NATIONAL GUIDANCE
FOR PLASTIC POLLUTION
HOTSPOTTING AND
SHAPING ACTION

FINAL REPORT FOR KENYA

December 2020

Implemented with

Supported by the Swedish International Development Cooperation Agency

Sida
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<thead>
<tr>
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To be cited as:
ACKNOWLEDGEMENT

It is with deep gratitude that the IUCN Marine Plastics and Coastal Communities (MARPLASTICCs) project leaders wish to thank the various partners from government, private sector and industry, academia and research, civil society and non-governmental organizations that contributed to this work through their participation in workshops, meetings, field excursions, and related consultations within the country.

This work could not have been accomplished, first and foremost, without the partners and stakeholders who supported the data collection efforts within each country. Finally, the tremendous technical guidance, cooperation, and support from Feng Wang and Ran Xie of the UNEP was pivotal in the development of the hotspotting methodology guidance. Above all, the MARPLASTICCs team acknowledges the generous support of the Swedish International Development Cooperation Agency (Sida).

IUCN wishes to thank the Government of Kenya, through its Ministry of Environment and Forestry (MEF), the National Environment Management Authority (NEMA), and members of the National Steering Committee (NSC) of the project for their strategic guidance and support in ensuring that national activities and engagements were executed in a smooth manner.

Thanks also goes to colleagues in the ESARO regional and country teams for their continuous and invaluable support throughout the implementation of the assessment, in particular Thomas Sberna, Regional Technical Coordinator, Marine and Coastal Resilience, Luther Bois Anukur, Regional Director, Charles Oluchina, Kaori Yasuda, Caroline Nyamamu, Francis Musau, and Celestine Chemorkok. In addition, the MARPLASTICCs team extends its gratitude to colleagues at IUCN Secretariat.
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SUMMARY AT A GLANCE

Global view on plastic in Kenya

92% Mismanaged rate
27% Collection rate
8% Collection for recycling
7% Domestic recycling rate
37 Kt Leakage
0.8 Kg Per capita leakage

Hotspots

Most critical polymers
- PP
- PET
- Polyester
- LDPE
- Synthetic Rubber
- HDPE
- PS
- PVC

Number of hotspots per waste management stage
- Waste generation
- Waste segregation
- Waste collection
- Leakage while waiting for collection
- Waste related behaviors
- Waste management infrastructure

Shaping action from the hotspots

11 Actionable Hotspots
13 Priority Interventions

4 Cities responsible for 40% of the country leakage
INTRODUCTION TO THE GUIDANCE
Provides the objectives of the Guidance, and introduces its associated workflow and main deliverables.

PLASTIC POLLUTION HOTSPOTS
Provides a detailed assessment of plastic leakage across five distinct yet complementary hotspots categories and draws clear statements to help shape action.

SHAPING ACTION
Provides a preliminary set of possible interventions and instruments in line with the plastic pollution hotspots results.

APPENDICES
Provides additional information including results data tables, hotspot score assessments and modelling assumptions.

BIBLIOGRAPHY
PLASTIC POLLUTION HOTSPOTS

2.1 Country Overview
Provides an outlook of the leakage assessment at the country level.

2.2 Detailed Hotspots Results
Provides a visual analysis and key interpretations across five complementary categories in which hotspots are prioritised based on a plastic leakage assessment.

2.3 Actionable Hotspots
Formulates clear statements based on the detailed hotspot analysis to help shape action towards plastic leakage abatement.

A. Polymer Hotspots
B. Application Hotspots
C. Sector Hotspots
D. Regional Hotspots
E. Waste Management Hotspots
**STRUCTURE AND OBJECTIVE OF THIS PRESENTATION**

**SHAPING ACTION**

3.1 Interventions

Suggests meaningful actions based on the actionable hotspots drawn from the detailed plastic hotspot analysis.

3.2 Instruments

Provides a list of possible instruments to implement and monitor progress of suggested interventions.
STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

APPENDICES

4.1 Data repository
Provides data tables with the detailed figures behind the graphs.

4.2 Data Quality Assessment
Provides an in-depth analysis of the quality scores behind the graphs.

BIBLIOGRAPHY
**ICONS AND COLOUR CODE TO GUIDE THE READER**

- Reference to the methodology (module/tool)
- Reference to the appendices
- Key take away as the main conclusion of a graph or result in a written format
- Learnings, that complement the key take aways with more details, of information that is not necessarily visible on the graph
- Limitations of the study, can be inaccurate data or gap in the modelling
- Things we foresee to unlock the limitations. They can serve as guidance for future studies

**Methodology and appendices**

**Sections slides**

**Results and interpretations**
**KEY DEFINITIONS**

**Hotspots:** They refer to the most relevant plastic polymers, applications, industrial sectors, regions or waste management stages causing the leakage of plastics into the environment (including land, air, water and marine environment), as well as associated impacts, through the life cycle of plastic products.

**Interventions:** They are tangible actions that can be taken to mitigate hotspots and are to be prioritised and designed to address the most influential hotspots in the plastic value chain.

**Instruments:** They are the ways an intervention may be practically implemented through specific regulatory, financial or informative measures, in light of context factors such as country dynamics and existing measures. As an illustrative example, a country may identify “mismanged polyethylene bottles” as one of its hotspots. A relevant intervention may be an increase in bottle collection rate. A relevant instrument may be to instate a bottle return deposit scheme.

**Properly disposed:** Waste fraction that is disposed in a waste management system where no leakage is expected to occur, such as an incineration facility or a sanitary landfill. We define a sanitary landfill as a particular area where large quantities of waste are deliberately disposed in a controlled manner (e.g., waste being covered on a daily basis, as well as the bottom of the landfill designed in a way to prevent waste from leaching out). Landfilling is mainly the result of a formal collection sector.

**Improperly disposed:** Waste fraction that is disposed in a waste management system where leakage is expected to occur, such as a dumpsite or an unsanitary landfill. A dumpsite is a particular area where large quantities of waste are deliberately disposed in an uncontrolled manner, and can be the result of both the formal and informal sectors. A landfill is considered as unsanitary when waste management quality standards are not met, thus entailing a potential for leakage.

**Littering:** Incorrect disposal of small, one-off items, such as: throwing a cigarette, dropping a crisp packet, or a drink cup. Most of the time these items end-up on the road or side-ways. They may or may not be collected by municipal street cleaning.

**Uncollected:** Waste fraction (including littering) that is not collected by the formal sector.

**Domestic waste:** Waste generated within the country.

**Mismanaged waste:** It is defined as the sum of uncollected and improperly disposed waste. It is plastic that is prone to be released to the environment. The mismanaged waste index is the ratio of the mismanaged waste and the total waste. It is abbreviated as MWI and its value given in percentage.

**Leakage:** It is defined as the plastic released to the to rivers and oceans. The leakage rate is ratio between leakage and total waste generated, and its value is given in percentage.

**Release rate:** It is defined as the ratio between leakage and total mismanaged waste, and its value is given in percentage.

**Macro-plastic:** Large plastic waste readily visible and with dimensions larger than 5 mm, typically plastic packaging, plastic infrastructure or fishing nets.

**Micro-plastic:** Small plastic particulates below 5 mm in size and above 1 mm. Two types of micro-plastics are contaminating the world’s oceans: primary and secondary micro-plastics. In this study, we focus on primary micro-plastics which are are plastics directly released into the environment in the form of small particulates.

**Mass balance:** Mass balancing is a mathematical process aiming at equalising inputs and outputs of a given material flow across a system boundary. In our case, inputs consist of domestic production and imports while outputs consists of exports, waste generation and increase of stock. A mass balance allows to check data consistency and helps reconcile different datasets when needed.

**Formal sector:** Waste management activities planned, sponsored, financed, carried out or regulated and/or recognized by the local authorities or their agents, usually through contracts, licenses or concessions.

**Informal sector:** Individuals or a group of individuals who are involved in waste management activities, but are not formally registered or formally responsible for providing waste management services. Newly established formalized organizations of such individuals; for example, cooperatives, social enterprises and programs led by non-governmental organizations (NGOs), can also be considered as the informal sector for the purpose of this methodology.

WHAT WE MEAN BY PLASTIC LEAKAGE / IMPACTS

By **plastic leakage** we refer to a quantity of plastic entering rivers and the oceans.

By **plastic impact** we refer to a potential effect the leaked plastic may have on ecosystems and/or human health.

# Parameters ruling the leakage quantification in the model
- General waste management
- Recycling
- Wastewater and run-off water management
- Plastic consumption patterns
- Population density
- Value of the polymer
- Size of application
- Type of use
- Distance to shore and rivers
- Hydrological patterns

# Parameters ruling qualitative impact assessment
- Beach clean-up data
- Size and shape of applications
- Presence of toxic substances in polymers or additives

Leaked plastic stems from uncollected and improperly disposed waste.

Note that the rest of the uncollected and improperly disposed plastic may be leaking into other environmental compartments such as "soil", "air" or "other terrestrial compartment" as defined in the Plastic Leak Project (PLP) guidance.

