

Project: "Promotion of BAT/BEP to reduce uPOPs releases from waste open burning in the participating African countries of SADC sub-region"

Module 2

Practices to Prevent open burning



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION



Table of contents

- I. Definitions
- II. The problem
- III. Situation in the SADC region
- IV. The hazard of open air burning
- V. Waste collection
- VI. Best practices



This presentation is part of the second module on practices preventing open burning within the scope of the project:

"Promotion of BAT/BEP to reduce uPOPs releases from waste open burning in the participating African countries of SADC sub-region."

I. Definitions

What is open air burning of waste?

Open air burning of waste indicates the combustion of any type of waste carried out in open air without the adoption of sanitary or environmental measures to reduce the high impacts it generates (*i.e.*, combustion with no equipment or containment present).



courtesy of S. Tunesi

II. The problem

Why it concerns policy-makers and administrators

Open burning of waste is a very serious threat to public health and the environment, for this reason it becomes a matter that **needs to be confronted by public policies**.

Moreover, it is almost always generated by an inefficient SWM system: it thus needs to be solved by defining a SWM strategy able to make the system evolve and become effective.

More generally, uncollected waste and poorly disposed of waste significantly affect public health and the environment, with long-term economic impacts of health burden and environmental recovery, often resulting in multiple times the costs of developing and operating simple, adequate waste management systems. (from SEPA)

OPEN AIR BURNING OF WASTE IN THE SADC REGION

BOTSWANA

Data

15 engineered landfills: in a 2019 survey only 5 didn't report open burning.

Despite Government's efforts to improve the waste sector, open waste burning is still a common practice, particularly in rural areas, and saw an increase.

Estimations were difficult and actual releases may be bigger.

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

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





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



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



More uPOPs releases in Kweneng District: the largest district by population close to the city.

Sources in this area include the Gamodubu Regional landfill (serving the Greater Gaborone).

The findings suggest that measures taken by Botswana to reduce backyard burning of domestic waste at household may have been successful.

Although dumpsites and landfills fires are prevalent across the country.

A workshop for municipal waste officers (in 2020) showed that there is still much to do across the country to reduce open burning by improving SWM, and concrete ideas for improvements were collected.





https://stopopenburning.unitar.org/guidance-and-examples/lesotho/



The absence of legislation pertaining to SWM has imposed a serious problem as roles and responsibilities are not clearly defined.

For instance, the Department of Environment (DoE) is legally mandated to coordinate all environment management issues including waste management. Whereas the Ministry of Local Government and Chieftainship Affairs (MoLGC) through its councils is responsible for SWM in their assigned areas.

The current set-up where DoE is not an independent authority makes difficult to ensure compliance.

The nonexistence of an Environmental unit as proposed in the Environment Act, in the MoLGC hinders smooth coordination of waste issues.

MADAGASCAR



open waste burning in the country (Inventory 2015)

In Madagascar, the implementation of integrated SWM practices is still only in its phase of experimentation at the country level.

There are very few SWM treatment facilities that meet standards or sanitary landfills, and recycling activities are only at beginning stage.

Because of the lacking waste management, there is few documentation and the actual fraction of municipal waste burning might be underestimated.

Table 5-6 Summary of emissions of Dioxin and Furan for 2015

	Open burning		Emission Factors (gTEQ/an)			
		Air	Water	Land	Product	Residue
6.1	Biomass burning					
1	Forest fires	0.72	ND	0.108	NA	NA
2	Grassland and savannah fires	0.276	ND	0.083	NA	NA
5	Sugarcane burning	0.444	ND	0.006	NA	NA
6.2	Open burning of waste and accidental fires					
3	Open burning of domestic waste	33.52	ND	0.838	NA	NA
	TOTAL	34.961		1.034		

MADAGASCAR

"Promotion of BAT / BEP to reduce releases of uPOPs from open burning of waste in Madagascar" - NATIONAL INVENTORIES OF WASTE OPEN BURNING PRACTICES SITES AND uPOPS RELEASE December 2017

MOZAMBIQUE

Data





Outcome 2 Activity 1

Initiate the process of development and reviewing existing Law and regulation, identify gaps and provide additional regulator provisions.

From "Technical Progress Report N1 – Mozambique. Promotion of BAT and BEP to reduce uPOPs releases from waste Open Burning in the participating African Countries of SADC Sub-region".

