed-crop cultivation in the same field occurred almost exclusively in the Central and Eastern region. This year's survey confirmed these findings. In 2011, the share of garda produced by those methods was revealed to be relatively small, amounting to about 2% of total production. In absence of a village survey in 2012, no separate estimate for cannabis produced in such fields could be provided. For the purpose of this report, it was assumed that the contribution of cannabis cultivated on field boundaries and mixed with other crops remained negligible.

Table 4 shows estimates of potential garda production for mono-crop cultivation in the Northern and North-eastern region and the other regions. As a reference, the 2011 production estimate was 1,300 tons.

Table 4: Potential commercial cannabis resin garda production, 2012

Region	1st garda (tons)	2nd garda (tons)	3rd garda (tons)	Rounded total (tons)
N/NE	25	31	19	75
S-E-W-C	474	520	301	1,295
Total production	499	551	320	**1,400 (900-1,900)**

More results from the yield survey

During the yield survey 108 farmers were asked about their planting practices, yield and their satisfaction with the years' harvest. Out of 108 farmers, 21 cultivated cannabis on the bunds of fields planted with other crops; 17 farmers planted cannabis together with other crops on the fields and 70 farmers planted cannabis as mono-crop cultivation. The farmers were not selected to be representative for all cannabis

farmers in Afghanistan. The shares of different planting schemes (mono-crop, on bunds, mixed fields) therefore do not reflect the shares of area cultivated under cultivation by scheme.

In 2012, out of the intercropped fields in the sample 58% were planted with cotton, 21% with Alfalfa, 11% with tomatoes, and 11% poppy. Only one field was reported to be planted in rows ("one row cannabis, one row Alfalfa"), all others were reported as cultivated with "randomly mixed" crops. The vast majority of farmers reported to sell their crop as garda powder (90%); only 10% per cent reported to sell the garda as hashish (garda processed into consumable drug).

Farmers were asked if they were satisfied with the 2012 yield. 86% of farmers were satisfied with the yield, 14% were not satisfied. The most frequent answers of the farmers for why they are satisfied was the high sales price (25%) and good income (19%). Favourable weather conditions were named as reasons for the good 2012 yield.

Cannabis economy

Farm-gate prices of cannabis garda

Differences in the farm-gate price of cannabis resin (garda) reflect different garda qualities and regional differences. Since most farmers sell their cannabis garda soon after harvest (in January), the January 2013 prices reported through the monthly price monitoring system were used to calculate farmers' income and the farm-gate value of cannabis production in 2012.

The national estimate presented was calculated by taking the average price weighted by production in each respective region. That average therefore represents the average "value" of 1 kg of each type of garda.

Table 5: Farm-gate prices of cannabis resin (garda), by region (US$/kg), January 2013

Region	1st garda (US$/kg)	2nd garda (US$/kg)	3rd garda (US$/kg)
N/NE*	96	70	45
S-E-W-C*	66	39	25
National Average**	68	41	26

**Simple average of all observations in the region. ** Average weighted by estimated cannabis production. Source: MCN/UNODC monthly price monitoring report, January 2013. Third garda prices in N/NE were calculated based on the prices in the S-E-W-C region.*

Farm-gate prices of cannabis resin and opium

Previous reports on cannabis and opium poppy cultivation have shown a clear connection between growing opium poppy and cannabis, both at the household and village level. The 2011 cannabis village survey shows that almost 58% of cannabis-growing households also cultivated poppy in the preceding season. In the Southern (69%) and Western regions (67%) it was even more pronounced, with almost seven out of ten cannabis farmers also cultivating opium poppy. The connection was also very obvious at the village level: in 51% of all poppy-cultivating villages (*Opium Survey 2011*) cannabis was also grown, whereas only 5% of non-poppy-cultivating villages cultivated cannabis. It is therefore safe to say that the majority of cannabis-cultivating households were involved in poppy cultivation.

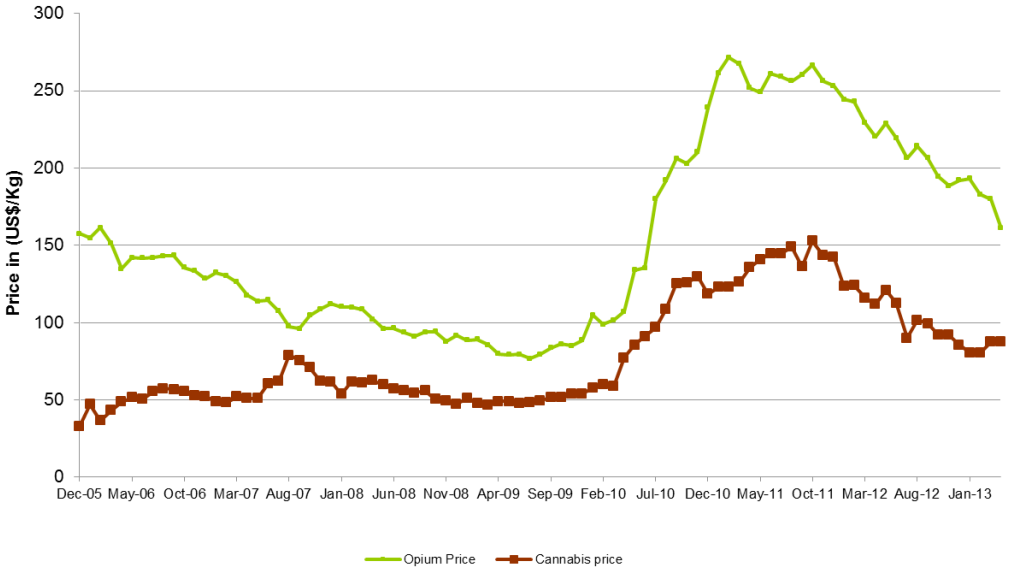
It seemed that the link between cannabis and opium cultivation also exists at the trade level: information gathered during the 2011 survey, and surveyor debriefings indicated that a large proportion of cannabis traders also trade in opium, thus many households have the opportunity to sell both illicit crops relatively easily.

