REPORT ON UPOPS RELEASES FROM OPEN BURNING IN BOTSWANA

NOVEMBER 1, 2019

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EXECUTIVE SUMMARY

The practice of open burning of waste is a growing public health concern worldwide. To address this issue at the regional level, Botswana with other six (6) SADC countries is participating in a regional project on the promotion of Best Available Techniques and Best Environmental Practices to reduce unintentionally-produced persistent organic pollutants (uPOPs) from open burning of waste. Unintentionally-produced persistent organic pollutants are part of the Stockholm Convention chemicals which for the past decades have increasingly been recognized as serious public health concern due to their impact on human health and the environment. The convention requires each Party to continuously minimize and, where feasible, eliminate releases of unintentionally produced organic pollutants. To achieve this goal, Botswana implements measures to reduce uPOPs releases from open burning as part of the action plan within its National Implementation Plan. Measures to reduce uPOPs releases were based on strategies employed to reduce open burning of waste.

This report presents an updated inventory of sources of unintentionally produced persistent organic pollutants in Botswana as well as estimation of uPOPs releases from those sources. The inventory seeks to weigh the success of measures taken by Botswana to reduce uPOPs releases from open burning of waste. The updated inventory was developed in 2019, based on data collected for the reference year 2018 using the Toolkit methodology as revised in 2013.

One interesting finding is that only five landfills out of the assessed 14 landfills and 34 dumpsites had no reports of landfill fires. From the 2018 activity rates used, it was estimated that around 30 000 tons of waste burnt annually and the data only applies for waste burnt at landfill and dumpsite. The updated releases of uPOPs to air from open burning of waste are thus estimated at 9.0 g TEQ per annum. Comparison of these findings with those of the revised baseline releases of (2.7 g TEQ/year) indicate a significant increase of uPOPs, particularly from open burning of waste at landfills and dumpsites.

One of the more significant findings reflected by the updated inventory is that currently backyard domestic burning of waste is rarely practiced across the country. These findings suggest that in general measures taken by Botswana to reduce backyard burning of domestic waste at household have been successful, although dumpsites and landfills fires are still prevalent across the country. These findings suggest several courses of action for uPOPs reduction from open burning of waste at landfills and dumpsites are still required. Continued efforts are needed to achieve a significant reduction of uPOPs releases by Botswana.

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1. INTRODUCTION

Botswana as Party to the Stockholm Convention on Persistent Organic Pollutants (POPs), is amongst other six (6) SADC countries participating in a regional project **"promotion of Best Available Technologies (BAT) and Best Environmental Practices (BEP) to reduce releases of Unintentionally-Produced Persistent Organic Pollutants (uPOPs) from waste open burning"**. This project was formulated after the transmission of countries national implementation plans through the establishment of the BAT/BEP Forum by countries from the SADC and COMESA regional blocks. The objective of the Forum is to implement activities towards reducing the releases of unintentionally produced POPs. Out of the four identified priority sector BAT/BEP projects by the SADC and COMESA regional blocks, open burning of waste was given priority. This regional project was justified by the number of countries prioritising open burning of waste. The aim of this project is to reduce unintentional production of Persistent Organic Pollutants (uPOPs) from Open Burning of Waste practices through the promotion of Best Available Technologies (BAT) and Best Environmental Practices (BEP). The project is in line with the convention's goal which requires parties to the Stockholm Convention to continuously minimize the releases of unintentionally produced organic pollutants and, where feasible, ultimate elimination.

In Botswana, open burning of waste is one of the top contributing sources of unintentionally-produced persistent organic pollutants. Unintentionally-produced persistent organic pollutants mostly result from the burning of waste at waste incinerators, landfills and dumpsite. To address this challenge, the following improvements were introduced, these include the formulation of institutional capacity and legal framework. In 1998, Botswana enacted the Waste Management Act and the Waste Management Strategy. This strategy being the main legislative framework, advocates for sustainable waste management solutions through the application of the waste management hierarchy. Recycling guidelines were also developed to promote waste recycling practices. Some of the improvements made include the waste management infrastructure development, as of today, 15 engineered landfills have been constructed across the country. Despite the government efforts to improve the waste sector, open waste burning is still a common practice in some parts of the country, particularly in rural areas.

On average, approximately 50 000 tons of waste is generated annually in Botswana, 60% is burned openly at dumpsites and landfills. As part of the action plan within the National Implementation Plan (NIP, Botswana sanctioned several measures to improve the waste sector and ultimately to reduce open burning of waste. Despite these efforts, open burning of waste is still a common practice in many parts of the country, particularly at rural areas.