No data on uPOPs emissions were provided.

eSWATINI

Through use of GIS-based census and affluence data coupled with field/actual waste disposal data, robust estimates were made of waste generation and uPOP emissions from open waste burning.

The total emissions from open burning were estimated at 1.17 g TEQ/a which is a decrease compared to the 2012 inventory (2.40 g TEQ/a). Similarly, backyard burning contributed 4.10 g TEQ/a in 2017.

This is largely due to the reductions on the incidents of burning in waste disposal facilities in areas such as Nhlangano, Manzini and Matsapha.

Data





The practice of open burning of waste is carried out in

- (i) dumpsites of some formal structures such as municipalities, company towns, and upcoming development areas
- (ii) waste pits in the domestic sector, particularly in the peri-urban and rural areas.

It is used as means to reduce the volume of waste produced and to dispose of combustible waste materials.

The formal structures disposing waste by open air burning were aware it is a bad practice but were faced with financial constraints and thought they did not have any other options.

Upcoming development areas were found to have inadequate knowledge that open waste burning was bad for the environment and human health.

UNIDO- 200'17 "SWAZILAND -NATIONAL INVENTORY ON OPEN BURNING PRACTICES and uPOPS RELEASES" by W. DLAMINI, M. MATHUNJWA, S. MKHONTA, G. MAVIMBELA, S. MABASO, I. VAN ZUYDAM

TANZANIA

Data



Burning is one of the SWM challenges in the municipality as it is currently used as disposal method by some residents.

Although it is prohibited and continuous education concerning its environmental impacts is given to residents, most of them use burning as an economical method for disposal of wastes.

Also, residents burns their farm's waste during cultivation season to clear their land.



Table 3.11: Solid waste management options in Ubungo municipality

SN	Waste Management options	Average	Proportion (%)
		(tons/day)	by volume
1.	Amount of solid waste transported and		
	disposed to the Pugu dumpsite	422	51
2.	Amount recycled or re-used	157	19
3.	Amount controlled with on-site disposal (burned, buried)	142	17
4.	Amount remaining without control	108	13
Total		828	100

The investigation in the Kigamboni Municipality found that the current collection system serves only 7% of the municipality population. The rest of the areas are either served by nonregistered collectors or are not served at all. This means that most of the waste is either dumped or burned informally.

Source: Environment and Solid Waste Management Department

"PROMOTION of BAT and BET TO REDUCE uPOPS RELEASES from WASTE OPEN BURNING IN THE PARTICIPATING AFRICAN COUNTRIES OF SADC SUB-REGION (Tanzania) - Baseline Assessment Report Submitted to UNIDO and DOE – VPO, URT". Feb 2019



Data

16,591,390 Population	290,587 sq mi Land Area	\$68.64 billion GDP (PPP)
60%	Less than 50%	35%
Fraction of the population in rural areas	Fraction of waste in disposal sites	Fraction of residential areas with waste management services
%	gram/year	
Fraction of municipal waste burned	Estimated uPOPs emissions from open waste burning in the country	

Table 4.1: Solid waste collection in Lusaka for the period 2016 - 2018

Year	Waste tonnage/year	Percentage
2016	257,143	24%
2017	300,000	28%
2018	375,000	35%

Zambia Environmental Management Agency. 2019. "National Inventories for Location of Dumpsites, Landfills and Related Hotspots in Zambia"

7.3 SWOT Assessment

On Livingstone Waste Collection System

Strengths	Weaknesses
 CBD very well serviced; clearly clean Council has been exploring innovative ideas to increase collection and to manage dumpsite better Some land still available for development Rich experience of franchised/contracted door-to-door collection Much better collection performance from public places like markets than in other cities like Lusaka 	 Very low sustaining cash available per unit of waste (57cents/ton) Clear cases of entrenched open burning behaviour in high-income areas, in townships and at dumpsite Yet to complete a full WACS Relatively high unemployment in city (experienced staff hard to find; household capacity to pay limited) Waste burying in backyard pits observed even in high-
Opportunities	income areas near CBD Threats
 Much goodwill from many stakeholders for better waste management to keep tourist town credentials Relatively low population Relatively high unemployment in city (low-skill roles easy to fill) Some already implemented recycling and waste sorting activities, ready to scale Unregulated waste pickers (available for mid-grid activities) 	 Unregulated waste pickers (forming a Zabbaleen-like community) Open burning and waste burying in backyard pits (both observed even in high-income areas) Dumpsite in ecologically sensitive location Low uptake of collection service especially in peri-urban areas.