Moreover, price developments in recent years substantiate the hypothesis of two closely integrated markets: price time series for both crops have shown a high correlation[11] since December 2005 when the collection of cannabis prices began (see Figure 3). The average prices for cannabis resin followed the opium price hike in 2010/2011. With the reduction of opium prices since end of 2011, prices for cannabis dropped as well (since October 2011).

[11] Pearson Correlation 0.897 significant at 0.01 level.

One factor to be considered might be fluctuations in the supply of cannabis. Yields in 2009 were relatively high (on average 145 kg/ha) when compared to 2010 (128 kg/ha) and 2011 (112 kg/ha). However, cannabis prices started to raise soon after the 2009 cannabis production probably reached the market, i.e. in early 2010. Based on the available information, it seems therefore more likely that prices have been driven rather by the opium market than the cannabis market: Opium traders might have bought and sold cannabis instead of opium as reaction of the opium shortfall after the opium crop failure in 2010 (which was caused by a disease). This substitution might have led to an increased demand for cannabis and thus to higher prices in this period. More observations in coming years are needed before a final conclusion can be drawn.

Figure 3 Price data of cannabis and opium, Dec 2005- Jan 2013



Source: Monthly price monitoring system, MCN/UNDOC.

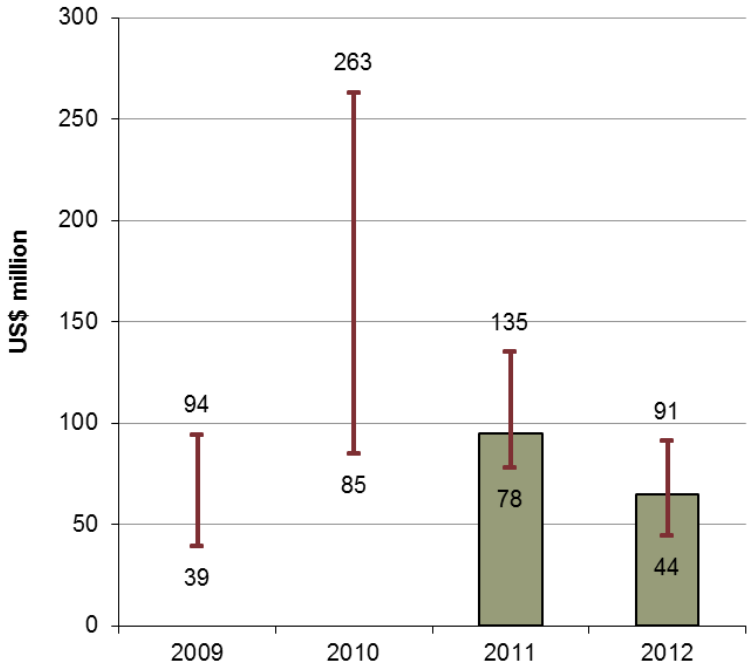
Farm-gate value of commercial cannabis resin production

The farm-gate value of commercial cannabis garda production in Afghanistan was calculated on the basis of production estimates and farm-gate price calculations. The total farm-gate value of cannabis resin (garda) in 2012 was US$ 65 million (US$ 44-91 million) and corresponded to 0.3% of the licit GDP of Afghanistan in that year. The farm-gate value dropped by almost a third compared to US$ 95 million in 2011 in spite of increased production; this drop was caused by lower cannabis prices in 2012 than in 2011.

Table 6: Farm-gate value of commercial cannabis production (US$ million), 2011 and 2012

	1st garda (US$ million)	2nd garda (US$ million)	3rd garda (US$ million)	Total 2012 (US$)
Farm-gate value	34	23	8	65 (44-91)

Figure 4 Farm-gate value of cannabis resin (US$ million), 2009-2012



Note: The bars indicate the upper and lower bound of the estimation range.
Source: MCN/UNODC Afghanistan Cannabis Surveys 2009, 2010, 2011, 2012.

Net income from cannabis cultivation is higher than from opium cultivation

Based on average prices at harvest time and the average 2012 resin yield, it can be concluded that farmers achieved a gross cash income[12] of US$ 6,400 per hectare from cannabis resin in 2012, which was higher than the gross income from opium (US$ 4,600 per hectare) in that year. When using an average area under cannabis cultivation of 0.29 hectare per household (2011 data), the average gross income per household from cannabis in 2012 would amount to US$ 1,863. In 2011, the average gross income of cannabis growing households was US$ 3,000 per hectare. Since yield increased and the same area estimate is used, the reduction in household income would mainly come from the reduced prices for cannabis.