This information is not required to shape action but could be calculated using the PLP guidance.

LINK to the PLP guidance
## Leakage Pathway at a Glance

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Land sources of plastic waste</strong></td>
<td><strong>Collected</strong> (through the formal waste collection system or informal sector)</td>
<td><strong>Collected for recycling</strong></td>
<td><strong>Domestic recycling</strong></td>
</tr>
<tr>
<td>(including imports and exports, domestic production and change of stock)</td>
<td></td>
<td><strong>Export of waste</strong></td>
<td><strong>Mismanaged</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Properly disposed</strong> * Sanitary landfills * Incineration facilities</td>
<td><strong>Leakage</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Improperly disposed</strong> * Dumpsites * Unsanitary landfills</td>
<td></td>
</tr>
<tr>
<td><strong>Uncollected</strong></td>
<td><strong>Uncollected</strong></td>
<td></td>
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</tbody>
</table>
# KEY ABBREVIATIONS AND UNITS

## Polymer abbreviations

<table>
<thead>
<tr>
<th>NAME</th>
<th>ABBREVIATION</th>
<th>TYPICAL PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene Terephthalate</td>
<td>PET*</td>
<td>bottles, food wrappings</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>PP</td>
<td>hot food containers, sanitary pad liners</td>
</tr>
<tr>
<td>Low-density Polyethylene</td>
<td>LDPE</td>
<td>bags, container lids</td>
</tr>
<tr>
<td>High-density Polyethylene</td>
<td>HDPE</td>
<td>milk containers, shampoo bottles</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>PS</td>
<td>food containers, disposable cups,</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>PVC</td>
<td>construction pipes, toys, detergent bottles</td>
</tr>
</tbody>
</table>

*In this study, PET resins are distinguished from Polyester which includes polyester fibres, polyester films and polyester engineered resins.

## Key units

<table>
<thead>
<tr>
<th>NAME</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Tonne</td>
<td>t</td>
</tr>
<tr>
<td>Kilo tonne (or thousand tonne)</td>
<td>kt</td>
</tr>
<tr>
<td>Mega tonne (or million tonne)</td>
<td>Mt</td>
</tr>
<tr>
<td>Kilometer</td>
<td>km</td>
</tr>
<tr>
<td>Square kilometer</td>
<td>km²</td>
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</tbody>
</table>

## Calculation variables

<table>
<thead>
<tr>
<th>NAME</th>
<th>ABBREVIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mismanaged waste index</td>
<td>MWI</td>
</tr>
<tr>
<td>Leakage rate</td>
<td>LR</td>
</tr>
<tr>
<td>Release rate</td>
<td>RR</td>
</tr>
</tbody>
</table>
1 INTRODUCTION TO THE GUIDANCE

National guidance for plastic pollution hotspotting and shaping action
The guidance allows users to:
1. Generate country-specific plastic waste management datasets
2. Identify plastic leakage and pollution hotspots
3. Prioritise actions

**Schematic of the Guidance**

**Technical Stream**
- **Data Collection**
  - T1 Inventory of plastic flows
  - T2 Characterisation of waste management
- **Modelling**
  - T3 Modelling polymer/application/sector hotspots
  - T4 Identifying waste management hotspots
  - T5 Modelling regional hotspots
  - T6 Assessing impacts

**Strategic Stream**
- **Stakeholder Engagement and Prioritisation**
  - S1 Actionable hotspots formulation
  - S2 Intervention identification
  - S3 Instrument alignment

**Hotspots**
- Where to act?

**Interventions**
- What to do?

**Instruments**
- How to do it?
RELATIONSHIP BETWEEN HOTSPOTS, INTERVENTIONS AND INSTRUMENTS

The guidance is built upon the backbone of three questions: where to act? (Hotspots), what to do? (Interventions) and how to do it? (Instruments)

1. Hotspots
   A component of the system that directly or indirectly contributes to the magnitude of plastic leakage and/or its impacts. It can be a component of the system, a type of product/polymer or a region within the country.

2. Interventions
   An action that can be taken to mitigate the leakage from a given hotspot or reduce its impacts.

3. Instruments
   A practical way to implement the intervention and enable progress.

Examples
- Low recycling rate for flexible packaging
- Single-use plastic bags
- Low waste collection rate in rural areas
- Implement better eco-design + chemical recycling
- Reduce plastic bag use in the country
- Increase waste collection
- Develop funding mechanism through EPR scheme
- Ban on plastic bags / introduce re-usable alternative
- Help local waste pickers to create a revenue stream
## STRUCTURE OF TOOLS ASSOCIATED WITH EACH MODULE

<table>
<thead>
<tr>
<th>MODULES</th>
<th>INPUT TOOLS</th>
<th>ASSESSMENT TOOLS</th>
<th>OUTPUT TOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1</strong></td>
<td>Inventory of plastic flows</td>
<td>COMTRADE data extraction</td>
<td>Raw data repository</td>
</tr>
<tr>
<td><strong>T2</strong></td>
<td>Characterisation of waste management</td>
<td>Fisheries model canvas</td>
<td>Fisheries leakage calculation</td>
</tr>
<tr>
<td><strong>T3</strong></td>
<td>Modelling polymer/application/sector hotspots</td>
<td>Polymer application/sector MFA &amp; leakage calculation</td>
<td>MFA modelling quality assessment</td>
</tr>
<tr>
<td><strong>T4</strong></td>
<td>Identification of waste management hotspots</td>
<td>Waste management hotspot canvas</td>
<td>Project data repository</td>
</tr>
<tr>
<td><strong>T5</strong></td>
<td>Modelling regional hotspots</td>
<td>GIS model</td>
<td>GIS modelling quality assessment</td>
</tr>
<tr>
<td><strong>T6</strong></td>
<td>Assessing impacts</td>
<td>Plastic application impact assessment</td>
<td>Actionable hotspot formulation</td>
</tr>
<tr>
<td><strong>S1</strong></td>
<td>Actionable hotspot formulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S2</strong></td>
<td>Intervention identification</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>S3</strong></td>
<td>Instrument alignment</td>
<td></td>
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</tr>
</tbody>
</table>

Plastic pollution hotspots: Kenya
DISCLAIMER

This report intends to present only the results of the analysis and not the detailed modelling process.

Additional information on the methodology and modelling process can be found directly in the modules and tools associated with the guidance and highlighted by this icon.
2 PLASTIC POLLUTION HOTSPOTS
2.1 COUNTRY OVERVIEW
COUNTRY PLASTIC MATERIAL FLOW [2018]

Summary of the results for all plastics in the country

<table>
<thead>
<tr>
<th>Input component</th>
<th>Output component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Import</td>
<td>Export of primary and products</td>
</tr>
<tr>
<td>Import of products</td>
<td>85</td>
</tr>
<tr>
<td>331 Thousand tonnes/year</td>
<td>177</td>
</tr>
<tr>
<td>Change in stock</td>
<td>Waste export</td>
</tr>
<tr>
<td>Improperly disposed</td>
<td>30</td>
</tr>
<tr>
<td>89</td>
<td>89</td>
</tr>
<tr>
<td>Recycling</td>
<td>Uncollected</td>
</tr>
<tr>
<td>3</td>
<td>399</td>
</tr>
<tr>
<td>Leakage</td>
<td>Improperly disposed</td>
</tr>
<tr>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

Waste: 506
Domestic: 503
Imported: 3

Key take-aways

- More than 98% of the plastic that is consumed in Kenya is imported, either in the form of product or in the form of primary virgin plastic.
- Only 27% of the plastic waste generated in Kenya is collected: 8% collected for recycling and the remaining 19% disposed in unsanitary landfills or dumpsites.
- 73% of all plastics waste is uncollected.
- Due to the absence of sanitary landfills and incineration facilities, there is no proper disposal of waste in Kenya. Therefore, all plastic that is not recycled is prone to leakage.
- In 2018, the per-capita plastic waste generation in Kenya is of 11 kg/year, which is below the global average of 29 kg/cap/year*, but matches the average for east-southern african countries of 12 kg/cap/year*.
- In Kenya, 37 thousand tonnes of plastic leak to the ocean every year. This is only a small fraction of the mismanaged waste, which reaches 465 thousands tons per year.

* Average plastic waste generation per capita values are derived from the What a Waste 2.0 database (Kaza et al., 2018)

Note: For simplicity, in this figure, we removed a part of the “leakage” from the “improperly disposed” and “uncollected”, so that the values displayed for these two metrics correspond to a post-leakage situation.
Plastic pollution hotspots: Kenya

MACRO-LEAKAGE VS MICRO-LEAKAGE [2018]

Micro-leakage contributes for 5% of the overall country leakage. This small contribution of micro-plastics is common for countries where the solid waste is still largely mismanaged.

Key take-aways

While tyre dust due to tyre abrasion from road vehicles is the first cause of primary plastic micro-leakage, micro-leakage of textile fibres from clothes washing and of microbeads from cosmetic products are also close in absolute value. This is due to the absence of wastewater treatment that provides no barrier to the release of primary plastic micro-particles in waterways and oceans.

