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NATIONAL GUIDANCE FOR PLASTIC POLLUTION HOTSPOTTING AND SHAPING ACTION

FINAL REPORT FOR KENYA

December 2020

Implemented with ea + Quantis

Supported by the Swedish International Development Cooperation Agency Sida

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Report published in December 2020, with results for year 2018

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To be cited as:

IUCN-EA-QUANTIS, 2020, National Guidance for plastic pollution hotspotting and shaping action, Country report Kenya

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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A number of organizations participated in the in-country workshop, or contributed data and information to the national hotspotting assessment process, including: **MEF, NEMA, KMFRI, KAM, MOITED, UoN, State Department of Fisheries, KEFRI, County Government of Nairobi, Mr. Green Africa, KEPSA, SIB-Kenya, PETCO-Kenya, RETRACK, KIPPRA, KFS, WRA, Environmental Compliance Institute, WWF Kenya, CORDIO, Ecoworld Watamu/WMA, County Government of Kilifi, Hanns Seidel Foundation, T3, KEWMA, Mazingira Yetu, CYNESA.**

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

4 Cities responsible for 40% of the country leakage

Shaping action from the hotspots

11 Actionable Hotspots

13 Priority Interventions

STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

1

INTRODUCTION TO THE GUIDANCE

Provides the objectives of the Guidance, and introduces its associated workflow and main deliverables.

2

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.

3

SHAPING ACTION

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

4

APPENDICES

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

5

BIBLIOGRAPHY

STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

1
2
3
4
5

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

1
2
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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

1
2
3
4 **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.

5 **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 writen 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 "mismanaged 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

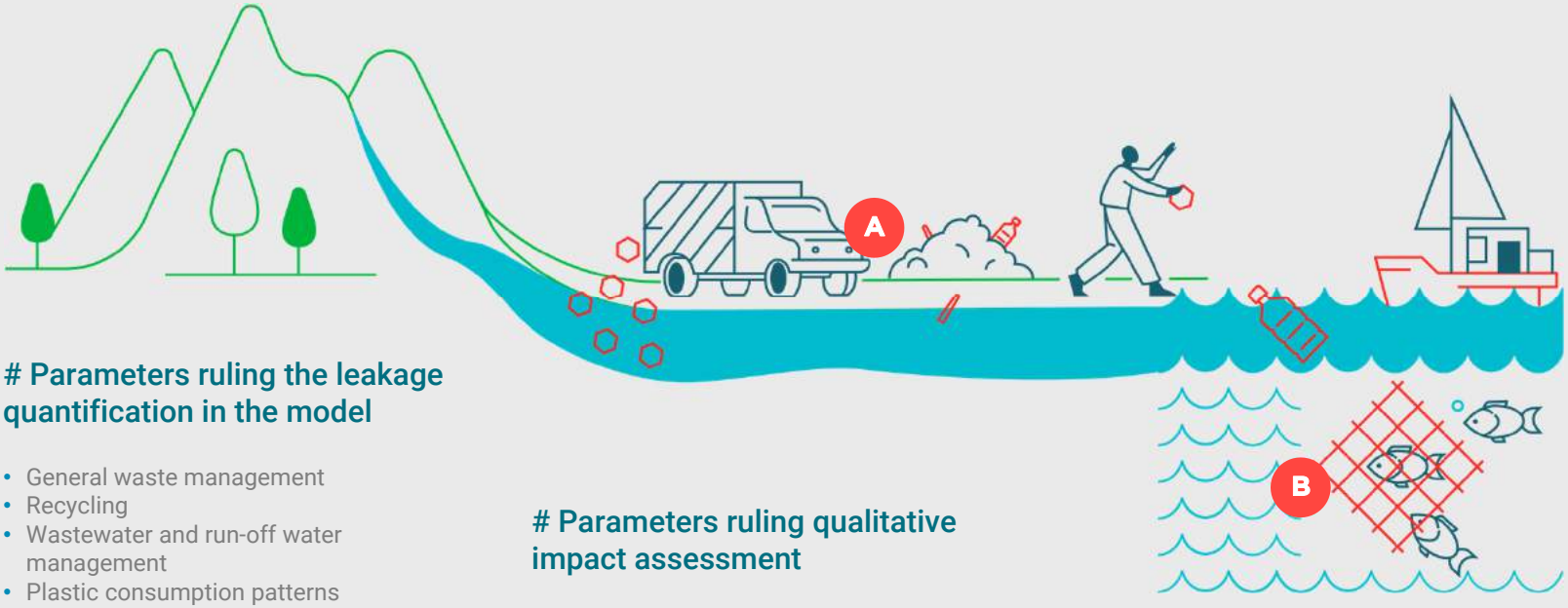
Informal sector: Individuals or a group of individuals who are involved in waste management activities, but are not formally registered or formally responsible for providing waste management services. Newly established formalized organizations of such individuals; for example, cooperatives, social enterprises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

For additional definitions, please refer to the publication: United Nations Environment Programme (2020). National guidance for plastic pollution hotspotting and shaping action - Introduction report. Boucher J.,; M. Zgola, et al. United Nations Environment Programme. Nairobi, Kenya. Definitions of formal and informal sector are taken from: United Nations Framework Convention On Climate Change - Clean Development Mechanism (UNFCCC-CDM) , 2010, AMS-III.AJ. EB70, Annex 28 - Small-scale Methodology: Recovery and Recycling of Materials from Solid Wastes.

WHAT WE MEAN BY PLASTIC LEAKAGE / IMPACTS

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

B 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

KEY ABBREVIATIONS AND UNITS

Polymer abbreviations

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

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

Key units

NAME	SYMBOL
Kilogram	kg
Tonne	t
Kilo tonne (or thousand tonne)	kt
Mega tonne (or million tonne)	Mt
Kilometer	km
Square kilometer	km^2

Calculation variables

NAME	ABBREVIATION
Mismanaged waste index	MWI
Leakage rate	LR
Release rate	RR

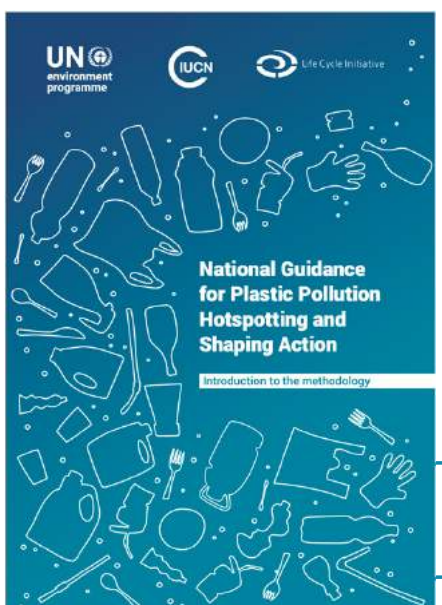
1 INTRODUCTION TO THE GUIDANCE

National guidance for plastic pollution hotspotting and shaping action

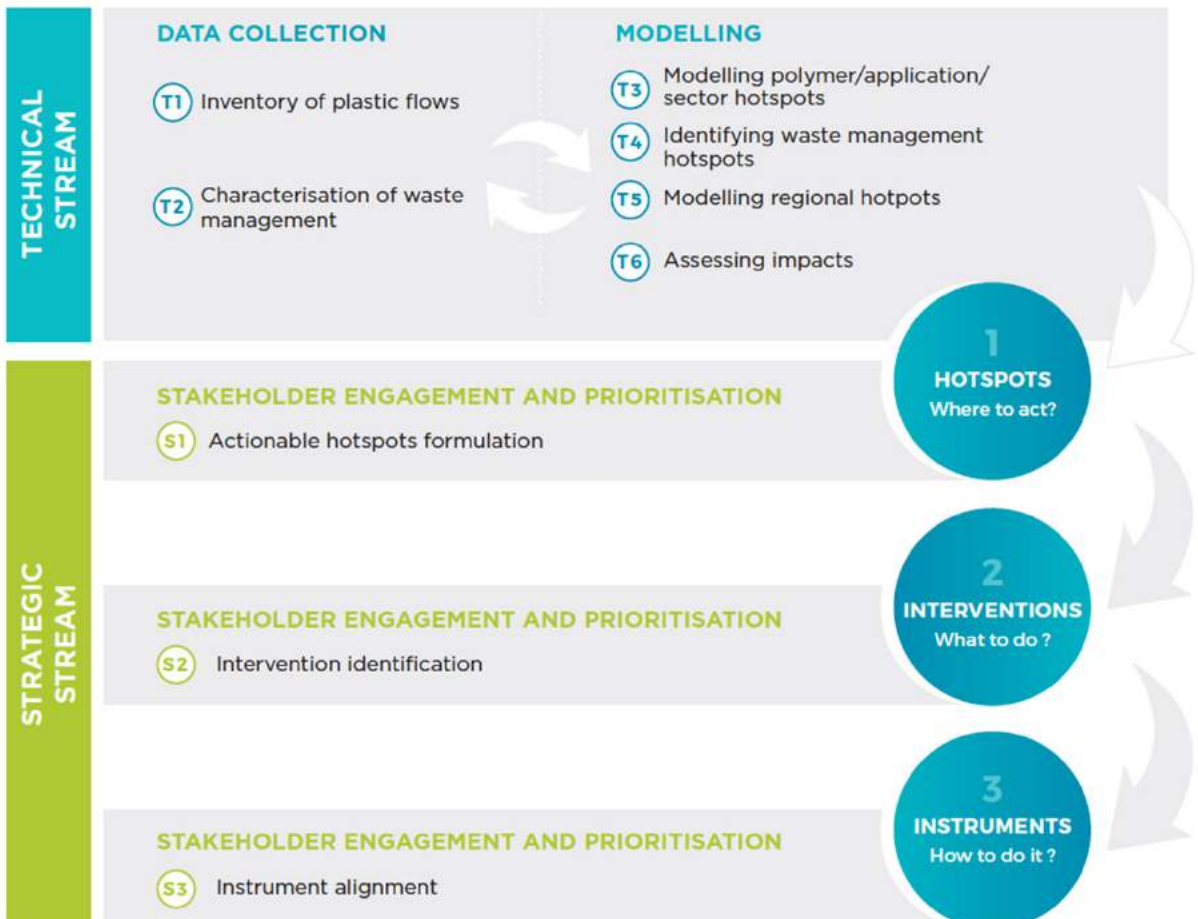
SCHEMATIC OF THE GUIDANCE

The guidance allows users to:

1. Generate country-specific plastic waste management datasets
2. Identify plastic leakage and pollution hotspots
3. Prioritise actions



LINK to the guidance



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

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

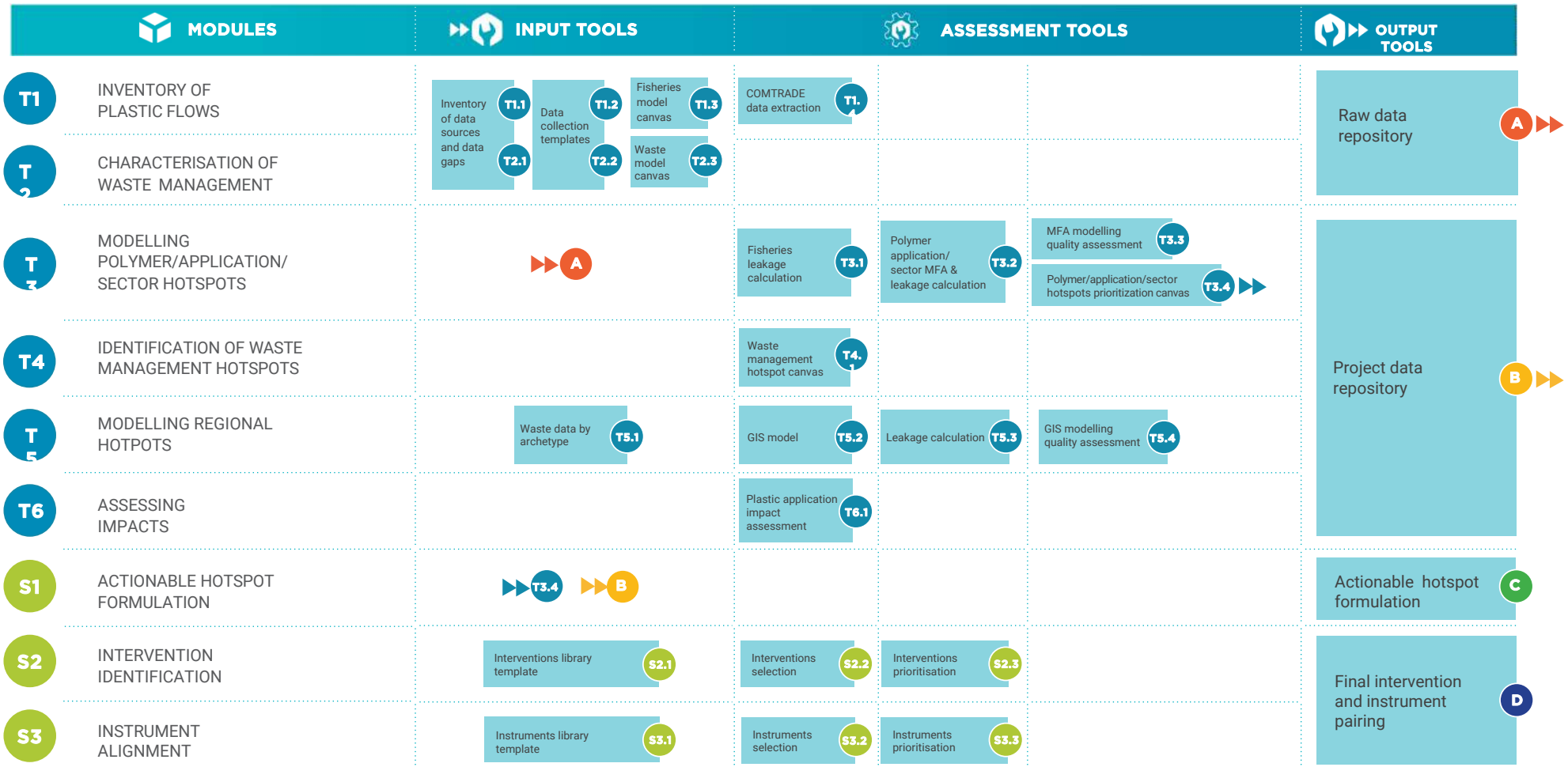
Examples

- 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



DISCLAIMER

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

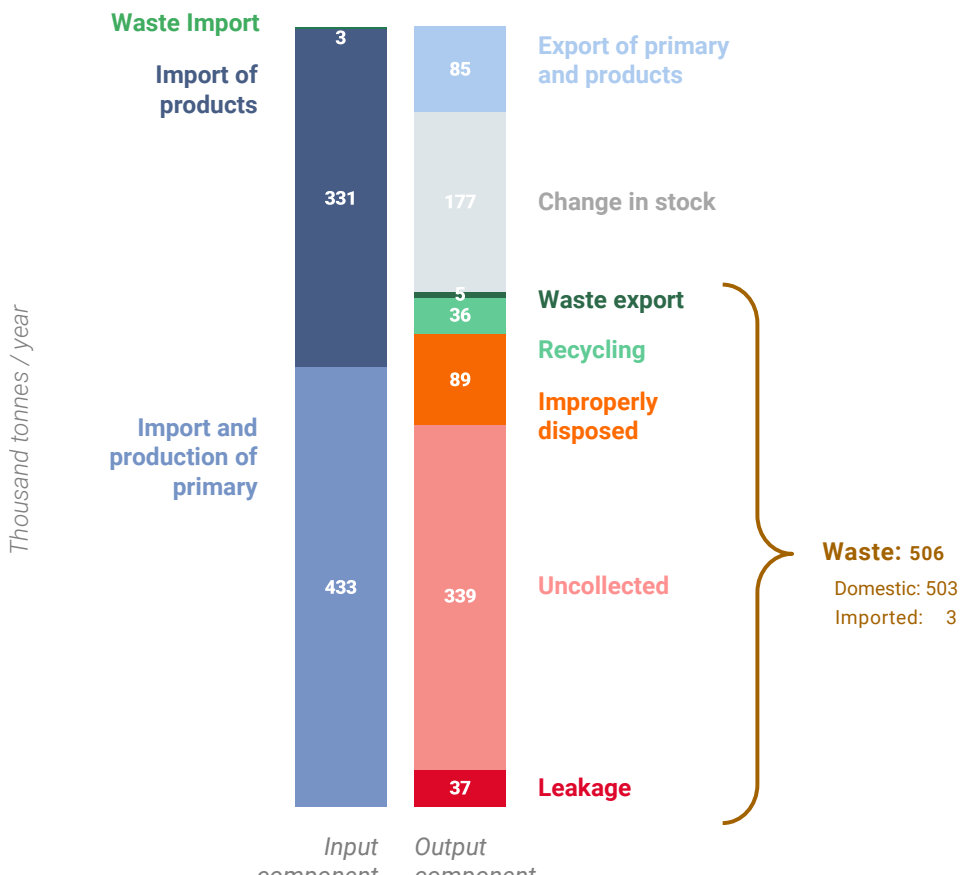
Additional information on the methodology and modelling process can be found directly in the **modules and tools** associated with the guidance and highlighted by this icon.