ZAMBIA

OBSERVATIONS ABOUT OPEN AIR BURNING OF WASTE IN THE SADC REGION

- Notwithstanding awareness campaigns, open air burning of waste appears to still be a significant problem in all SADC Countries participating in the project, given no SWM alternatives are provided.
- Open burning is also performed as a waste management system in municipal nonsanitary landfills, as a cheap means of reducing volume.
- These UN analysis underline that giving a permanent solution to these practice requires:
 - ✓ designing at the National scale of a SWM Strategy and
 - ✓ building in every City of an effective Solid Waste Management system.

The hazard of open air burning: principles of risk assessment

to understand how open air burning of waste generates environmental and public health hazards

THE 3 FACTORS OF RISK



An impact from pollution exists if there is a connection between a **source** and a **receptor**



For exposure to take place and health risk to exist there must be a connection between three elements:

SOURCES

abandoned waste

• leaking non-sanitary

• open air fires

landifills

MIGRATION PATHS

- dust from surface soil
- emission to air of volatile toxic substances
- emission of particles

- TARGETS/ RECEPTORS
- workers
- residents
- crop
- ecosystems
- contributes to global environment



HOW DO WE GET EXPOSED?

An exposure route is how a substance enters the human body; they are :

- Ingestion of contaminated matter: food water, soil particles, waste particles.
- Inhalation takes place during respiration when substances in the vapor or gas phase: or airborne particles enter the body.
- Dermal Contact: contaminants present ir water, air and soil or in waste can be uptaker directly from the skin.



ENVIRONMENTAL IMPACTS OF POLLUTION

After emission from sources, pollutants migrate and transfer from one environmental media to another:

- air \rightarrow water
- water \rightarrow soil
- soil \rightarrow groundwaters
- rivers \rightarrow sea
- surface waters→ sediments



The fumes and particles formed during the open air burning of waste – the source of pollution - move to the surrounding environmental media (soil, water, air) and to crops.

From the polluted air, soil, water and crop toxic substances can reach humans and damage health.



Major Pathways of Human Exposure to Environmental Contaminants

SOURCE OF ENVIRONMENTAL **ROUTE OF** RECEPTOR PERSON OR CONTAMINATION MEDIA EXPOSURE POPULATION AT POINT OF EXPOSURE INHALATION AIR SKIN CONTACT INGESTION SKIN CONTACT SOIL INHALATION INGESTION WATER SKIN CONTACT FOOD INGESTION

DESCRIBE AND QUANTIFY EXPOSURE TO MANAGE RISK



courtesy of S. Tunesi

Waste management is expensive: for local administrations in low-income countries → 20% of a municipal budget.

LANDFILLING WITHOUT ENGINEERING:

without a sanitary landfill, these are regular operations not episodic events



courtesy of S. Tunesi

Volatilisation of toxic substances and of methane (climate change)



RISK DESCRIPTION, QUANTIFICATION AND MANAGEMENT

RISK ANALYSIS IS A TOOL FOR ACTION.

In the operational practice the risk can be **managed** – and **exposure reduced** - by acting on the following factors:

- the concentration at the source can be reduced: reduce the number of open-air fires or apply Best Practice when it cannot be eliminated
- the migration pathways can be interrupted: fires can take place only far from residence to prevent direct contact with contaminated dust and mitigate diffusion to air
- warding off measures can be undertaken: monitor and turn off smouldering fires; restrict access to landfills with fences and guards.

Control campaigns are a relevant measure.

THE RELEVANCE OF WASTE COLLECTION IN REDUCING OPEN AIR BURNING OF WASTE





Bologna – Italy – street containers for segregated waste collection

EFFECTIVE WASTE MANAGEMENT BEGINS WITH COLLECTION: IT CAN BE CARRIED OUT IN DIFFERENT WAYS

In Lusaka, Zambia: the formal, municipality, collection service



PLANNING COLLECTION IS THE NECESSARY FIRST STEP

In planning for a more effective SW collection system, the existing reality has to be carefully considered: consider the role of the informal collectors and intermediaries/dealers of recyclables



THE ROLE OF COLLECTION IN AN INTEGRATED SWM SYSTEM

- COLLECTION: AN EFFECTIVE SYSTEM BEGINS WITH A GOOD ORGANIZATION
- TRANSPORT TO FIRST DESTINATION MUST BE ENSURED
- Transfer Stations
- Recovery of Materials
- Recovery of the organic fractions
- Residual waste to landfill
- Residual waste to energy recovery