Nevertheless, cannabis seems to be an important cash crop. When comparing data on sources of income of previous surveys, for all three types of farmers interviewed — cannabis-cultivating farmers, farmers who ceased cultivating cannabis in 2011 or before, and farmers who had never grown cannabis — it can be seen that the average reported income of cannabis-cultivating farmers was higher than the income of farmers who ceased cultivation and farmers who had never cultivated cannabis.

Possible explanations why cannabis is cultivated to a lesser extent than opium

Economic logic would suggest that if a farmer gets involved in illicit crop cultivation the crop of choice would be cannabis as it promises a higher net income. Furthermore, cannabis is less labour intensive as it needs less weeding and its harvest is easier than poppy lancing. However, MCN/UNODC's cannabis and opium surveys revealed that poppy is cultivated more frequently, by more households and over larger areas than cannabis.

There are several possible explanations why cannabis is cultivated less than poppy:

- Cannabis can be cultivated in summer only, which is when there is less land available for cultivation due to the decrease in the availability of water for irrigation. Conversely, during the main poppy and wheat season at the beginning of the year there is much more land available because of water released during snowmelt.

[12] The gross income from cannabis resin does not take into account the potential value of cannabis by-products such as cannabis seeds or stalks.

- Cannabis cultivation is particularly dependent on irrigation: there was a clear positive relationship between the availability of irrigation and cannabis cultivation at the village level.
- In subsistence agriculture, food crops and fodder are to a certain extent indispensable and may compete with cannabis for scarce land during summer.
- Cannabis has a comparatively long vegetation cycle. In other words, the field is "blocked" for an extended time when farmers could possibly grow several short-cycle crops such as vegetables. Furthermore, cultivating winter crops might not be possible on a former cannabis field because of its late harvest.

To fully understand the decision-making process of illicit crop farmers more detailed research on crop rotation, multi-period costs of cultivation and the agricultural conditions necessary for various crops is needed. Other important aspects to research are options for substitution: it seems that cannabis and opium are more complementary crops (farmers choose to cultivate both crops) than substitutes for each other (an either/or situation). Indeed, the increasing levels of poppy cultivation together with the stabilization of cannabis cultivation point to cannabis being complementary to opium poppy. But this only reflects the current situation since, with increasing pressure on poppy cultivation through eradication and other measures, the possibility of the commercial production of cannabis gradually playing a much bigger role in the illicit economy of Afghanistan is not beyond the realms of imagination.

Photo 4: Heli-picture of cannabis fields in Paktya province, 2011

3 AFGHANISTAN CANNABIS AGRICULTURE

The cannabis plant[13]

Cannabis (also known as marijuana or "marihuana") is a plant belonging to the Cannabaceae family. It is a dioecious plant, meaning that the male and female flowers develop on separate plants, although monoecious examples with both sexes on one plant are also found. The development of branches containing flowering organs varies greatly between male and female plants. Female flowers are tightly crowded between small leaves while male flowers hang in long, loose, multi-branched, clustered limbs up to 30 centimetres (12 inches) long and shed their pollen before dying several weeks prior to seed ripening on the female plant. Female plants tend to be shorter and have more branches than male pants and are leafy to the top with many leaves surrounding the flowers, while male plants have fewer leaves near the top, with few if any leaves along the extended flowering limbs, and can produce hundreds of seeds. Stems are erect, green and hollow and longitudinally grooved. It has been noted that cannabis plants can grow from 1 to 3 metres in height in different parts of Afghanistan.

Cannabis normally matures annually and timing is mainly influenced by changes in the photo-period (length of daylight), as well as other environmental conditions. Flowering usually starts when darkness exceeds 11 hours per day, and the flowering cycle lasts between 4 and 12 weeks, depending on environmental conditions.

In order to maximise yield and potency, floral clusters should be harvested when resin secretion and associated terpenoid and cannabinoid biosynthesis are at their peak, which is just after the pistils have begun to turn brown but before the calyx stops growing. Floral clusters are responsible for the production of seeds, drugs and aromatic resins.

Yield varies across the different regions of the country. The product obtained from the dried cannabis plant through threshing and sieving is a powdery substance with varying proportions of resin and other plant matter, known locally as "garda". Further processing is required to turn garda into hashish (or "charas" as it is called in the local language), the consumable form of cannabis resin.

Photo 5: Morphological differences between male and female cannabis plants

Female cannabis plant in Dand district (Kandahar)

