World Drug Report 2013

Story

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Spotfire Dashboard

Research Notes

1. I attend this Meetup and made some comments
2. I did a Google Search for: Smuggling data

Identifying Smugglers: Local Outlier Detection in Big Geospatial Data
Introduction
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Sponsors
How was the Meetup?

Nathan Danneman
Doug_S
Nathan Danneman
Doug_S
Nathan Danneman
Robert Dempsey
Doug_S
Doug_S
Doug_S
Brand Niemann
Brand Niemann
Michael Kim
Nathan Danneman
Nathan Danneman
Ryan Harvey
Ryan Harvey
Nevin House
Eric W
Harlan Harris
Bill Eger
David J. Elkind
Robert Dempsey
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Aaron Schumacher
Nathan Danneman
Andrea
Manish Sehgal
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Andrew Davis
Joe Coggins
Ajaya Upadhyay
Tom Fitzwater
Xinyue(Cindy) Chen

World Drug Report 2013 Executive Summary

The global picture
Global drug use situation remains stable
Injecting drug use and HIV remain a public health concern
Maritime trafficking poses challenge to authorities
New drug trafficking routes

Overall trends across drug categories
Opiates
Cocaine
Amphetamine-type stimulants
Cannabis

New psychoactive substances
Origin and manufacture
Role of technology

Spread of new psychoactive substances at the regional level

The road ahead

Footnotes

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World Drug Report 2013 Methodology

Sources of information
Figure Member states that provided annual reports questionnaire drug demand data for 2011
Figure Member states that provided annual reports questionnaire drug supply data for 2011

Data on drug use and health consequences
Overview
Indicators used
Extrapolation methods used
Adjustment for differences in age groups
Extrapolation of results from lifetime prevalence to annual prevalence
Figure Annual and lifetime prevalence rates of cocaine use in West and Central Europe
Extrapolations based on school surveys
Extrapolations based on treatment data
Making regional and global estimates of the number of people who use drugs and the health consequences
Estimates of the total number of people who used illicit drugs at least once in the past year

Approach 1

Approach 2

Estimates of the number of ‘problem drug users’

Table Relative risk coefficient

Estimates of the prevalence of injecting drug use, and HIV and hepatitis (C and B virus) among injecting drug users

Country-level estimates:

Regional and Global estimates:

Estimates of the number of drug-related deaths

Drug cultivation, production and manufacture

Net cultivation

Indirect estimation of illicit opium poppy cultivation

Yield and production

Conversion factors

Figure Impact of conversion factors on global estimates of potential cocaine HCl production (mt)

Potential production

Colombia

Peru

The Plurinational State of Bolivia

Drug trafficking

Seizures

Table Weight of tablets in milligrams

Trafficking routes and volumes

Market analysis

Drug price and purity data

New Psychoactive Substances

Footnotes

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Story

Drug Smuggling: Global and Local Detection

Ben Shneiderman's "8 Golden Rules of Data Science" are:

Preparation

• Choose actionable problems & appropriate theories
• Consult domain experts & generalists

Exploration

• Examine data in isolation & contextually
• Keep cleaning & add related data
• Apply visualizations & statistical patterns, clusters, gaps, outliers, missing & uncertain data

Decision

• Evaluate your efficacy, refine your theory
• Take responsibility, own your failures
• World is complex, proceed with humility

I attended the recent Data Science DC Meetup on Identifying Smugglers: Local Outlier Detection in Big Geospatial Data by Nathan Dannenman, Data Tactics, who provided his presentation materials for review.

I raised the question to the community if his presentation was statistics or data science? In support of that discussion I did a "data science audit" using the original data, some authoritative global data, and Shneiderman's "8 Golden Rules of Data Science.

First, I downloaded the original data (CSV (147 MB) and imported into Spotfire and found it contained 1,198,492 rows and 17 columns. This is much larger than "Around 1,300 ships, 9 months, 600k pings" 6 column column names: "Boat ID, lat, long, speed,,bearing, and timestamp". See Slide 7 below.

Note that Spotfire implements Ben Shneiderman's Information Visualization: Mantra of Overview, zoom & filter, details-on-demand. See Slide 17 below

Next I did a Google Search for "Smuggling data" and found an authoritative source of global scale information and data sets:

United Nations Office of Drugs and Crime: "Corruption is the thief of economic and social development; stealing the opportunities of ordinary people to progress and to prosper," said UNODC Chief, Yury Fedotov, at the opening of the Fifth Session of the Conference of States Parties to the UN Convention against Corruption in Panama City - COSP5. [Read More]
See Research Notes below for more details.

Finally, I added my comments to Shneiderman's "8 Golden Rules of Data Science:

- **Choose actionable problems & appropriate theories**
  - This is an actionable problem, but I am not sure outlier detection on only a subset of the original data set is an appropriate theory or methodology.

- **Consult domain experts & generalists**
  - I consulted the [United Nations Office on Drugs and Crime](http://www.unodc.org) for domain expertise

- **Examine data in isolation & contexually**
  - I examined the complete data set and added data sets for more context.

- **Keep cleaning & add related data**
  - I did not clean the AIS data set, but cleaned the UNODC related data sets.

- **Apply visualizations & statistical patterns, clusters, gaps, outliers, missing & uncertain data**
  - I used Spotfire to do more interactive Exploratory Data Analysis.

- **Evaluate your efficacy, refine your theory**
  - I think it is effective to do a "data science audit" to understand someone else's work and to improve upon it.

- **Take responsibility, own your failures**
  - I acknowledge that I have only begun to improve and expand work on this problem with multiple sources of data and I invite others to improve upon my work.

- **World is complex, proceed with humility**
  - Yes, the world is complex and full of corruption, and I am humbled by the enormous effort to collect data on smuggling and use it to better inform real-time and longer-term decision making.

Some relevant excerpts from the UN ODC 2013 Reports are:

**World Drug Report 2013 Executive Summary**
- Maritime trafficking poses challenge to authorities
- New drug trafficking routes
- New psychoactive substances
- Origin and manufacture
- Role of technology
- Spread of new psychoactive substances at the regional level
- The road ahead

**World Drug Report 2013 Methodology**
- Figure Member states that provided annual reports questionnaire drug demand data for 2011
- Figure Member states that provided annual reports questionnaire drug supply data for 2011
- Figure Annual and lifetime prevalence rates of cocaine use in West and Central Europe
- Table Relative risk coefficient
- Figure Impact of conversion factors on global estimates of potential cocaine HCl production (mt)
- **Drug trafficking**
- **Seizures**
- **Table Weight of tablets in milligrams**
- **Trafficking routes and volumes**
  - Information of trafficking routes was mainly obtained from analyses of individual drug seizures reported to UNODC, as well as analyses of trafficking routes reported by Member States.
  - My Note: The Strait of Hormuz does not appear to be significant in the global views of heroin and cocaine for 2008:
    - Slide 21 Global heroin flows from Asian points of origin
    - Slide 22 Main global cocaine flows, 2008

MORE TO FOLLOW USING THE UN ODC REPORTS

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**Slides**

**Slides**

**Slide 1 Geospatial Outlier Detection: Nathan Danneman**

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Geospatial Outlier Detection: Locating Suspicious Maritime Activity

Nathan Danneman

Data Science DC Meetup
November 21, 2013

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Updated: Sat, 19 Sep 2015 10:58:10 GMT
Slide 2 Table of Contents: Nathan Danneman

Table of Contents

- Introductions
- What is an Outlier?
- The Model, by Example
- Results and Conclusions

Slide 3 Background: The Strait of Hormuz: Nathan Danneman

Background: The Strait of Hormuz

Importance
- Oil
- Embargo
- Smuggling

Updated: Sat, 19 Sep 2015 10:58:10 GMT
Powered by mindtouch
Slide 4 Background: "White" Smuggling: Nathan Danneman

Slide 5 Background: Current Interdiction Strategies: Nathan Danneman

How it's currently done...

- Identify each ship's source and destination
- Calculate the average duration of that trip
- Factor in adverse conditions
- Search ships that took "too long"

Note: this only works for ships heading to the US.
Slide 6 Background: Goals: Nathan Danneman

**Background: Goals**

In order to stop smugglers, we want to be able to identify:

- Which boats are undertaking illicit activities
- Where and when boats are congregating to undertake illicit activities
- Where suspicious boats depart and arrive

Slide 7 Background: AIS Data: Nathan Danneman

**Background: AIS Data**

Around 1,300 ships, 9 months, 600k pings

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<th>Boat ID</th>
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<th>long</th>
<th>speed</th>
<th>bearing</th>
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<td>54.807</td>
<td>4.2</td>
<td>106</td>
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</tr>
</tbody>
</table>
Towards a Working Definition

- I'll know it when I see it
- Observations that don't fit my model
- "An observation that deviates so much from other observations as to arouse suspicion that it was generated by a different mechanism" (Hawkins, 1980)

An Additional Wrinkle: Many Types of Ships
Characteristics of a Good Model

A good model for this data should...
- Leverage all of the available data
- Take advantage of local information (i.e. not global patterns)
- Not get confused by the variety of patterns (shipping, fishing)
- Be able to identify ships that are only occasionally deviant
- Identify ships and place-times (spatio-temporal locales) that are deviant
- Be estimable with reasonable computational resources

Output:
- Predicted probability of each boat-time (i.e. observation) being a real boat.
- High probabilities indicate observations doing something “normal” or “predictable.”
- Low probabilities indicate observations doing something “discrepant.”

<table>
<thead>
<tr>
<th>Boat ID</th>
<th>lat</th>
<th>long</th>
<th>speed</th>
<th>timestamp</th>
<th>pr</th>
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<td>0.64</td>
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</tbody>
</table>
Slide 12 Value I: Location of Anomalous Activities: Nathan Danneman

Slide 13 Value II: Identify Potentially Devious Boats: Nathan Danneman
Slide 14 Value III: Prioritized List of Anomolous Boats

Value III: Prioritized List of Anomalous Boats

Model generates probabilities on an interval scale.
Allows prioritization of scarce enforcement/surveillance resources.

Slide 15 Next Steps: Nathan Danneman

Next Steps (aka doing this better)

- Think hard about “local”
- Thing hard about model specification
- Incorporate heading information
Slide 18 World Drug Report 2013: Spotfire

Slide 19 Drug Seizures Report: Spotfire
Drug trafficking is a global illicit trade involving the cultivation, manufacture, distribution and sale of substances which are subject to drug prohibition laws. UNODC is continuously monitoring and researching global illicit drug markets in order to gain a more comprehensive understanding of their dynamics. Drug trafficking is a key part of this research. Further information can be found in the yearly World Drug Report.

At current levels, world heroin consumption (340 tons) and seizures represent an annual flow of 430-450 tons of heroin into the global heroin market. Of that total, opium from Myanmar and the Lao People’s Democratic Republic yields some 50 tons, while the rest, some 380 tons of heroin and morphine, is produced exclusively from Afghan opium. While approximately 5 tons are consumed and seized in Afghanistan, the remaining bulk of 375 tons is trafficked worldwide via routes flowing into and through the countries neighbouring Afghanistan.

The Balkan and northern routes are the main heroin trafficking corridors linking Afghanistan to the huge markets of the Russian Federation and Western Europe. The Balkan route traverses the Islamic Republic of Iran (often via Pakistan), Turkey, Greece and Bulgaria across South-East Europe to the Western European market, with an annual market value of some $20 billion. The northern route runs mainly through Tajikistan and Kyrgyzstan (or Uzbekistan or Turkmenistan) to Kazakhstan and the Russian Federation. The size of that market is estimated to total $13 billion per year.
In 2008, global heroin seizures reached a record level of 73.7 metric tons. Most of the heroin was seized in the Near and Middle East and South-West Asia (39 per cent of the global total), South-East Europe (24 per cent) and Western and Central Europe (10 per cent). The global increase in heroin seizures over the period 2006-2008 was driven mainly by continued burgeoning seizures in the Islamic Republic of Iran and Turkey. In 2008, those two countries accounted for more than half of global heroin seizures and registered, for the third consecutive year, the highest and second highest seizures worldwide, respectively.