2 PLASTIC POLLUTION HOTSPOTS

2.1 COUNTRY OVERVIEW

COUNTRY PLASTIC MATERIAL FLOW [2018]

Summary of the results for all plastics in the country



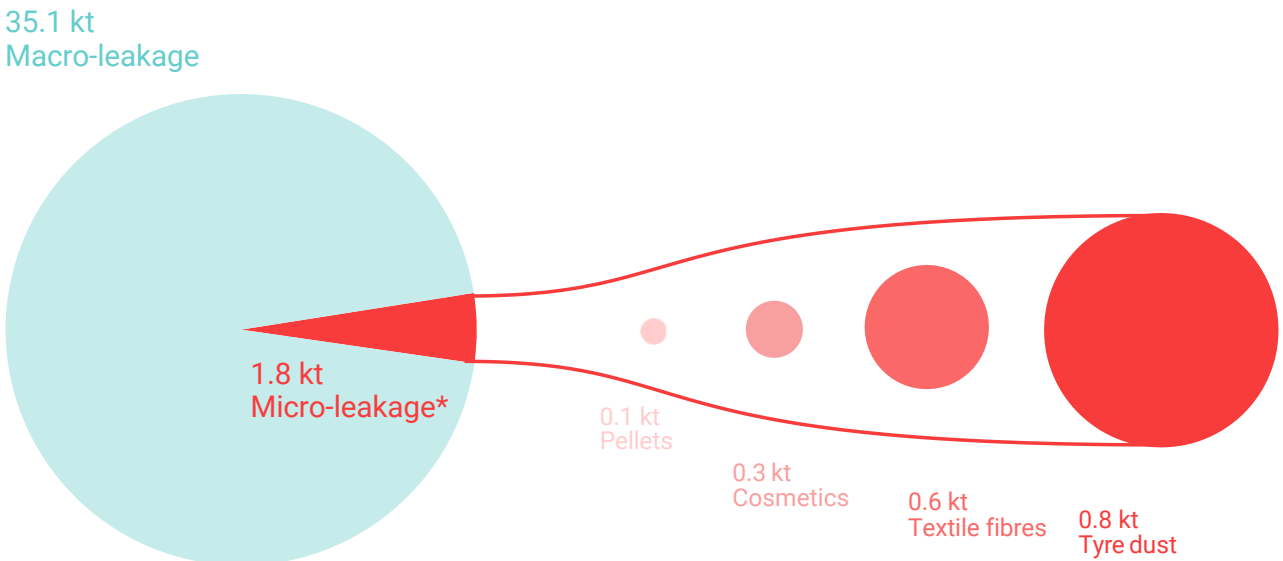
Key take-aways

- 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.

MACRO-LEAKAGE VS MICRO-LEAKAGE [2018]



TO WATERWAYS AND OCEANS:

37 kt

Key take-aways

- **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

Learnings

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.

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

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.

Limitations

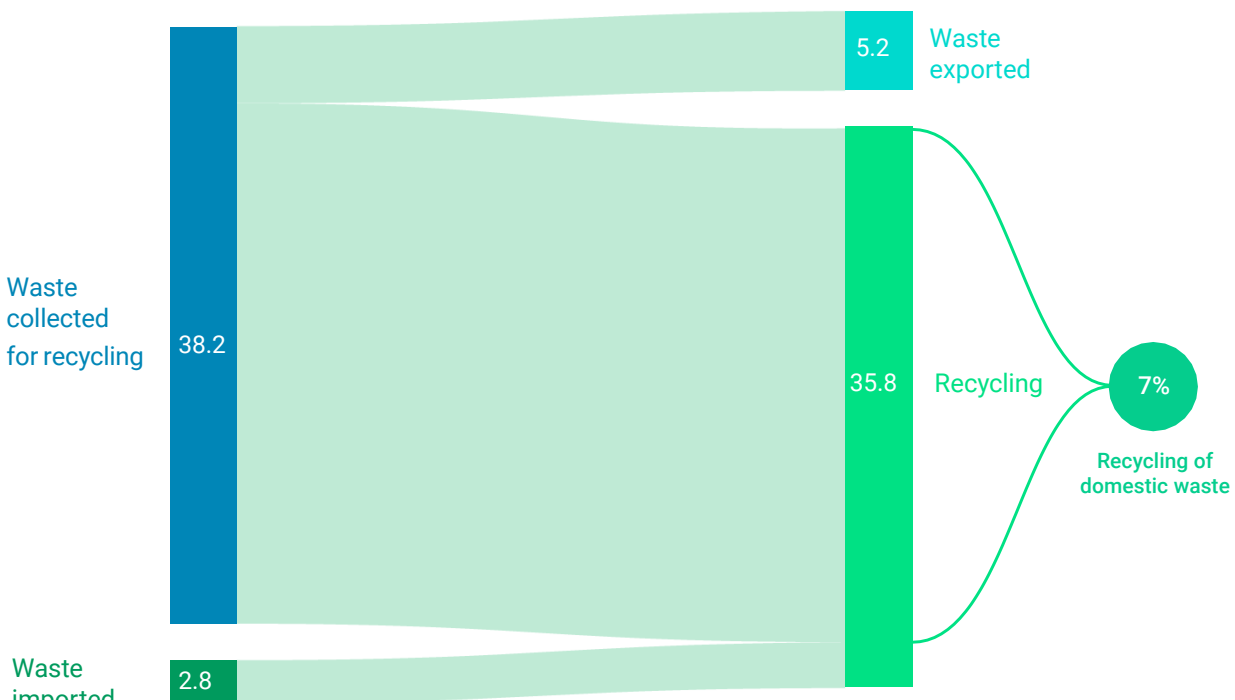
Although we do not have specific data on burning, we suggest a rough estimate of how much plastic could be polluting the air by using the assumptions made in the *Breaking the Plastic Wave* report (*Lau et al, 2020*): 60% of uncollected plastic waste and 13% of plastic waste at dumpsites are burnt on 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.

Unlocking limitations

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

RECYCLING: TRADE OF WASTE AND DOMESTIC RECYCLING

Quantities in thousand tonnes



Key take-aways

- 7% of the 503 thousand tonnes of plastic waste generated are recycled domestically

Learnings

- 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 aupicable, in order to avoid country recycling capacity to be dedicated to imported waste.

Limitations

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.

Unlocking limitations

Investigate illegal trade of waste, either at border or at recycling companies.

2.2 DETAILED HOTSPOTS RESULTS

5 CATEGORIES OF HOTSPOTS

WHAT

WHAT

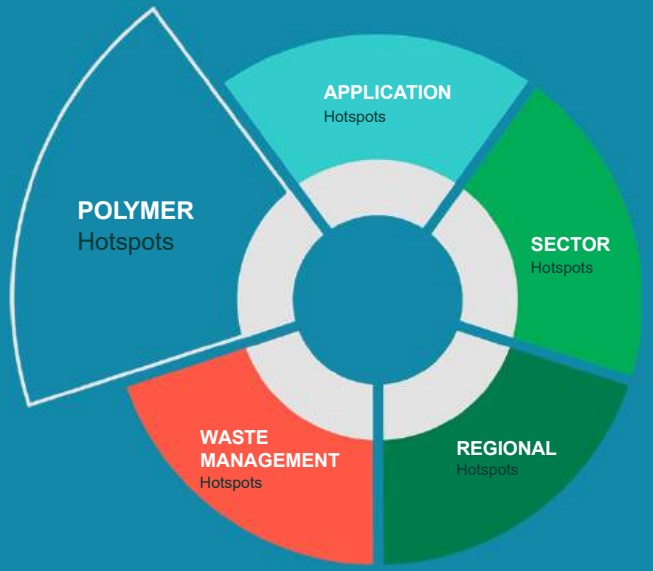
WHERE

WHERE

WHY

ACTIONABLE HOTSPOTS FORMULATION

A POLYMER HOTSPOTS

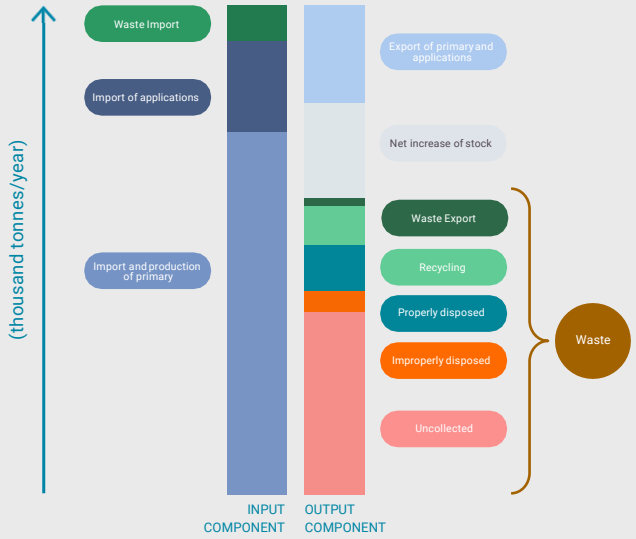


OBJECTIVE AND INSTRUCTIONS

Key question answered:

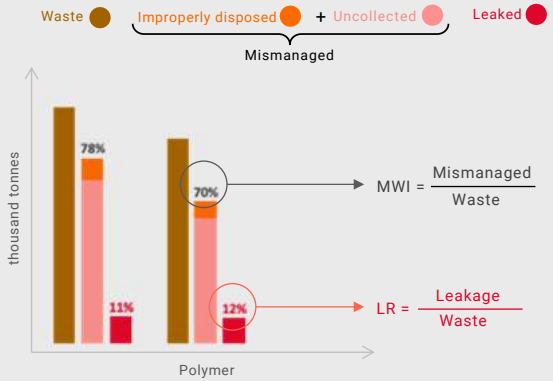
Which polymers are most critical in the country regarding plastic leakage?

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

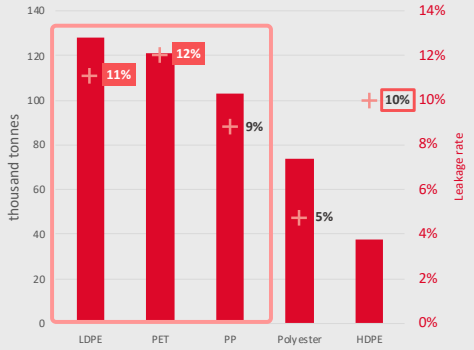


How to read the polymer hotspot graph?

1. Determine leakage from mismanaged waste

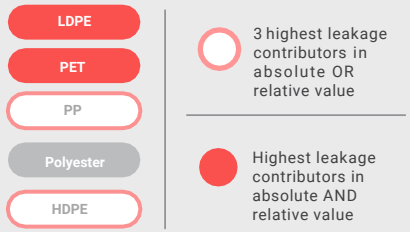


2. Focus on leakage and leakage rate



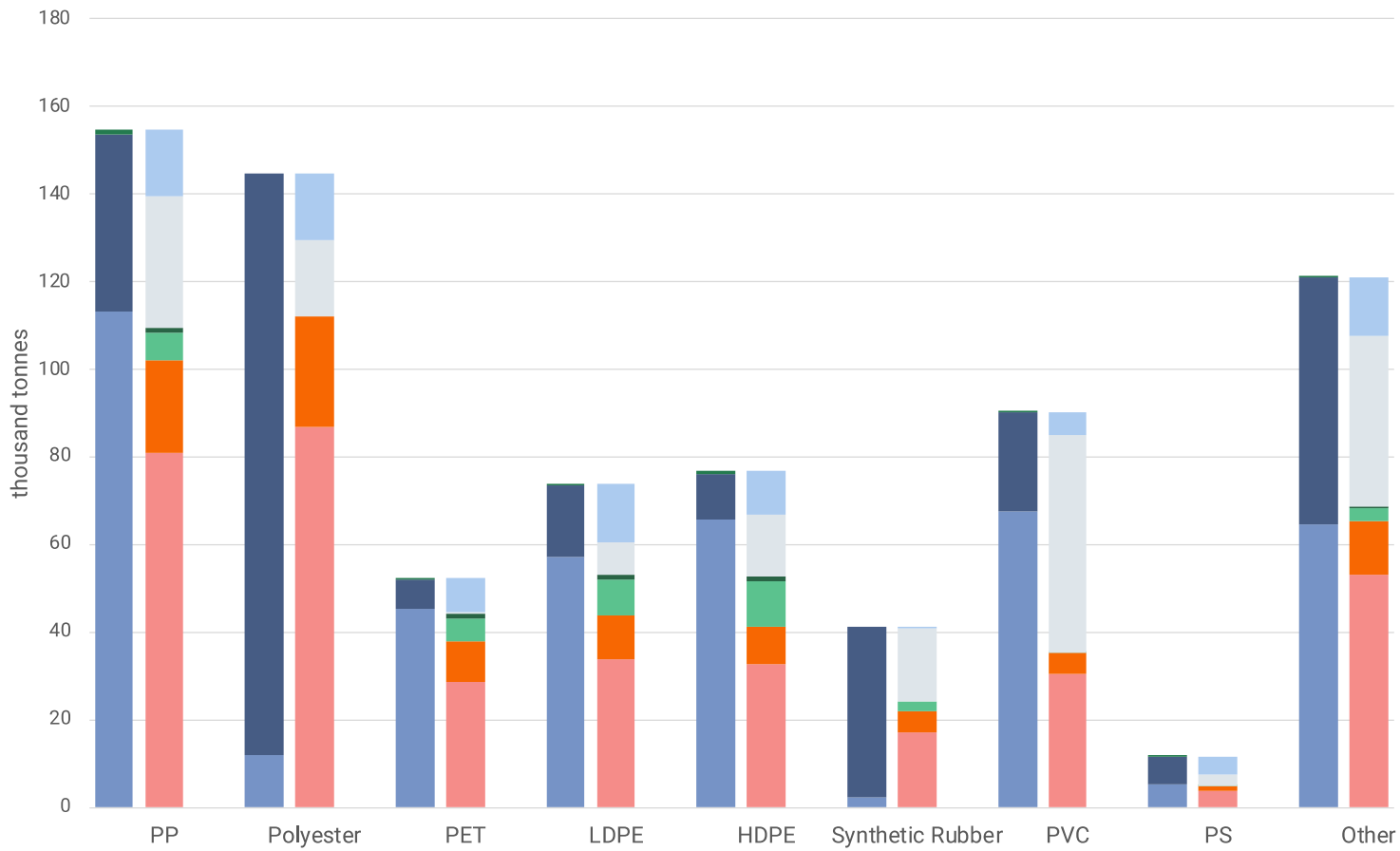
For more details, please read the Methodology