Similarly to other POPs chemicals, unintentionally-produced persistent organic pollutants are highly toxic and bio-accumulative. These chemicals have the potential to cause adverse health effects on humans and animals. Hence the need to reduce open burning of waste through the application of appropriate measures to reduce or eliminate the releases of unintentionally-produced persistent organic pollutants for the ultimate protection of public health. Therefore, preparation of an inventory of unintentionally-produced persistent organic pollutants sources and estimation of their releases from those sources is one of the first steps toward meeting the Convention's goal. This inventory is a critical component in the action plan that is specified under Article 5 of the Convention, which obligates each Party to develop an action plan that is "designed to identify, characterize and address the release" of UPOPs listed in Annex C: 2

1.1. INVENTORY BACKGROUND

In 2006, Botswana developed the baseline inventory of the unintentionally-produced persistent organic pollutants. The assessment identified possible sources and their locations as well as estimation of their releases from those sources. The unintentional POPs emission releases were calculated based on the Toolkit 2005 methodology, by applying old emission factors. The baseline release estimates showed waste open burning among the most contributing sources of uPOPs in Botswana. However, due to several triggering factors, parties to the Stockholm Convention are required to revise their baseline inventories and one of these factors is the revision of emission factors in the Toolkit.

2. REVISED BASELINE INVENTORY

In Botswana, open burning processes releasing unintentionally produced POPs include domestic waste burning and waste burning at landfills and dumpsites. The baseline inventory of Botswana was developed in 2006 based on data collected for the reference year 2005/6. Data on waste burning was collected from all Local Authorities (Districts and sub-Districts) in Botswana. The survey estimated the annual amount of waste burnt in 2006 to be 13 000 tons. The baseline inventory indicated that more releases of dioxins and furans were from open burning of waste than any source in this category. Table 1 below presents the results obtained from the initial assessment of uPOPs releases from open burning of waste. Release estimations were calculated by multiplying activity rate with the revised corresponding emission factor, the results are as shown in table 1 below:

Table 1: Revised Baseline Releases of uPOPs from open burning of waste, 2006

Source category	Source class	Activity rate (t/year)	Annual Release (g TEQ/a)					Total
			Air	Water	Land	Product	Residue	
Waste burning and accidental fires	Fires at waste dumps (compacted, wet, high Corg content)	9,000	2.700		0.090			2.79
	Open burning of domestic waste	13,000	0.520		0.013			0.53

The revised annual releases of the baseline year 2005/6 were calculated based on the revised emission factors taken from the Toolkit 2013 methodology of 300 and 40 µg TEQ/t of air for the total 13 tonnes of domestic waste burned and landfill and dumpsites fires per year respectively. The revised baseline releases to air from open burning of domestic waste and landfill and dumpsite fires are thus 0.5 g TEQ/year and 2.7 g TEQ/year respectively.

3. UPDATE OF THE INVENTORY

Botswana implements measures to reduce uPOPs releases from open burning as part of the action plan within its National Implementation Plan. Measures to address the open burning of waste include the promotion of waste recycling through the development of the waste recycling guidelines in 2012. Education and awareness-raising campaigns and strengthening enforcement were taken into consideration. Other developments include provision of waste management infrastructure, fifteen (15) landfills have been constructed across the country. To assess the success of these measures, Botswana initiated the process to update the uPOPs inventory in 2019.

Figure 1: Open burning of waste observed at one of the dumpsites in Kweneng District.(October 2019)

The updated inventory was developed based on the activity data collected for the reference year 2018 and the Toolkit methodology as revised in 2013. Data collection was conducted by the inventory team using a questionnaire to retrieve the information needed for classification of facilities, selection of emission factors, and estimation of activity rates to allow calculation of releases.

Activity rates for open burning at dumpsites during the year 2018 were calculated from number of refuse bags collected, whereas in cases of no data available, extrapolation per capita waste production to population levels was used mainly at rural areas. Data of waste burnt at landfills was obtained from records from landfill weigh-bridges at the 14 landfills. From waste disposed at landfills which had fire incidents, it was assumed that 70% of the waste had completely burnt.

4. ASSESSMENT FINDINGS

A total of fourteen (14) landfills and thirty-four (34) major waste dumpsites from 14 Districts and 12 Sub-Districts were assessed during data collection exercise. Summary of the assessed sources is presented in Appendix A. From these sources, approximately 50 000 tons of waste is generated annually, around 30,000 tons of which is considered to have burnt annually.