**Slide 22 Main global cocaine flows, 2008**


*Source: UNODC World Drug Report 2010*

In 2007 and 2008, cocaine was used by some 16 to 17 million people worldwide, similar to the number of global opiate users. North America accounted for more than 40 per cent of global cocaine consumption (the total was estimated at around 470 tons), while the 27 European Union and four European Free Trade Association countries accounted for more than a quarter of total consumption. These two regions account for more than 80 per cent of the total value of the global cocaine market, which was estimated at $88 billion in 2008.

For the North American market, cocaine is typically transported from Colombia to Mexico or Central America by sea and then onwards by land to the United States and Canada. Cocaine is trafficked to Europe mostly by sea, often in container shipments. Colombia remains the main source of the cocaine found in Europe, but direct shipments from Peru and the Plurinational State of Bolivia are far more common than in the United States market.
Following a significant increase over the period 2002-2005, global cocaine seizure totals have recently followed a stable trend, amounting to 712 tons in 2007 and 711 tons in 2008. Seizures continued to be concentrated in the Americas and Europe. However, the transition from 2007 to 2008 brought about a geographical shift in seizures towards the source countries for cocaine. Seizures in South America accounted for 59 per cent of the global total for 2008, compared with 45 per cent in 2007.

Spotfire Dashboard

For Internet Explorer Users and Those Wanting Full Screen Display Use: Web Player Get Spotfire for iPad App

Media, iframe, embed and object tags are not supported inside of a PDF.

Research Notes

1. I attend this Meetup and made some comments

Identifying Smugglers: Local Outlier Detection in Big Geospatial Data: http://www.meetup.com/Data-Science-DC/events/146953142/?af_eid=146953142&af=event&a=uc1_vmy Note: See Below

Nathan Dannenman: http://www.nathandanneman.com/presentations-and-materials

I had the privilege of giving a talk at Data Science DC’s Meetup on November 21, 2013. The experience was great; sharp audience, friendly people, and a nice space. Attached is a zip file with the slides and R code. The AIS transponder data that matches the code can be found here.

http://www.nathandanneman.com/wp-con...k-and-Code.zip
2. I did a Google Search for: Smuggling data


"Corruption is the thief of economic and social development; stealing the opportunities of ordinary people to progress and to prosper," said UNODC Chief, Yury Fedotov, at the opening of the Fifth Session of the Conference of States Parties to the UN Convention against Corruption in Panama City - COSP5. [Read More]


See Maps: Global heroin flows from Asian points of origin and Main global cocaine flows, 2008


The World Drug Report presents a comprehensive overview of the latest developments in drug markets. It covers production, trafficking, consumption and the related health consequences. [Read More]

Executive Summary: http://www.unodc.org/unodc/secured/wdr/wdr2013/Executive_summary.pdf (PDF) 6 pages


Seizures: Drug seizures by country and drug type, 2007-2011 (XLS) 1.5 MB

Drug Seizures Report: https://stats.unodc.org/sys/rpt?reportfile=seizures-list-blue-wide&REGION=_ALL&REGION__label=All&SUBREGION=_ALL&SUBREGION__label=All&COUNTRY=_ALL&COUNTRY__label=All

Identifying Smugglers: Local Outlier Detection in Big Geospatial Data

Source: http://www.meetup.com/Data-Science-DC/events/146953142/?_af_eid=146953142&_af=event&a=uc1_vm
Introduction

For our November Meetup, we’re thrilled to bring you a presentation about a key technique used when analyzing geospatial data -- detection of outliers. As sensor data gets cheaper and more ubiquitous, as business data becomes precisely geotagged, and as locality becomes key in everything from surveys to log files, the well-rounded data scientist needs to be familiar with techniques for effectively working with latitudes, longitudes, points, and geometric objects. Nathan Danneman will talk about techniques he’s used for finding geographic outliers -- points that may be signal in the noise, or perhaps noise in the signal -- when you don’t have a good model of the data-generating process.

Agenda

6:30pm -- Networking, Empenadas, and Refreshments

7:00pm -- Introduction

7:15pm -- Presentations and discussion

8:30pm -- Adjourn for Data Drinks (Circa, 2221 I St.)

Abstract

This talk describes a method for unsupervised, local outlier detection that does not rely on specifying a parametric model for the unlabelled data. The method is a unique amalgam of several “off-the-shelf” techniques, and creates a potent, flexible, scalable solution for identifying local (Type II) outliers. I apply this model to transponder data from ships in the Strait of Hormuz to demonstrate its capabilities, as well as some of the challenges associated with its use.

Bio

Nathan Danneman is an analytics engineer at Data Tactics, where he analyzes geospatial, textual, and cyber-related data. He holds a PhD in political science from Emory University (2013), with focus areas in applied statistics and international conflict. Some of his past and current work includes quantitative studies of human rights abuses, formal and quantitative modeling of international conflict mediation, and a book on mining and analyzing social media data.

Sponsors

This event is sponsored by Intridea, Statistics.com, Elder Research, MemSQL, and ParkMe.

How was the Meetup?
Nathan Danneman

All,

Thanks very much for all of the your feedback. My thoughts, and the method generally, will certainly mature as a result of the talk. Also, the data that goes with the R code is now linked to Dropbox from my website, per several great recommendations! All of the materials can be found at www.nathandanneman.com.

Nathan

Doug_S

And for testing the quality of models, let's try holding out 20 to 30 percent of the points, chosen at random, developing competing models on the remaining points, and then testing how well the models do on the holdout sample.

Nathan Danneman

I like the idea of this approach; what metric would we use to evaluate it? That is, how would we know if the points in the holdout set were outliers or not?

Doug_S

On the "data science" side, we need to see more mucking around in the data, looking for patterns -- without artificial random points, which have much potential to confuse matters rather than clarifying them. I'd like to see what he has in six months or a year. Meanwhile, if we're going to talk about advantages and disadvantages of various methods, let's illustrate it with data sets that have been more throughly explored and analyzed.

Nathan Danneman

Doug, great comment. I like the idea of doing a more heads-up comparison between this method and others. However, the false observations are central to this approach, and are actually key to helping identify non-fake boats!

Robert Dempsey

Great topic, and definitely more on the technical side, as proven by the questions asked after the presentation.

Doug_S

And where are you these days? Rumor has it you left Intridea.

Doug_S

For starters, how about plugging the points into something like ArcGIS and looking (pictorially) for relationships between where things happen and when they happen? ArcGIS will also let you draw density maps of how often things happen, by location -- a way to get some statistical insight without abandoning the visual depiction.
Doug_S

The topic was stimulating, and the presentation introduced it well. However, I don't think this presentation is a good starting point for a discussion of data science versus statistical modeling. What we saw was too preliminary to frame that discussion. We need to see what would happen with exploratory data analysis (a la Tukey and Mosteller, classic text from about 1977), other kinds of statistical models (as another commenter pointed out, logistic regression is not the best modeling approach for outlier detection), maybe nearest-neighbor discriminant analysis.

Brand Niemann

Continued
So statistics seems to be inclined to accept a data set and try to model it while data science says look around first to see if there is better data to gain insight into the problem and then do the number crunching.

What does the community think?

Brand Niemann

So I am going to write a blog about this presentation because I think it illustrates the difference between statistics and data science. I asked the question after the presentation about combining the 6 column by 600,000 row data set with other data that could/would allow one to be more confident of the results and their value and the presenter agreed that should be done.

The title seems misleading to me because one does not need or should not use Outlier Detection for Identifying Smugglers in a very limited data set when that has already been done by for example the United Nations Drug Report 2013: http://www.unodc.org/wdr/ with really big geo-spatial data (the entire world for multiple years). One can download a spreadsheet: http://www.unodc.org/unodc/secu... and do both meaningful statistics and data science.

Michael Kim

I just wanted to point out that logistic regression (glm with logit link) is not robust to outliers in the explanatory variables. http://www.sciencedirect.com/sc...

This might not be a problem since you can use any (possibly robust) classifier instead of logistic regression. If you're interested in robust methods R has a lot of useful tools for it: http://cran.r-project.org/web/v...

Nathan Danneman

This is a great point, and was also brought to my attention by another audience member after the talk. I'll note that, given the density of the data, the presence of a few observations with extreme values for one or two covariates is unlikely to present problems in this particular application. That said, there's no reason not to choose a method that would be robust to this concern!

Nathan Danneman

All,
Thanks for your wonderful attention, feedback, and company at Data Drinks! R code and slides are now up at my website (http://www.nathandanneman.com/p...). I'd like to share the data as well, but haven't found a clever way to post it to word press. Any thoughts?

Thanks,
Nathan Danneman

Ryan Harvey

Agreed, Dropbox works well.

Like · 3 days ago

Ryan Harvey

There's also datahub.io, which sometimes works well.

Nevin House

Top notch high brow entertainment for all; I guess Emory does more than medical education. If I were a Navy Admiral allocating scare resources to that part of the world, I wonder if I could test my assumptions about "best time of day to look for bad activity" with this kind of model?

Eric W

Fascinating presentation and some really good, thought-provoking questions following it. However, it would have been neat to compare the results of the logistic models to those obtained from alternative methods such as discriminant analysis.

Harlan Harris

Thanks to everyone who attended! Would anyone like to write an event review for the blog? Free publicity! We'll have slides and audio available for you (and they'll be posted publicly soon too). Let me know!

Bill Eger

Generally good.

David J. Elkind

I am very happy with this event. The speaker was very engaging, worked on a hard problem with an intriguing data set, and explained an interesting approach to solve his problem which is also able to be generalized to other contexts and data sets.

On quibble though: the speaker presented a slide with model-fitted probabilities that that the boats were anomalous. These are not meaningful probabilities because they were generated from a logistic regression model with a case-control design (cases being real boats and controls being the randomly-generated fake boats). In this case, the
regression coefficients are all statistically valid except for the intercept term, which will be intrinsically fixed from the start by the ratio of cases to controls.

Without correcting the intercept term to reflect the true ratio of real boats to fake boats, it is not possible to interpret the probability output of a logistic model. The odds ratio, however, is still meaningful.

**Robert Dempsey**

Looking forward to the meetup tonight. See you all there!

carlos ramos

A conflict came up for me so I cannot make it. I look forward to the online collateral

**Aaron Schumacher**

Can't make it! :( Hack and Tell conflicts. I'd love to see slides if they can be made available afterward though! :)

**Nathan Danneman**

That's a shame Aaron. I'll make sure the slides get posted somewhere accessible.

**Andrea**

Sorry still recovering from a 48 hr hackathon

**Manish Sehgal**

Looking forward to it!

**Michael Kim**

I'd be interested in talking about outlier detection and potential academic papers with the presenter. My experience in this area can be found @ mathworks.com/matlabcentral/fileexchange/authors/307195

**Jason Hinton**

This should be great.

**Allen**

Looking forward to it

**Xinyue(Cindy) Chen**

eager to learn more
World Drug Report 2013 Executive Summary


The World Drug Report presents a comprehensive overview of the latest developments in drug markets. It covers production, trafficking, consumption and related health consequences. Chapter 1 of this year’s report examines the global situation and the latest trends in the different drug markets and the extent of illicit drug use, as well as the related health impact.

Chapter 2 addresses the phenomenon of new psychoactive substances (NPS), which can have deadly consequences for their users but are hard to control, with dynamic, fast-mutating producers and “product lines” which have emerged over the past decade.