3. Select hotspots based on absolute and relative leakage

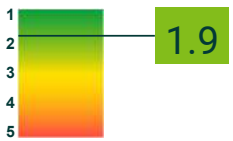


4. Assess the quality score of the results

MASS BALANCE BY POLYMER [2018]



Quality Score



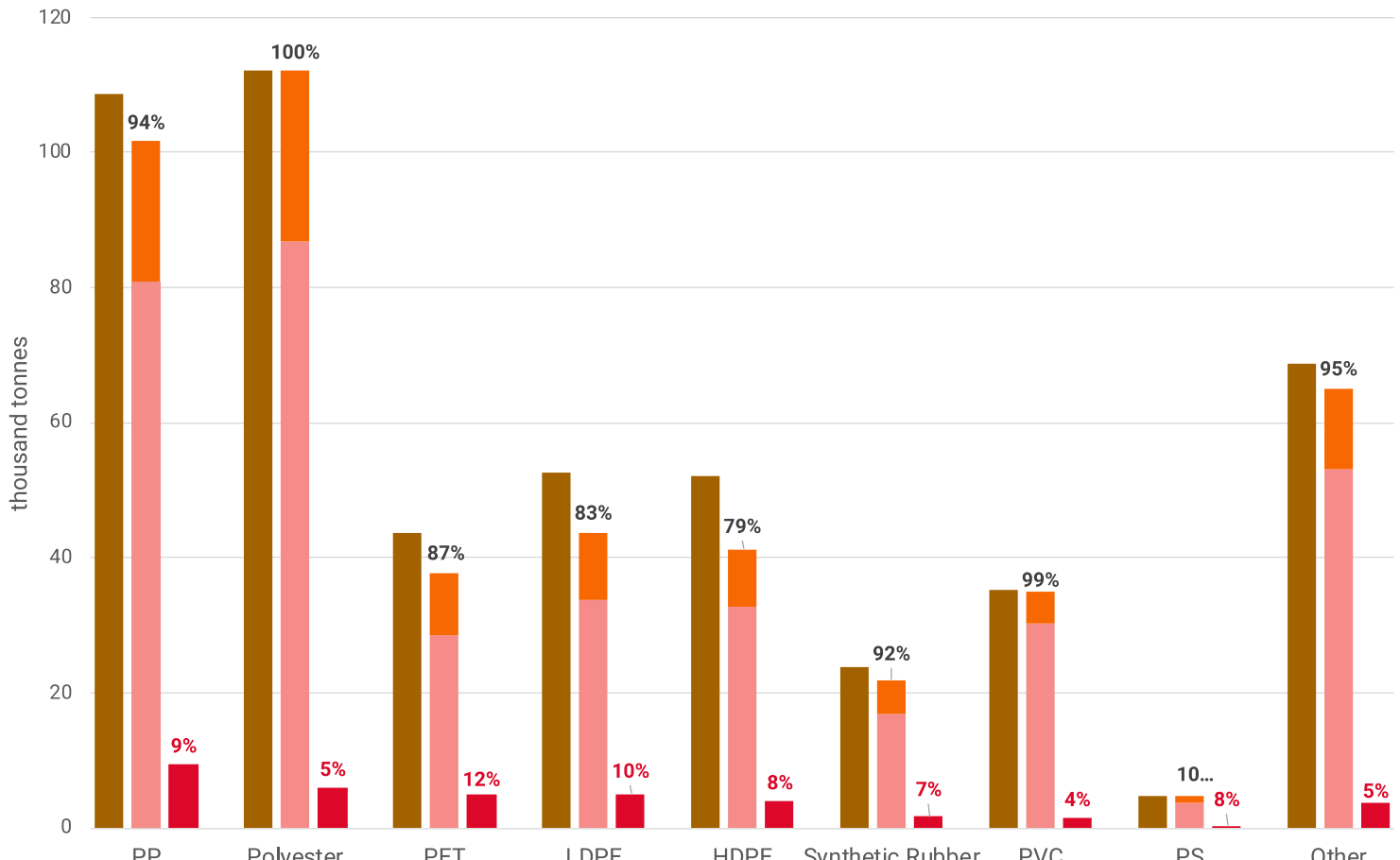
INPUT

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

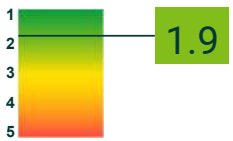
OUTPUT

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

MISMANAGED WASTE AND LEAKAGE BY POLYMER [2018]



Quality Score



Domestic waste

Improperly disposed

+

Uncollected

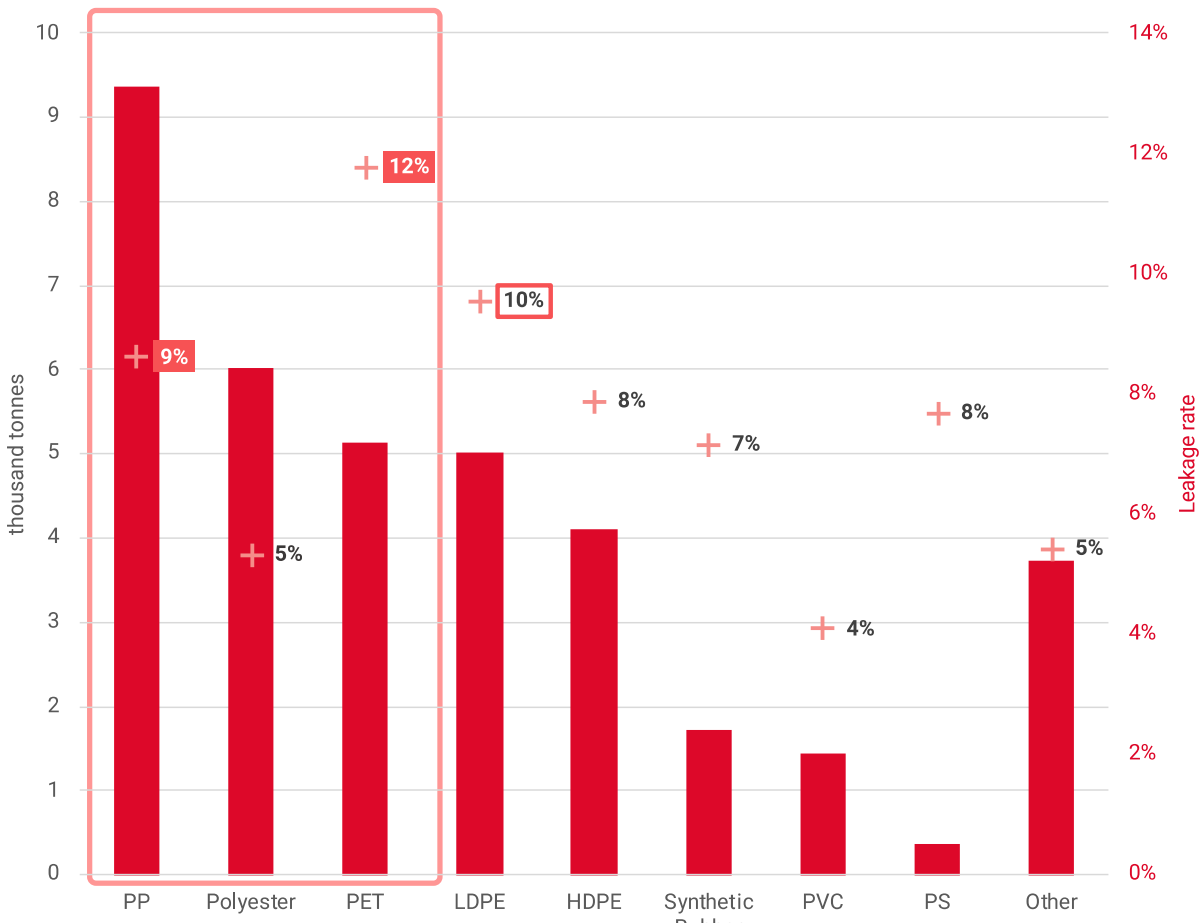
Mismanaged

Leaked

X% | Mismanaged Waste Index (MWI)

X% | Leakage Rate (LR)

POLYMER HOTSPOTS [2018]

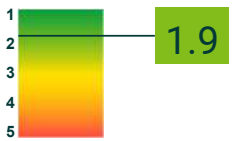


PP
PET
Polyester
LDPE
Synthetic Rubber
HDPE
PS
PVC
Other

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Quality Score



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 (6kt).
- **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%).

POLYMER HOTSPOTS:
INTERPRETATION AND LIMITATIONS

PP

Learnings

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.

Polyester

Learnings

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, beecause 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.

PET

Learnings

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.

LDPE

Learnings

Similarly to PET, also LDPE is extensively used in Packaging, altough 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%.

POLYMER HOTSPOTS:
INTERPRETATION AND LIMITATIONS

All polymers

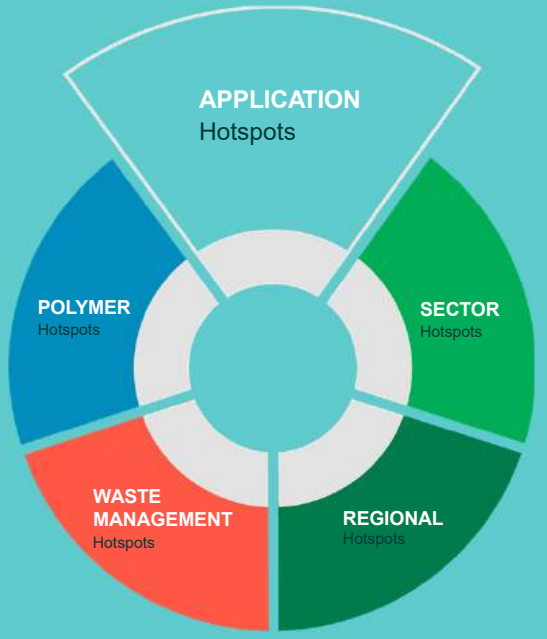
Limitations

- 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*).

Unlocking limitations

- 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.

B APPLICATION HOTSPOTS

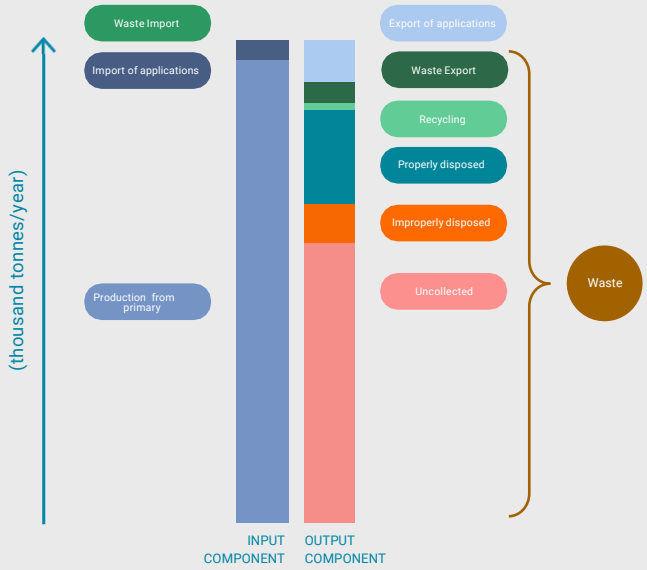


OBJECTIVE AND INSTRUCTIONS

Key question answered:

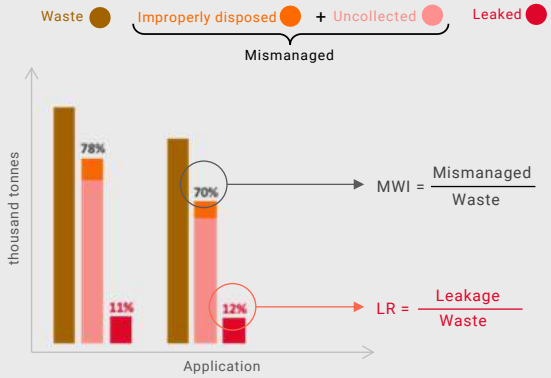
Which applications are most critical in the country regarding plastic leakage?

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

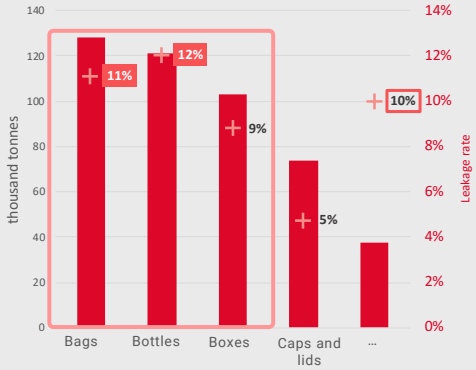


How to read the application hotspot graph?