Out of the 14 assessed landfills, five (5) did not have reports on landfill fires. These are landfills at Masunga, Serowe, Selibe-Phikwe, Jwaneng and Ghanzi Districts. Kweneng District is the most significant contributing sources of uPOPs with releases of above 5 g TEQ/annum. Sources of uPOPs in this area include major dumpsites at Letlhakeng, Lephephe, Lentsweletau, Motokwe and Takatokwane.

4.1. RESULTS AND DISCUSSIONS

Table 2: Updated Releases of uPOPs from open burning of waste in Botswana, 2018

Source category	Source class	Activity rate (t/year)	Annual Release (g TEQ/a)					Total
			Air	Water	Land	Product	Residue	
Waste burning and accidental fires	Fires at waste dumps (compacted, wet, high Corg content)	30,000	**9**		**0.3**			**9.3**

Table 2 above provides the summary statistics for uPOPs releases from updated inventory using revised emission factors. It can be seen from the data in Table 2 that releases to air are much higher than releases estimated during the initial assessment. The updated uPOPs releases to air in 2018 resulting from 30 000 tons of waste burnt annually, was estimated at 9 g TEQ/annum.

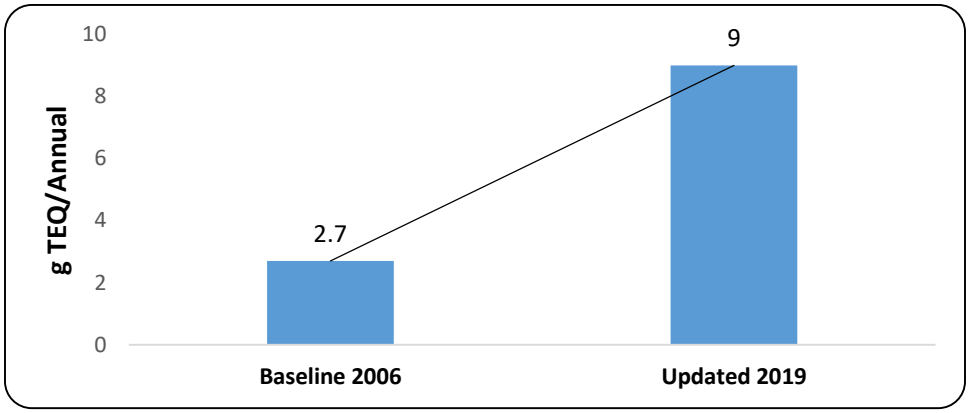

Figure 2: Trend over time in releases from waste burning and accidental fire (revised baseline 2006 inventory versus updated 2019 inventory)

Figure 2 above compares uPOPs releases obtained during initial assessment with releases from the updated inventory. From the graph we can see that the updated inventory reported a significant increases much than what was reported in the initial assessment. The graph shows a steep increase in the amount of uPOPs released in Botswana since 2006. These findings raise intriguing questions regarding the success of government interventions to reduce uPOPs releases from open burning.

An increase in uPOPs releases could be due to an increase in amount of waste burnt at landfills and dumpsites, in the initial assessment, 13 000 tons of waste were used while the updated inventory used 30 000 tons of waste. Burning of waste at dumpsite is a common practice mostly in rural areas where there are no landfills. There have been a rise in accidental fires reported at most of the landfills across the country, some of which resulted from disposal of hot incinerator ash. Despite Government effort to improve the waste sector, open burning of waste is still a challenge.