The global picture

Global drug use situation remains stable

On the whole, the global drug use situation has remained stable. While there has been some increase in the estimated total number of users of any illicit substance, estimates show that the number of drug users with dependence or drug use disorders has remained stable. The increase in the annually estimated number of users is, to a large extent, a reflection of an increase in the world population.
However, poly-drug use, especially the combination of prescription drugs and illicit substances, continues to be a concern. The misuse of sedatives and tranquillisers is of particular concern, with more than 60 per cent of the countries covered in the report ranking such substances as among the first three misused types of substances.

The increasing number of NPS appearing on the market has also become a major public health concern, not only because of increasing use but also because of the lack of scientific research and understanding of their adverse effects.

**Injecting drug use and HIV remain a public health concern**

New data reveal that the prevalence of people who inject drugs and those who inject drugs and are also living with HIV in 2011 was lower than previously estimated: 14.0 million people between the ages of 15 and 64 are estimated to be injecting drugs, while 1.6 million people who inject drugs are living with HIV. This reflects a 12 per cent decline in the number of people who inject drugs and a 46 per cent decline in the number of people who inject drugs that are living with HIV since the 2008 estimates.

In 2011, the number of drug-related deaths was estimated at 211,000. Most of those deaths were among the younger population of users and were, to a large extent, preventable. Opioids remained the most commonly reported group of substances involved in drug-related deaths. There continues to be a major gap in the delivery of treatment services for drug dependence: only an estimated one in six problem drug users had received treatment in the preceding year.

**Maritime trafficking poses challenge to authorities**

Given the large quantities of licit substances that make their way across oceans and continents every day, in containers and even small boats, maritime trafficking poses a particularly knotty challenge for the authorities.

East and West Africa seem to be gaining in prominence with regard to routes for maritime trafficking. A new maritime route going southwards from Afghanistan via ports in the Islamic Republic of Iran or Pakistan is increasingly being used by traffickers to reach consumer markets through East and West African ports. Since 2009, seizures of heroin have risen sharply in Africa, especially in East Africa, where they increased almost 10-fold.

Experience has shown that a maritime seizure is consistently more likely to be larger than a seizure involving transport by road or rail. In fact, although maritime seizures constitute no more than 11 per cent of all cases across all drug categories globally, each maritime seizure was on average almost 30 times larger than seized consignments trafficked by air. Targeted interdiction efforts by the authorities would enable them to seize larger quantities of drugs being trafficked over water.

**New drug trafficking routes**

Traffickers are increasingly looking for new routes to supplement the old ones: new land routes for heroin smuggling seem to be emerging, e.g. in addition to the established Balkan and northern routes, heroin is trafficked southward from Afghanistan via the Islamic Republic of Iran or Pakistan, leading through the Middle East via Iraq. While the Balkan trafficking route remains the most popular one, a decrease in the amount of heroin being trafficked on this route has been noted.

Moreover, Afghan opiates seem to be emerging as competition to opiates produced and consumed in the East and South-East Asia subregion, as seizures made in countries of that region show.

While it is clear that the African continent is becoming increasingly important and vulnerable in terms of the proliferation of trafficking routes, the availability of data is very limited. In order to effectively monitor this worrying trend, there is an urgent need to improve the data collection and analysis capacity of countries in the region.

Cocaine seizures in Colombia indicate that the Atlantic route may be gaining in prominence as compared with the Pacific route in maritime trafficking; linguistic ties appear to play a role in cocaine trafficking from South America to
Europe via Brazil, Portugal and lusophone countries in Africa. The cocaine market seems to be expanding towards the emerging economies in Asia.

Overall trends across drug categories

Opiates
Trends with regard to the production and consumption of opiates witnessed some major shifts.

The limited available data suggest that opioid use (prescription opioids, heroin and opium) has gone up in parts of Asia (East and South-East Asia, as well as Central and West Asia) and Africa since 2009.

Use of opiates (heroin and opium), on the other hand, remains stable (around 16.5 million people, or 0.4 per cent of the population aged 15-64), although a high prevalence for opiate use has been reported from South-West and Central Asia, Eastern and South-Eastern Europe and North America.

In Europe specifically, there are indications that heroin use is declining, due to a number of factors, including an aging user population in treatment and increased interdiction of supply. Nevertheless, non-medical use of prescription opioids continues to be reported from some parts of Europe.

Production-wise, Afghanistan retained its position as the lead producer and cultivator of opium globally (74 per cent of global illicit opium production in 2012). While the global area under poppy cultivation rose by 15 per cent in 2012, driven largely by increases in Afghanistan and Myanmar, global opium production fell by almost 30 per cent, to less than 5,000 tons in 2012, mainly as a result of poor yields in Afghanistan. Mexico remained the largest producer of opium in the Americas.

It appears that opium production in the Lao People’s Democratic Republic and Myanmar may not be able to meet the demand posed by the increasing number of heroin users in some parts of Asia.

While seizures of morphine and heroin increased globally in 2011, declines were noted in specific regions and countries, including Turkey and Western and Central Europe.

Cocaine
The global area under coca cultivation amounted to 155,600 ha in 2011, almost unchanged from a year earlier but 14 per cent lower than in 2007 and 30 per cent less than in 2000. Estimates of the amounts of cocaine manufactured, expressed in quantities of 100 per cent pure cocaine, ranged from 776 to 1,051 tons in 2011, largely unchanged from a year earlier. The world’s largest cocaine seizures (not adjusted for purity) continue to be reported from Colombia (200 tons) and the United States (94 tons). However, there has been an indication in recent years that the cocaine market has been shifting to several regions which have not been associated previously with either trafficking or use. Significant increases have been noted in Asia, Oceania and Central and South America and the Caribbean. In Central America, intensified competition in trafficking of cocaine has led to growing levels of violence.

Cocaine has long been perceived as a drug for the affluent. There is some evidence which, though inconclusive, suggests that this perception may not be entirely groundless, all other factors being equal. Nonetheless, the extent of its use is not always led by the wallet. There are examples of wealthy countries with low prevalence rates, and vice-versa.

Arguably, parts of East and South-East Asia run a higher risk of expansion of cocaine use (although from very low levels). Seizures in Hong Kong, China, rose dramatically, to almost 600 kg in 2010, and had exceeded 800 kg by 2011. This can be attributed to several factors, often linked to the glamour associated with its use and the emergence of more affluent sections of society. In the case of Latin America, in contrast, most of the increase appears to be linked to “spill-over” effects, as cocaine is widely available and relatively cheap owing to the proximity to producing countries.

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In North America, seizures and prevalence have declined considerably since 2006 (with the exception of a rebound in seizures in 2011). Between 2006 and 2011, cocaine use among the general population in the United States fell by 40 per cent, which is partly linked to less production in Colombia, law enforcement intervention and inter-cartel violence.

While, earlier, North America and Central/Western Europe dominated the cocaine market, today they account for approximately one half of users globally, a reflection of the fact that use seems to have stabilized in Europe and declined in North America.

In Oceania, on the other hand, cocaine seizures reached new highs in 2010 and 2011 (1.9 and 1.8 tons, respectively, up from 290 kg in 2009). The annual prevalence rate for cocaine use in Australia for the population aged 14 years or older more than doubled from 1.0 per cent in 2004 to 2.1 per cent of the adult population in 2010; that figure is higher than the European average and exceeds the corresponding prevalence rates in the United States.

**Amphetamine-type stimulants**

There are signs that the market for amphetamine-type stimulants (ATS) is expanding: seizures and consumption levels are increasing, manufacture seems to be spreading and new markets are developing.

The use of ATS, excluding "ecstasy", remains widespread globally, and appears to be increasing in most regions. In 2011, an estimated 0.7 per cent of the global population aged 15-64, or 33.8 million people, had used ATS in the preceding year. The prevalence of "ecstasy" in 2011 (19.4 million, or 0.4 per cent of the population) was lower than in 2009.

While use is steady in the traditional markets of North America and Oceania, there seems to be an increase in the market in Asia's developed economies, notably in East and South-East Asia, and there is also an emerging market in Africa, an assessment that is borne out by increasing diversions of precursors, seizures and methamphetamine manufacture. The estimated annual prevalence of ATS use in the region is higher than the global average.

At the global level, seizures have risen to a new high: 123 tons in 2011, a 66 per cent rise compared with 2010 (74 tons) and a doubling since 2005 (60 tons). Mexico clocked the largest amount of methamphetamine seized, more than doubling, from 13 tons to 31 tons, within the space of a year, thus surpassing the United States for the first time.

Methamphetamine continues to be the mainstay of the ATS business; it accounted for 71 per cent of global ATS seizures in 2011. Methamphetamine pills remain the predominant ATS in East and South-East Asia where 122.8 million pills were seized in 2011, although this was a 9 per cent decline compared with 2010 (134.4 million pills). Seizures of crystalline methamphetamine, however, increased to 8.8 tons, the highest level during the past five years, indicating that the substance is an imminent threat.

Methamphetamine manufacture seems to be spreading as well: new locations were uncovered, inter alia, in Poland and the Russian Federation. There is also an indication of increased manufacturing activity in Central America and an increase in the influence of Mexican drug trafficking organizations in the synthetic drugs market within the region.

Figures for amphetamine seizures have also gone up, particularly in the Middle East, where the drug is available largely in pill form, marketed as “captagon” pills and consisting largely of amphetamine.

Europe and the United States reported almost the same number of amphetamine laboratories (58 versus 57) in 2011, with the total number remaining fairly stable compared with 2010.

While “ecstasy” use has been declining globally, it seems to be increasing in Europe. In ascending order, Europe, North America and Oceania remain the three regions with a prevalence of “ecstasy” use that is above the global average.
Cannabis

Providing a global picture of levels of cannabis cultivation and production remains a difficult task: although cannabis is produced in practically every country in the world, its cultivation is largely localized and, more often than not, feeds local markets.

Cannabis remains the most widely used illicit substance. There was a minor increase in the prevalence of cannabis users (180.6 million or 3.9 per cent of the population aged 15-64) as compared with previous estimates in 2009. The areas of cannabis eradicated increased in the United States, possibly indicating an increase in the area under cultivation. Cultivation also seems to have gone up in the Americas as a whole. In South America, reported cannabis herb seizures rose by 46 per cent in 2011.

In Europe, seizures of cannabis herb increased, while seizures of cannabis resin (“hashish”) went down. This may indicate that domestically produced cannabis continues to replace imported resin, mainly from Morocco. The production of cannabis resin seems to have stabilized and even declined in its main producing countries, i.e. Afghanistan and Morocco.

Many countries in Africa reported seizures of cannabis herb, with Nigeria reporting the largest quantities seized in the region.

In Europe, cannabis is generally cultivated outdoors in countries with favourable climatic conditions. In countries with less favourable climatic conditions, such as Belgium and the Netherlands, a larger number of indoor plants are found. It is difficult to compile an accurate picture of cultivation and eradication, as this varies widely across countries and climatic zones. Plant density fluctuates wildly, depending on the cultivation method (indoor or outdoor) and environmental factors.

New psychoactive substances

While new harmful substances have been emerging with unfailing regularity on the drug scene, the international drug control system is floundering, for the first time, under the speed and creativity of the phenomenon known as new psychoactive substances (NPS).

The number of NPS reported by Member States to UNODC rose from 166 at the end of 2009 to 251 by mid-2012, an increase of more than 50 per cent. For the first time, the number of NPS actually exceeded the total number of substances under international control (234). NPS are substances of abuse, either in a pure form or a preparation, that are not controlled by international drug conventions, but which may pose a public health threat. In this context, the term “new” does not necessarily refer to new inventions but to substances that have newly become available in specific markets. In general, NPS is an umbrella term for unregulated (new) psychoactive substances or products intended to mimic the effects of controlled drugs.

Member States have responded to this challenge using a variety of methods within their legislative frameworks, by attempting to put single substances or their analogues under control.