Micro-leakage* TO WATERWAYS AND OCEANS: 37 kt

35.1 kt Macro-leakage

1.8 kt Micro-leakage*

0.1 kt Pellets

0.3 kt Cosmetics

0.6 kt Textile fibres

0.8 kt Tyre dust

More details available in Appendices

* The methodology used to calculate micro-plastics leakage is based on the Plastic Leak Project (2019)
**OPEN BURNING: A ROUGH ESTIMATE**

**415 kt**
Total plastic mismanaged

**56%**
released into the air as noxious chemical substances through open burning

**POLLUTION TO THE AIR:**
**233 kt**

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**Key take-aways**
- Open burning of mismanaged plastic waste in Kenya poses significant risks for human health (due to the release of noxious chemical substances such as dioxine and particulate matters) and directly contributes to climate change.

Although we do not have specific data on burning, we suggest a rough estimate of how much plastic could be polluting the air by using the assumptions made in the *Breaking the Plastic Wave* report (Lau et al, 2020): 60% of uncollected plastic waste and 13% of plastic waste at dumpsites are burnt on average worldwide. In the case of Kenya, it would translate into having 56% of the total plastic mismanaged ending up polluting the air through open burning.

Investigate open burning practices and conduct field studies to estimate the amount of mismanaged plastic waste that is burned.
Plastic pollution hotspots: Kenya

**RECYCLING: TRADE OF WASTE AND DOMESTIC RECYCLING**

**Key take-aways**
- 7% of the 503 thousand tonnes of plastic waste generated are recycled domestically

**Waste trade and recycling**
- Collection of plastic waste for recycling in Kenya is mainly focused in cities or touristic area (e.g. Watamu project). Recycling factories are located mainly in Nairobi (Elliott, T. et al. 2018).
- Trade of waste currently represents only a small fraction of the waste recycling market. This is acceptable, in order to avoid country recycling capacity to be dedicated to imported waste.

**Learnings**
- Data on waste trade come from UN Comtrade (2020) database, and are based on reporting from Kenyan authorities to the UN. Illegal waste trade is not captured.
- Investigate illegal trade of waste, either at border or at recycling companies.

**Limitations**
- Recycling capacity data is from UN Comtrade (2020) database.
2.2 DETAILED HOTSPOTS
RESULTS
5 CATEGORIES OF HOTSPOTS

- POLYMER Hotspots
- APPLICATION Hotspots
- SECTOR Hotspots
- REGIONAL Hotspots
- WASTE MANAGEMENT Hotspots

WHY is it leaking?
WHAT is leaking?
WHERE is it leaking?

WHAT
WHAT
WHERE
WHERE
WHY

ACTIONABLE HOTSPOTS FORMULATION
OBJECTIVE AND INSTRUCTIONS

Key question answered:
Which polymers are most critical in the country regarding plastic leakage?

How to read the polymer hotspot graph?
1. Determine leakage from mismanaged waste
2. Focus on leakage and leakage rate
3. Select hotspots based on absolute and relative leakage
4. Assess the quality score of the results

What are the bar components of the polymer mass balance graph?

For more details, please read the Methodology.

Criteria
- Raw data
- Reliability
- Modelling
- Geographic correlation
- Temporal correlation
- Granularity

Score

Pedigree matrix

2.0
MASS BALANCE BY POLYMER [2018]

Plastic pollution hotspots: Kenya

Quality Score

1.9

INPUT
- Waste Import
- Import of products
- Import and production of primary

OUTPUT
- Change in stock
- Waste Export
- Export of primary and products
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

Input and production of primary polymer:
- PP
- Polyester
- PET
- LDPE
- HDPE
- Synthetic Rubber
- PVC
- PS
- Other
MISMANAGED WASTE AND LEAKAGE BY POLYMER [2018]

Uncollected Domestic waste Improperly disposed Leakage Rate
X% | Mismanaged Waste Index (MWI)
X% | Leakage Rate (LR)

Quality Score

Plastic pollution hotspots: Kenya
POLYMER HOTSPOTS [2018]

**Highest leakage contributors in absolute AND relative value**
- PP is the top contributor in absolute leakage (9.4 kt), with a leakage rate of 9%.
- Polyester, extensively used in textile, is the second polymer by absolute leakage (6 kt).
- PET is the third contributor to leakage (5.1 kt), with a leakage rate of 12%.
- LDPE is a hotspot due to its high relative leakage (10%).

**Key take-aways:**
- PP is the top contributor in absolute leakage (9.4 kt), with a leakage rate of 9%.
- Polyester, extensively used in textile, is the second polymer by absolute leakage (6 kt).
- PET is the third contributor to leakage (5.1 kt), with a leakage rate of 12%.
- LDPE is a hotspot due to its high relative leakage (10%).

**Quality Score**
- 1.9
**Plastic pollution hotspots: Kenya**

**Polymer Hotspots: Interpretation and Limitations**

**PP**

PP is the top leaking polymer by absolute leakage, with 9.4 thousand tons/year leaking into the marine environment. There are two main factors contributing to this: PP waste generation is the second highest in Kenya (the first being Polyester), and half of this PP waste comes from the Packaging sector (which has a high release). Only 6% of the PP that went to waste in 2018 was collected for recycling.

**PET**

PET is the top leaking polymer by relative leakage because it is almost exclusively used in packaging sector where products have a higher chance of leakaging. Hence, although packaging corresponds to 40% of the total waste produced in the country, it causes 55% of the country leakage. Since PET represents 25% of the mismanaged waste of packaging, it also represent 25% of packaging leakage, which results in a high leakage rate. 13% of PET is collected for recycling.

**Polyester**

Polyester (i.e. polyester fibres, films and engineering resins) is the first polymer by waste generation with 112 thousand tons a year and no recycling put in place (MWI = 100%). Nevertheless, because it is mostly used in products from the textile and automotive sectors that are less likely to leak when mismanaged, it comes (only) second in absolute leakage with 6 thousand tons/year.

**LDPE**

Similarly to PET, also LDPE is extensively used in Packaging, although around 30% of LDPE is used in other sectors. Moreover 17% of LDPE is collected for recycling (9kt). The overall absolute leakage from LDPE is 5 kt, while the relative leakage is 10%.

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Plastic pollution hotspots: Kenya 33
All polymers

- Illegal import of waste might be an issue in Kenya. We could not assess the magnitude of the phenomenon.

- Although the total amount of waste legally imported is known thanks to Comtrade database (United Nations, 2020), the database lacks details on which type of polymer is imported. So we assumed that the polymer composition of imported waste matches the Kenyan recycling market.

- The stock assessment by polymer, as well as the proper and improper management of waste, are derived from the sector analysis through a sector to polymer mapping. This mapping is based on the EU market (from Plastics Europe, 2018).

- Investigate illegal trade of waste.

- Improve tracking of waste trade by polymer type. This effort has to be performed at a global level.

- Having a sector to polymer mapping based on the Kenyan market would improve the quality of the analysis.
OBJECTIVE AND INSTRUCTIONS

Key question answered:
Which applications are most critical in the country regarding plastic leakage?

How to read the application hotspot graph?
1. Determine leakage from mismanaged waste

2. Focus on leakage and leakage rate

3. Select hotspots based on absolute and relative leakage

4. Assess the quality score of the results

What are the bar components of the application mass balance graph?

For more details, please read the Methodology.
The application analysis covers most of known short-lived products, which corresponds to **43% of total plastic waste** in 2018.
### MISMANAGED WASTE AND LEAKAGE BY APPLICATION [2018]

#### Quality Score

- **Domestic waste**
- **Improperly disposed**
- **Uncollected**
- **Leaked**

<table>
<thead>
<tr>
<th>Application</th>
<th>Mismanaged Waste Index (MWI)</th>
<th>Leakage Rate (LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other bottles</td>
<td>91%</td>
<td>7%</td>
</tr>
<tr>
<td>Lids and caps</td>
<td>92%</td>
<td>13%</td>
</tr>
<tr>
<td>Dairy packaging</td>
<td>91%</td>
<td>13%</td>
</tr>
<tr>
<td>Bags</td>
<td>91%</td>
<td>20%</td>
</tr>
<tr>
<td>Baby diapers</td>
<td>100%</td>
<td>14%</td>
</tr>
<tr>
<td>Drinks bottles</td>
<td>91%</td>
<td>8%</td>
</tr>
<tr>
<td>Boxes, cases, crates</td>
<td>91%</td>
<td>7%</td>
</tr>
<tr>
<td>Cigarette filters</td>
<td>100%</td>
<td>22%</td>
</tr>
<tr>
<td>Sanitary towels</td>
<td>100%</td>
<td>14%</td>
</tr>
<tr>
<td>Fishing nets</td>
<td>100%</td>
<td>8%</td>
</tr>
<tr>
<td>Other packaging</td>
<td>92%</td>
<td>11%</td>
</tr>
</tbody>
</table>

**Quality Score**: 3.3
Plastic pollution hotspots: Kenya

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Harmful to marine life and ecosystems

Key take-aways

- Other bottles (non-drinking bottles) are the highest contributors in absolute leakage (5.4 kt).
- Lids and caps and dairy packaging are the 2nd and 3rd highest contributor in absolute leakage (3.1 kt and 2.4 kt respectively).
- Bags were banned in Kenya in 2017, but in 2018 there was still trade of plastic bags being recorded. Plastic bags are an hotspot because of their high leakage rate (20%).
- Cigarette filters, baby diapers and sanitary towels rank low in absolute leakage, but have high relative leakage.