1. Determine leakage from mismanaged waste



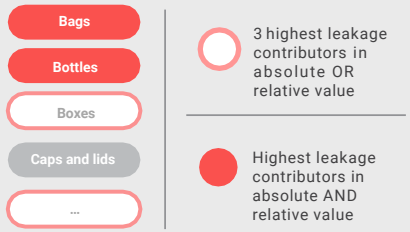
2. Focus on leakage and leakage rate



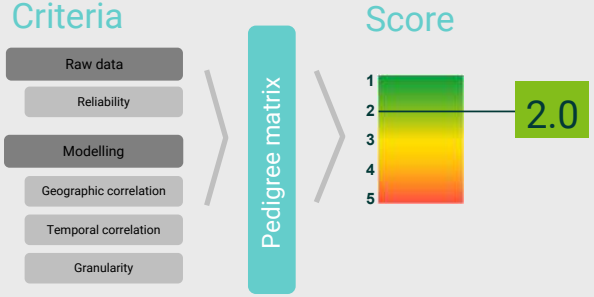
For more details, please read the Methodology

T3

3. Select hotspots based on absolute and relative leakage

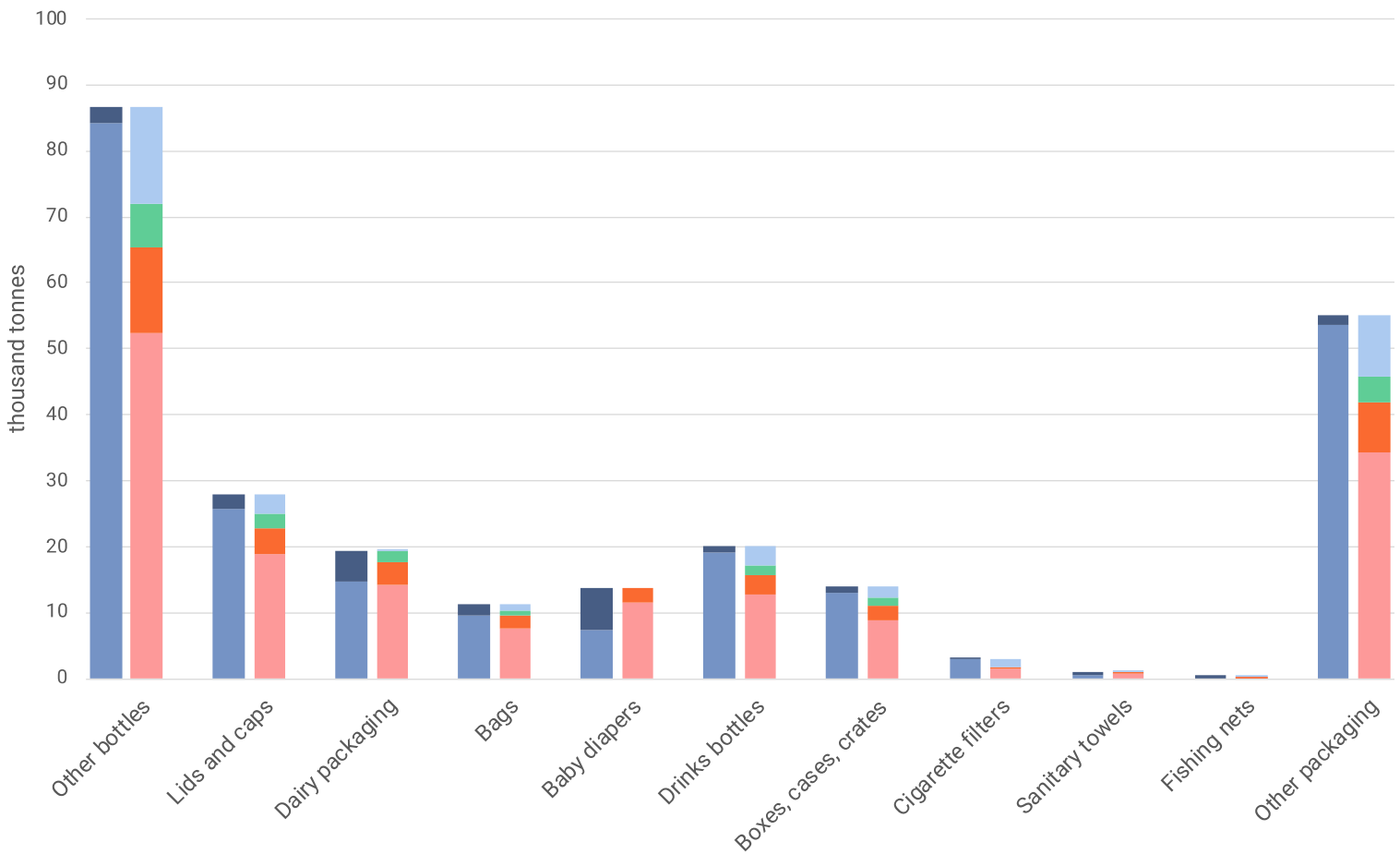


4. Assess the quality score of the results

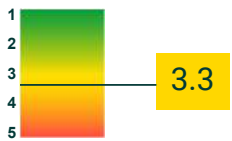


MASS BALANCE BY APPLICATION [2018]

The application analysis covers most of known short-lived products, which corresponds to **43% of total plastic waste** in 2018.



Quality Score



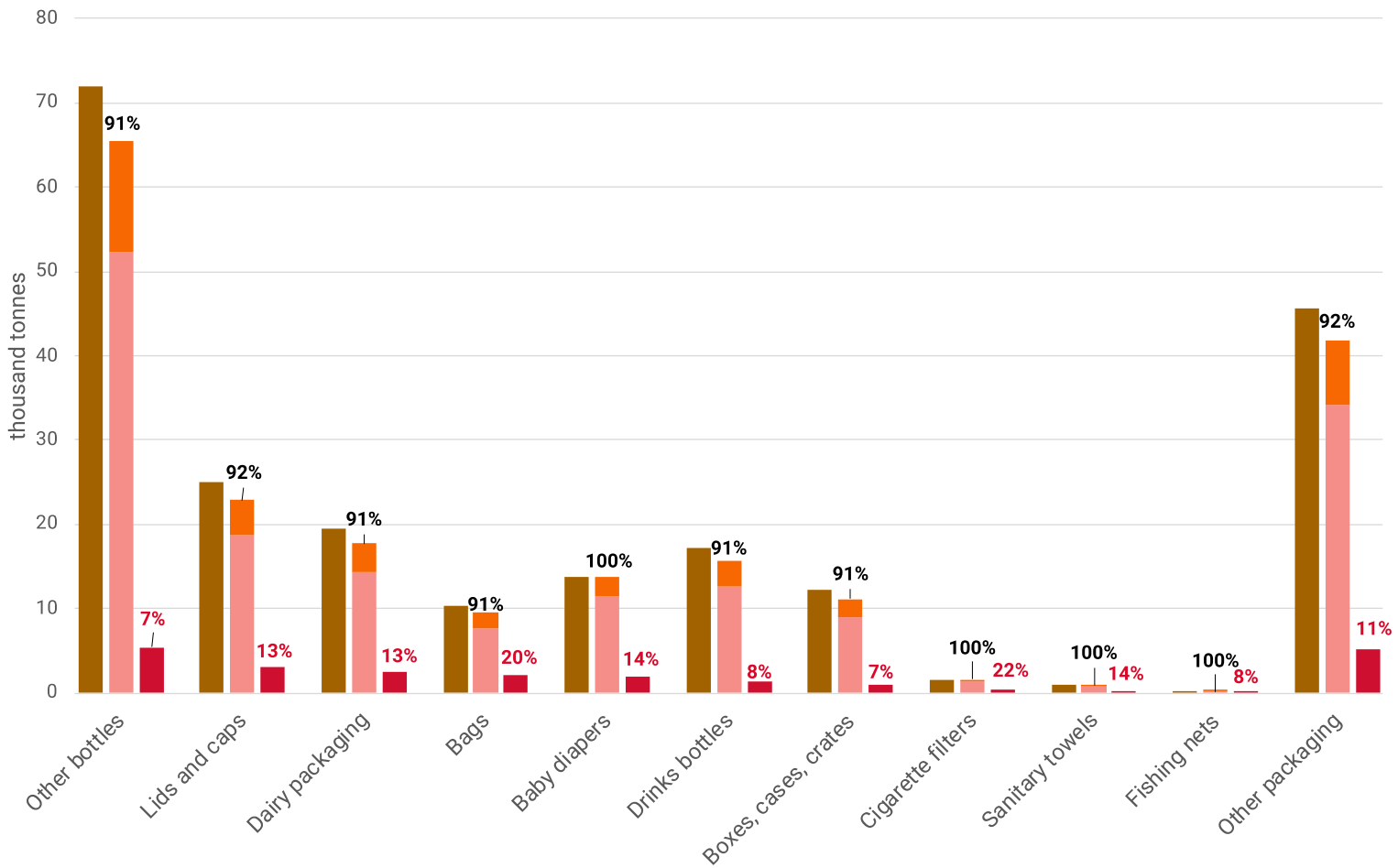
INPUT

- Waste Import
- Import of products
- Production from primary

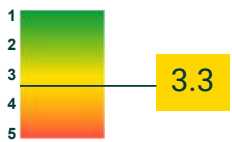
OUTPUT

- Waste Export
- Export of applications
- Recycling
- Properly disposed
- Improperly disposed
- Uncollected

MISMANAGED WASTE AND LEAKAGE BY APPLICATION [2018]



Quality Score



Domestic waste

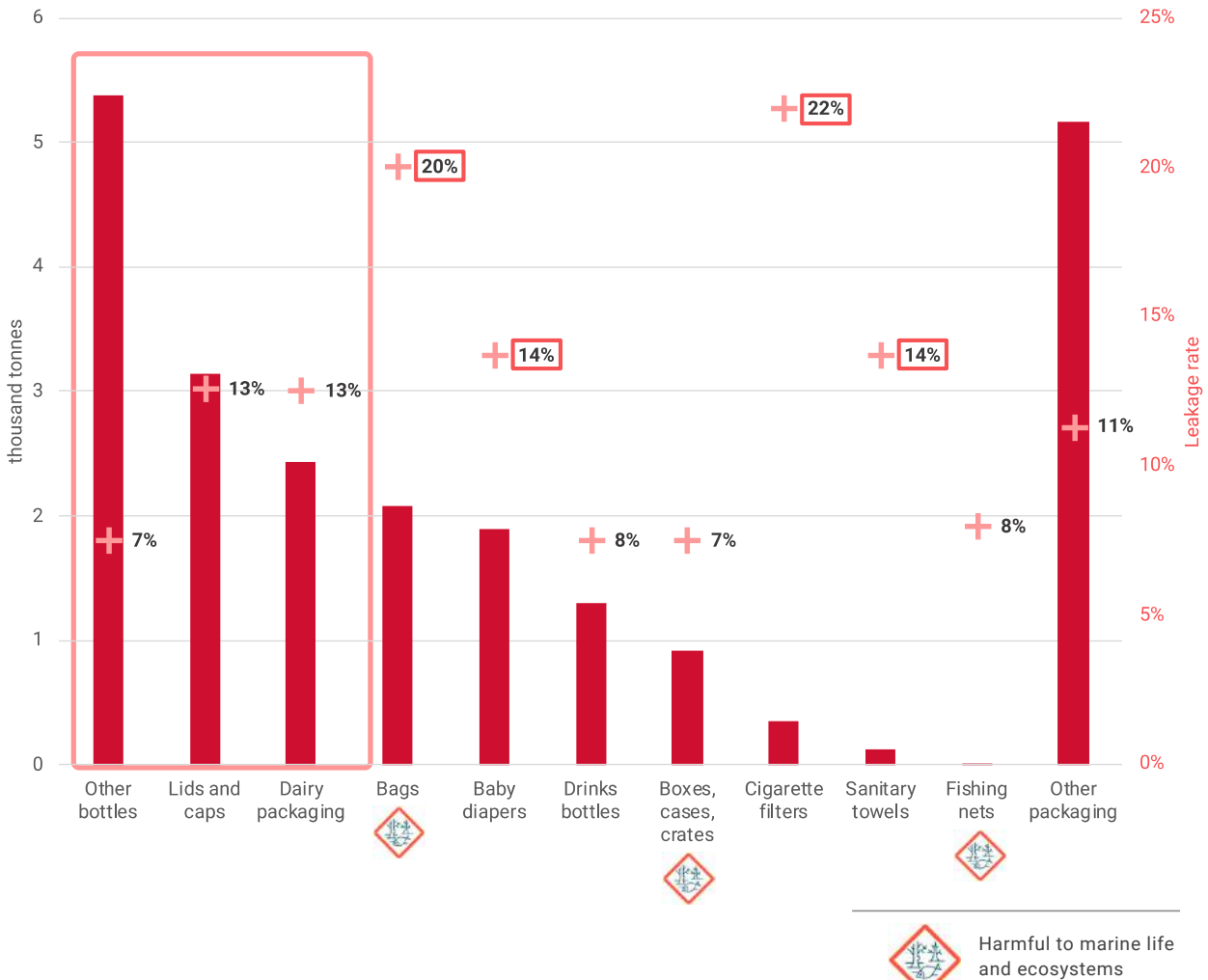
Improperly disposed + Uncollected } Mismanaged

Leaked

X% | Mismanaged Waste Index (MWI)

X% | Leakage Rate (LR)

APPLICATION HOTSPOTS [2018]

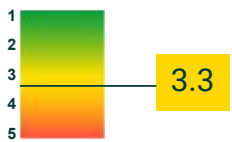


Other bottles
Lids and caps
Diary packaging
Bags
Baby diapers
Cigarette filters
Sanitary towels
Drinks bottles
Fishing nets
Boxes, cases, crates

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Quality Score



Key take-aways

- **Other bottles (non-driking bottles)** are the highest contributors in absolute leakage (5.4 kt)
- **Lids and caps** and **diary 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 wes 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.

APPLICATION HOTSPOTS:
INTERPRETATION AND LIMITATIONS

All applications

Limitations

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.

Unlocking limitations

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

Bags

Learnings

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). Nonethelesse, 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%.

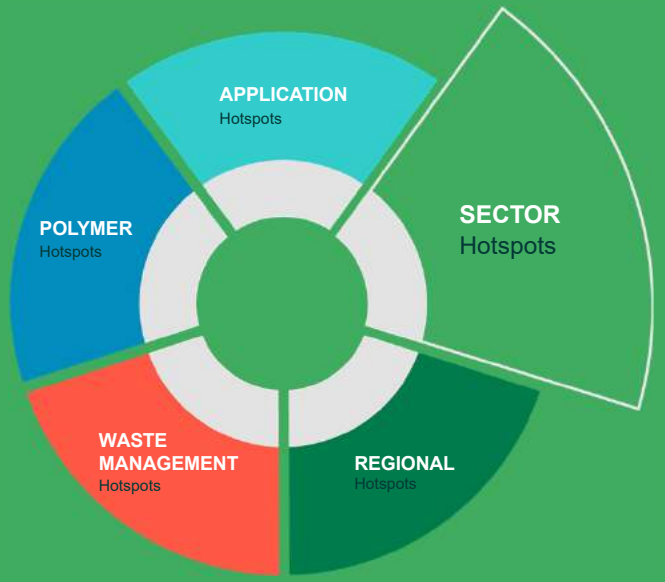
Limitations

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

Unlocking limitations

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.