S. Tunesi, J. Gorelick. 2018. "Solutions design for Solid Waste management - A Guidebook to an effective method for low and middle-income Countries and Cities". CreateSpace



WHAT CONDITION GENERATES OPEN AIR BURNING OF WASTE



S. Tunesi, J. Gorelick. 2018. "Solutions design for Solid Waste management - A Guidebook to an effective method for low and middle-income Countries and Cities". CreateSpace

DIFFERENT COLLECTION SCHEMES CAN BE ADOPTED. IT IS A CHOICE CITY PLANNERS MAKE





Citizens deposit separated wastes at their door step



PROXIMITY / BRING SYSTEMS





PROXIMITY COLLECTION: CONTAINERS ON STREET



Containers of variable size can be selected – from large (steel containers 3,200L)



to medium size (240-360 L plastics bins).



Containers are located in public areas; location is agreed between the service providers and the Local Authority; containers can be permanently opened to deposit waste.

The number of collected waste fraction varies: it is a strategic choice. In absence of a recycling policy, there is only one container for residual waste.



Citizens, shops, restaurants bring waste to the containers and the service provider collects and transports waste to the 1st destination







Either way, it is never easy!



Between proximity and 'door to door' collection the essential difference for service users is NOT in the size or shape of the containers but in the flexibility by which service users can deposit waste:

Proximity: containers can be accessed and opened at any time

Door to door: small bins must be deposited on street collections areas for emptying only on selected days and times decided by the service providers.

CONSIDER THE 'COMFORT' OF COLLECTION

Waste collection systems require the participation of citizens: they have to be willing to follow the waste collection procedures set up by the City.

Practical experiences, and surveys, show that through 'comfortable' collection systems, citizens are better motivated to participate, which leads to better collection results:

- **DISTANCE** to containers \rightarrow < 200m
- TIMING of collection \rightarrow free vs limited
- **CLARITY** of organization and instruction



The service provider can also collect selected types of waste, here large items



BRING-IN COLLECTION CENTERS







BRING-IN COLLECTION CENTERS

Opening times are set by service provider in agreement with Local Authority.

Waste deposit can be made by individual citizens or enterprises authorized to waste transport, such as: building enterprises for C&D waste; commercial enterprise for old WEEE; city truck for green waste from public parks.

Weighing /estimating the amount deposited, if required. May also be charged to general municipal taxes.







BRING-IN DEDICATED CONTAINERS



Dedicated containers for aluminum cans, plastics bottles, etc can be placed in commercial centers, schools,



EXAMPLE OF THE STRATEGIC CHOICE OF A EUROPEAN CITY



Proximity collection

for households and small businesses (restaurants, shops,...) operating in the urban area. Ecological islands

Bring-in to Collection centers

complement the other collection methods for selected type of waste

Door to door for selected target

generators of specific types of waste: glass; food waste; cardboard

THE MOST COMMON WAY TO BEGIN: THE CITY GETS WASTE CONTAINERS

Advantages	Disadvantages
High collection performance	Investment in containers
Standardized system	Investment in special-purpose vehicles
Enhanced Hygiene (no loose waste on the street, reduction of dust)	Container and special trucks need maintenance
Easily recognizable for citizens	Special training of workers
Improved worker's safety	
Many types and sizes of containers available	
Accepted basis for a collection- fee-system (clearly understandable for citizens)	

FLEXIBILITY: In low and medium-income realities, when financing collection can be a constraint, bins can be provided by citizens, and segregated collection of selected waste fractions can be done directly on the collection vehicles.





ORGANIZING COLLECTION IS NOT EASY

"The Mangalore City Corporation launched door-todoor collection of solid waste 25 days ago, but the odd collection time in some wards has made the efforts go to waste. For instance, workers reach Kodical at around noon to pick waste.

"By that time none of us are at home. How does one hand over the waste to them (at that time)," asked an employee of an oil marketing company. "Why can't they come before 9 a.m."

http://www.thehindu.com/news/cities/Mangalore/odd-timings-mardoortodoor-waste-collection/article4289604.ece

WASTE COLLECTION TRUCKS

Together with containers, collection vehicles are the backbone of a modern waste collection system: they provide the logistical connection between the place where the waste is "produced" (i.e. the household) and the recycling or treatment plant.

Depending on the SIZE OF THE CITY OR REGION and the TYPE OF SETTLEMENT, different kinds of collection vehicles are used.