Quality Score

3.3
APPLICATION HOTSPOTS:
INTERPRETATION AND LIMITATIONS

All applications

For the applications targeted in this study, Kenya mostly imports virgin plastic or intermediate plastics such as plates, sheets and films of plastic, that are then turned into products by local manufacturers. Usually, the lack of insights on local manufacturing and retailing of products makes it very challenging to know precisely the consumption quantities. In the case of Kenya, for packaging, we assumed that the production of an application is proportional to the relative importance that the application has in trade, and that the total production matches the Packaging sector production. Since trade of packaging is 4 to 5 times smaller than production of packaging, this means that we are guessing around 80% of the input bar.

Engage collaborative research projects to close the gap on these specific data.

Bags

Although plastic bags were banned in Kenya in 2017, and submitted to heavy fines, in 2018 there was still some import and export of plastic bags, as declared by Kenyan customs to the UN trading body (Comtrade code 392321, 392322). Nonetheless, the trade of plastic bags fell from 16kt in 2016, before the ban, to 3kt in 2018, after the ban (United Nations, 2020), a drop of 80%.

The import and export was then mirrored in the country production, which in the case of plastic bags especially, could be distant from reality.

Gather a better understanding of specific type of plastic bags that might be exempt from the ban, in order to assess their production quantity in Kenya.
OBJECTIVE AND INSTRUCTIONS

Key question answered:

Which sectors are most critical in the country regarding plastic leakage?

How to read the sector hotspot graph?

1. Determine leakage from mismanaged waste

2. Focus on leakage and leakage rate

3. Select hotspots based on absolute and relative leakage

4. Assess the quality score of the results

For more details, please read the Methodology

What are the bar components of the sector mass balance graph?

Long-lived products: products that are disposed after the year of study (Life-time > 1 year)

Short-lived products: products that are disposed within the year of study (Life-time < 1 year)

* Short-lived products: products that are disposed within the year of study (Life-time < 1 year)

** Long-lived products: products that are disposed after the year of study (Life-time > 1 year)
Plastic pollution hotspots: Kenya

MISMANAGED WASTE AND LEAKAGE BY SECTOR [2018]

Quality Score

<table>
<thead>
<tr>
<th>Sector</th>
<th>Thousand tonnes</th>
<th>Mismanaged Waste Index (MWI)</th>
<th>Leakage Rate (LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>100%</td>
<td>89%</td>
<td>1</td>
</tr>
<tr>
<td>Textile</td>
<td>100%</td>
<td>100%</td>
<td>2</td>
</tr>
<tr>
<td>Automotive-parts</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>100%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Automotive-other</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Agriculture</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Electrical &amp;</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Medical</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
<tr>
<td>Tourism</td>
<td>100%</td>
<td>100%</td>
<td>3</td>
</tr>
<tr>
<td>Fishing</td>
<td>100%</td>
<td>100%</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>91%</td>
<td>91%</td>
<td>3</td>
</tr>
</tbody>
</table>

X% | Mismanaged Waste Index (MWI)
X% | Leakage Rate (LR)
The **packaging sector** contributes to more than 50% of the total plastic leakage with 20.3 kt of packaging waste leaking into oceans and waterways.

The **textile sector** is the 2nd highest contributor to plastic leakage in absolute value (4.4 kt).

Medical, fishing, agriculture and tourism sectors have a low contribution in absolute leakage but have high leakage rates (respectively 19%, 12%, 10% and 10%).
Packaging

Packaging is the sector with the highest absolute leakage, higher all other sectors combined. This is due to various reasons. Firstly, packaging is the sector with the highest plastic consumption and, unlike other sectors, all of the products in the packaging sector are short lived and become waste within the year (no stock). Secondly, although most of the plastic collected for recycling in Kenya comes from the packaging sector, this represents only 9% of the entire plastic packaging production. Thirdly, plastic in packaging has one of the highest release rates.

Medical

Medical waste appears to have high relative leakage and low absolute leakage. The high relative leakage is most likely not accurate, as we do not assume that there is a special treatment of medical waste, as should be the case in most countries, with the majority of the medical waste being incinerated. On the other hand we witnessed during a field visit some leakage of medical waste in canals.

Unlocking limitations

Gain a better understanding regarding the fate of medical waste in Kenya.

Textile

Textile is the second sector by absolute leakage, the plastic embedded in textile is not recycled, but the overall relative leakage is smaller because of lower release rate with respect to packaging.
SECTOR HOTSPOTS: INTERPRETATION AND LIMITATIONS

Fishing

Fishing has a high relative leakage, but a very low absolute leakage. In Kenya, commercial fishing is not very developed, and the fishermen are mostly going out fishing a few kilometers from the coast. Fishermen represent only 0.02% of the population and 20% of them are foot fishers. There is a push to develop a commercial fleet in Kenya (KMFRI), which could be a good opportunity to promote good practices among fishermen about waste disposal at sea as well and proper disposal of fishing gear.

Automotive-tyres

Automotive-tyres appear as the third sector by absolute leakage, but we could not include in our analysis a quantification of the automotive-tyres that are burnt in kiln, get rethreaded or get reused to produce shoes as it is common practice in Kenya.

Gather information on amount of tyres being burnt in kiln (properly disposed). Investigate the rethread and reuse practices, which would lengthen the lifetime of tyres.
REGIONAL HOTSPOTS
Key question answered:
Which areas are most critical in the country regarding plastic leakage?

1) Overlaying different information available at city / district / sub-district level and/or modelled through archetypes...
2) ... and using geographic, hydrographic and demographic information...
3) ... allows to compute a leakage map and identify regional hotspots...
WASTE GENERATION:
MAP AND INTERPRETATIONS

Key take-aways

- Waste generation patterns vary sharply between urban (30 kg/cap/year) and rural areas (4 kg/cap/year).

Limitations

Due to lack of more granular data, we assumed all Kenyan cities to have the same per capita consumptions patterns. Similarly, all rural areas are considered alike, with no distinction made between touristic and non-touristic areas.

Unlocking limitations

Conduct waste generation characterisation studies at households level in different cities to infer town-specific per capita waste generation quantities.

Identify main touristic hubs, especially in rural areas, and gain better understanding of plastic consumption by the tourism sector.

More details available in Appendices
WASTE COLLECTION: MAP AND INTERPRETATIONS

Key take-aways

- There are no collection services in rural areas
- Waste collection in urban areas varies from 20% to 72%. Average collection rate in the country is 27%.

More details available in Appendices
Plastic pollution hotspots: Kenya

MISMANAGED WASTE INDEX:
MAP AND INTERPRETATIONS

Key take-aways

• Due to the lack of sanitary landfills and incineration facilities, all of the plastic that is not recycled is mismanaged.

• Average MWI: 92%

The only plastic waste that is not mismanaged in Kenya is the waste collected for recycling.

Learnings

We assumed collection of plastic for recycling to be limited to urban areas. Lacking more granular data, we assume collection of recyclable plastic to be proportional to plastic waste generation in urban areas.

Limitations

Contact recycling companies and gather information on origin of recyclable waste.

Unlocking limitations

More details available in Appendices
Key take-aways

- Annual leakage of mismanaged waste: 35'139 tonnes
- Annual leakage from mismanaged/lost at sea fishing gears and from overboard litter: 14 tonnes
- 67% of the leakage comes from urban areas because of high per capita waste generations compared to rural areas.
E WASTE MANAGEMENT HOTSPOTS
Key question answered:
Which waste management stages are most critical in the country regarding plastic leakage?