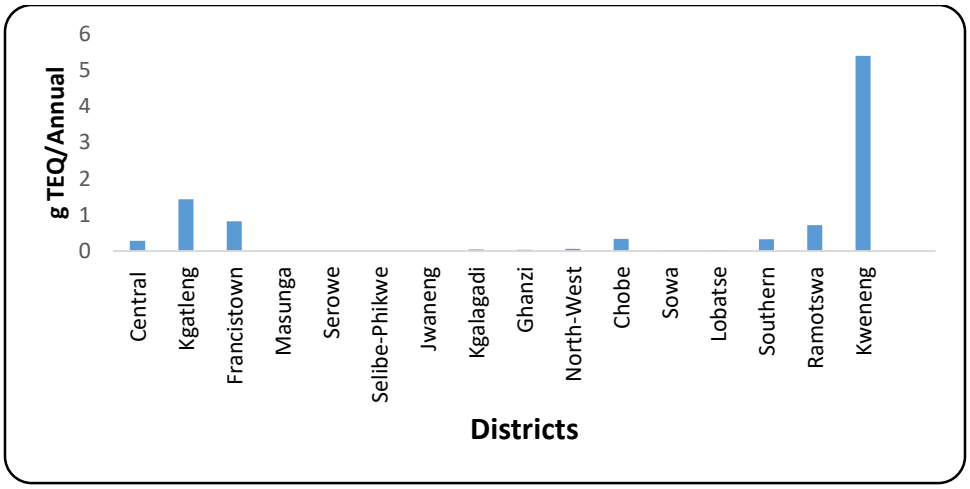

Figure 3: Variation on uPOPs releases at different Districts. Landfills at Jwaneng, Masunga, Serowe, Selibe Phikwe and Ghanzi reported zero incidents of landfill fires

Figure 3 above shows the breakdown of uPOPs releases according to source locations. The graph shows Kweneng District has uPOPs releases of 5.4 g TEQ/annum, followed by Kgatleng District with releases of 1.43 g TEQ/annum. More uPOPs releases in Kweneng District could be justified by the demography of this districts, which is the largest district by population close to the city. Sources in this area include the Gamodubu Regional landfill which serves areas within the Greater Gaborone. The second highest contribution of uPOPs releases were from Kgatleng District.

5. CONCLUSIONS

One of the more significant findings reflected by the updated inventory is that backyard domestic burning of waste is rarely practiced in Botswana. These findings suggest that in general measures taken by Botswana to reduce backyard burning of domestic waste at household have been successful, although dumpsites and landfills fires are prevalent across the country. The findings suggest several courses of action for reduction of unintentionally produced persistent organic pollutants from open burning of waste at landfills and dumpsites. Continued efforts are needed in order to achieve significant reduction levels of uPOPs releases by Botswana.

6. RECOMMENDATIONS

In an effort to address open burning of waste, and to achieve continuous reduction of the releases of unintentionally produced organic pollutants the following are recommended:

1. Botswana should strengthen public awareness on the health impacts of open burning through stakeholder engagements with the Ministry of Health and Wellness and the Local Authorities being the Litter Authorities.
2. Government should enter into partnership with private companies in addressing waste management issues
3. Improve waste recycling rate and reducing the waste inflow into final disposal sites such as landfills and dumpsites to enable timely compaction and covering of waste
4. Provision of adequate machinery at final disposal sites
5. Government should promote waste segregation at source to encourage waste recycling
6. To derive value from waste, incentives should be provided across all the waste streams
7. Government should improve financial sustainability of the solid waste management systems

APPENDIX A: LOCATIONS OF SOURCES OF UPOPS (OPEN BURNING)

#	Districts & Cities & Towns	Location of Landfill	Location of Dumpsites
1.	Central District	1. Serowe 2. Selibe Phikwe	1. Palapye 2. Lecheng 3. Maunatlala 4. Radisele 5. Lerala 6. Bobonong 7. Tsetsebjwe 8. Tonota 9. Tutume 10. Nata 11. Gweta 12. Letlhakane
2.	Kgatleng	Pilane	1. Dikwididi 2. Mathubudukwane
3.	Francistown	Francistown City	
4.	Masunga	Masunga village	
5.	Jwaneng	Jwaneng township	
6.	Kgalagadi	Tsabong	1. Umaweneno 2. Kang 3. Hukuntsi 4. Tshane
7.	Ghanzi	Gantsi	1. Charles Hill
8.	North-West	Maun	1. Gumare 2. Shakawe 3. Seronga
9.	Chobe	Kasane	
10.	Sowa		1. Sowa township
11.	Lobatse	Lobatse township	
12.	Southern	Kanye	1. Mabutsane 2. Goodhope 3. Moshupa 4. Phitshane-molopo 5. Borobadilepe 6. Mabule
13.	Ramotswa	Ramotswa	
14.	Kweneng	Gamodubu	1. Letlhakeng 2. Lentsweletau 3. Motokwe 4. Takatokwane 5. Lephephe

APPENDIX B: Observed Incidents of Open burning of waste

Figure 5: Letlhakane dumpsite (September, 2019)

Figure 4: Moshupa dumpsites (October, 2019)

Figure 7: Gumare Dumpsite (October, 2019)

Figure 6: Letlhakeng dumpsite (October, 2019)

Figure 9: Borobadilepe dumpsite (October, 2019)

Figure 8: Shoshong dumpsite (September, 2019)

Figure 10: Lephephe dumpsite (October, 2019)