C SECTOR HOTSPOTS

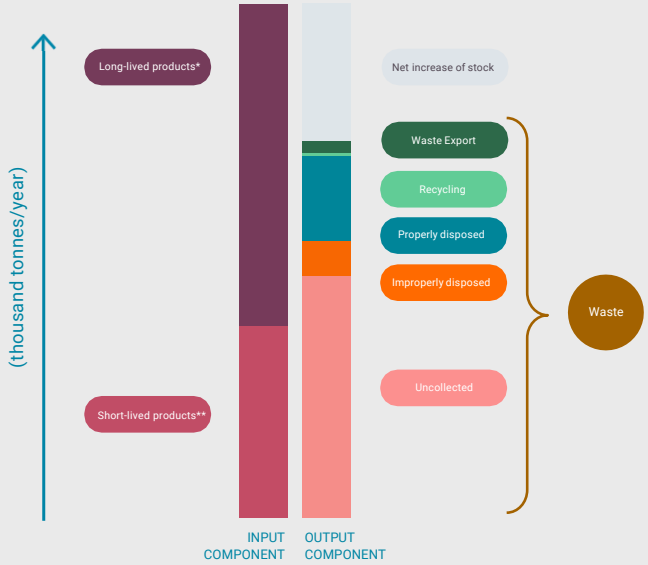


OBJECTIVE AND INSTRUCTIONS

Key question answered:

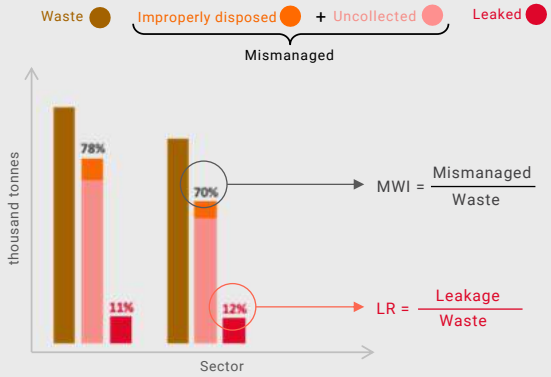
Which sectors are most critical in the country regarding plastic leakage?

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

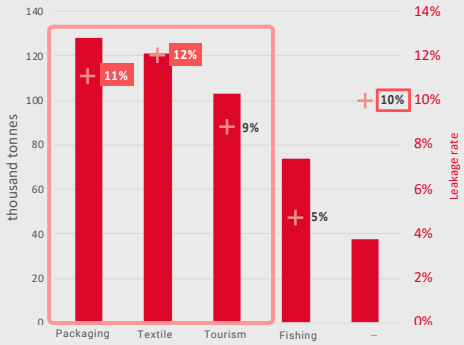


How to read the sector hotspot graph?

1. Determine leakage from mismanaged waste

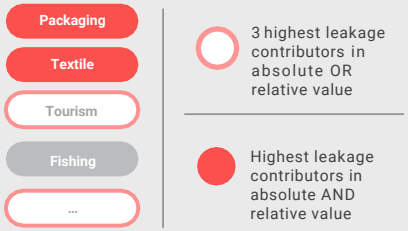


2. Focus on leakage and leakage rate

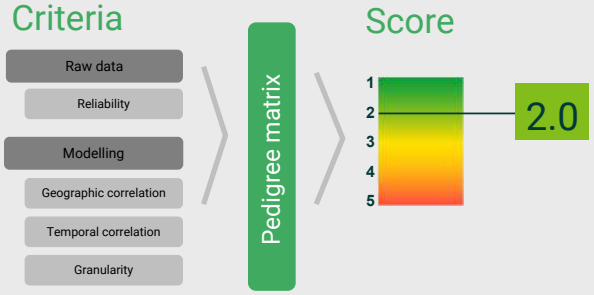


For more details, please read the Methodology

3. Select hotspots based on absolute and relative leakage

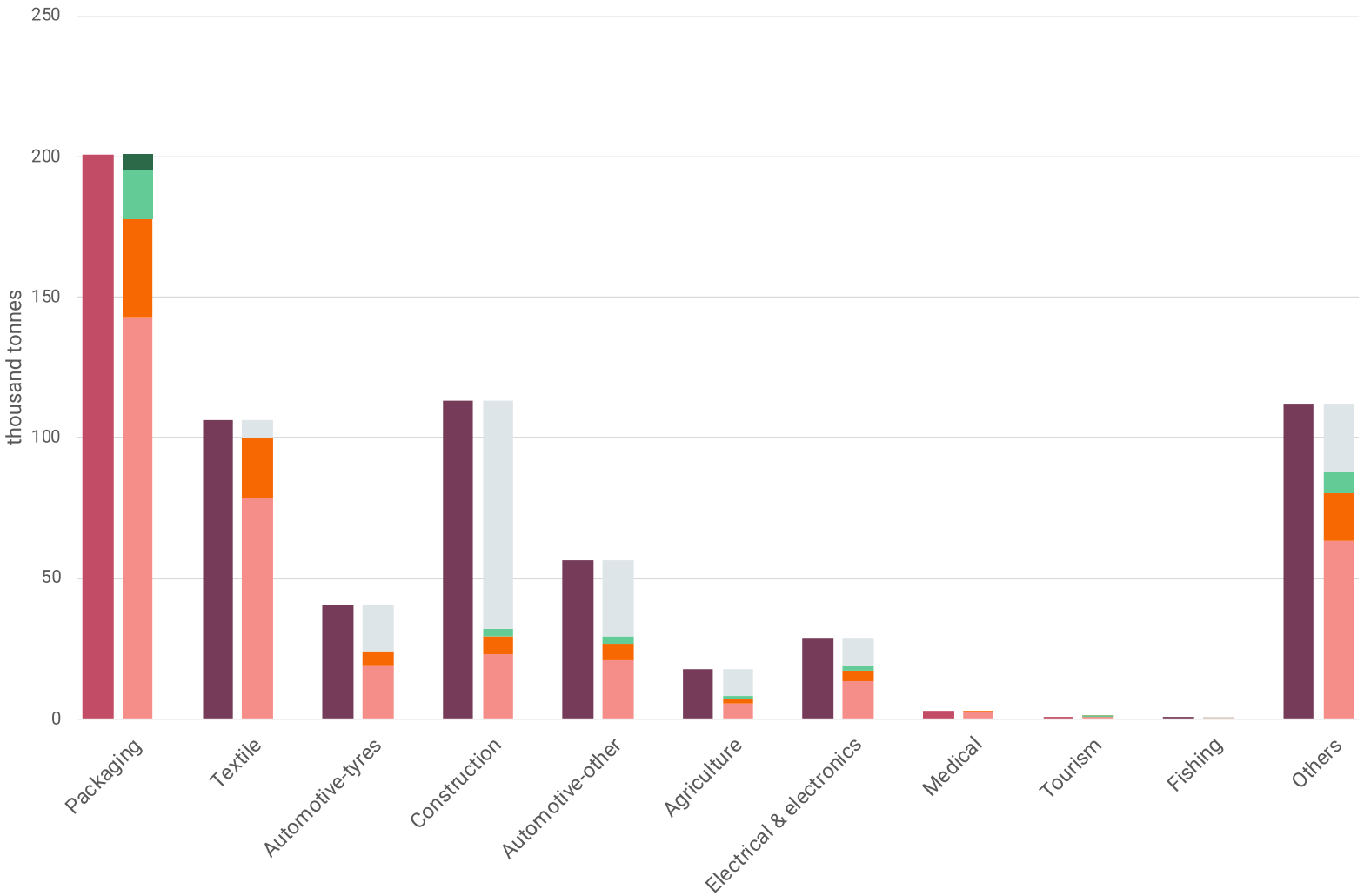


4. Assess the quality score of the results

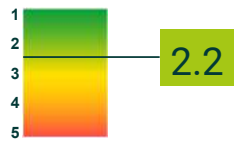


* **Short-lived products:** products that are disposed within the year of study (Life-time < 1 year)
** **Long-lived products:** products that are disposed after the year of study (Life-time > 1 year)

MASS BALANCE BY SECTOR [2018]



Quality Score



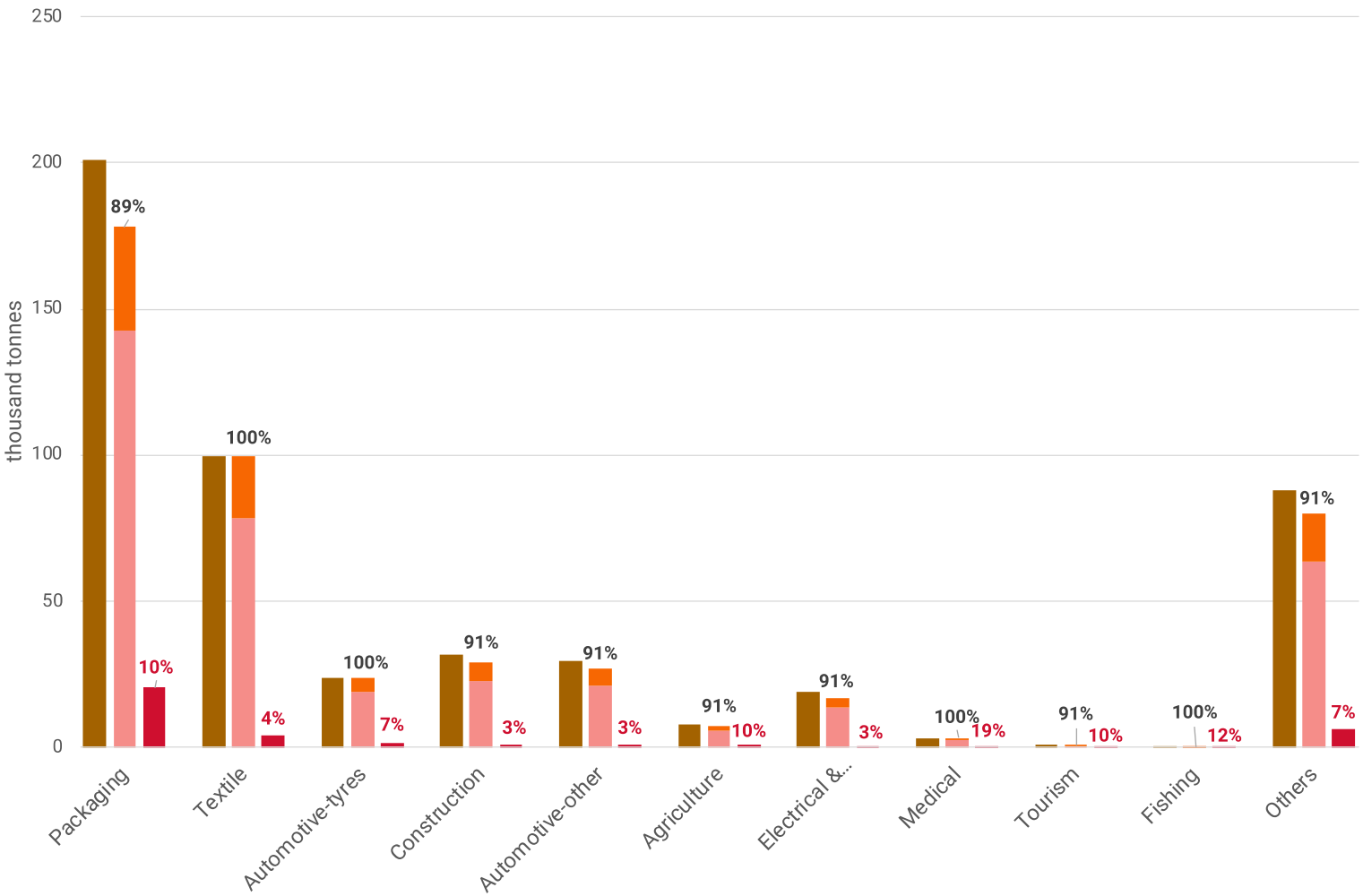
INPUT

- Short-lived products
- Long-lived products

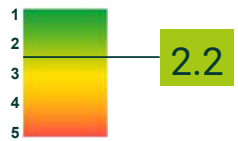
OUTPUT

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

MISMANAGED WASTE AND LEAKAGE BY SECTOR [2018]



Quality Score



Domestic waste

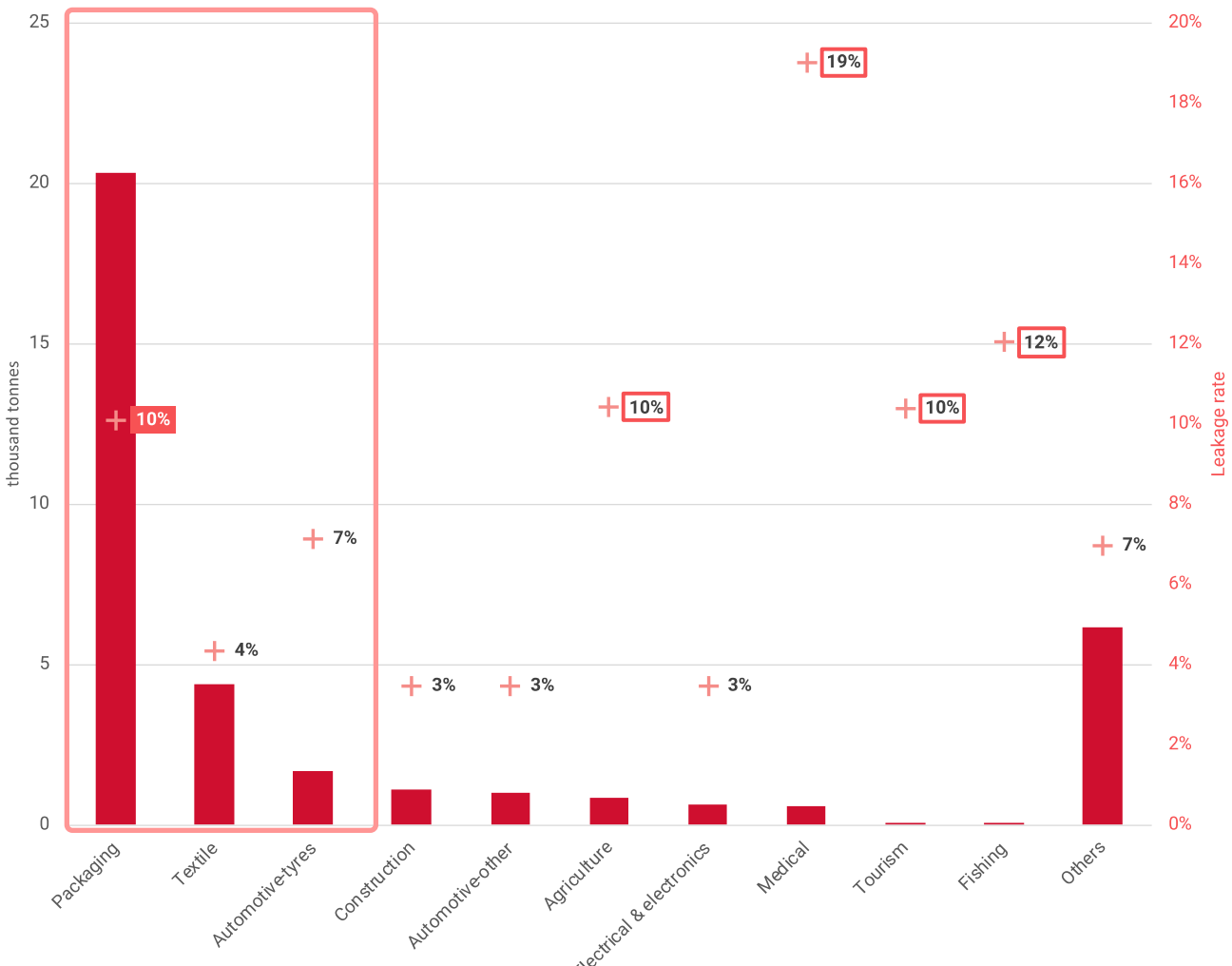
Improperly disposed + Uncollected = Mismanaged

Leaked

X% | Mismanaged Waste Index (MWI)

X% | Leakage Rate (LR)

SECTOR HOTSPOTS [2018]



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

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Quality Score

Key take-aways

- 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%).