1) Decide for each element* of the waste management system if its contribution to leakage mitigation is positive (coolspot), neutral or negative (hotspot)

<table>
<thead>
<tr>
<th>Waste management stage</th>
<th>Potential hotspot</th>
<th>Is it a hotspot?</th>
<th>Justification</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic waste import</td>
<td>HOTSPOT</td>
<td></td>
<td>Only 7% of the waste recycled in the country is locally sourced, the remaining 93% is imported. The formal sector only recycles imported waste (around 11% of a year) and it does not recycle domestic waste (e.g., VVA, VCE). Domestic waste is recycled by the informal sector in improper conditions.</td>
<td>VFA interviews and VCE report VN_1/4</td>
</tr>
<tr>
<td>Plastic waste export</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic waste per capita generation</td>
<td></td>
<td></td>
<td>Vcee produces around 50 kg of plastic waste per person per year.</td>
<td>IA - Country baseline analysis</td>
</tr>
<tr>
<td>Share of plastic in waste stream</td>
<td>HOTSPOT</td>
<td></td>
<td>Vcee is a WWTP. 99% of plastic in waste stream is from 15% ± 20% depending on the source, VN_C09 6A Circular summarises the waste characterization studies</td>
<td></td>
</tr>
</tbody>
</table>

2) Understand at a glance the status of the waste management system in the country

*For detailed element descriptions and methodology, refer to tool T4.1
Plastic pollution hotspots: Kenya

**Key takeaways**

- Plastic waste generation in Kenya is low compared to the world average (coolspot).
- Segregation of waste is performed solely by waste pickers. There is no segregation of waste at source.
- Value of recyclable plastic is low, curbing the country recycling rate. EPR schemes to subsidise plastic recycling are being discussed but are not implemented.
- Collection rates are low, especially in rural areas and informal settlements.
- Littering and burning of waste are common habits even in city centers.
- Due to the absence of sanitary landfills and incinerators, there is no proper disposal of waste in Kenya.

*For more details and justifications, check tool T4.1*
PLASTIC WASTE JOURNEY IN PICTURES

Formal waste management

Houses → Waste Collector → Transfer Station → Truck

Waste Picker

Buy-back center (sorting and aggregation of recyclable waste)

Informal collection and recycling

Incineration and sanitary landfill

Unsanitary landfill and dumpsite

Formal recycling

Informal recycling
Plastic pollution hotspots: Kenya

Storage of recyclable waste

Informal settlement
Plastic pollution hotspots: Kenya

Leakage to waterways

Burning of waste
2.3 ACTIONABLE HOTSPOTS
HOTSPOTS IN BRIEF

Plastic pollution hotspots: Kenya

3 highest leakage contributors in absolute OR relative value
Highest leakage contributors in absolute AND relative value

Polymer
- PP
- PET
- Polyester
- LDPE
- Synthetic Rubber
- HDPE
- PS
- PVC
- Other

Application
- Other bottles
- Lids and caps
- Diary packaging
- Bags
- Baby diapers
- Cigarette filters
- Sanitary towels
- Other bottles
- Lids and caps
- Baby diapers
- Other bottles

Sector
- Packaging
- Agriculture
- Tourism
- Fishing
- Medical
- Automotive-tyres
- Electrical & electronics
- Automotive-other
- Construction

Regional

Waste management

- Plastic waste import
- Plastic waste export
- Plastic waste per capita generation
- Share of plastic in waste stream

- Segregation of recoverable waste
- Segregation of non-recoverable waste
- Segregation by the internal sector
- Public infrastructure models

- Formal collection of municipal waste
- Formal collection of industrial waste
- Value of recycled plastic
- Value of non-recycled plastic

- Design of waste bins
- Frequency of collection
- Climatic conditions
- Other (e.g. animals)

- Littering driven by cultural habits
- Littering due to a lack of public waste bins
- Frequency of illegal burning
- Frequency of illegal burning

- Share of waste in dispensaries
- Share of waste in hospitals
- Internal recycling
- Recycling capacity

- Frequency of city clean-up
- Frequency of river clean-up
- Frequency of coastal clean-up
- Frequency of other clean-up activities

- Management of non-off waste
- Waste water collection
- Waste water treatment efficiency
- Fate of WTPs flushed
<table>
<thead>
<tr>
<th>[#]</th>
<th><strong>[ ACTIONABLE HOTSPOT ]</strong></th>
<th>[ •/〇]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waste leaks in Kenya because there is no proper disposal of waste, no sanitary landfill or incineration facility, all collected waste that is not recycled accumulates in dumpsites or unsanitary landfills.</td>
<td>〇</td>
</tr>
<tr>
<td>2</td>
<td>Plastic is leaking from Kenyan cities due to a much higher plastic consumption than in rural areas.</td>
<td>〇</td>
</tr>
<tr>
<td>3</td>
<td>Light plastic products of PP and PET are leaking in Kenya due to high consumption in packaging sector and higher chances of leaking to waterways.</td>
<td>〇</td>
</tr>
<tr>
<td>4</td>
<td>Plastic from the packaging sector leaks in Kenya due to higher consumption.</td>
<td>〇</td>
</tr>
<tr>
<td>5</td>
<td>Lack of waste segregation reduces the quality and quantity of recyclable waste.</td>
<td>〇</td>
</tr>
<tr>
<td>6</td>
<td>Burning of waste reduces the amount of waste being collected for recycling.</td>
<td>〇</td>
</tr>
<tr>
<td>7</td>
<td>Widespread littering reduces the amount of waste collected for recycling.</td>
<td>〇</td>
</tr>
<tr>
<td>8</td>
<td>In slums and informal settlements collection rates are extremely low and waste collection infrastructure is absent.</td>
<td>〇</td>
</tr>
<tr>
<td>9</td>
<td>Low collection rates across the country reduce the amount of waste available to recyclers and increase leakage.</td>
<td>〇</td>
</tr>
<tr>
<td>10</td>
<td>Business model for private collection companies does not incentivise disposal at landfills.</td>
<td>〇</td>
</tr>
<tr>
<td>11</td>
<td>There is a lack of maintenance capacity for waste management equipment (e.g. waste trucks), which can lead to a disruption of waste collection.</td>
<td>〇</td>
</tr>
</tbody>
</table>

**GENERIC** (Concerns all plastic types and all regions)  
**SPECIFIC** (Concerns specific plastic types and all regions)
Each actionable hotspot can address plastic pollution at one or multiple stages along the plastic value chain. We notice that the list of actionable hotspots for Kenya calls for a well-balanced set of actions across the value chain, yet with an emphasis on the end-of-life.
3 SHAPING ACTION
3.1 INTERVENTIONS
**METHODOLOGY FOR IDENTIFYING INTERVENTIONS**

**STEP 1:** choose up to 3 interventions for each actionable hotspot

<table>
<thead>
<tr>
<th>Actionable hotspots (AH)</th>
<th>AH 1</th>
<th>AH 2</th>
<th>AH 3</th>
<th>...</th>
<th>AH x</th>
</tr>
</thead>
</table>

**STEP 2:** assess criteria levels for each chosen intervention

<table>
<thead>
<tr>
<th>Interventions (I)</th>
<th>Leakage mitigation potential*</th>
<th>Unintended consequences**</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>I2</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>I3</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>I4</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>I5</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I79</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>I80</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>I81</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>I82</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>I83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* **Leakage mitigation potential:** high mitigation potential actions are those that contribute to meaningful reductions of plastic leakage and impacts.

**Unintended consequences:** highly consequential actions are those most likely to generate unintended environmental or socio-economic trade-offs (e.g., substitution from plastic to another material may generate additional environmental impacts such as GHG emissions).

**STEP 3:** visualise priority interventions in the top right corner of the chart

- HIGH Plastic leakage mitigation
- MEDIUM Plastic leakage mitigation
- LOW Plastic leakage mitigation

Intervention 79
Intervention 82
Intervention 3
Intervention 2
Intervention X
Intervention 80
Intervention 81

**Unintended Consequences**

- HIGH with acute environmental and socio-economic trade-off
- MEDIUM with potential environmental and socio-economic trade-off
- LOW with no environmental and socio-economic trade-off
PRELIMINARY SELECTION OF INTERVENTIONS

Points are randomly distributed within the designated box to avoid overlapping. Each box on this 9 facets grid corresponds to a couple low/low or low/medium or low/high, etc. Only the facet in which the point falls into should be accounted for, not its relative position to points nearby.

The list of interventions results from the hotspot analysis; it is currently based on the author perception. A final version of the interventions should be elaborated through a multi-stakeholder consultation process.

Set up a workshop for a multi-stakeholder process and repeat the interventions selection procedure.