Cannabis crop calendar

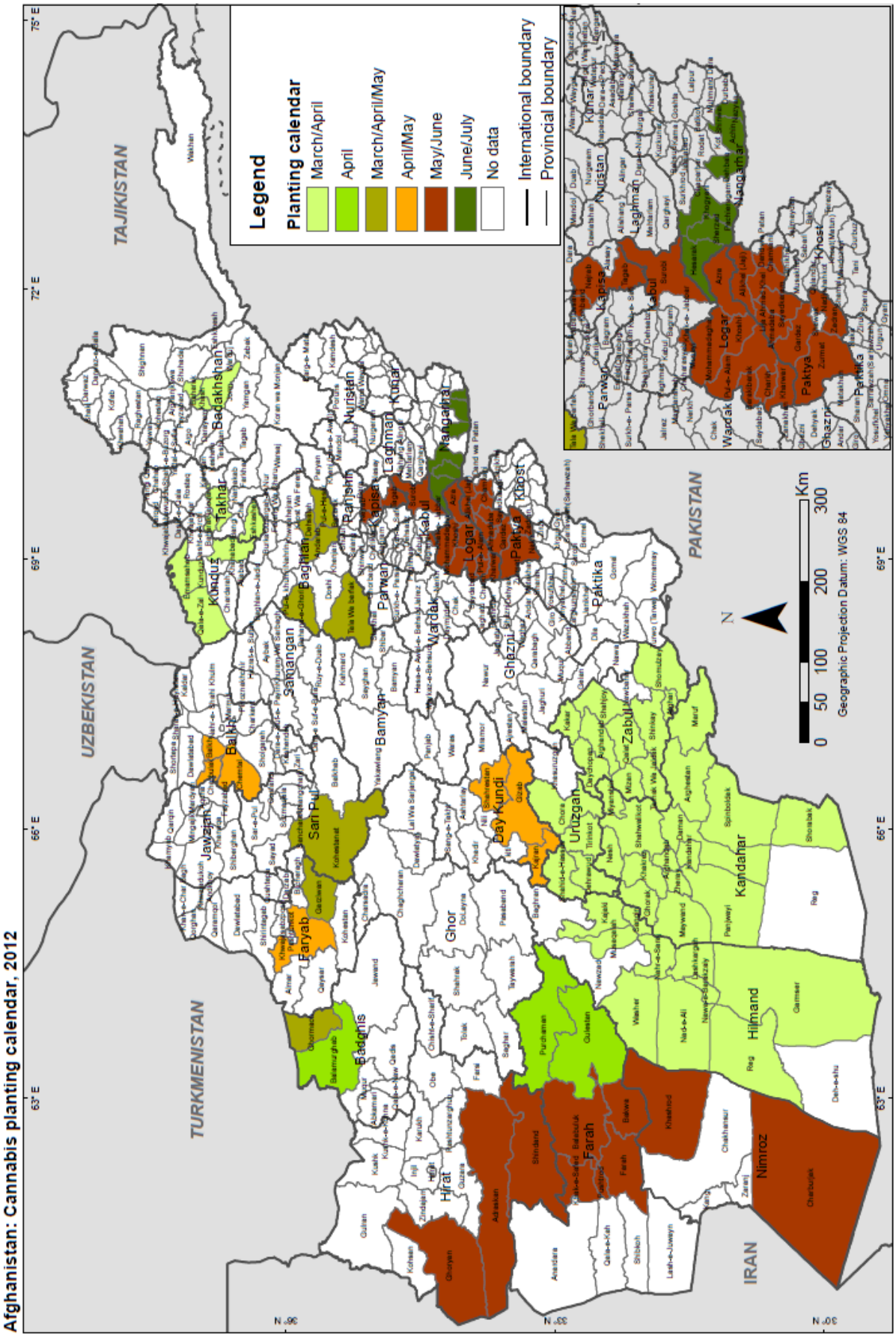
Typically, the planting season for cannabis in Afghanistan is between March and May. The stem elongation stage of cannabis is between July and August and the crop is in full bloom from September to October. In 2012, in most areas cannabis plants were fully matured and harvested from the field by the end of December. The resin was extracted between December 2012 and January 2013.

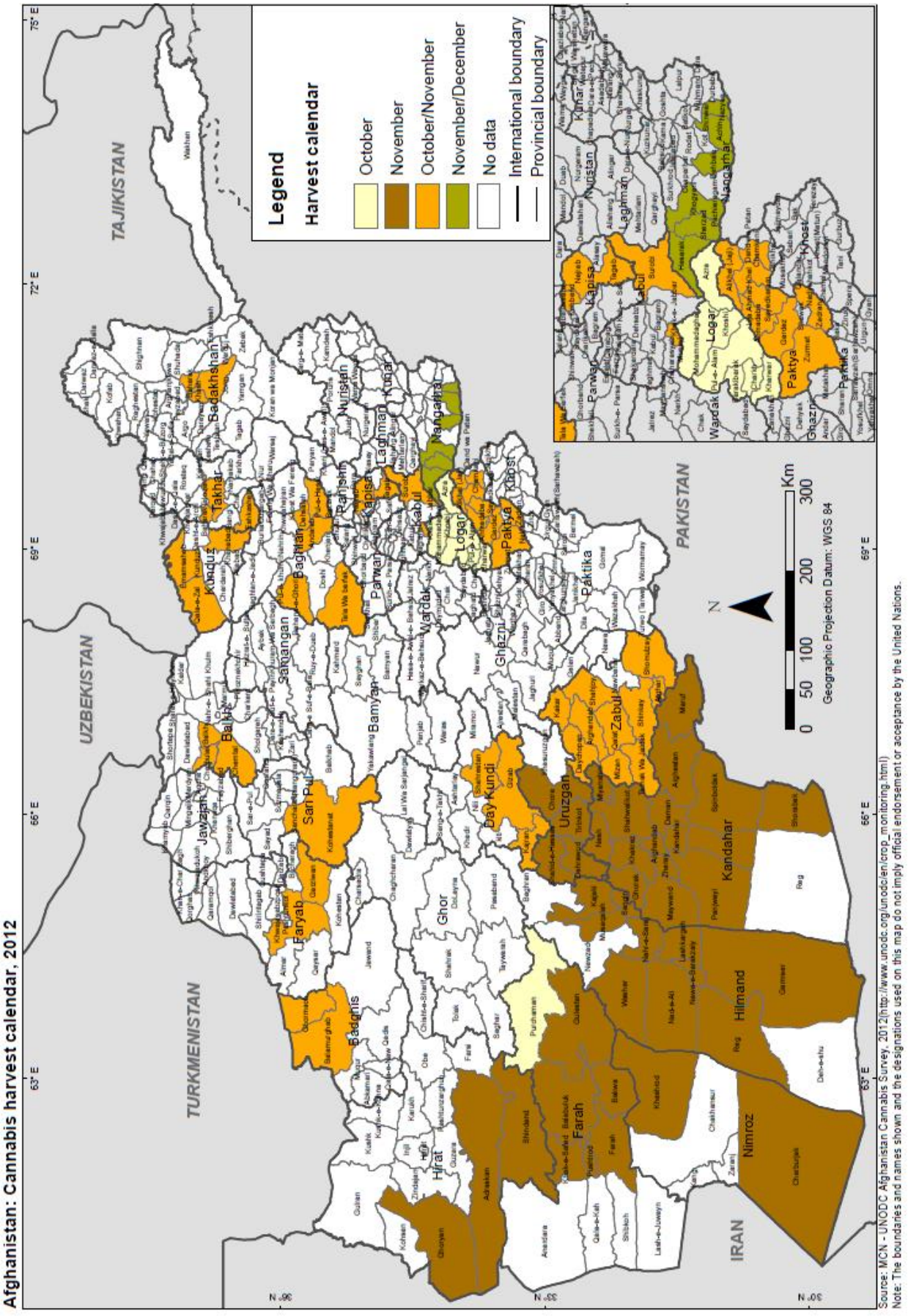
[13] Information from David T. Brown (1998): *Cannabis, the Genus Cannabis. Amsterdam*; Robert C. Clarke (1981): *Marijuana Botany,* Oakland*;* and from UNODC internal reports on cannabis in Afghanistan.