SECTOR HOTSPOTS:
INTERPRETATION AND LIMITATIONS

Packaging

Learning

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.

Textile

Learning

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.

Medical

Limitation

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.

SECTOR HOTSPOTS:
INTERPRETATION AND LIMITATIONS

Fishing

Learning

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

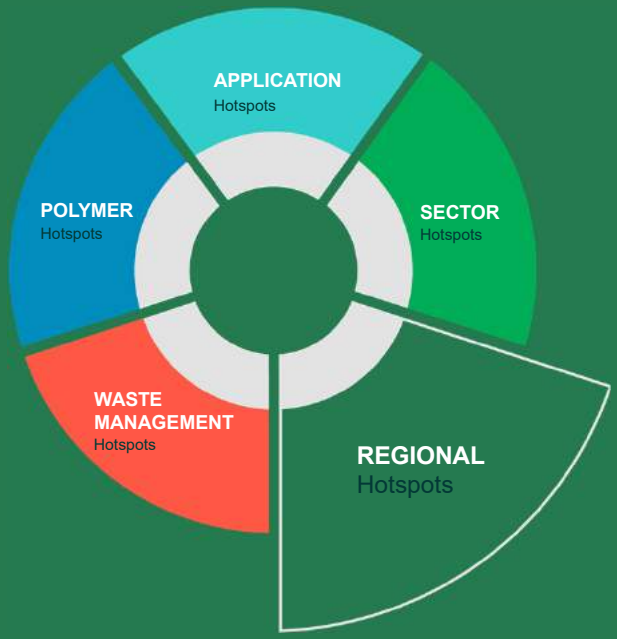
Limitation

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.

Unlocking limitations

Gather information on amount of tyres being burnt in kiln (properly disposed).
Investigate the rehread and reuse practices, which would lengthen the lifetime of tyres.

D REGIONAL HOTSPOTS

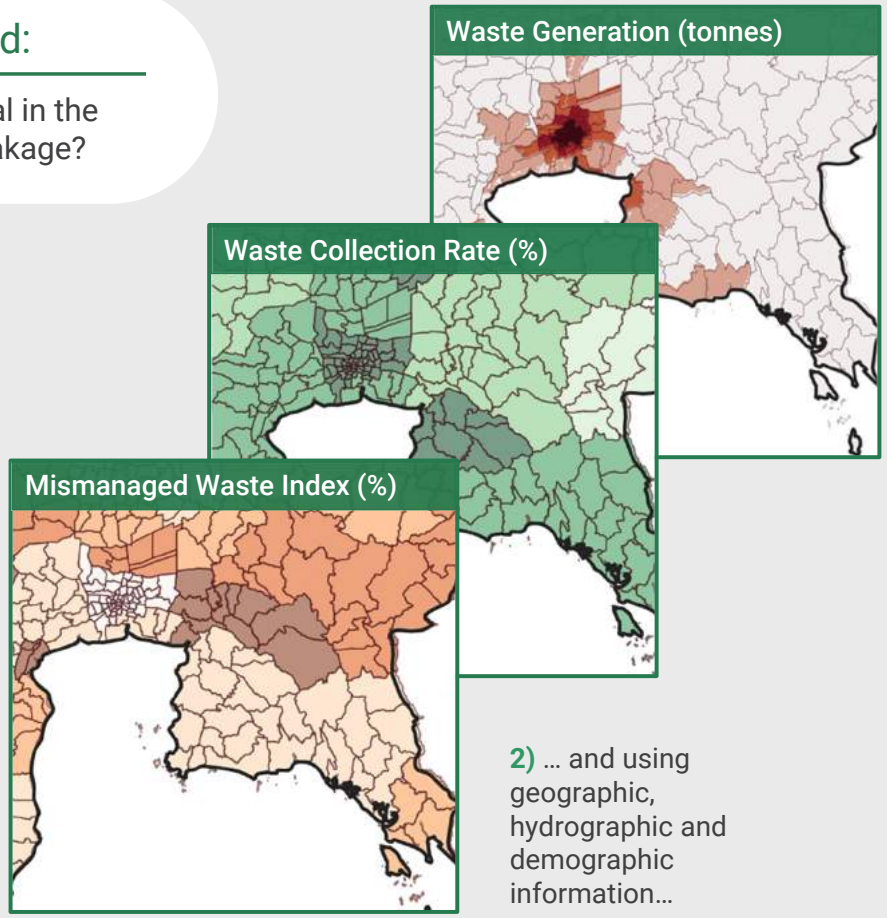


OBJECTIVE AND INSTRUCTIONS

Key question answered:

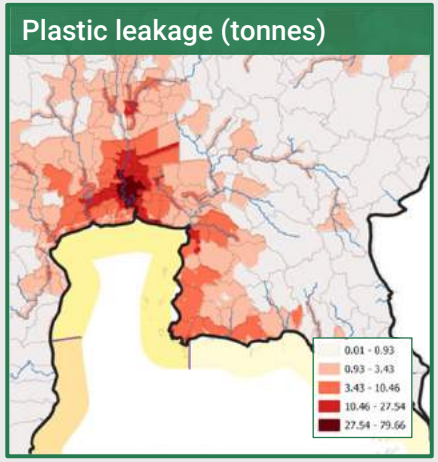
Which areas are most critical in the country regarding plastic leakage?

1) Overlaying different information available at city / district / sub-district level and/of modelled through archetypes…

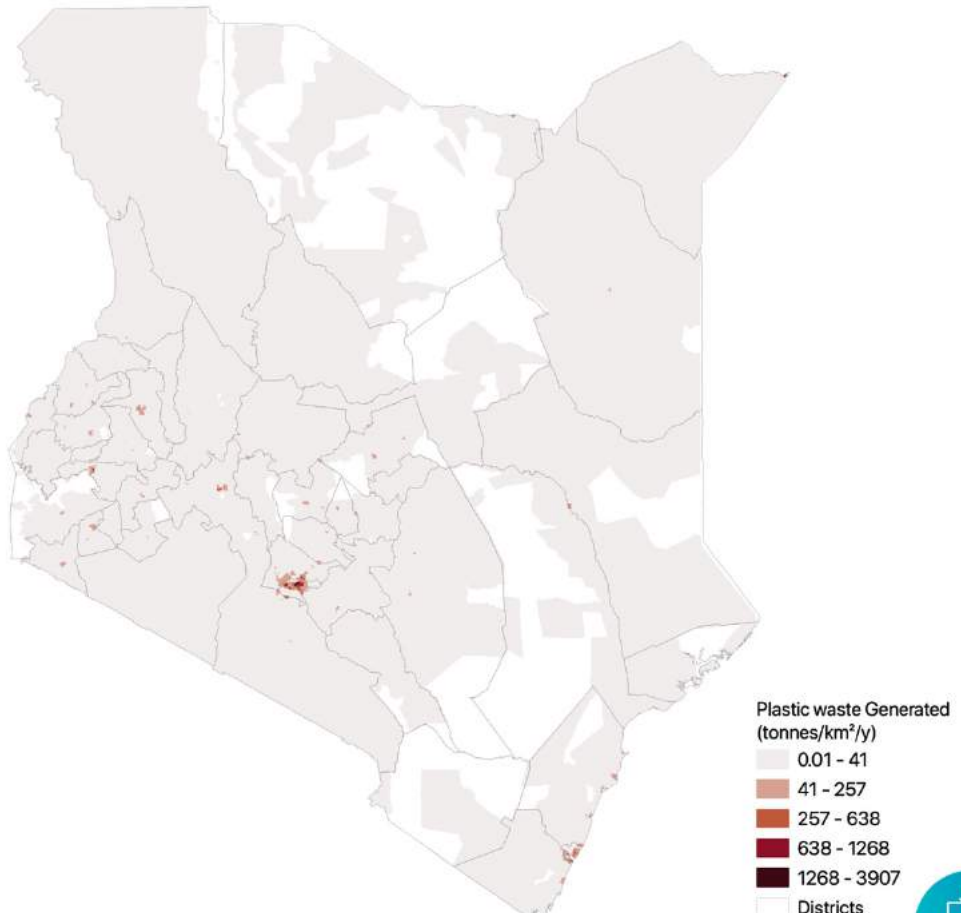


2) … and using geographic, hydrographic and demographic information…

3) … allows to compute a leakage map and identify regional hotspots



WASTE GENERATION:
MAP AND INTERPRETATIONS



More details available in Appendices

Key take-aways

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

Limitations

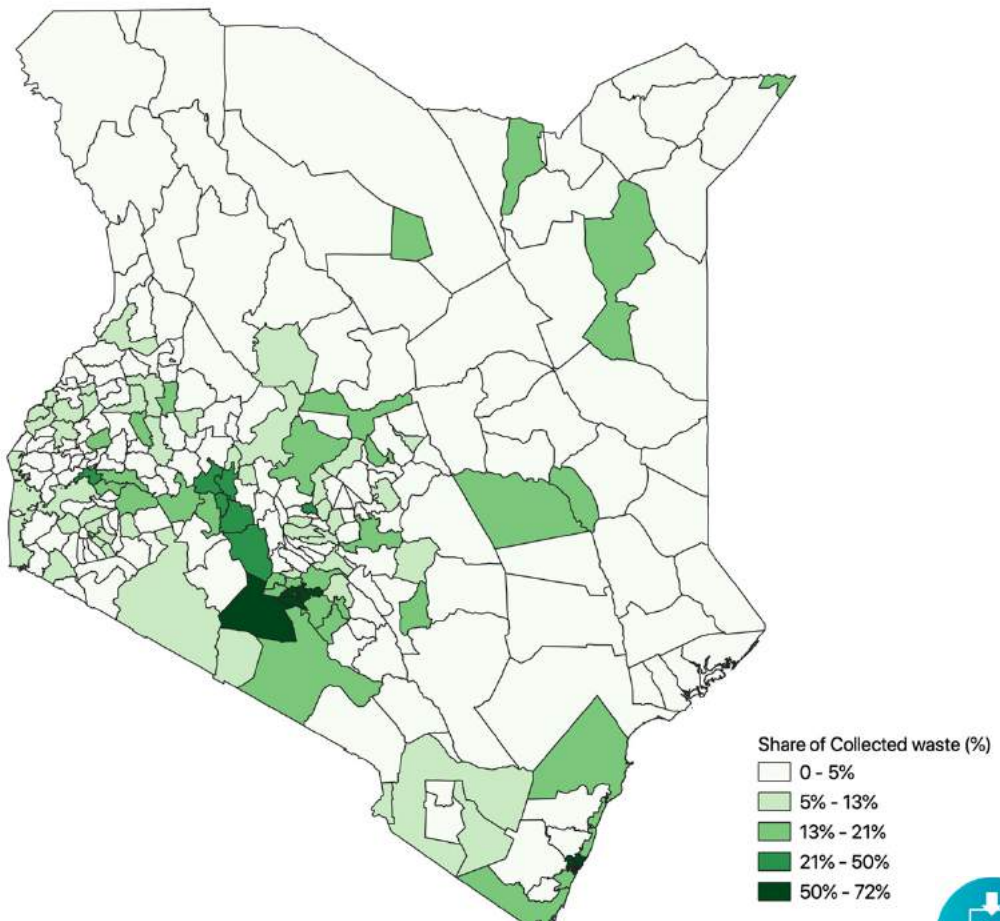
Due to lack of more granular data, we assumed all Kenyan cities to have the same per capita consumptions patterns. Similarly, all rural areas are considered alike, with no distinction made between touristic and non-touristic areas.

Unlocking limitations

Conduct waste generation carachterisation 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.

WASTE COLLECTION:
MAP AND INTERPRETATIONS

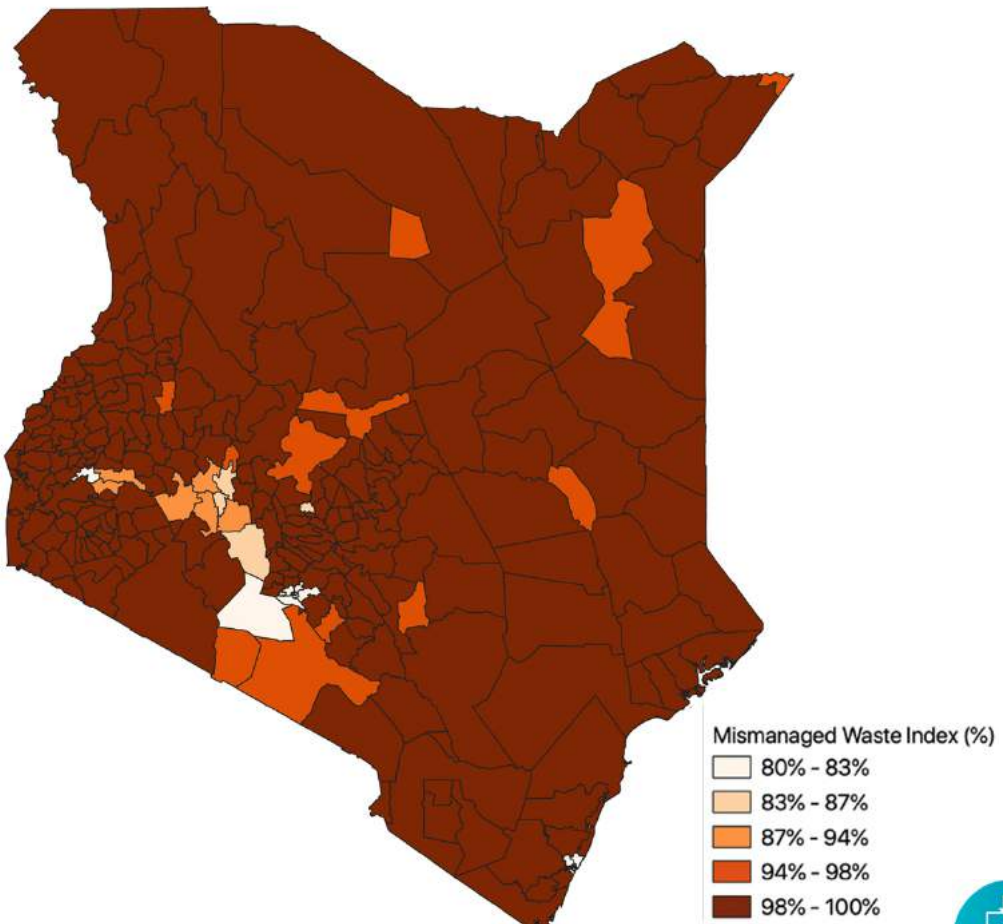


More details available in Appendices

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%.