I04: Increase recycling capacity for domestic plastic waste (PP)
I07: Increase recycling capacity for domestic plastic waste (PET)
I14: Reduce littering in urban areas
I29: Avoid producing / importing plastic objects that do not benefit from a recycling solution in the country
I43: Reduce open burning of plastic waste
I46: Plan more frequent waste collection in areas prone to plastic leakage (taxi stations, informal settlements, ...)
I47: Increase door-to-door waste collection
I48: Increase plastic segregation at household level
I59: Ensure plastic waste has enough value to cover collection costs (for all polymers)
NI1: Ensure proper disposal of waste at landfill by private collectors
I71: Increase capacity for proper waste disposal (sanitary landfills if other upstream solutions cannot be applied)
I74: Ensure proper maintenance of waste management equipment (vehicles, assets)
I75: Reduce losses from non-sanitary landfills and dumpsites (from wind and flooding)
Interventions may occur at any point along the value chain. We categorise them into six types of approaches along the value chain.
## Preliminary Priority Interventions List

<table>
<thead>
<tr>
<th>Intervention Class</th>
<th>Priority Intervention</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Production</td>
<td>Avoid producing or importing plastic objects that do not benefit from a recycling solution in the country</td>
<td>I29</td>
</tr>
<tr>
<td>Waste Collection Systems</td>
<td>Plan more frequent waste collection in areas prone to plastic leakage</td>
<td>I46</td>
</tr>
<tr>
<td></td>
<td>Increase door-to-door waste collection</td>
<td>I47</td>
</tr>
<tr>
<td></td>
<td>Ensure proper disposal of waste at landfill by private collectors</td>
<td>NI1</td>
</tr>
<tr>
<td>Waste Infrastructure</td>
<td>Increase capacity for proper waste disposal (sanitary landfills if other upstream solutions cannot be applied)</td>
<td>I71</td>
</tr>
<tr>
<td></td>
<td>Ensure proper maintenance of waste management equipment (vehicles, assets)</td>
<td>I74</td>
</tr>
</tbody>
</table>
3.2 INSTRUMENTS
METHODOLOGY FOR IDENTIFYING INSTRUMENTS

**STEP 1:** choose up to 3 instruments for each intervention selected in S2

**STEP 2:** assess criteria levels for each chosen instrument

<table>
<thead>
<tr>
<th>Instruments (J)</th>
<th>Feasability*</th>
<th>Synergies**</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>J2</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>J3</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>J4</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>J5</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J79</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>J80</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>J81</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>J82</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>J83</td>
<td>high</td>
<td>medium</td>
</tr>
</tbody>
</table>

**Feasability:** technical and socio-economic assessment of each instrument should be performed. We do not assert a method to perform the assessment as this is beyond the scope of the Guidance. The user can decide on the method to use based on resources available. A by default qualitative assessment with three levels is suggested.

**Synergies:** Some instruments may be beneficial to multiple interventions, thus creating a positive synergetic effect. This criterion does not only evaluate the number of suggested interventions benefitting from an instrument, but also assess if the proposed instrument harmonises well with instruments already in place.

**STEP 3:** visualise priority instruments in the top right corner of the chart
LIST OF POSSIBLE INSTRUMENT CATEGORIES

Knowledge creation
- Database
- Mapping
- Expertise

Awareness raising
- Businesses
- Citizens
- Waste sector

Capacity building
- Partnership
- Structuration
- R&D
- Social
- Technology fisheries
- Technology microplastics
- Technology waste

Innovation
- Incentive
- Informal sector
- Investment
- New business models
- Tax
- Ban
- Extended producer responsibility (EPR)
- Enforcement
- Industry regulation
- Municipality regulation
- Trade regulation
- Waste sector regulation
- Standardisation
- Monitoring

Economic

Policy / Regulatory

INSTRUMENTS
4 APPENDICES
### Detailed Shares by Polymer

<table>
<thead>
<tr>
<th>Polymer Type</th>
<th>Waste produced in country</th>
<th>Domestic recycling of collected</th>
<th>Export of collected</th>
<th>Properly disposed</th>
<th>Improperly disposed</th>
<th>Uncollected</th>
<th>Tot</th>
<th>Collected</th>
<th>Mismanaged</th>
<th>Leaked</th>
<th>Waste produced and imported</th>
<th>Domestic recycling incl imported</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>44</td>
<td>10%</td>
<td>3%</td>
<td>0%</td>
<td>21%</td>
<td>66%</td>
<td>100%</td>
<td>34%</td>
<td>87%</td>
<td>12%</td>
<td>44</td>
<td>11%</td>
</tr>
<tr>
<td>PP</td>
<td>109</td>
<td>5%</td>
<td>1%</td>
<td>0%</td>
<td>19%</td>
<td>74%</td>
<td>100%</td>
<td>26%</td>
<td>94%</td>
<td>9%</td>
<td>110</td>
<td>6%</td>
</tr>
<tr>
<td>Polyester</td>
<td>113</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>23%</td>
<td>77%</td>
<td>100%</td>
<td>23%</td>
<td>100%</td>
<td>5%</td>
<td>113</td>
<td>0%</td>
</tr>
<tr>
<td>LDPE</td>
<td>53</td>
<td>15%</td>
<td>2%</td>
<td>0%</td>
<td>18%</td>
<td>64%</td>
<td>100%</td>
<td>36%</td>
<td>83%</td>
<td>10%</td>
<td>53</td>
<td>16%</td>
</tr>
<tr>
<td>HDPE</td>
<td>52</td>
<td>19%</td>
<td>2%</td>
<td>0%</td>
<td>16%</td>
<td>63%</td>
<td>100%</td>
<td>37%</td>
<td>79%</td>
<td>8%</td>
<td>53</td>
<td>20%</td>
</tr>
<tr>
<td>PS</td>
<td>5</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>18%</td>
<td>82%</td>
<td>100%</td>
<td>18%</td>
<td>100%</td>
<td>8%</td>
<td>5</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>69</td>
<td>4%</td>
<td>1%</td>
<td>0%</td>
<td>18%</td>
<td>77%</td>
<td>100%</td>
<td>23%</td>
<td>95%</td>
<td>5%</td>
<td>69</td>
<td>4%</td>
</tr>
<tr>
<td>Synthetic Rubber</td>
<td>24</td>
<td>8%</td>
<td>0%</td>
<td>0%</td>
<td>21%</td>
<td>71%</td>
<td>100%</td>
<td>29%</td>
<td>92%</td>
<td>7%</td>
<td>24</td>
<td>8%</td>
</tr>
<tr>
<td>PVC</td>
<td>35</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>13%</td>
<td>86%</td>
<td>100%</td>
<td>14%</td>
<td>99%</td>
<td>4%</td>
<td>35</td>
<td>1%</td>
</tr>
<tr>
<td>All</td>
<td>503</td>
<td>7%</td>
<td>1%</td>
<td>0%</td>
<td>19%</td>
<td>73%</td>
<td>100%</td>
<td>27%</td>
<td>92%</td>
<td>7%</td>
<td>506</td>
<td>7%</td>
</tr>
</tbody>
</table>

- **Waste** = Collected + Uncollected
- **Collected** = Domestic recycling of collected + Export of collected + properly disposed + Improperly disposed
- **Mismanaged** = Improperly disposed + Uncollected
### Waste Management by Geographical Archetype

<table>
<thead>
<tr>
<th>Archetypes</th>
<th>Population 2020</th>
<th>Generated t</th>
<th>Collected t</th>
<th>Collected for recycling t</th>
<th>Properly disposed t</th>
<th>Improperly disposed t</th>
<th>Uncollected t</th>
<th>Mismanaged t</th>
<th>Leaked t</th>
<th>Generated kg/hab</th>
<th>Collected for recycling kg/hab</th>
<th>Mismanaged kg/hab</th>
<th>Share of collected</th>
<th>Share of mismanaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mombasa</td>
<td>665449</td>
<td>19915</td>
<td>14275</td>
<td>3799</td>
<td>0</td>
<td>10475</td>
<td>5641</td>
<td>16116</td>
<td>1010</td>
<td>29.9</td>
<td>5.7</td>
<td>24.2</td>
<td>72%</td>
<td>81%</td>
</tr>
<tr>
<td>Kisumu</td>
<td>400942</td>
<td>11999</td>
<td>4231</td>
<td>2289</td>
<td>0</td>
<td>1942</td>
<td>7768</td>
<td>9710</td>
<td>498</td>
<td>29.9</td>
<td>5.7</td>
<td>24.2</td>
<td>35%</td>
<td>81%</td>
</tr>
<tr>
<td>Nakuru</td>
<td>846194</td>
<td>25324</td>
<td>14053</td>
<td>4831</td>
<td>0</td>
<td>9222</td>
<td>11271</td>
<td>20493</td>
<td>1204</td>
<td>29.9</td>
<td>5.7</td>
<td>24.2</td>
<td>55%</td>
<td>81%</td>
</tr>
<tr>
<td>Nairobi</td>
<td>4782357</td>
<td>143124</td>
<td>85736</td>
<td>27305</td>
<td>0</td>
<td>58430</td>
<td>57388</td>
<td>115818</td>
<td>11582</td>
<td>29.9</td>
<td>5.7</td>
<td>24.2</td>
<td>60%</td>
<td>81%</td>
</tr>
<tr>
<td>Urban other</td>
<td>3903692</td>
<td>116828</td>
<td>23366</td>
<td>0</td>
<td>0</td>
<td>23366</td>
<td>93462</td>
<td>116828</td>
<td>9210</td>
<td>29.9</td>
<td>0.0</td>
<td>29.9</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>Rural</td>
<td>43535850</td>
<td>185577</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>185577</td>
<td>185577</td>
<td>11634</td>
<td>4.3</td>
<td>0.0</td>
<td>4.3</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Per capita values are calculated by dividing total values by the 2020 population forecasted by NASA in 2015.
4.2 DATA QUALITY ASSESSMENT
### POLYMER HOTSPOTS