Results of the village surveys conducted in previous years showed that the cannabis crop cultivation cycle differs slightly across the country due to variations in climatic conditions:

- Cultivation in the Southern region starts between March and June. Harvesting is done between September and December.
- Cultivation in the Central region starts between early April and May. Harvesting is done in October and November.
- Cultivation in the Northern region starts between April and May. Harvesting is done in November and December.
- Cultivation in the North-eastern region starts between March and April. Harvesting is done in October and November.
- Cultivation in the Western region starts between March and June. Harvesting is done in October and November.
- Cultivation in the Eastern region starts between May and June. Harvesting is done between October and December.

Photo 6 Cannabis plants being dried, 2012


Afghanistan: Cannabis planting calendar, 2012
Legend
Planting calendar
March/April
April
March/April/May
April/May
May/June
June/July
No data
International boundary
Provincial boundary
TAJIKISTAN
UZBEKISTAN
TURKMENISTAN
IRAN
PAKISTAN
Badakhshan
Takhar
Kunduz
Baghlan
Nuristan
Kapisa
Parwan
Panjsher
Kabul
Laghman
Nangarhar
Logar
Paktya
Khost
Paktika
Samangan
Balkh
Jawzjan
Sar-e-Pul
Faryab
Ghor
Bamyan
Wardak
Ghazni
Day Kundi
Uruzgan
Zabul
Badghis
Herat
Farah
Nimroz
Kandahar
Helmand
0 50 100 200 300 Km
Geographic Projection Datum: WGS 84
N
Source: MCN - UNODC Afghanistan Cannabis Survey, 2012(http://www.unodc.org/unodc/en/crop_monitoring.html)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.


Afghanistan: Cannabis harvest calendar, 2012
Legend
Harvest calendar
October
November
October/November
November/December
No data
International boundary
Provincial boundary
TAJIKISTAN
UZBEKISTAN
TURKMENISTAN
IRAN
PAKISTAN
Kunduz
Takhar
Badakhshan
Baghlan
Nuristan
Kunar
Laghman
Nangarhar
Panjsher
Kapisa
Kabul
Logar
Paktya
Khost
Paktika
Samangan
Balkh
Jawzjan
Sar-e Pul
Bamyan
Wardak
Ghazni
Faryab
Ghor
Day Kundi
Uruzgan
Zabul
Kandahar
Badghis
Helmand
Farah
Hirat
Nimroz
N
0 50 100 200 300 Km
Geographic Projection Datum: WGS 84
Source: MCN - UNODC Afghanistan Cannabis Survey, 2012(http://www.unodc.org/unodc/en/crop_monitoring.html)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

The production of cannabis resin

The production of cannabis resin in Afghanistan involves several steps.[14] First, cannabis plants need to be dried, then threshed and sieved to produce a powdery substance known locally as "garda". Through repeated sieving, farmers produce a graded quality that contains different concentrations of cannabis resin and are categorized as "first" garda, "second" garda and "third" garda. First garda is considered the best quality since it contains the highest proportion of resin and is thus more expensive than second and third garda. It is not yet known exactly how farmers and traders determine the garda grade other than by counting the number of sieving processes performed to extract the resin. The first, gentle shaking of the plant and sieving of plant material usually produces first garda quality, although this first garda powder may later be mixed with garda from subsequent sieving and still be known and traded as first garda.