MISMANAGED WASTE INDEX:
MAP AND INTERPRETATIONS



More details available in Appendices

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%

Learnings

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

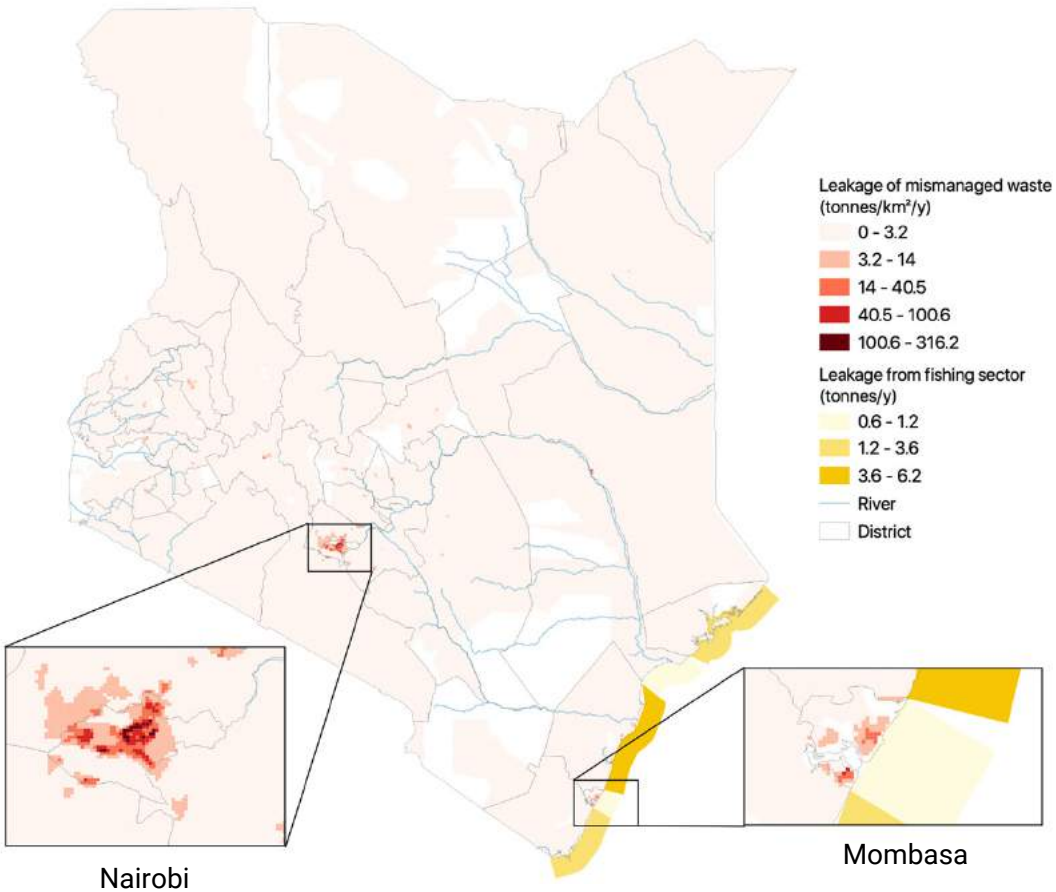
Limitations

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.

Unlocking limitations

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

REGIONAL LEAKAGE:
MAP AND INTERPRETATIONS



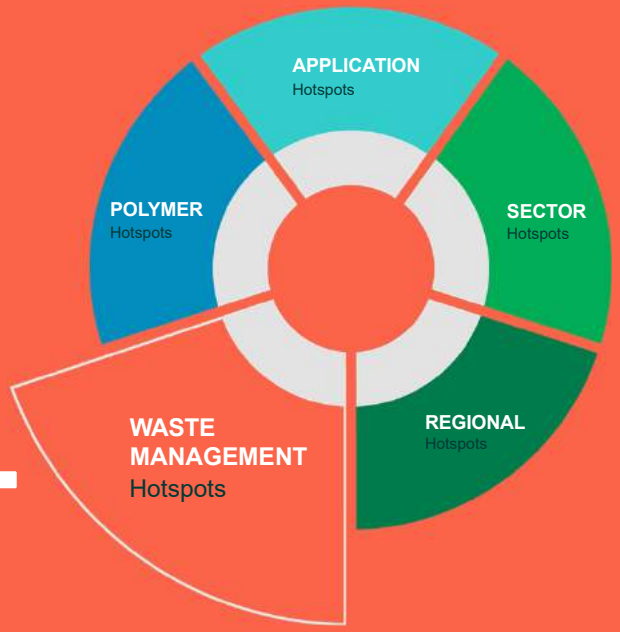
Key take-aways

- 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.

More details available in Appendices

E

WASTE MANAGEMENT HOTSPOTS



OBJECTIVE AND INSTRUCTIONS

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)

Waste management stage	Potential hotpsot	Is it a hotspot?	Justification	Source
Waste generation	Plastic waste import	HOTSPOT	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 850kt a year) and it does not recycled domestic waste (cit. VPA, VCCI). Domestic waste is recycled by the informal sector in improper conditions.	VPA interview and VCCI report VN_r14
	Plastic waste export			
	Plastic waste per capita generation		Vietnam produces around 50 kg of plastic waste per person per year	EA - Country baseline analysis
	Share of plastic in waste stream	HOTSPOT	Vietnam is a LMC (8% of plastic in waste stream on average), but the share of plastic in the waste stream is from 15% to 20% depending on the source	VN_r10 GA Circular summarises the waste characterisation studies

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

WASTE **GENERATION**	Plastic waste import	Plastic waste export	Plastic waste per capita generation	Share of plastic in waste stream
WASTE **SEGREGATION**	Segregation of compostable waste	Segregation of recyclable plastics	Segregation by the informal sector	Public infrastructure availability
WASTE **COLLECTION**	Formal collection of municipal waste	Formal collection of industrial waste	Value of recycled plastics	Value of non-recycled plastics
LEAKAGE WHILE **WAITING FOR COLLECTION**	Design of waste bins	Frequency of collection	Climatic conditions	Other (e.g. animals)
WASTE RELATED **BEHAVIOURS**	Littering driven by cultural habits	Littering due to a lack of public waste bins	Frequency of fly-tipping	Frequency of illegal burning
WASTE MANAGEMENT **INFRASTRUCTURE**	Share of waste in dumpsites	Share of waste in landfills	Informal recycling	Recycling capacity
POST-LEAKAGE MANAGEMENT	Frequency of city cleaning and sweeping	Frequency of waterway cleaning	Frequency of coastal clean-up	Frequency of other clean-up activities
WASTE WATER MANAGEMENT	Management of run-off waters	Waste water collection	Waste water treatment efficiency	Fate of WWTP sludges

*For detailed element descriptions and methodology, refer to tool T4.1

WASTE MANAGEMENT HOTSPOTS

SOURCE	WASTE **GENERATION**	Plastic waste import	Plastic waste export	Plastic waste per capita generation	Share of plastic in waste stream
COLLECTION	WASTE **SEGREGATION**	Segregation of compostable waste	Segregation of recyclable plastics	Segregation by the informal sector	Public infrastructure availability
	WASTE **COLLECTION**	Formal collection of municipal waste	Formal collection of industrial waste	Value of recycled plastics	Value of non-recycled plastics
	LEAKAGE WHILE **WAITING FOR COLLECTION**	Design of waste bins	Frequency of collection	Climatic conditions	Other (e.g. animals)
	WASTE RELATED **BEHAVIOURS**	Littering driven by cultural habits	Littering due to a lack of public waste bins	Frequency of fly-tipping	Frequency of illegal burning
END-OF-LIFE	WASTE MANAGEMENT **INFRASTRUCTURE**	Share of waste in dumpsites	Share of waste in unsanitary landfills	Informal recycling	Recycling capacity
	POST-LEAKAGE MANAGEMENT	Frequency of city cleaning and sweeping	Frequency of waterway cleaning	Frequency of coastal clean-up	Frequency of other clean-up activities
	WASTE WATER MANAGEMENT	Management of run-off waters	Waste water collection	Waste water treatment efficiency	Fate of WWTP sludges

Negative contribution to the leakage

Neutral contribution

Positive contribution

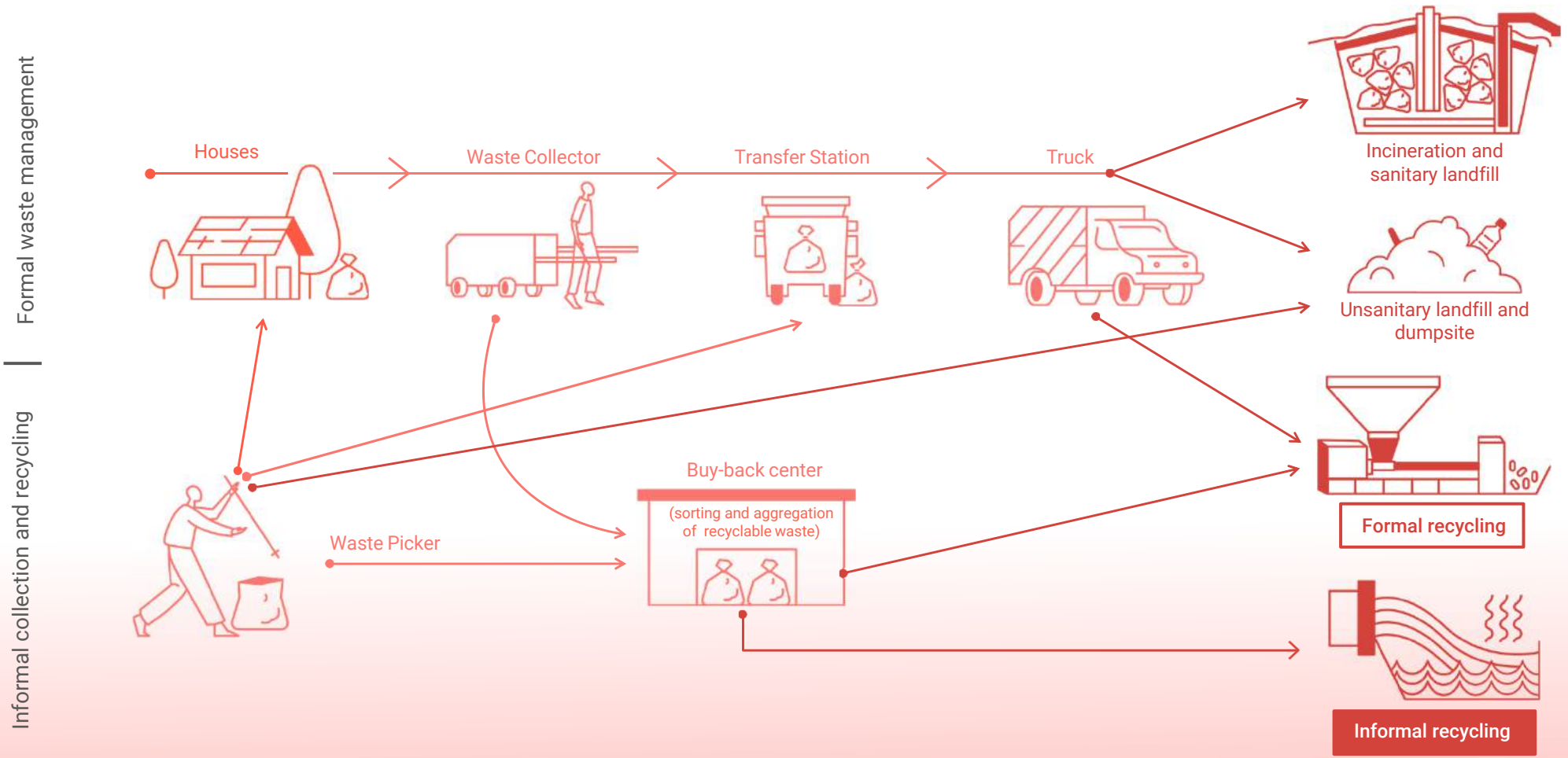
Not assessed

*For more details and justifications, check tool T4.1

Key take-aways

- 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.

PLASTIC WASTE JOURNEY IN PICTURES



Storage of recyclable waste

Informal settlement

Leakage to waterways

Burning of waste

2.3 ACTIONABLE HOTSPOTS

HOTSPOTS IN BRIEF

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
- Drinks bottles
- Fishing nets
- Boxes, cases, crates

Sector

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

Regional

Waste management

WASTE **GENERATION**	Plastic waste import	Plastic waste export	Plastic waste per capita generation	Share of plastic in waste stream
WASTE **SEGREGATION**	Segregation of compostable waste	Segregation of recyclable plastics	Segregation by the informal sector	Public infrastructure availability
WASTE **COLLECTION**	Formal collection of municipal waste	Formal collection of industrial waste	Value of recycled plastics	Value of non-recycled plastics
LEAKAGE WHILE **WAITING FOR COLLECTION**	Design of waste bins	Frequency of collection	Climatic conditions	Other (e.g. animals)
WASTE RELATED **BEHAVIOURS**	Littering driven by cultural habits	Littering due to a lack of public waste bins	Frequency of fly-tipping	Frequency of illegal burning
WASTE MANAGEMENT **INFRASTRUCTURE**	Share of waste in dumpsites	Share of waste in unsanitary landfills	Informal recycling	Recycling capacity
POST-LEAKAGE MANAGEMENT	Frequency of city cleaning and sweeping	Frequency of waterway cleaning	Frequency of coastal clean-up	Frequency of other clean-up activities
WASTE WATER MANAGEMENT	Management of run-off waters	Waste water collection	Waste water treatment efficiency	Fate of WWTP sludges

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Negative contribution to the leakage