It has generally been observed that, when a NPS is controlled or scheduled, its use declines shortly thereafter, which has a positive impact on health-related consequences and deaths related to the substance, although the “substitution effect” has inhibited any in-depth research on the long-term impact of NPS scheduling. There are of course, instances when scheduling or controlling a NPS has had little or no impact. Generally, the following kinds of impacts have been observed after the scheduling of a NPS:

(a) The substance remains on the market, but its use declines immediately. Examples include mephedrone in the United Kingdom of Great Britain and Northern Ireland, BZP in New Zealand, “legal highs” in Poland, mephedrone in Australia and MDPV in the United States of America;
(b) Use of the substance declines after a longer interval, maybe a year or more (e.g. ketamine in the United States);

(c) Scheduling has little or no immediate impact on the use of the substance, e.g. 3,4-methylenedioxyn-Nmethylamphetamine (MDMA), commonly known as “ecstasy”, in the United States and other countries.

Further, there are cases of NPS disappearing from the market. This has also been the case with the majority of the substances controlled under the 1961 Convention and the 1971 Convention. Of the 234 substances currently under international control, only a few dozen are still being misused, and the bulk of the misuse is concentrated in a dozen such substances.

It is obvious that legislations to control NPS are not a “one size fits all” solution, and there are always exceptions to the rule. However, a holistic approach which involves a number of factors — prevention and treatment, legal status, improving precursor controls and cracking down on trafficking rings — has to be applied to tackle the situation.

There is a lack of long-term data which would provide a much-needed perspective: no sooner is one substance scheduled, than another one replaces it, thus making it difficult to study the long-term impact of a substance on usage and its health effects.

The problem of NPS is a hydra-headed one in that manufacturers produce new variants to escape the new legal frameworks that are constantly being developed to control known substances. These substances include synthetic and plant-based psychoactive substances, and have rapidly spread in widely dispersed markets. Until mid-2012, the majority of the identified NPS were synthetic cannabinoids (23 per cent), phenethylamines (23 per cent) and synthetic cathinones (18 per cent), followed by tryptamines (10 per cent), plant-based substances (8 per cent) and piperazines (5 per cent). The single most widespread substances were JWH-018 and JWH-073 among the synthetic cannabinoids; mephedrone, MDPV and methylene among the synthetic cathinones; and m-chlorophenylpiperazine (mCPP), N-benzylpiperazine (BZP) and 1-(3-trifluoromethylphenyl)piperazine (TFMPP) among the piperazines. Plant-based substances included mostly kratom, khat and Salvia divinorum.

What makes NPS especially dangerous and problematic is the general perception surrounding them. They have often been marketed as “legal highs”, implying that they are safe to consume and use, while the truth may be quite different. In order to mislead the authorities, suppliers have also marketed and advertised their products aggressively and sold them under the names of relatively harmless everyday products such as room fresheners, bath salts, herbal incenses and even plant fertilizers.

Countries in nearly all regions have reported the emergence of NPS. The 2008-2012 period in particular saw the emergence of synthetic cannabinoids and synthetic cathinones, while the number of countries reporting new phenethylamines, ketamine and piperazines declined (as compared with the period prior to 2008).

**Origin and manufacture**

While most widespread in Europe and North America, NPS seem to originate nowadays primarily in Asia (East and South Asia), notably in countries known for their advanced chemical and pharmaceutical industries. Domestic manufacture has also been reported by countries in Europe, the Americas and Asia. Nonetheless, the overall pattern is one of transregional trafficking which deviates from the clandestine manufacture of controlled psychotropic substances such as ATS, which typically occurs within the same region as where the consumers are located.

**Role of technology**

The Internet seems to play an important role in the business of NPS: 88 per cent of countries responding to a UNODC survey said that the Internet served as a key source for the supply in their markets. At the same time, a Eurobarometer survey found that just 7 per cent of young consumers of NPS in Europe (age 15-24) used the Internet to actually
purchase such substances, indicating that, while the import and wholesale business in such substances may be increasingly conducted via the Internet, the end consumer still retains a preference for more traditional retail and distribution channels.

**Spread of new psychoactive substances at the regional level**

With its early warning system, comprising 27 European Union countries and Croatia, Norway and Turkey, Europe has the most advanced regional system in place to deal with emerging NPS. Through the early warning system, formal notification was provided for a total of 236 new substances during the 2005-2012 period, equivalent to more than 90 per cent of all substances found globally and reported to UNODC (251). The number of identified NPS in the European Union rose from 14 in 2005 to 236 by the end of 2012.

NPS seem to constitute a significant market segment already. Close to 5 per cent of people aged 15-24 have already experimented with NPS in the European Union, which is equivalent to one-fifth of the numbers who have tried cannabis and close to around half of the number who have used drugs other than cannabis. While cannabis use has clearly declined among adolescents and young people in Europe over the past decade, and the use of drugs other than cannabis has remained largely stable, the use of NPS has gone up.

Within Europe, Eurobarometer data for 2011 suggest that five countries account for almost three-quarters of all users of NPS: United Kingdom (23 per cent of the European Union total), followed by Poland (17 per cent), France (14 per cent), Germany (12 per cent) and Spain (8 per cent). The United Kingdom is also the country that identified the most NPS in the European Union (30 per cent of the total during the 2005-2010 period).

The United States identified the largest number of NPS worldwide: for 2012 as a whole, a total of 158 NPS were identified, i.e. twice as many as in the European Union (73). The most frequently reported substances were synthetic cannabinoids (51 in 2012, up from 2 in 2009) and synthetic cathinones (31 in 2012, up from 4 in 2009). Both have a serious negative impact on health. Excluding cannabis, use of NPS among students is more widespread than the use of any other drug, owing primarily to synthetic cannabinoids as contained in Spice or similar herbal mixtures. Use of NPS among youth in the United States appears to be more than twice as widespread as in the European Union.

In Canada, authorities identified 59 NPS over the first two quarters of 2012, i.e. almost as many as in the United States. Most of the substances were synthetic cathinones (18), synthetic cannabinoids (16) and phenethylamines (11). In a national school survey, widespread use was reported among tenth-grade students for Salvia divinorum (lifetime prevalence of 5.8 per cent), jimson weed or Datura (2.6 per cent), a hallucinogenic plant, and ketamine (1.6 per cent).

NPS are also making inroads in the countries of Latin America, even though, generally speaking, levels of misuse of such substances in the region are lower than in North America or Europe. Reported substances included ketamine and plant-based substances, notably Salvia divinorum, followed by piperazines, synthetic cathinones, phenethylamines and, to a lesser extent, synthetic cannabinoids. Brazil also reported the emergence of mephedrone and of DMMA (a phenethylamine) in its market; Chile reported the emergence of Salvia divinorum and tryptamine; Costa Rica reported the emergence of BZP and TFMPP, two piperazines.

For many years, New Zealand has played a key role in the market for piperazines, notably BZP. A large number of NPS are also found in Australia, similar to the situation in Europe and North America. Overall, 44 NPS were identified during the first two quarters of 2012 in the Oceania region, equivalent to one quarter of all such substances identified worldwide. Australia identified 33 NPS during the first two quarters of 2012, led by synthetic cathinones (13) and phenethylamines (8).

According to the UNODC survey undertaken in 2012, the second-largest number of countries reporting the emergence of NPS was in Asia. The emergence of such substances was reported from a number of countries and areas, mostly in East and South-East Asia (Brunei Darussalam; China; Hong Kong, China; Indonesia; Japan; Philippines; Singapore; Thailand; Viet Nam), as well as in the Middle East (Bahrain, Israel, Jordan, Oman, Saudi Arabia and United Arab Emirates).
Hong Kong, China, reported the emergence of a number of synthetic cannabinoids (such as JWH-018) and synthetic cathinones (4-methylisoxcathinone and butylone). Indonesia informed UNODC of the emergence of BZP. Singapore saw the emergence of a number of synthetic cannabinoids (including JWH-018) and synthetic cathinones (3-fluoroketamethcathinone and 4-methylcathinone). Oman witnessed the emergence of synthetic cannabinoids (JWH-018). Japan reported the emergence of phenethylamines, synthetic cathinones, piperazines, ketamine, synthetic cannabinoids and plant-based substances.

The two main NPS in Asia in terms of consumption are ketamine and kratom, mostly affecting the countries of East and South-East Asia. Ketamine pills have been sold for several years as a substitute for “ecstasy” (and sometimes even as “ecstasy”). In addition, large-scale traditional consumption of khat is present in Western Asia, notably in Yemen.

In total, 7 African countries (Angola, Cape Verde, Egypt, Ghana, South Africa, Togo and Zimbabwe) reported the emergence of NPS to UNODC. Egypt reported not only the emergence of plant-based substances (Salvia divinorum) but also the emergence of synthetic cannabinoids, ketamine, piperazines (BZP) and other substances (2-diphenylmethylpiperidine (2-DPMP) and 4-benzylpiperidine). Nonetheless, the overall problems related to the production and consumption of NPS appear to be less pronounced in Africa. There are, however, a number of traditionally used substances (such as khat or ibogaine) that fall under the category of NPS and that, in terms of their spread, may cause serious health problems and other social consequences.

The road ahead

Scheduling or controlling a substance is a lengthy — and costly — process, especially as it is the authorities who bear the onus of proof. Additionally, controlling an ever-larger number of substances, affecting police, customs, forensic laboratories, import/export authorities and the health authorities, among others, may stretch some Member States beyond their capacities.

Alternative systems, such as the establishment of “early warning systems” for NPS, “emergency scheduling”, “analogue scheduling”, “generic scheduling”, application of the “medicines law” and other creative approaches, all have their pros and cons. Most have improved the situation and have taught valuable lessons in planning for future control regimes. However, what is missing is coordination at the global level so that drug dealers cannot simply exploit loopholes, both within regions and even within countries.

The establishment of a global early warning system is needed to inform Member States of emerging substances and to support them in their response to this complex and changing phenomenon. While the international drug control conventions offer the possibility of scheduling new substances, the sheer rapidity of emerging NPS makes this a very challenging undertaking. What is needed is an understanding and sharing of methods and lessons learned in regional responses to the situation involving NPS before exploring the setting up of a global response to the problem.

Footnotes

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In its resolution 56/4 of 15 March 2013, the Commission on Narcotic Drugs encouraged the United Nations Office on Drugs and Crime “to share and exchange ideas, efforts, good practices and experiences in adopting effective responses to address the unique challenges posed by new psychoactive substances, which may include, among other national responses, new laws, regulations and restrictions”.

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Considerable efforts have been made over the years to improve the estimates presented in the World Drug Report, which rely, to a large extent, on information submitted by Member States through the Annual Report Questionnaire (ARQ). Nonetheless, challenges remain in making such estimates because of data gaps and the varying quality of the available data. One major problem is the irregularity and incompleteness in ARQ reporting by Member States. Irregular reporting may result in absence of data for some years, and may influence the reported trend in a given year. Secondly, submitted questionnaires are not always complete or comprehensive, and thirdly, much of the data collected are subject to limitations and biases. These issues affect the reliability, quality and comparability of the information received.

Sources of information

Under the International Drug Conventions, Member States are formally required to provide national drug control related information annually to the ‘Secretary General’ of the United Nations (i.e. the Secretariat of UNODC). For this purpose, the Commission on Narcotic Drugs developed the Annual Report Questionnaire (ARQ) which forms the basis of information in the World Drug Report.