Most cannabis farmers sell garda (resin) to traders in its powdery form, though some process it further into hashish, known locally as "charas". This transformation of garda into hashish is usually done by traders and is the final product used for trafficking and consumption. Information collected during previous surveys[15] suggests that the amount of hashish produced from 1 kg of cannabis garda varies across regions, probably due to different hashish production methods. From current knowledge of different hashish production methods used in Afghanistan, it is reasonable to assume a 1:1 conversion rate of cannabis garda into hashish.

Photo 7 Cannabis garda processing in Logar province

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Separating cannabis leaves and flowers from the stalk (1)</td><td>Sieving of cannabis flowers through muslin cloth (2)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>First garda collection after sieving (3)</td><td>Final product, hashish (4)</td></tr>
</table>

[14] More information on cannabis resin yield and hashish production can be found in UNODC/MCN: *Afghanistan Cannabis Survey 2009*, April 2010.

[15] UNODC/MCN: *Afghanistan Cannabis Survey 2009*, April 2010.

Photo 8 Pictures of cannabis fields at flowering stage

Cannabis at flowering stage cultivated as mono crop, Sherzad district of Nangarhar province.

Cannabis at flowering stage cultivated on bund in wheat field in Baraki Barak district of Logar province.

Cannabis at flowering stage cultivated as mixed crop with maize in Sherzad district of Nangarhar province.

Cannabis at flowering stage cultivated as mono crop in Shindand district of Hirat province.

4 METHODOLOGY

The survey was made up of two main components:

- A remote sensing survey using a sample of satellite images, randomly selected under an area frame sampling approach supplemented by a full coverage of certain limited areas outside the sampling frame.
- A yield observation survey, which investigates cannabis yield per field, harvest and processing of cannabis, using a non-statistical opportunity sample.

Information from different survey instruments was complemented by information from the monthly price monitoring system, which also covers cannabis resin, and from the Annual Opium Surveys where appropriate.

Survey components

Remote sensing survey

All provinces in the cannabis risk area (see Table 7) were associated with large-scale cannabis cultivation suitable for a remote sensing survey with satellite imagery. For 6 out of those 16 provinces a targeting approach was used, i.e. the area covered by the imagery was chosen based on field information on cannabis cultivation, because the area under cultivation was expected to be too low and/or too concentrated in just a view locations for a sampling approach to be successful with the available means for acquiring satellite imagery. In the remaining 10 provinces cannabis cultivation was too widespread to use the target approach, therefore a sampling approach with randomly sampled images was used.

The image size was set to 8 km by 8 km. With that size a total of 128 images was available for sampling (6 missed and could not be evaluated) and 32 images for targeted provinces, making a total of 160 very high-resolution (VHR) satellite images.

Table 7: Sample and target provinces, 2012

Sample	Baghlan, Balkh , Farah, Hilmand, Hirat, Kandahar, Logar, Nimroz, Paktya, Zabul	Total: 10
Target	Badakhshan, Nangarhar, Uruzgan, Kabul, Takhar, Kunduz	Total: 6

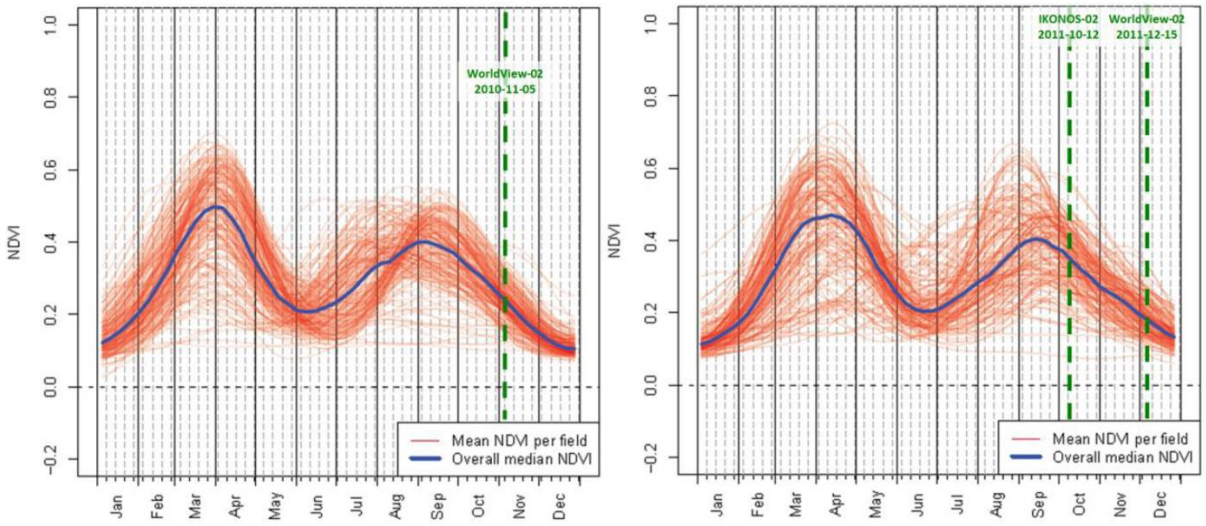
The sampling method was a systematic sampling. This method is an equal-probability method, in which every k^{th} element in the frame of size N is selected, where k is the sampling interval given by $k = N/n$ with n the sample size. To ensure equal inclusion probabilities for all sampling units a random cell is chosen, from which a two-dimensional step pattern is started. This form of sampling ensures a geographically equally distributed sample over the whole frame, which is a particular advantage if little is known about the distribution of the area of interest. The sample was not drawn on the basis of provinces, but on a national scale, and is therefore not suitable for making estimates of sufficient precision at the province level.