#### DATA QUALITY ASSESSMENT (1/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Data as reported by Kenya to UNEP**</td>
<td>2018</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>* Data as reported by Kenya to UNEP</td>
<td>2018</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>This study - Polymer</td>
<td>Import of waste by polymer</td>
<td>2018</td>
<td>1</td>
</tr>
<tr>
<td>This study - Sector</td>
<td>Change in stock by sector</td>
<td>2018</td>
<td>1</td>
</tr>
<tr>
<td>PlasticsEurope, 2018</td>
<td>Polymers to Sectors correspondence matrix</td>
<td>2018</td>
<td>1</td>
</tr>
<tr>
<td>PlasticsEurope, 2018</td>
<td>Production quantity per polymer (non-rubber)</td>
<td>2018</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Quality Score

1.9

---

* Net import = net export - recycling of imported + import of products - export of primary and products = import and production of primary

*** "Recycling of imported waste" together with "recycling of domestic waste" constitute the country’s "recycling" bar
### Data Quality Assessment (2/2)

#### Raw Data

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Elliott T. et al., 2018</td>
<td>Collected for recycling by polymer</td>
</tr>
<tr>
<td>UN, 2020, COMTRADE database*</td>
<td>Total waste export (2018 data)</td>
</tr>
<tr>
<td>NEMA interview, 2020</td>
<td>No sanitary landfill or incineration facility</td>
</tr>
<tr>
<td>PlasticsEurope, 2018</td>
<td>Sector to polymer mapping based on EU market</td>
</tr>
<tr>
<td>This study - Sector</td>
<td>Improperly disposed by sector</td>
</tr>
<tr>
<td>This study - Polymer</td>
<td>Remaining after recycling and properly managed</td>
</tr>
<tr>
<td>This study - Polymer</td>
<td>Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed</td>
</tr>
<tr>
<td>This Study - Sector</td>
<td>Leaks by sector</td>
</tr>
<tr>
<td>This Study - Polymer</td>
<td>Mismanaged waste by polymer</td>
</tr>
</tbody>
</table>

#### Modelling

<table>
<thead>
<tr>
<th>Year</th>
<th>Temporal</th>
<th>Geographic</th>
<th>Granularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2018</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2018</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Final Metric

<table>
<thead>
<tr>
<th>Metric</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Export of waste</td>
<td>2.0</td>
</tr>
<tr>
<td>Domestic recycling of collected waste**</td>
<td>2.0</td>
</tr>
<tr>
<td>Properly disposed</td>
<td>1.0</td>
</tr>
<tr>
<td>Improperly disposed</td>
<td>2.0</td>
</tr>
<tr>
<td>Uncollected</td>
<td>1.8</td>
</tr>
<tr>
<td>Leaked</td>
<td>2.2</td>
</tr>
</tbody>
</table>

#### Quality Score

<table>
<thead>
<tr>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9</td>
</tr>
</tbody>
</table>

---

*Data as reported by Kenya to UN***

**Recycling of imported waste” together with "recycling of domestic waste" constitute the country’s “recycling” bar.
APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

### Raw data

<table>
<thead>
<tr>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN, 2018, COMTRADE database*</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Modelling

<table>
<thead>
<tr>
<th>Temporal</th>
<th>Geographic</th>
<th>Granularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

See Comtrade flowchart in module T1, T2 of the methodology. Granularity is not as refined as necessary in order to inform action.

### Final metric

<table>
<thead>
<tr>
<th>Import of products</th>
<th>Export of products</th>
<th>Production from primary</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### Quality Score

Quality Score: 3.3
### Application Hotspots

#### Data Quality Assessment (2/2)

<table>
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<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
<th>Quality Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Temporal</td>
<td>Export of waste</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Geographic</td>
<td>Domestic recycling of collected waste***</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Granularity</td>
<td>Properly disposed</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improperly disposed</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uncollected</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leaked</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

#### Additional Notes:

- For packaging applications: See Application flowchart.
- For non-packaging applications, taken into account, we assume no recycling.
- Littering rates based on Europe. Recycling quantity and export specific to Kenya.
- European littering rates. Data on improperly disposed plastic from packaging and tourism are from KE, as well as waste by application.
- For packaging applications, see Application flowchart.
- For other applications, see additional notes.
- Lead to oceans = (Waste - Recycling - Properly disposed)*Release Rate, adjusted so that the total leakage matches leakage from the geographical analysis.
- Improperly disposed, for sanitary landfill or incineration.
- No proper management of waste = no sanitary landfill or incineration.
- Properly disposed.
- Export of waste.
**APPLICATION HOTSPOTS**

**MODELLING NOTES**

**Cigarette filters:** We estimate the number of cigarette filters from cigarette production data of the Tobacco Atlas project (src: Kostova, D. et al. (2014)). The plastic weight of a cigarette filter is 0.17gr (Longwood University 2008). From these data we obtain the waste generated. Trade data on import and export are determined through comtrade (code: 240220). Recycling is set to zero. The share of properly disposed is taken from the average share of properly disposed (sector hotspot), applied to the cigarette filters that are not littered. Littering rate is set to 29% (European Commission, 2018). The improperly disposed is based on the average share of improperly disposed (sector hotspot), applied to cigarette filters not littered. The release rate is taken from PLP (2019) and applied to uncollected and improperly disposed to determine total leakage.

**Sanitary towels:** Import and export are determined through comtrade (code: 961900). Waste generation is estimated to be 462 million units (assuming that women living in urban area between 16 and 54 use once a month 3 sanitary towels a day during 4 days), with one sanitary towel weighting 2gr. Recycling is set to zero. The share of properly disposed is taken from the average share of properly disposed (sector hotspot), applied to the sanitary towels that are not littered. Littering rate is set to 29% (European Commission, 2018). The improperly disposed is based on the average share of improperly disposed (sector hotspot), applied to sanitary towels not littered. The release rate is taken from PLP, 2019 and applied to uncollected and improperly disposed to determine total leakage.

**Baby diapers:** To determine waste generation we consider that the middle and high income population (55%) from 0-2 years old (half of the 0-4 population in UN statistics database), uses 4.16 unit of diapers/day (Mendosa et al., 2018). Average weight of a baby diaper is 29.1 grams, from which 33% is made of plastic components (Espinosa et al. 2015). Recycling is set to zero. The share of properly disposed is taken from the average share of properly disposed (sector hotspot), applied to the baby diapers that are not littered. Littering rate is set to 21%, based on EU littering report (using sanitary towels as a proxy). The improperly disposed is based on the average share of improperly disposed (sector hotspot), applied to baby diapers not littered or properly disposed. The release rate for baby diapers is the same as for sanitary towels. Release rate is applied to uncollected and improperly disposed to determine total leakage.
### SECTOR HOTSPOTS DATA QUALITY ASSESSMENT (1/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Temporal</td>
<td>Geographical</td>
<td>Granularity</td>
</tr>
</tbody>
</table>

#### Quality Score

<table>
<thead>
<tr>
<th>Source</th>
<th>Data Source</th>
<th>Data Quality</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PlasticsEurope, 2018</td>
<td>Polymer to Sector mapping based on EU market</td>
<td>1</td>
<td>1.875</td>
</tr>
<tr>
<td>Geyer et al., 2017</td>
<td>Product lifetime by sector, mean and std.</td>
<td>1</td>
<td>1.5</td>
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<tr>
<td>This study – Polymer</td>
<td>Net input by polymer*</td>
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<td>1.266667</td>
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</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Data Source</th>
<th>Data Quality</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The World Bank, 2012</td>
<td>Manufacturing, added value, GDP growth</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Geyer et al., 2017</td>
<td>Product lifetime by sector, mean and standard dev.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>This study – Sector</td>
<td>Net input* by sector</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>The heightec Group Ltd, 2012</td>
<td>Product lifetime of textile sector</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

#### Modelling

- Mapping from Polymer net input to Sector net input based on EU market, adapted through KE polymer net input.
- For net input quantity see Sector hotspot flowchart for all sector except for fishing, medical and tourism. Tourism net input is removed from packaging, fishing and medical net input are removed from “Other” sector. To determine long and short lifetime from net input, see sector hotspot flowchart.