The World Drug Report 2013 is based primarily on data obtained from the ARQ returned by Governments to UNODC up to 31 December 2012. The data collected in the current ARQ normally refer to the drug situation in 2011. UNODC sent out the questionnaire to 192 Member States, as well as 15 territories. In response, up to 31 December, 2012 UNODC had received 88 replies to its questionnaire on the “Extent and patterns of and trends in drug use (ARQ Part III)” and 91 replies to Part IV on “Extent and patterns and trends in drug crop cultivation, manufacturing and trafficking”. By the end of February 2013, 3 additional responses on Part III and 6 responses on Part IV were received that have also been included in the data and its analysis reported in the WDR 2013. The best coverage was from Member States in Europe where over 90 per cent of the countries responded, in Asia 62 per cent and in the Americas 41 per cent of the countries filled in the ARQ. Within the Americas, the response rate was 35 per cent from the Latin American and Caribbean Member States. In the case of Africa, nearly 13 per cent of the Member States and in the Oceania region, only two out of the 14 countries responded to the Annual Report Questionnaire. Member States’ responses to the ARQ are shown on the maps which follow.
and Kashmir has not yet been agreed upon by the parties. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

**Figure Member states that provided annual reports questionnaire drug supply data for 2011**

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dashed lines represent undetermined boundaries. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. The final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

In general, the quantity of information provided on illicit drug supply is significantly better than that of information provided on drug demand. Analysis of responses to Part IV of the ARQ revealed that 88% of them were ‘substantially completed compared to 80% of Part III. (ARQ which were more than 50% completed were classified as having been ‘substantially filled in‘; less than 50% completion is classified as having been ‘partially filled in‘).

In order to analyse the extent to which Member States provided information, a number of key questions in the ARQ were identified:

- **For Part III**, on the extent and patterns and trends of drug abuse, the key questions used for the analysis referred to: trends in drug use, for which 82% of the Member States and territories returning the ARQ provided information; prevalence of different drugs among the general population for which 67% of the Member States responded; for prevalence of drug use among youth 66% responded; and for treatment demand 92% responded. The overall response rate of completion was 80% for the countries which submitted Part III to UNODC, however this analysis does not take into account the completeness or quality of the information provided in response to each of the areas mentioned.

- **For Part IV**, on the extent and patterns and trends in drug crop cultivation, manufacturing and trafficking, the analysis included replies to the questions on: the quantities seized for which all of the Member States returning the ARQ provided the information; on trafficking of illicit drugs 90% of the Member States provided responses; for prices and purity 85% of the Member States responded, and for drug related arrests 81% of the Member States provided information. The overall analysis of these data revealed that 88% of the Part IV responses were “substantially” completed. However this analysis does not take into account the completeness of responses or the quality of information provided in each of sections mentioned.

Information provided by Member States in the ARQ form the basis for the estimates and trend analysis provided in the World Drug Report. Often, this information and data is not sufficient to provide an accurate or comprehensive picture of the world’s drug markets. When necessary and where available, the data from the ARQ are thus supplemented with data from other sources.

As in previous years, seizure data made available to UNODC via the ARQ was complemented primarily with data from Interpol/ICPO, and data provided to UNODC by the Heads of National Law Enforcement Agencies (HONLEA) at their
regional meetings. Price data for Europe were complemented with data from Europol. Precursor data presented are mainly those collected by the International Narcotics Control Board (INCB). Demand related information was obtained through a number of additional sources, including the national assessments of the drug situation supported by UNODC, the drug control agencies participating in the UNODC’s, ‘Drug Abuse Information Network for Asia and the Pacific’ (DAINAP), as well as various national and regional epidemiological networks such as the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) or the Inter-American Drug Abuse Control Commission (CICAD). Reports published by National governments and academic research published in the scientific literature were also used as additional sources of information. This type of supplementary information is useful and necessary as long as Member States lack the monitoring systems necessary to produce reliable, comprehensive and internationally comparable data.

To this end, UNODC encourages and supports the improvement of national monitoring systems. Major progress has been made in the area of illicit crop monitoring over the last few years in some of the countries that have major illicit crop cultivations. In close cooperation with UNODC and with the support of major donors – these countries have developed impressive monitoring systems designed to identify the extent of, and trends in, the cultivation of narcotic plants. These data form a fundamental basis for trend analysis of illicit crop cultivation and drug production presented in the World Drug Report.

There remain significant data limitations on the demand side. Despite commendable progress made in a number of Member States, in the area of prevalence estimates for example, far more remains to be done to provide a truly reliable basis for trend and policy analysis and needs assessments. The work currently being done on the World Drug Report 2013 provides yet another opportunity to emphasize the global need for improving the evidence base available to the policy makers and programme planners.

Data on drug use and health consequences

Overview

UNODC estimates of the extent of illicit drug use in the world have been published periodically since 1997. Assessing the extent of drug use (the prevalence and number of drug users) is a particularly difficult undertaking because it involves in most settings measuring the size of a ‘hidden’ population. Regional and global estimates are reported with ranges to reflect the information gaps. The level of confidence expressed in the estimates varies across regions and drug types.

A global estimate of the level of use of a specific drug involves the following steps:

1. Identification and analysis of appropriate sources (starting from the ARQ);

2. Identification of key benchmark figures for the level of drug use in all countries where data are available (annual prevalence of drug use among the general population aged 15-64) which then serve as ‘anchor points’ for subsequent calculations;

3. ‘Standardization’ of existing data if reported with a different reference population than the one used for the World Drug Report (for example, from age group 12 and above to a standard age group of 15-64);

4. Adjustments of national indicators to estimate an annual prevalence rate if such a rate is not available (for example, by using the lifetime prevalence or current use rates; or lifetime or annual prevalence rates among the student population), includes the identification of adjustment factors based on information from countries in the region with similar cultural, social and economic situations where applicable;

5. Imputation for countries where data are not available, based on data from countries in the same subregion. Ranges are calculated by considering the 10th and 90th percentile of the subregional distribution;
6. Extrapolation of available results for a subregion were calculated only for subregions where prevalence estimates for at least two countries covering at least 20% of the population were available. If, due to a lack of data, subregional estimates were not extrapolated, a regional calculation was extrapolated based on the 10th and 90th percentile of the distribution of the data available from countries in the region.

7. Aggregation of subregional estimates rolled-up into regional results to arrive at global estimates.

For countries that did not submit information through the ARQ, or in cases where the data were older than 10 years, other sources were identified, where available. In nearly all cases, these were government sources. Many estimates needed to be adjusted to improve comparability (see below).

In cases of estimates referring to previous years, the prevalence rates were left unchanged and applied to new population estimates for the year 2011. Currently, only two countries measure drug prevalence among the general population on an annual basis. The remaining countries that regularly measure it - typically the more economically developed - do so usually every three to five years. Therefore, caution should be used when interpreting any change in national, regional or even global prevalence figures, as changes may in part reflect newer reports from countries, at times with changed methodology, or the exclusion of older reports, rather than actual changes in prevalence of a drug type.

Detailed information on drug use is available from countries in North America, a large number of countries in Europe, a number of countries in South America, the two large countries in Oceania and a limited number of countries in Asia and Africa. One key problem in national data is the level of accuracy, which varies strongly from country to country. Not all estimates are based on sound epidemiological surveys. In some cases, the estimates simply reflect the aggregate number of drug users found in drug registries, which cover only a fraction of the total drug using population in a country. Even in cases where detailed information is available, there is often considerable divergence in definitions used, such as chronic or regular users; registry data (people in contact with the treatment system or the judicial system) versus survey data (usually extrapolation of results obtained through interviews of a selected sample); general population versus specific surveys of groups in terms of age (such as school surveys), special settings (such as hospitals or prisons), et cetera.

To reduce the error margins that arise from simply aggregating such diverse estimates, an attempt has been made to standardize - as a far as possible - the heterogeneous data set. All available estimates were transformed into one single indicator – annual prevalence among the general population aged 15 to 64 - using transformation ratios derived from analysis of the situation in neighbouring countries, and if such data were not available, using global average estimates. The basic assumption is that though the level of drug use differs between countries, there are general patterns (for example, young people consume more drugs than older people; males consume more drugs than females; people in contact with the criminal justice system show higher prevalence rates than the general population, et cetera) which apply to most countries. It is also assumed that the relationship between lifetime prevalence and annual prevalence among the general population or between lifetime prevalence among young people and annual prevalence among the general population, except for new or emerging drug trends, do not vary greatly among countries with similar social, cultural and economic situations.

For this year's World Drug Report UNODC have suppressed the estimates of the prevalence of drug use in countries with smaller populations (less than approximately 100,000 population aged 15-64) where the prevalence estimates were based on the results of youth or school surveys that were extrapolated to the general adult population.

**Indicators used**

The most widely used indicator at the global level is the annual prevalence rate: the number of people who have consumed an illicit drug at least once in the last twelve months prior to the study. Annual prevalence has been adopted by UNODC as one of key indicators to measure the extent of drug use. It is also part of the Lisbon Consensus on core epidemiological demand indicators which has been endorsed by the Commission on Narcotic Drugs. The other key epidemiological indicators of drug use are:
1. Drug consumption among the general population (prevalence and incidence);

2. Drug consumption among the youth population (prevalence and incidence);

3. High-risk drug use (number of injecting drug users and the proportion engaged in high-risk behaviour, number of daily drug users);

4. Utilization of services for drug problems (treatment demand);

5. Drug-related morbidity (prevalence of HIV, hepatitis B virus and hepatitis C virus among drug users);

6. Drug-related mortality (deaths attributable to drug use).

Efforts have been made to present the overall drug situation from countries and regions based on these key epidemiological indicators.

The use of annual prevalence is a compromise between lifetime prevalence data (drug use at least once in a lifetime) and data on current use (drug use at least once over the past month). The annual prevalence rate is usually shown as a percentage of the youth and adult population. The definitions of the age groups vary, however, from country to country. Given a highly skewed distribution of drug use among the different age cohorts in most countries, differences in the age groups can lead to substantially diverging results.

Applying different methodologies may also yield diverging results for the same country. In such cases, the sources were analysed in-depth and priority was given to the most recent data and to the methodological approaches that are considered to produce the best results. For example, it is generally accepted that nationally representative household surveys are reasonably good approaches to estimating cannabis, ATS or cocaine use among the general population, at least in countries where there are no adverse consequences for admitting illicit drug use. Thus, household survey results were usually given priority over other sources of prevalence estimates.

When it comes to the use of opiates (opium, heroin, and other illicit opiates) injecting, or use of cocaine and ATS among regular or dependent users, annual prevalence data derived from national household surveys tend to grossly underestimate such use, because heroin or other problem drug users often tend to be marginalized or less socially integrated, and may not be identified as living in a ‘typical’ household (they may be on the streets, homeless or institutionalized). Therefore, a number of ‘indirect’ methods have been developed to provide estimates for this group of drug users, including benchmark and multiplier methods (benchmark data may include treatment demand, police registration or arrest data, data on HIV infections, other services utilization by problem drug users or mortality data), capture-recapture methods and multivariate indicators. In countries where there was evidence that the primary ‘problem drug’ was opiates, and an indirect estimate existed for ‘problem drug use’ or injecting drug use, this was preferred over household survey estimates of heroin use. Therefore for most of the countries, prevalence of opioid or opiates use reported refers to the extent of use of these substances measured through indirect methods.

For other drug types, priority was given to annual prevalence data found by means of household surveys. In order to generate comparable results for all countries, wherever needed, the reported data was extrapolated to annual prevalence rates and/or adjusted for the preferred age group of 15-64 for the general population.

**Extrapolation methods used**

**Adjustment for differences in age groups**

Member States are increasingly using the 15-64 age group, though other groups are used as well. Where the age groups reported by Member States did not differ significantly from 15-64, they were presented as reported, and the age
group specified. Where studies were based on significantly different age groups, results were typically adjusted. A number of countries reported prevalence rates for the age groups 15+ or 18+. In these cases, it was generally assumed that there was no significant drug use above the age of 64. The number of drug users based on the population age 15+ (or age 18+) was thus shown as a proportion of the population aged 15-64.