In the cannabis surveys it has become clear that the active agricultural area on the imagery taken for the cannabis estimates is much smaller than the potential agricultural land ("ag mask") on which the sampling frame is based. Active agricultural land is by definition smaller than the potential agricultural land. However, the differences were larger than those observed in the poppy cultivation season, because cannabis is grown later in the year, when less water is available. UNODC, together with academic partners, is undertaking research to better understand the year-to-year changes of active agricultural land and differences between winter and summer agricultural seasons in Afghanistan.

In addition, research has been undertaken to optimise the acquisition dates of the very high resolution satellite imagery. This was done the University of Natural Resources and Applied Life Sciences in Vienna, that processed hundreds of archive imagery (Landsat5 and Landsat 7) to obtain a time series of vegetation index values (abbreviated by NDVI). Vegetation indexes are calculated from specific spectral bands collected by the satellite and are an indication for the vegetation vigour at a certain location. The time series gives an insight when the vegetation was at its peak of development, which ideally is the time to acquire the VHR resolution satellite imagery that are used for the area estimates. The graph below shows

an application of the resulting vegetation curves and the collection dates of the VHR images. It shows for two examples in 2010 and 2011 that the VHR images were collected after the vegetation peaked at the cannabis cultivation sites, which is sub-optimal for the cannabis identification. This fact was used to correct the collection dates for the survey in 2012.

Figure 4. Time series of vegetation index values (NDVI) from a cannabis growing site in Hilmand. In addition the actual acquisition dates of the very high resolution dates is indicated.



Ground truth collection

Ground truth refers to information that is collected "on location". This is especially important for relating image data to actual cannabis fields on the ground. The collection of ground-truth data enables calibration and aids in the interpretation and analysis of areas of interest on the satellite images.

Ground truth information (GPS points) was collected in Badakhshan, Nangarhar, Kabul, Takhar, Kunduz and Uruzgan provinces. The collection of ground truth in most of the Southern region was not possible due to the high level of insecurity prevailing there.

Over-flights with helicopters were carried out in Nangarhar, Logar, Paktya, Kandahar, Hilmand, Uruzgan and Baghlan provinces to collect high resolution aerial pictures using digital SLR camera with GPS. The helicopter pictures provided useful surrogate ground information for identification of cannabis field signatures on satellite imageries.

Cannabis Yield Observation Survey

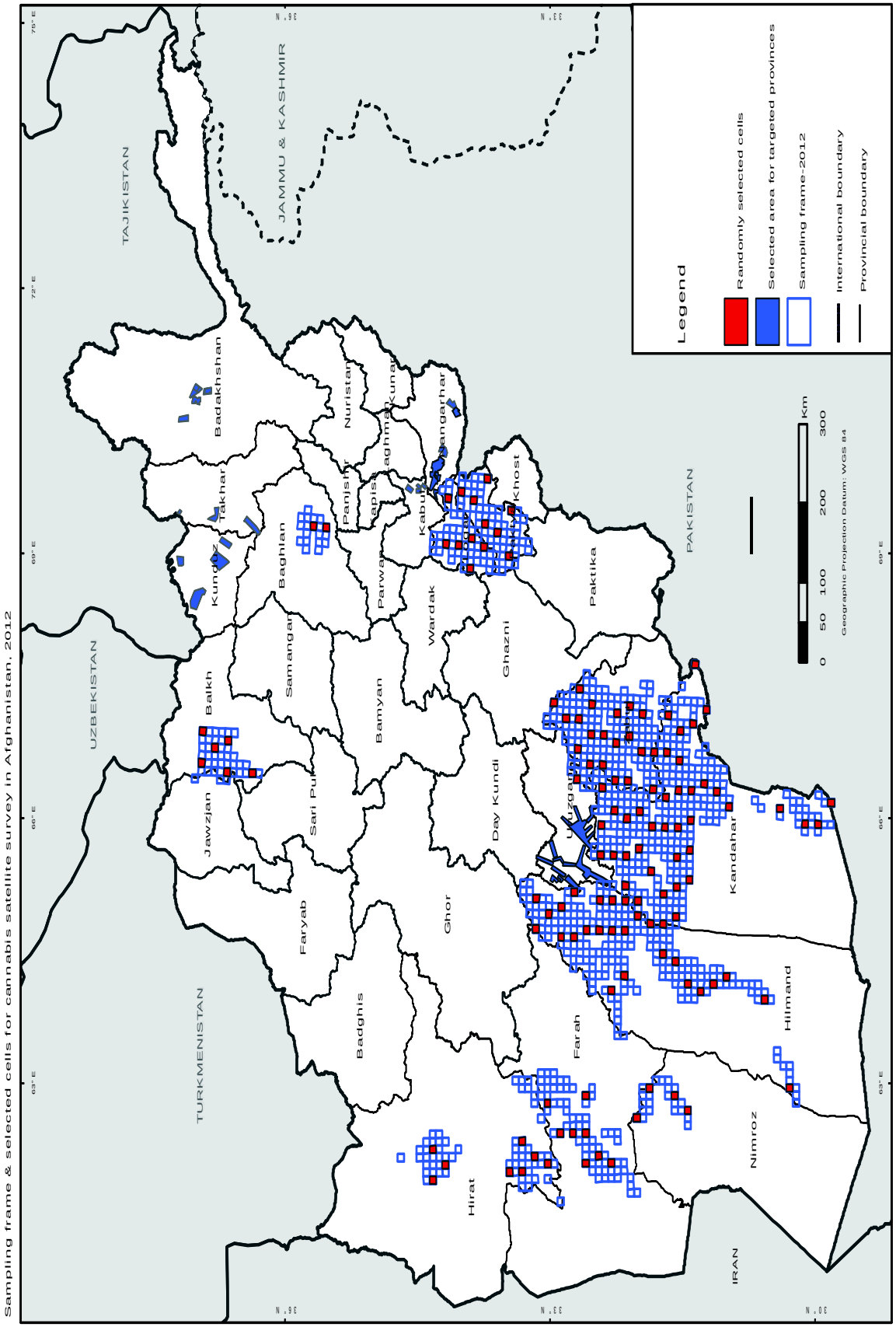
Cannabis yield was estimated based on the results of the cannabis yield observation survey. This survey was conducted from October 2012 to January 2013, when farmers actually processed the harvested and dried cannabis plants to obtain cannabis resin. In December 2012, surveyors went to selected farmers and witnessed the cannabis resin (garda) production from those fields. The garda yield of different qualities was measured.