#### Final metric

- Short-lived products
- Long-lived products

#### Change in stock

- Change in stock

For net input quantity see Sector hotspot flowchart for all sector except for fishing, medical and tourism. Tourism net input is removed from packaging, fishing and medical net input are removed from “Other” sector. To determine long and short lifetime from net input, see sector hotspot flowchart.
### SECTOR HOTSPOTS
### DATA QUALITY ASSESSMENT (2/2)

#### Raw data

<table>
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<th>Source</th>
<th>Data Description</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elliott T. et al., 2018</td>
<td>Plastic collected for recycling from packaging sector, and plastic collected for recycling from all other sectors</td>
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</tr>
<tr>
<td>UN, 2020, COMTRADE database</td>
<td>Total export of plastic waste (data 2018)</td>
<td>2</td>
</tr>
<tr>
<td>This study - Sector</td>
<td>Waste generated by sector</td>
<td>2.5</td>
</tr>
<tr>
<td>NEMA interview, 2020</td>
<td>No sanitary landfill or incineration facility in Kenya</td>
<td>1</td>
</tr>
<tr>
<td>This Study - Sector</td>
<td>Micro-leakage by sector (see additional notes)</td>
<td>2.5</td>
</tr>
<tr>
<td>This Study - Regional</td>
<td>Total plastic being improperly disposed</td>
<td>3</td>
</tr>
<tr>
<td>This Study - Sector</td>
<td>Waste - Properly managed - Recycled - Export of Waste</td>
<td>3.6</td>
</tr>
<tr>
<td>Plastic Leak Project, 2018</td>
<td>Littering rate by sector</td>
<td>3.0</td>
</tr>
<tr>
<td>This study - Sector</td>
<td>Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed</td>
<td>2.0</td>
</tr>
<tr>
<td>This Study - Sector</td>
<td>Mismanaged</td>
<td>2.3</td>
</tr>
<tr>
<td>Plastic Leak Project, 2018</td>
<td>Release rate by sector (based on product size and value for informal recyclers)</td>
<td>3</td>
</tr>
<tr>
<td>This Study - Regional</td>
<td>Total micro-leakage from mismanaged waste</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Modelling

<table>
<thead>
<tr>
<th>Year</th>
<th>Temporal</th>
<th>Geographic</th>
<th>Granularity</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Export of waste</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Domestic recycling of collected waste***</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Properly disposed</td>
<td>1.0</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Improperly disposed</td>
<td>2.5</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Uncollected</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>Leakage</td>
<td>2.4</td>
</tr>
</tbody>
</table>

#### Quality Score

- **Export of waste**: 2
- **Domestic recycling of collected waste*****: 2
- **Properly disposed**: 1.0
- **Improperly disposed**: 2.5
- **Uncollected**: 2
- **Leakage**: 2.4

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**Note**: Import = Import waste - Recycling of import = Import of products - Export of primary and products = Import and production of primary.

***Recycling of imported waste* together with ‘recycling of domestic waste’ constitute the country’s ‘recycling’ tax.

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**References**

- Elliott T. et al., 2018
- NEMA interview, 2020
- Plastic Leak Project, 2018
- UN, 2020, COMTRADE database

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**Methodology**

- See Sector flowchart in module T3 of the methodology.
**SECTOR HOTSPOTS MODELING NOTES (1/2)**

**Fishing:** Data on number of fishing gears comes from *State Department of Fisheries (2014)*. By default plastic weights by fishing gear type were derived from technical designs found in multiple publications including *Nédélec et al. (1990)*. Combining these two pieces of information yields the net plastic input from fishing gears. Note: according to *State Department of Fisheries (2014)* there are more than 9000 longlines used in Kenya. According to *Nédélec et al. (1990)* a longline is composed of 600 hooks for a length of 31km. 9000 longlines seems like an excessively large number, for comparison in Thailand there are 24 longlines in use (*FAO, 2014*). For this reason we considered that for the case of Kenya a longline consists in 1 hook and has a length of 52meters.

**Medical:** Total plastic waste generated by the medical sector is computed by combining the number of hospital beds (*KNBS, 2018, 56728 beds*), the average bed occupancy rate, the total waste generated by bed and the average plastic share in medical waste (*Udofia et al. 2014*). No distinction was made infectious and non-infectious medical waste. In Kenya there is informal medical sector that operates outside of hospitals which we do not capture. Nonetheless, plastic waste from the medical sector significantly smaller than plastic waste from the packaging sector, thus not a hotspot in the country.

**Tourism:** Data on number of tourists and average length of stay comes from *KNBS (2018)*. We combine this information with the average country plastic waste generation per capita per day derived from our calculations, in order to estimate the plastic waste generated by the tourism sector. We make the assumption that a tourist will generate as much plastic waste as a kenyan citizen.

We assume these three sectors to be short-lived and for all the plastic in these sector to go to waste within the year, no stock generated. This is accurate for Medical and Tourism and it aligns with the way we computed the net input from these two sectors. For fishing instead it could mean that we are over-estimating the waste generated. Note that the waste generated from fishing gears is already quite low.
Micro-leakage contribution

- **Tyre dust**: loss and leakage of synthetic rubbers particles from tyres to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Automotive-tyres”. Data on vehicles numbers as well as average distance travelled are based on *Notter et al. (2019)*.

- **Textile fibres**: loss and leakage of textile fibers to the marine environment is calculated based on the methodology described in the *PLP (2020)*.

- **Cosmetics**: loss and leakage of plastic micro-particles from cosmetics to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Others”.

- **Pellets**: loss and leakage the marine environment of plastic pellets during transportation and production stages is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in “Others”.

Plastic pollution hotspots: Kenya

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study – Sector: Plastic waste generated in the country</td>
<td>2.1</td>
<td>Per capita waste generation in urban areas comes from Eunomia study (for both household waste and non-household waste). The share of plastic is household and non-household waste is from McDonald 2015. This gives us plastic waste generation by the urban population of Kenya. The plastic waste generated by the rural population is determined by subtracting the urban one to the total plastic waste as derived in the Polymer hotspot. Waste generated by km² = population per km² * per capita waste generated (urban/rural)</td>
<td>Waste generated</td>
</tr>
<tr>
<td>Elliott T. et al., 2018</td>
<td>2018-2020</td>
<td>We assume waste collected for recycling only in the main cities (Nairobi, Mombasa, Kisumu and Nakuru). The share of collected for recycling = population share wrt the total population of the four cities.</td>
<td>Collected for recycling</td>
</tr>
<tr>
<td>Nairobi City Council, interview, 2020</td>
<td>2018</td>
<td>Nairobi population comes from the City Council. For each of the remaining cities we choose the highest collection rate from the ones reported by Eunomia.</td>
<td>Properly disposed</td>
</tr>
<tr>
<td>This study – Sector: Waste – Collected for recycling - Properly disposed; Improperly disposed by province</td>
<td>2.3</td>
<td>Uncollected = Waste - Collected for recycling - Properly disposed - Improperly disposed</td>
<td>Uncollected</td>
</tr>
</tbody>
</table>

Quality Score 2.3
### Regional Hotspots: Data Quality Assessment (2/2)

#### Quality Score

<table>
<thead>
<tr>
<th>Raw data</th>
<th>Modelling</th>
<th>Final metric</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reliability</strong></td>
<td><strong>Temporal</strong></td>
<td><strong>Geographic</strong></td>
<td><strong>Granularity</strong></td>
</tr>
<tr>
<td>This Study - Regional</td>
<td>Mismanaged = Uncollected + Improperly managed by district</td>
<td>2016</td>
<td>1</td>
</tr>
<tr>
<td>This Study - Regional</td>
<td>Waste generated by district</td>
<td>2018</td>
<td>1</td>
</tr>
<tr>
<td>This Study - Regional</td>
<td>Collected = Collected for recycling + Properly disposed + Improperly disposed</td>
<td>2018</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Sources and Methods

- **Richardson et al., 2020**: Loss rate by fishing gear type
- **Håkansson et al., 2019**: Drawings of various fishing gear
- **State Department of Fisheries, 2014**: Number of fishing gear per type and number of fishermen for each coastal province in Kenya
- **Nédélec et al., 1990**: Drawings of various fishing gear
- **WWF HydroSHEDS**: Country watersheds
- **WWF HydroSHEDS**: Country rivers
- **NASA - SEDAC population count**: GIS Population on 1kmx1km grid
- **Lebreton et al., 2017**: Catchment run-off of watersheds

#### Notes

- Leakage of pixel = population of pixel x MWI of province x RR
- Leakage from fishing sector
- Macro-leakage from land

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* *1 With max release rate from Jambeck et al., 2015: 25%; D1 short < 2 km, D2 long > 100 km (Sistemiq), R1 small < 1st quartile of world runoff, R3 large > 3rd quartile of world runoff (Lebreton et al., 2017)"
Fishing:

Leakage from lost/mismanaged fishing gear & overboard litter is estimated for all coastal provinces of the Kenyan coastline and includes three parameters:

1) Leakage due to gears lost at sea is computed using loss rates by fishing gear type provided by Richardson et al. (2019). For some fishing gears, loss is considered for fragments of the gear only, thus we had to make an assumption on how big a fragment would be (10%, 50% or 90% of a gear unit). Our default calculation takes the assumption of a fragment representing 50% of a gear unit.

2) Leakage from gear waste mismanaged on land is computed from the difference between net input and loss at sea, to which specific loss and release rates are applied.

3) Overboard littering is estimated by taking the average daily littering rate for packaging products in the country and applying it to the number of days each fisherman is out at sea (assumption: 120 days per year at sea for full time fishermen). The number of fishermen comes also from State Department of Fisheries (2014).
5 BIBLIOGRAPHY
BIBLIOGRAPHY (1/3)


Boucher, J. et al. (2019). The Marine Plastic Footprint. IUCN.


Kostova, D. et al. (2014). Exploring the relationship between cigarette prices and smoking among adults: a cross-country study of low-and middle-income nations. nicotine & tobacco research, 16(Suppl_1), S10-S15.


BIBLIOGRAPHY (2/3)


Kenya Country report

Published in December 2020, with results for year 2018

Implemented with

Supported by the Swedish International Development Cooperation Agency