**Extrapolation of results from lifetime prevalence to annual prevalence**

Some countries have conducted surveys in recent years without asking the question whether drug consumption took place over the last year. In such cases, results were extrapolated to reach annual prevalence estimates. For example, country X in West and Central Europe reported a lifetime prevalence of cocaine use of 2%. Taking data for lifetime and annual prevalence of cocaine use in countries of West and Central Europe, it can be shown that there is a strong positive correlation between the two measures (correlation coefficient R = 0.94); that is, the higher the lifetime prevalence, the higher the annual prevalence and vice versa. Based on the resulting regression line (with annual prevalence as the dependent variable and lifetime prevalence as the independent variable) it can be estimated that a country in West and Central Europe with a lifetime prevalence of 2% is likely to have an annual prevalence of around 0.7% (see figure). Almost the same result is obtained by calculating the ratio of the unweighted average of annual prevalence rates of the West and Central European countries and the unweighted average lifetime prevalence rate (0.93/2.61 = 0.356) and multiplying this ratio with the lifetime prevalence of the country concerned (2% * 0.356 = 0.7%).

A similar approach was used to calculate the overall ratio by averaging the annual/lifetime ratios, calculated for each country. Multiplying the resulting average ratio (0.334) with the lifetime prevalence of the country concerned provides the estimate for the annual prevalence (0.387 * 2% = 0.8%). There is a close correlation observed between lifetime and annual prevalence (and an even stronger correlation between annual prevalence and monthly prevalence). Solid results (showing small potential errors) can only be expected from extrapolations done for a country in the same region. If instead of using the West and Central European average (0.387), the ratio found in the USA was used (0.17), the estimate for a country with a lifetime prevalence of cocaine use of 2% would decline to 0.3% (2% * 0.17). Such an estimate is likely to be correct for a country with a drug history similar to the USA, which has had a cocaine problem for more than two decades, as opposed to West and Central Europe, where the cocaine problem is largely a phenomenon of the last decade. Therefore, data from countries in the same subregion with similar patterns in drug use were used, wherever possible, for extrapolation purposes.
Both approaches—the regression model and the ratio model—were used to determine upper and lower uncertainty range estimates calculated at a 90% confidence interval among those aged 15-64 years in the given country. The greater the range, the larger the level of uncertainty around the estimates. The range for each country is reported in the statistical annex, where available.

**Extrapolations based on school surveys**

Analysis of countries which have conducted both school surveys and national household surveys shows that there is, in general, a positive correlation between the two variables, particularly for cannabis, ATS and cocaine. The correlation, however, is weaker than that of lifetime and annual prevalence or current use and annual prevalence among the general population. But it is stronger than the correlation between opiate use and injecting drug use and between treatment demand and extent of drug use in the general population.

These extrapolations were conducted by using the ratios between school surveys and household surveys of countries in the same region or with similar social structure where applicable. As was the case with extrapolation of results from lifetime prevalence to annual prevalence, two approaches were taken: a) the unweighted average of the ratios between school and household surveys in the comparison countries with an upper and lower uncertainty range estimate calculated at a 90% confidence interval; and b) a regression-based extrapolation, using the relationships between estimates from the other countries to predict the estimate in the country concerned, with an upper and lower uncertainty range estimate calculated at a 90% confidence interval. The final uncertainty range and best estimate are calculated using both models, where applicable.

**Extrapolations based on treatment data**

For a number of developing countries, the only drug use-related data available was drug users registered or treatment demand. In such cases, other countries in the region with a similar socio-economic structure were identified, which reported annual prevalence and treatment data. A ratio of people treated per 1,000 drug users was calculated for each
country. The results from different countries were then averaged and the resulting ratio was used to extrapolate the likely number of drug users from the number of people in treatment.

**Making regional and global estimates of the number of people who use drugs and the health consequences**

For this purpose, the estimated prevalence rates of countries were applied to the population aged 15-64, as provided by the United Nations Population Division for the year 2011.

Ranges have been produced to reflect the considerable uncertainty that arises when data are either extrapolated or imputed. Ranges are provided for estimated numbers and prevalence rates in the Report. Larger ranges are reported for subregions and regions with less certainty about the likely levels of drug use – in other words, those regions for which fewer direct estimates are available, for a comparatively smaller proportion of the region’s population.

Countries with one published estimate (typically those countries with a representative household survey, or an indirect prevalence estimate that did not report ranges) did not have uncertainty estimated. This estimate is reported as the ‘best estimate’.

To account for populations in countries with no published estimate, the 10th and 90th percentile in the range of direct estimates was used to produce a lower and upper estimate. For example, there are three countries in the North Africa subregion with past year prevalence estimates for cannabis use: Algeria (0.52, a point estimate), Egypt (2.9 – 9.6) and Morocco (4.2, a point estimate). These are extrapolated to the population of the remaining three countries without prevalence data, namely the Libyan Arab Jamahiriya, Sudan and Tunisia. The 10th percentile of the lower bound of the uncertainty range (0.52, 2.9, and 4.2) is 1.0 and the 90th percentile of the upper bound (0.52, 9.6, and 4.2) is 8.5. The 1.0 and 8.5 figures are applied to the population of the remaining three countries without prevalence data to derive a a subregional total lower and upper estimate of 2.16 and 6.8 per cent respectively.

In some cases, not all of a region’s subregions had estimates due to a lack of country level data. For example, past year amphetamines-group prevalence was calculated for East and South-East Asia and the Near and Middle East/South West Asia, however the remaining subregions— South Asia and Central Asia—had no estimates. To calculate an overall Asia lower and upper estimate for populations in subregions with no published estimate, all of the countries throughout the region were considered using the 10th and 90th percentile of the regional distribution. These results were then combined with those subregions where an estimate was possible. One exception was South Asia’s subregional opiate and cannabis estimates. In this case, India’s population accounts for 85% of the six countries in the subregion, but recent reliable estimates of drug use for India were not available. Instead of using all prevalence estimates for Asia (that is, estimates from the Near and Middle East to East Asia) to determine India’s contribution to the subregional uncertainty, it was determined that India’s contribution was best reflected by its neighbouring countries.

This produces conservative (wide) intervals for subregions where there is geographic variation and/or variance in existing country-level estimates; but it also reduces the likelihood that skewed estimates will have a dramatic effect on regional and global figures (since these would most likely fall outside the 10th and 90th percentile).

**Estimates of the total number of people who used illicit drugs at least once in the past year**

This year’s Report used the same approach as last year. Two ranges were produced, and the lowest and highest estimate of each the approaches were taken to estimate the lower and upper ranges, respectively, of the total illicit drug using population. This estimate is obviously tentative given the limited number of countries upon which the data informing the two approaches were based. The two approaches were as follows:
Approach 1
The global estimates of the number of people using each of the five drug groups in the past year were added up. Taking into account that people use more than one drug type and that these five populations overlap, the total was adjusted downward. The size of this adjustment was made based upon household surveys conducted in 15 countries globally including countries from North America (Canada, Mexico and the United States, Europe (Germany, Spain and England and Wales), Latin America (Argentina, Brazil, Plurinational State of Bolivia, Chile, Peru and Uruguay), Asia and the Pacific (Indonesia, Philippines, and Australia), which assessed all five drug types, and reported an estimate of total illicit drug use. Across these studies, the extent to which adding each population of users over estimated the total population was a median factor of 1.171. The summed total was therefore divided by 1.171.

Approach 2
This approach was based on the average proportion of the total drug using population that comprises cannabis users. The average proportion was obtained from household surveys conducted in the same countries as for Approach 1. Across all of these studies, the median proportion of total drug users that comprised cannabis users was 77%. The range of cannabis users at the global level was therefore divided by 0.77.

The global lower estimate was the lower of the two values obtained from the two approaches, while the upper estimates was the upper value derived from the two approaches described.

Estimates of the number of ‘problem drug users’
It is useful to make estimates of the number of drug users whose use is particularly problematic as this subgroup of drug users is most likely to come to the attention of health and law enforcement. Moreover, this subgroup’s drug use has been estimated to cause the main public health and public order burden.

The number of problem drug users is typically estimated with the number of dependent drug users. Sometimes, an alternative approach is used. The EMCDDA uses ‘injecting or long duration use of opioids, amphetamines or cocaine’ to guide country-level indirect prevalence estimation studies of problem drug use.

In this Report, as in previous years, each of the five range estimates of the number of people using each of the five drug groups was converted into a ‘heroin user equivalent’. This was calculated through the use of ‘relative risk coefficients’ (see below) derived from the UNODC Harm Index. This method enables the aggregation of results from different drugs into one reference drug.

Table Relative risk coefficient

<table>
<thead>
<tr>
<th>Drug</th>
<th>Treatment Index</th>
<th>IDU</th>
<th>Toxicity</th>
<th>Deaths index</th>
<th>Relative risk coefficient</th>
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</thead>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cocaine</td>
<td>85.3</td>
<td>47.8</td>
<td>88</td>
<td>18.5</td>
<td>59.9</td>
</tr>
</tbody>
</table>

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A lower range was calculated by summing each of the five lower range estimates; the upper end of the range was calculated by summing the upper range of the five estimates.

To obtain an estimate of the number of ‘problem drug users’, these totals were multiplied by the proportion of past year heroin users in the United States National Survey on Drug Use and Health (range 53-68% over the past six years of this survey). Hence, the LOW estimate is the lower proportion (53%) multiplied by the lower estimated size of the heroin use equivalent population (29.9 million heroin user equivalents). The HIGH estimate is the higher proportion (68%) multiplied by the higher estimated size of the heroin use equivalent population (56.9 million heroin user equivalents). This gives a range of 15.9 to 38.7 million problem drug users globally.

### Estimates of the prevalence of injecting drug use, and HIV and hepatitis (C and B virus) among injecting drug users

#### Country-level estimates:

**Injecting drug users**

1. For the countries that reported an estimate, either a prevalence estimate for injecting drug use may be available (with possibly a lower and upper estimate), or alternatively an estimate for the total number of injecting drug users, in which case a prevalence (%) is calculated using the adult population corresponding to the year of the estimated number.

2. Based on the prevalence estimate(s) for each country, the total number of injecting drug users for 2011 is calculated, with possibly a range in the numbers if the lower and upper prevalence estimates are available.

**Injecting drug users living with HIV**

The prevalence estimates for HIV and hepatitis C and B among injecting drug users do not usually have a range at the country level. However, for the number of injecting drug users living with HIV in 2011 a best estimate and range are calculated. The lower estimate is calculated from the lower estimate of the number of injecting drug users for 2011 and the lower estimate (if available) of the prevalence of HIV among injecting drug users. Similarly, calculations are made for the best estimate and the upper estimate of the numbers of injecting drug users living with HIV.

#### Regional and Global estimates:

The country level estimates grouped by regions are used to provide estimates at the regional and global levels. The regional best estimates of the prevalence of injecting drug use are given by the population-weighted country estimates. The regional best estimates of the prevalence of HIV (or hepatitis) among injecting drug users are given by the injecting drug user population-weighted country estimates.

The ranges given reflect the variability in the prevalence from countries for which we have an estimate. For countries with no estimates, the 10th and 90th percentiles of the prevalence values for the known countries within the same region are applied. Combining estimates for all countries we derive the regional estimates which are subsequently summed to produce the global estimates.
For many countries the estimates for injecting drug use and HIV among injecting drug users have been updated since the previous values published by the Reference Group on HIV and Injecting Drug Use in 2008. The new estimates often reflect improved survey methods and do not necessarily relate to actual changes in injecting behaviour or the prevalence of HIV among injecting drug users.

Estimates of the number of drug-related deaths

Drug-related deaths include those directly or indirectly caused by the intake of illicit drugs, but it may also include deaths where the use of illicit drugs was a contributory cause, including cases where drug use was involved in the circumstances of the deaths (for example, violence and traffic accidents). Member States report on drug-related deaths according to their own definitions and therefore care should be taken in making country comparisons.