Large compactors (5-15 tons) loaders are the most commonly used types of collection vehicles in large roads.

BUT large compactors cannot be operated in narrow inner city areas or in unpaved roads.



ISWA. 2004. "Overview of Household Collection Systems in Different Cities and Regions"

EXAMPLES OF VEHICLES FOR PROXIMITY COLLECTION



Waste compacting double-operator rear-loading truck



Waste compacting single-operator side-loading truck

The city's regulations for the waste collection service must address:

- 1. The types and sources of waste covered by the public service (often industrial and commercial waste are excluded by the service provided by local authorities)
- 2. The organization of the collection service
- 3. Transportation vehicles: transporters requirements and permits
- 4. The logistics transfer stations / transfer areas to make transport more efficient and safe
- 5. The management and operation at Collection Centers.

COLLECTION BENCHMARK BASIC INDICATORS

Segregated Collection [%]

The ratio between the amount of waste collected in a segregated way and sent to recovery AND the total amount of collected waste

Segregated Collection per capita [kg / inhabitants / year]

The total amount of waste collected in a segregated way and sent to recovery per inhabitant included in the served territory

Net recovery / Segregated collection [%]

The ratio between the total amount of waste really sent to reprocessing AND the total amount collected by SC: it doesn't include rejects from sorting plants



Example of small size / volume waste containers opening



Example of electronic reader to open street containers

Waste collection trucks: road distance and conditions

Road conditions are key: they determine the speed of a single collection operation, fuel consumption, vehicles breakages and amortization costs. Of course, paved roads improve the collection service greatly.

Distances to consider in planning the collection service are:

- 1) Kilometers along the collection routing to fill one truck
- 2) Distance to 1st destination (e.g.landfill) (once the truck is full) and back to collecting route (or garage)

SWM PLANNING: STEPS TO IMPROVE WASTE COLLECTION

A strategic planning choice is to be made by national legislation: define materials recovery targets e.g. EU: new 65% for municipal waste by 2030

Before building a collection system, data is needed

Data is needed for the City to quantify several factors relevant in designing how to organize collection:

- 1. Waste amount and composition: waste per capita (kg/inhabitant)
- 2. Urban structure: define homogenous areas
- 3. Define types of waste generators: restaurants, offices, shops,...

Waste collection and transportation can reach up to 70% of a MSW system COST and segregated collection raises collection costs.

Costs can be summarized in three main categories:

- Up-front: include initial investments in equipment for collection and transport (bins, vehicles and other types of equipment)
- Operating: expenses of managing MSW on a daily basis (costs of workforce, fuel and managing waste collection on a daily basis, and maintenance costs and depreciation rate for equipment)
- Back-end: expenses in proper care of vehicles and containers at end-of-life

FACTORS AFFECTING COLLECTION AND TRANSPORTATION COSTS

- Total number and type of service users
- Amount of similar waste collected with municipal waste
- Territory characteristics: mountains; high density; no traffic zones
- Seasonal changes, such as tourism
- Collection service standard: frequency of collection; number of containers per dwellers
- Collection organisation: proximity; DtD
- Target given to SC
- Provision of specific services, such as collection on call
- Collection centers
- Home composting bins

VI. Best Practices

BEST PRACTICES TO AVOID OPEN AIR BURNING OF WASTE

SELECT SOLUTIONS WHOSE COST CAN BE SUSTAINABLY FINANCED

Effective SWM is part of a comprehensive policy for public service provision.

The evolution of an ineffective SWM system requires both up-front capital investment as well as a plan for covering the costs of the operations and maintenance of equipment, facilities and plants.

Policy-makers and designers advocating and promoting the evolution of the SWM system and the elimination of open-air burning must know the:

- costs-revenues structure of the existing system, and provide an estimate of the costs-revenues structure of each SWM alternative solution proposed
- total available financial resources for investment into SWM
- capability of the financial management team to ensure effective billing and tariffs collection from service users (i.e., households, commercial, business, and industrial premises)
- debt service of any repayable financing.

VI. Best Practices

THE RELEVANCE OF WASTE COLLECTION IN DETERMINING THE SERVICE FEE FOR EACH USER

Waste generators who use public collection service should be required to pay a SWM service fee

For example, the EU legislation requires total (100%) coverage of SWM service cost from fees paid by collection service users

This economic balance took decades to evolve, for long time the service was covered with other local or national taxes

Thank you for your attention!