In the survey the following fields were included:

Table 8: Distribution of fields, by type in the yield observation study, 2011

Mono Crop	Mixed cultivation	Cultivation on boundaries	Total number of fields
68	17	21	105

Farmers were interviewed on the yield obtained from a previously identified field, including all yield qualities, as well as on the cannabis extraction method used, cannabis seed yield, timing and duration of harvesting, drying, and garda extraction, people involved and hashish production.


Sampling frame & selected cells for cannabis satellite survey in Afghanistan, 2012
Legend
Randomly selected cells
Selected area for targeted provinces
Sampling frame-2012
International boundary
Provincial boundary
TAJIKISTAN
JAMMU & KASHMIR
UZBEKISTAN
PAKISTAN
TURKMENISTAN
IRAN
Badakhshan
Takhar
Kunduz
Baghlan
Nuristan
Panjsir
Laghman
Kunar
Nangarhar
Kabul
Kapisa
Parwan
Wardak
Samangan
Balkh
Jawzjan
Sari Pul
Bamyan
Ghazni
Paktika
Paktya
Khost
Uruzgan
Day Kundi
Kandahar
Faryab
Ghor
Badghis
Farah
Hilmand
Nimroz
Hirat
0 50 100 200 300 Km
Geographic Projection Datum: WGS 84
Source : MCN - UNODC Afghanistan Cannabis Survey, 2012(http://www.unodc.org/unodc/en/crop_monitoring.html)
Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Capacity building

- Training of Survey Coordinators of MCN for yield survey
- Training for surveyors for collection of GPS points for target provinces
- Hands-on training for satellite image interpretation for the MCN.
- Collection of cannabis aerial pictures through helicopter over-flights.

Estimation methods

Area estimation from remote sensing in sampled provinces

The sample was designed for yielding an estimate for all provinces under consideration, meaning that it was designed for directly providing an estimate of the total area under cultivation in all 10 sampled provinces (see table 7). The total area was estimated by employing a ratio estimate on the share of cannabis cultivation within the available agricultural area. Hence, the ratio A_c/A_a is estimated, where A_c denotes the area of cannabis cultivation and A_a the agricultural area. The ratio estimator employed uses the ratio of the sum of the values of A_p for the sampled cells, divided by the sum of the values of A_a for the sampled cells: Let $\hat{r}$ be the estimate of the ratio $r = A_{ctot} / A_{atot}$ with

$$\hat{r}_{ratio} = \frac{\sum_{sample} A_c}{\sum_{sample} A_a}.$$

By applying the estimated ratio to the agricultural area an estimate of total area under cannabis cultivation is yielded.

Estimation of yield and production

The basis of the yield estimates is the yield observation study (see respective section for details). Information on these fields was used for calculating a yield per hectare separately for mono-crop fields in the Northern and North-Eastern region and for the South-East-Central-West region. This distinction stems from different garda production practices, which result in different yields.

Farm-gate value of cannabis production

Similar to the methodology used in the *Annual Opium Survey*, the farm-gate value of cannabis was calculated based on the prices observed in the monthly price monitoring in the month of harvesting/garda production, when farmers were actually able to start selling their products. Thus, prices from January 2013 were used. As monthly price monitoring only collects prices of all gardas from the S-E-W-C region, prices in the N/NE were calculated from the average price difference between second and third garda in the S-E-W-C region. The garda price of the yield regions used in this report was calculated as the simple average of the provincial prices reported in the price monitoring report.

The upper and lower bound of the farm-gate value was calculated by using the upper and lower bounds of the area estimates.

Income from cannabis

The potential gross income per hectare from cannabis resin was calculated based on monthly price report and regional yields, using the regional divisions described above. The gross income does not take into account expenditures, and is the potential cash income individual farmers would get if they sold the total resin produced in January 2013. The weighted average was calculated using the proportions of regional cannabis cultivation from the remote sensing survey as weights.