The total number of drug-related deaths reported by Member States were used to determine a rate for the reporting year and this rate was used to produce an estimate of the number of drug-related deaths corresponding to the year 2011. The estimated number of drug-related deaths for 2011 were aggregated at the regional level. To account for non-responding countries, an upper and lower estimate of the number of deaths was made using the 10th and 90th percentiles of the mortality rates for countries that did report within the same region. In North America, all countries reported and therefore, no range was given. Because of the lack of reported information on drug-related deaths in Africa, an alternative source was used. The global estimate of the number of drug-related deaths is the sum of the regional estimates. The overall estimated number of deaths for a region was presented as a range to account for uncertainty, and also presented as a rate per 1 million population aged 15-64 to allow for some degree of comparison across regions.

Drug cultivation, production and manufacture

Data on cultivation of opium poppy and coca bush and production of opium and coca leaf for the main producing countries (Afghanistan, Myanmar and the Lao People’s Democratic Republic, for opium; and Colombia, Peru and the Plurinational State of Bolivia for coca) are mainly derived from national monitoring systems supported by UNODC in the framework of the Global Illicit Crop Monitoring Programme (ICMP). Estimates of cannabis cultivation since 2009 in Afghanistan, as well as cannabis cultivation in 2003, 2004 and 2005 in Morocco, were also produced by the UNODC-supported national monitoring systems. Estimates for other countries were drawn from ARQ replies and various other sources, including reports from Governments, UNODC field offices and the United States Department of State’s Bureau for International Narcotics and Law Enforcement Affairs. Opium poppy cultivation in countries which do not conduct area surveys, was estimated with an indirect method (see below).


Net cultivation

Not all the fields on which illicit crops are planted are actually harvested and contribute to drug production. For Afghanistan, a system of monitoring opium poppy eradication is in place which provides all necessary information to calculate the net cultivation area. In Myanmar and the Lao People’s Democratic Republic, only the area of opium poppy eradicated before the annual opium survey is taken into account for the estimation of the cultivation area. Not enough information is available to consider eradication carried out after the time of the annual opium survey.

A major difference between coca and other narcotic plants such as opium poppy and cannabis is that the coca bush is a perennial plant which can be harvested several times per year. This longevity of the coca plant should, in principle, make it easier to measure the area under coca cultivation. In reality, the area under coca cultivation is dynamic which makes it difficult to determine the exact amount of land under coca cultivation at any specific point in time or within a given year. There are several reasons why coca cultivation is so dynamic, including new plantation, reactivation of previously abandoned fields, abandonment, manual eradication and aerial spraying.
The issue of different area concepts and data sources used to monitor illicit coca bush cultivation continues to be investigated by UNODC. To improve the comparability of estimates between countries, in this report, the 2011 net coca cultivation area at 31 of December is presented not only for Colombia but also for Peru. For technical reasons, the initial area measurement of coca fields takes place on satellite images acquired at different dates of the year and sometimes having different technical specifications. For the Bolivian and Peruvian estimate, these difference are considered to have a limited effect only, whereas the dynamic situation in Colombia requires adjustment to maintain year-on-year comparability. The Colombia coca cultivation series includes adjustments for small fields since 2009 while previous years did not require adjustment.

**Indirect estimation of illicit opium poppy cultivation**

Eradication and plant seizure reports indicate that illicit opium poppy cultivation exists in many countries, which do not regularly conduct illicit crop surveys. Starting 2008 a new methodology was introduced to estimate the extent of this illicit cultivation with an indirect method based on two indicators available in UNODC's databases: eradicated poppy area and opium poppy (plant, capsule) seizures reported as units or weight.

*Prioritization of data sources*: Whenever possible, the eradicated poppy area was used as this indicator is conceptually closest. If this indicator was not available, poppy plant seizure data was used, which requires an additional conversion of the seized amount into area eradicated. It can be assumed that plant seizures are often a different way of recording eradication. e.g. in cases where area measurements are technically difficult or because the law requires all seized material to be weighed even if the seizure consist actually of eradicating plants on a field. Large-scale or long-distance illicit trade with opium poppy plants is unlikely as the plants are bulky, perishable and of low value.

*Eradication factor*: Evidence from countries which provide both illicit cultivation and eradication data indicates that illicit cultivation is typically a multiple of the area eradicated. This relationship, averaged over the last five years for which information is available, was used to calculate a factor which allowed to estimate illicit cultivation in countries from eradication figures. Since 2008, this factor is based on opium poppy cultivation and eradication data from Colombia, Lao People's Republic, Mexico, Myanmar, Pakistan and Thailand. It ranged between 2.1 and 3.0 (eradicated area x factor = net cultivation area). Afghanistan was not considered for the calculation of the factor as the objective was to estimate low to mid-levels of illicit cultivation. Afghanistan, representing two thirds or more of global illicit poppy cultivation, clearly fell outside this range.

*Plant seizures*: seizures of poppy plant material usually happen close to the source, i.e. in vicinity of the cultivation area. The data available in UNODC's databases does not allow to determine the parts of the plant seized as only one category exists (“plant, capsules”) for plant seizures. Most (roots, stem, leaves, capsules) or only some parts (poppy straw, capsules only) may be seized. While this does not influence seizure data given in plant units, it plays a role when interpreting seizure data given as weight.

*Plant seizure data in units* represent plant numbers, which can be converted into area (ha) using an average number of opium poppy plants per hectare. Yield measurements from Afghanistan and Myanmar, where UNODC has conducted yield surveys over several years, indicate an average figure of about 190,000 plants per hectare. Dividing poppy plant seizure numbers by this factor results in estimate of the area on which the seized material was cultivated. This is equivalent to eradicated area, as the seized material was taken out of the production cycle. Eradicated area multiplied with the eradication factor described above yields then cultivation area.

*Plant seizure data reported as weight*: In order to convert the weight of seized poppy plants into area, a typical biomass per hectare of poppy was estimated based on the evaluation of various sources. The biomass yield in oven-dry equivalent including stem, leaves, capsule and seeds reported by a commercial licit opium poppy grower in Spain was 2,800 kg/ha for rain-fed and 7,200 kg/ha for irrigated fields respectively. Information on the weight of roots was not available. Loewe found biomass yields between 3,921 kg/ha to 5,438 kg/ha in trial cultivation under greenhouse conditions. Acock et al. found oven-dry plant weights of about 37 grams including roots in trials under controlled conditions corresponding to a biomass yield of around 7,000 kg/ha with the assumed plant density of 190,000/ha.
Among the available biomass measurements only the figures from Spain referred to poppy grown under field conditions. All other results fell into the range between the non-irrigated and irrigated biomass yields (2,800 – 7,200 kg/ha) reported. For purposes of this calculation the simple average of these two values was taken.

Two caveats have to be made: a) As the reporting format does not differentiate between capsules and plants or between the different growth stages of a poppy plant, it was assumed that the reported weight refers to whole, mature plants. This leads to a conservative estimate as many plant seizures are actually carried out on fields before the poppy plants reach maturity. b) The reference biomass measurements from scientific studies are expressed in oven-dried equivalents, whereas the reported weights could refer to fresh weight or air-dry weight; both of which are higher than the oven-dry equivalent weight equivalent. This would lead to an over-estimation of the illicit cultivation area. In the case of young plants, which are typically fresh but not yet fully grown, both errors could balance off, whereas in the case of mature or harvested plants, which tend to be drier, both errors would be smaller.

Missing values: Not all states with illicit opium poppy cultivation report eradication or plant seizures on a yearly basis. If values were missing, the value used for that specific year was the average of the last 5 years. If no eradication or plant seizure was reported in that period, no value was calculated.

Yield and production

To estimate potential production of opium, coca leaf and cannabis (herb and resin), the number of harvests per year and the total yield of primary plant material has to be established. The UNODC-supported national surveys take measurements in the field and conduct interviews with farmers, using results from both to produce the final data on yield.

Opium yield surveys are complex. Harvesting opium with the traditional lancing method can take up to two weeks as the opium latex that oozes out of the poppy capsule has to dry before harvesters can scrape it off and several lancings take place until the plant has dried. To avoid this lengthy process, yield surveyors measure the number of poppy capsules and their size in sample plots. Using a scientifically developed formula, the measured poppy capsule volume indicates how much opium gum each plant potentially yields. Thus, the per hectare opium yield can be estimated. Different formulas were developed for South-East and South-West Asia. In Afghanistan and Myanmar, yield surveys are carried out annually.

For coca bush, the number of harvests varies, as does the yield per harvest. In the Plurinational State of Bolivia and Peru, UNODC supports monitoring systems that conduct coca leaf yield surveys in several regions, by harvesting sample plots of coca fields over the course of a year, at points in time indicated by the coca farmer. In these two countries, yield surveys are carried out only occasionally, due to the difficult security situation in many coca regions and because of funding constraints. In Colombia, coca leaf yield estimates are updated yearly through a rotational monitoring system introduced in 2005 that ensures that every yield region is revisited about every three years. However, as the security situation does not allow for surveyors to return to the sample fields, only one harvest is measured, and the others are estimated based on information from the farmer.

Conversion factors

The primary plant material harvested - opium in the form of gum or latex from opium poppy, coca leaves from coca bush, and the cannabis plant - undergo a sequence of extraction and transformation processes, some of which are done by farmers onsite, others by traffickers in clandestine laboratories. Some of these processes involve precursor chemicals and may be done by different people in different places under a variety of conditions, which are not always known. In the case of opium gum, for example, traffickers extract the morphine contained in the gum in one process, transform the morphine into heroin base in a second process, and finally produce heroin hydrochloride. In the case of cocaine, coca paste is produced from either sun-dried (in the Plurinational State of Bolivia and Peru) or fresh coca leaves (in Colombia), which is later transformed into cocaine base, from where cocaine hydrochloride is produced.
The results of each step, for example, from coca leaf to coca paste, can be estimated with a conversion factor. Such conversion factors are based on interviews with the people involved in the process, such as farmers in Colombia, who report how much coca leaf they need to produce 1 kg of coca paste or cocaine base. Tests have also been conducted where so-called ‘cooks’ or ‘chemists’ demonstrate how they do the processing under local conditions. A number of studies conducted by enforcement agencies in the main drug-producing countries have provided the orders of magnitude for the transformation from the raw material to the end product. This information is usually based on just a few case studies, however, which are not necessarily representative of the entire production process. Farmer interviews are not always possible due to the sensitivity of the topic, especially if the processing is done by specialists and not by the farmers themselves. Establishing conversion ratios is complicated by the fact that traffickers may not know the quality of the raw material and chemicals they use, which may vary considerably; they may have to use a range of chemicals for the same purpose depending, on their availability and costs; and the conditions under which the processing takes place (temperature, humidity, et cetera) differ.

It is important to take into account the fact that the margins of error of these conversion ratios – used to calculate the potential cocaine production from coca leaf or the heroin production from opium - are not known. To be precise, these calculations would require detailed information on the morphine content of opium or the cocaine content of the coca leaf, as well as detailed information on the efficiency of clandestine laboratories. Such information is limited. This also applies to the question of the psychoactive content of the narcotic plants.

UNODC, in cooperation with Member States, continues to review coca leaf to cocaine conversion ratios as well as coca leaf yields and net productive area estimates. More research is needed to establish comparable data for all components of the cocaine production estimate.

Figure Impact of conversion factors on global estimates of potential cocaine HCl production (mt)

Many cannabis farmers in Afghanistan and Morocco conduct the first processing steps themselves, either by removing the upper leaves and flowers of the plant to produce cannabis herb or by threshing and sieving the plant material to extract the cannabis resin. The herb and resin yield per hectare can be obtained by multiplying the plant material yield with an extraction factor. The complex area of cannabis resin yield in Afghanistan was investigated in 2009, 2010 and 2011. The yield study included observation of the actual production of resin, which is a process of threshing and sieving the dried cannabis plants. In Morocco, this factor was established by using information from farmers on the methods.
used and on results from scientific laboratories. Information on the yield was obtained from interviews with cannabis farmers. Given the high level of uncertainty and the continuing lack of information in many cannabis-cultivating countries, the estimate of global cannabis herb and resin production have not been.

**Potential production**

‘Potential’ heroin or cocaine production shows the total production of heroin or cocaine if all the cultivated opium or coca leaf were transformed into the end products in the respective producer country in the same year. However, part of the opium or coca leaf is directly consumed in the producing countries or in neighbouring countries, prior to the transformation into heroin or cocaine. In addition, significant quantities of the intermediate products, coca paste or morphine, are also consumed in the producing countries. Some products such as opium can be stored for extended periods of time and be converted into intermediate or final products long after the harvest year. These factors are partly taken into account: for example, consumption of coca leaf considered licit in the Plurinational State of Bolivia and Peru is not taken into account for the transformation into cocaine. Other factors, such as the actual amount of illicit coca paste or opium consumption and storage, are difficult to estimate and were not taken into account.

For cocaine, potential production of 100% pure cocaine is estimated. In reality, clandestine laboratories do not produce 100% pure cocaine but cocaine of lower purity which is often referred to as ‘export quality’. For heroin, not enough information is available to estimate the production of heroin of 100% purity. Instead, potential production of export quality heroin is estimated, whose exact purity is not known and may vary.

Although it is based on current knowledge on the alkaloid content of narcotic plants and the efficiency of clandestine laboratories, ‘potential production’ is a hypothetical concept and is not an estimate of actual heroin or cocaine production at the country or global level. The concept of potential production is different from the theoretical maximum amount of drug that could be produced if all alkaloids were extracted from opium and coca leaf. The difference between the theoretical maximum and the potential production is expressed by the so-called laboratory efficiency, which describes which proportion of alkaloids present in plant material clandestine laboratories are actually able to extract.

**Colombia**

In 2010, for the first time, the net productive area was estimated, in addition to the previous approach of using the average area under coca cultivation of the reporting year and the previous year. For reasons of comparability, the latter was presented as the point estimate. A range was calculated whereby the estimate based on the previous methodology forms the lower bound, and the cocaine estimate based on the net productive area the upper bound. For years before and after 2010, the net productive area had not yet been calculated at the time of printing.

**Peru**

Potential cocaine production in Peru is estimated from potential coca leaf production after deducting the amount of coca leaf estimated to be used for traditional purposes according to Government sources (9,000 mt of sun-drycoca leaf).

**The Plurinational State of Bolivia**

Potential cocaine production in the Plurinational State of Bolivia is estimated from potential coca leaf production after deducting the amount of coca leaf produced on 12,000 ha in the Yungas of La Paz where coca cultivation is authorized under national law.

**Drug trafficking**
Seizures

The analysis presented in this report is mainly derived from the ARQ responses from Member States up to the 2011 reporting year. Including information from other sources, UNODC was able to obtain seizure data from 121 countries and territories for 2011. Seizures are the most comprehensive indicator of the drug situation and its evolution at the global level. Although seizures may not always reflect trafficking trends correctly at the national level, they tend to show reasonable representations of trends at the regional and global levels.

With regard to the 2011 reporting year, comprehensive seizure data for the United Kingdom were not available at the time of preparation of this report. For this reason, in several instances the text and charts of the report reflects only data for England and Wales for the relevant reporting period (which, in the case of the United Kingdom, is taken to be the 2011/2012 financial year) and this is reflected in footnotes where relevant. Consolidated and comprehensive data for the United Kingdom, which became available at a later stage, are available in the accompanying seizure listings.

Countries may report seizures of drugs using a variety of units, primarily by weight (kg) but also in litres, tablets, doses, blotters, capsules, ampoules, et cetera. When reporting about individual countries in individual years, UNODC endeavours to be as faithful as possible to the reports received, but often it is necessary to aggregate data of different types for the purposes of comparison. For the aggregation, conversion factors are used to convert the quantities into ‘kilogram equivalents’ (or ‘ton equivalents’). UNODC continues to record and report the disaggregated raw data, which are available in the seizure listings published at: [http://www.unodc.org/unodc/en/data-analysis/WDR.html](http://www.unodc.org/unodc/en/data-analysis/WDR.html) In these tables, seizure quantities are reproduced as reported. In the rest of the Report, seizure data are often aggregated and transformed into this unique unit of measurement. Moreover, at some points in the analysis, purity adjustments are made where relevant and where the availability of data allows.

### Table Weight of tablets in milligrams

<table>
<thead>
<tr>
<th>Weight of tablets in milligrams</th>
<th>Ecstasy (MDMA or analogue)</th>
<th>Amphetamine</th>
<th>Methamphetamine</th>
<th>Non-specified amphetamines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>271</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Asia (excluding Near and Middle East/South-West Asia)</td>
<td>300</td>
<td>250</td>
<td>90</td>
<td>250</td>
</tr>
<tr>
<td>Europe</td>
<td>271</td>
<td>253</td>
<td>225</td>
<td>250</td>
</tr>
<tr>
<td>Central and South America and Caribbean</td>
<td>271</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Near and Middle East/ South-West Asia</td>
<td>237</td>
<td>170</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>North America</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Oceania</td>
<td>276</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
</tbody>
</table>
The conversion factors affect seizure totals of amphetamine-type stimulants in particular, as a significant share of seizures of these drug types is reported in number of tablets. Apart from seizures of ATS tablets, drug seizures are mainly reported to UNODC by weight. This includes seizures of ATS which are not seized in tablet form (for example, crystalline methamphetamine, ATS in powder form) as well as seizures of other drug types, such as heroin and cocaine. Moreover, ATS seizures made in tablet form are also sometimes reported by weight, and in some cases, the reported total weight possibly includes ATS seized in different forms. Reports of seizures by weight usually refer to the bulk weight of seizures, including adulterants and diluents, rather than the amount of controlled substance. Moreover, given the availability of data, accurate purity adjustments for bulk seizure totals in individual countries are feasible in a small minority of cases, as they would require information on purity on a case by case basis or statistically calibrated data, such as a weighted average or a distribution. The bulk weight of tablets is easier to obtain and less variable.

To ensure the comparability of seizure totals across different years and countries, UNODC uses conversion factors for ATS tablets intended to reflect the bulk weight of the tablets rather than the amount of controlled substance. The factors used in this edition of the World Drug Report are based on available forensic studies and range between 90 mg and 300 mg, depending on the region and the drug type, and also apply to other units which are presumed to represent a single consumption unit (dose). The table below lists the factors used for ‘ecstasy’, amphetamine, methamphetamine, and non-specified ATS. The conversion factors remain subject to revision as the information available to UNODC improves.

UNODC is also in the process of establishing conversion factors for the drug types that were newly introduced with the recent revision of the Annual Report Questionnaire.

For the other drug types, the weight of a ‘typical consumption unit’ was assumed to be: for cannabis herb, 0.5 g; for cannabis resin, 0.135 g; for cocaine and morphine, 0.1 g; for heroin, 0.03 g; for LSD, 0.00005 g (50 micrograms); and for opium, 0.3 g. For opiate seizures (unless specified differently in the text), it was assumed that 10 kg of opium were equivalent to 1 kg of morphine or heroin. Though these transformation ratios can be disputed, they provide a means of combining the different seizure reports into one comprehensive measure. The transformation ratios have been derived from those normally used by law enforcement agencies, in the scientific literature and by the International Narcotics Control Board, and were established in consultation with UNODC’s Laboratory and Scientific Section. As in previous editions of the World Drug Report, seizures quantified by volume (litres) are aggregated using a conversion ratio of 1 kilogram per litre, which applies to all drug types. Cannabis plants are assumed to have a weight of 100 grams.

In addition to the aggregate annual seizure data collected via the ARQ, UNODC also collects data of significant individual drug seizures on a case by case basis. At the time of preparation of the World Drug Report 2013, the database contained records of approximately 177 000 seizure cases which were made over the period 1997-2012 in a total of 129 countries and territories.

Some tables and charts in the World Drug Report 2013 were produced on the basis of these data, including Figures 22-26, Figures 28-29, Figure 58, and two tables in Annex II, titled “Most frequently mentioned countries of provenance for individual drug seizure cases, by drug type (all modes of transportation), 2001-2012” and “Most frequently mentioned countries of provenance for individual maritime drug seizure cases, 2001-2012”.

Given that the data on individual drug seizures available to UNODC does not provide universal coverage, caution should be exercised in the interpretation of these figures and tables. In particular, the correct interpretation needs to take into account whether the figure or table in question is based on the number of seizure cases or the quantities seized. In the former case, multiple seizures, even if small, will carry a bigger weight than a single large seizure.

**Trafficking routes and volumes**

Information of trafficking routes was mainly obtained from analyses of individual drug seizures reported to UNODC, as well as analyses of trafficking routes reported by Member States.

**Market analysis**


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Drug price and purity data

Price and purity data, if properly collected and reported, can be powerful indicators of market trends. Trends in supply can change over a shorter period of time when compared with changes in demand and shifts in prices and purities are good indicators for increases or declines of market supply. Research has shown that short-term changes in the consumer markets are first reflected in purity changes while prices tend to be rather stable over longer periods of time. UNODC collects its price data from the ARQ, and supplements this data with other sources such as DAINAP, EMCDDA and Government reports. Prices are collected at farm-gate level, wholesale level ('kilogram prices') and at retail level ('gram prices'). Countries are asked to provide minimum, maximum and typical prices and purities. When countries do not provide typical prices/purities, for the purposes of certain estimates, the mid-point of these estimates is calculated as a proxy for the 'typical' prices/purities (unless scientific studies are available which provide better estimates). What is generally not known is how data were collected and how reliable it is. Although improvements have been made in some countries over the years, a number of law enforcement bodies have not yet established a regular system for collecting purity and price data.

Prices are collected in local currency but are often converted into US dollars for the purposes of comparability among countries. The conversion into US dollars is based on official UN rates of exchange for the year. However, comparisons of prices from different years need to be made with caution as they are influenced by changes in the exchange rates and may not necessarily reflect changes in the local markets.

New Psychoactive Substances

Chapter 2 of the World Drug Report 2013 draws on the findings of the UNODC report ‘The challenge of new psychoactive substances’, (March 2013) and other recent reports on the topic in an attempt to alert an even larger audience to the issues at stake. The information and data were obtained primarily through an electronic questionnaire on NPS, which was sent to all Member States as well as to the drug analysis laboratories that participate in the UNODC International Collaborative Exercises (ICE) in July 2012. The questionnaire covered a wide spectrum of issues related to NPS, inter alia, legislation, seizures of NPS, substances detected and analyzed, identification of NPS, sources, trafficking, distribution and the use of NPS. The Chapter includes an analysis of the responses received by February 2013 (80 countries and territories). Most responses were received from countries in Europe (33), followed by countries and territories in Asia (23), in the Americas (12), in Africa (10) and in the Oceania region (2). In total 70 countries and territories, 70 i.e. 88 per cent of all responding countries, reported the emergence of NPS. Only 10 countries had not identified NPS in recent years. Additional information was obtained from Government reports, scientific literature and data extracted from the UNODC ICE Portal.

Footnotes

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Plant disease and pests are not considered here as their impact is likely to be captured in the coca leaf yield estimates.

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Personal communication, 2010, from Alcaliber company.

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7

Further information on the methodology of opium and coca leaf yield surveys conducted by UNODC can be found in United Nations (2001): Guidelines for Yield Assessment of Opium Gum and Coca Leaf from Brief Field Visits, New York (ST/NAR/33).

8

More detailed information on the ongoing review of conversion factors was presented in the 2010 World Drug Report, p.251 ff.

9


10

More information on the results of the two approaches and the methodology used can be found in the report on coca cultivation in Colombia (UNODC/ Government of Colombia, June 2011) available on the internet at http://www.unodc.org/unodc/en/crop-m...ing/index.html.

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