Neutral contribution

Positive contribution

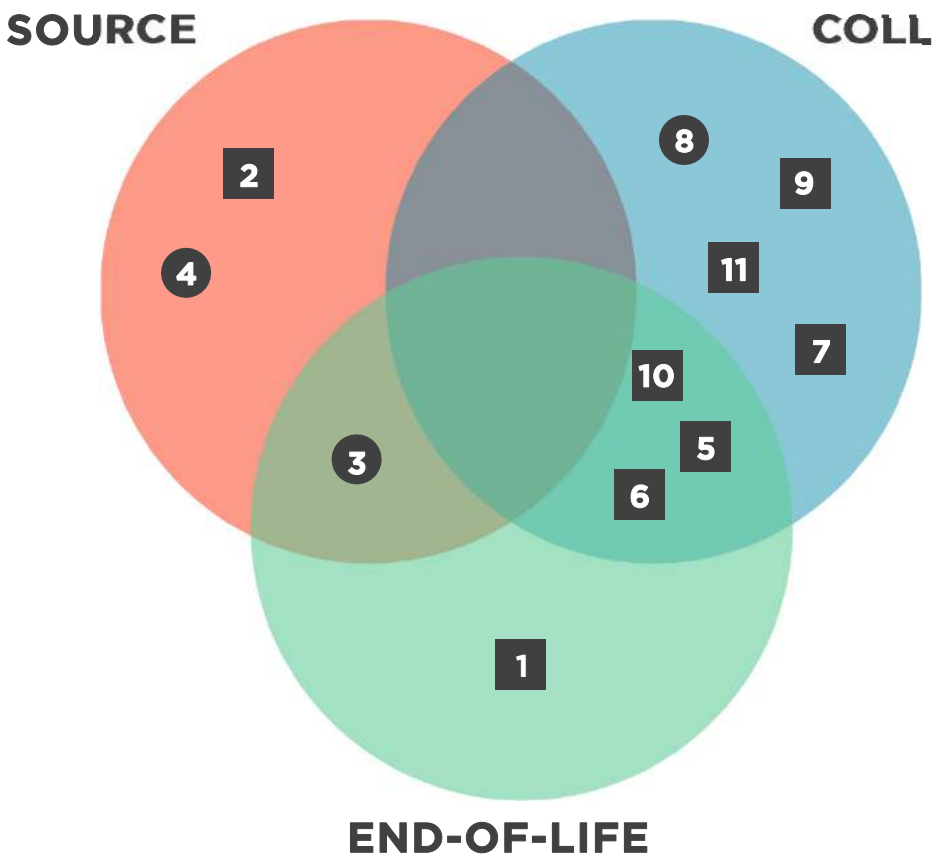
Not assessed

ACTIONABLE HOTSPOTS LIST

[#]	[ACTIONABLE HOTSPOT]	[■/●]
1	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.	■
2	Plastic is leaking from Kenyan cities due to a much higher plastic consumption than in rural areas.	●
3	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.	●
4	Plastic from the packaging sector leaks in Kenya due to higher consumption.	●
5	Lack of waste segregation reduces the quality and quantity of recyclable waste.	■
6	Burning of waste reduces the amount of waste being collected for recycling.	■
7	Widespread littering reduces the amount of waste collected for recycling.	■
8	In slums and informal settlements collection rates are extremely low and waste collection infrastructure is absent.	●
9	Low collection rates across the country reduce the amount of waste available to recyclers and increase leakage.	■
10	Business model for private collection companies does not incentivise disposal at landfills.	■
11	There is a lack of maintenance capacity for waste management equipment (e.g. waste trucks), which can lead to a disruption of waste collection.	■

■ **GENERIC**(Concerns all plastic types and all regions) ● **SPECIFIC**(Concerns specific plastic types and all regions)

ACTIONABLE HOTSPOTS CHARACTERISATION



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.

GENERIC (Concerns all plastic types and all regions)

SPECIFIC (Concerns specific plastic types or regions)

3 SHAPING ACTION

3.1 INTERVENTIONS

METHODOLOGY FOR IDENTIFYING INTERVENTIONS

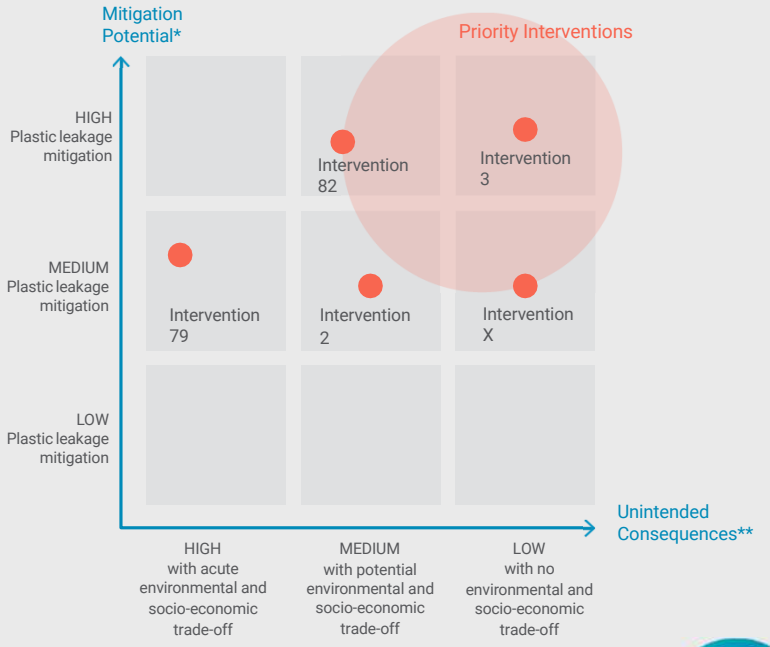
STEP 1: choose up to 3 interventions for each actionable hotspot

STEP 2: assess criteria levels for each chosen intervention

Actionable hotspots (AH)
AH 1
AH 2
AH 3
...
AH x

Interventions (I)	Leakage mitigation potential*	Unintended consequences**
I1		
I2	medium	medium
I3	high	low
I4		
I5		
...		
I79	medium	high
I80		
I81		
I82	high	medium
I83		

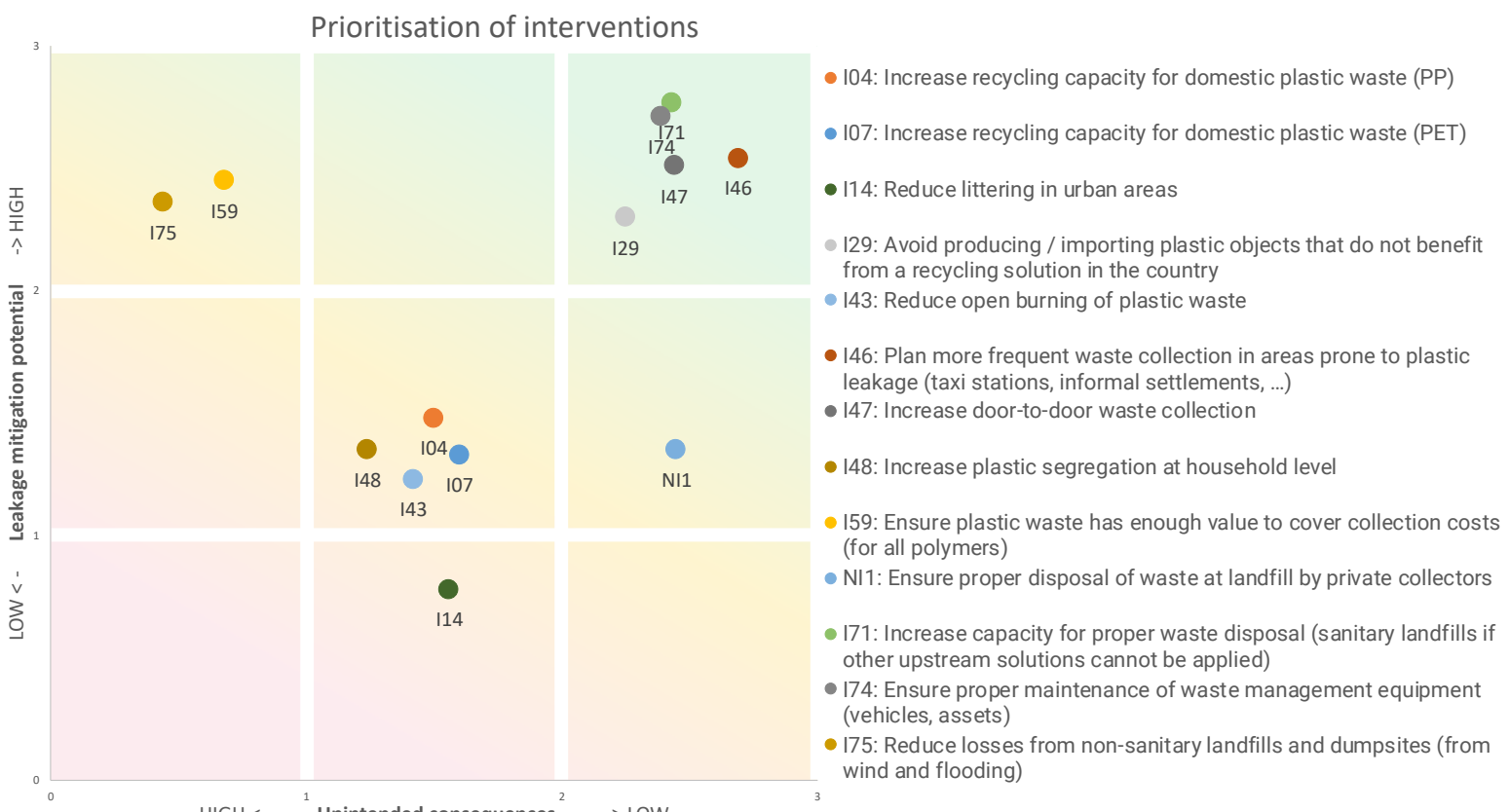
STEP 3: visualise priority interventions in the top right corner of the chart



* **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).

S2

PRELIMINARY SELECTION OF INTERVENTIONS



- 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)

Learning

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.

Limitations

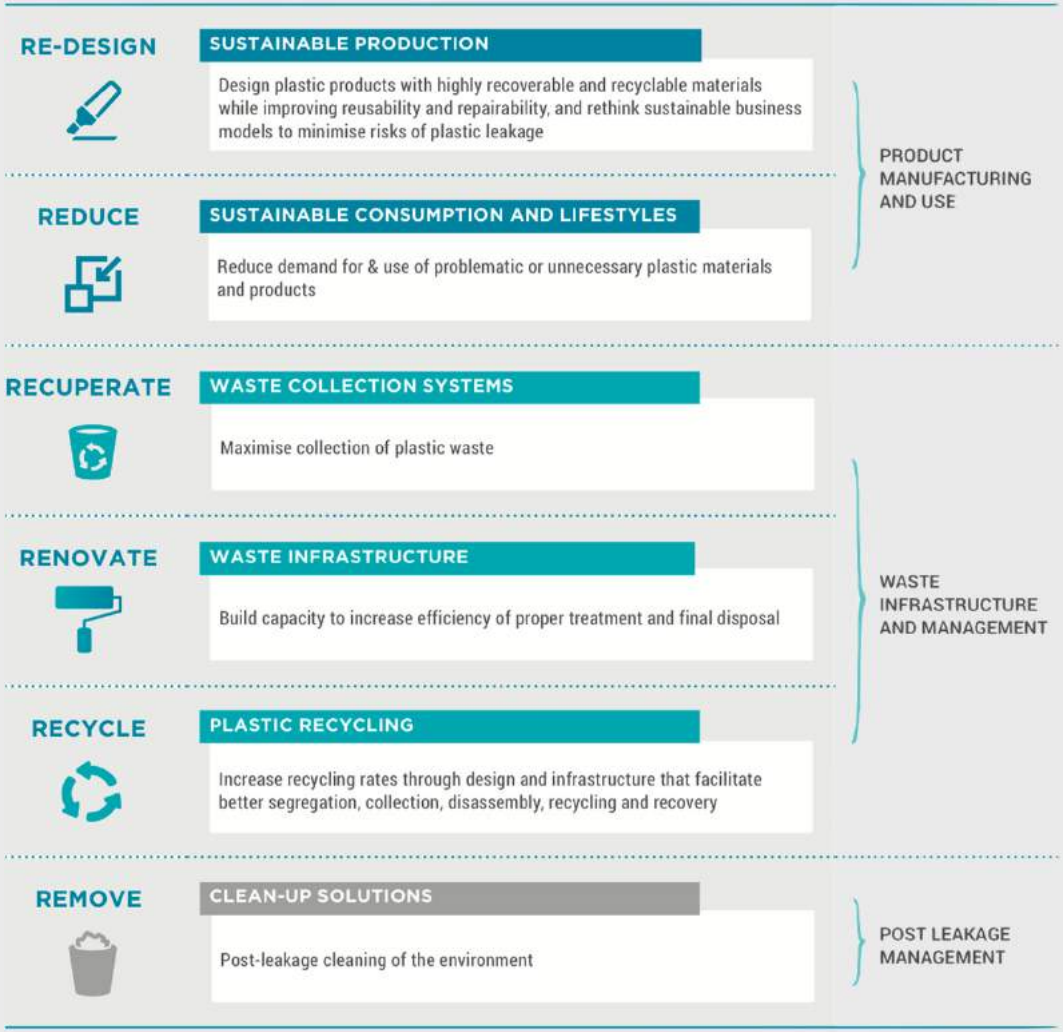
The list of interventions results from the hotspot analysis ; it is currently based on the author perception. A final version of the interventions should be elaborated through a multi-stakeholder consultation process.

Unlock button

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

INTERVENTIONS CLASSIFICATION

Interventions may occur at any point along the value chain.
We categorise them into six types of approaches along the value chain.



S2

PRELIMINARY PRIORITY INTERVENTIONS LIST

[INTERVENTION CLASS]	[PRIORITY INTERVENTION]	[CODE]
SUSTAINABLE PRODUCTION	Avoid producing or importing plastic objects that do not benefit from a recycling solution in the country	**I29**
WASTE COLLECTION SYSTEMS	Plan more frequent waste collection in areas prone to plastic leakage	**I46**
	Increas door-to-door waste collection	**I47**
	Ensure proper disposal of waste at landfill by private collectors	**NI1**
WASTE INFRASTRUCTURE	Increase capacity for proper waste disposal (sanitary landfills if other upstream solutions cannot be applied)	**I71**
	Ensure proper maintenance of waste management equipment (vehicules, assets)	**I74**

3.2 INSTRUMENTS

METHODOLOGY FOR IDENTIFYING INSTRUMENTS

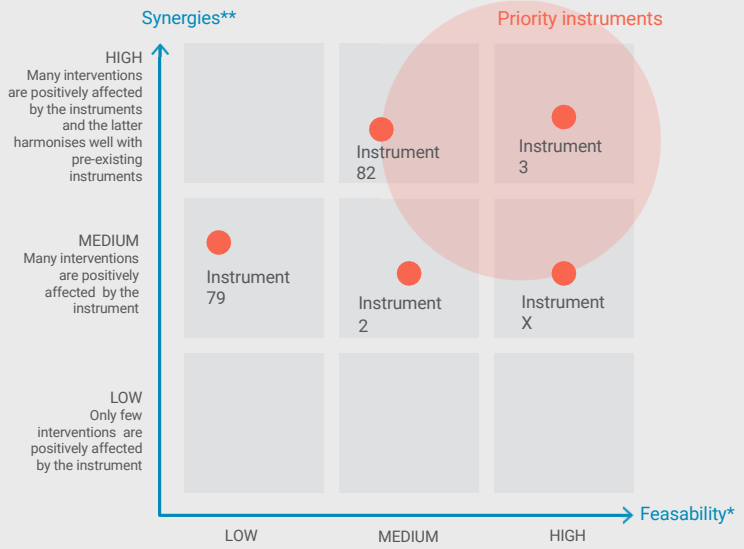
STEP 1: choose up to 3 instruments for each intervention selected in S2

STEP 2: assess criteria levels for each chosen instrument

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

Intervention (I)
I2
I3
...
I79
I82

Instruments (J)	Feasability*	Synergies**
J1		
J2	medium	medium
J3	high	high
J4		
J5		
...		
J79	medium	low
J80		
J81		
J82	high	medium
J83		

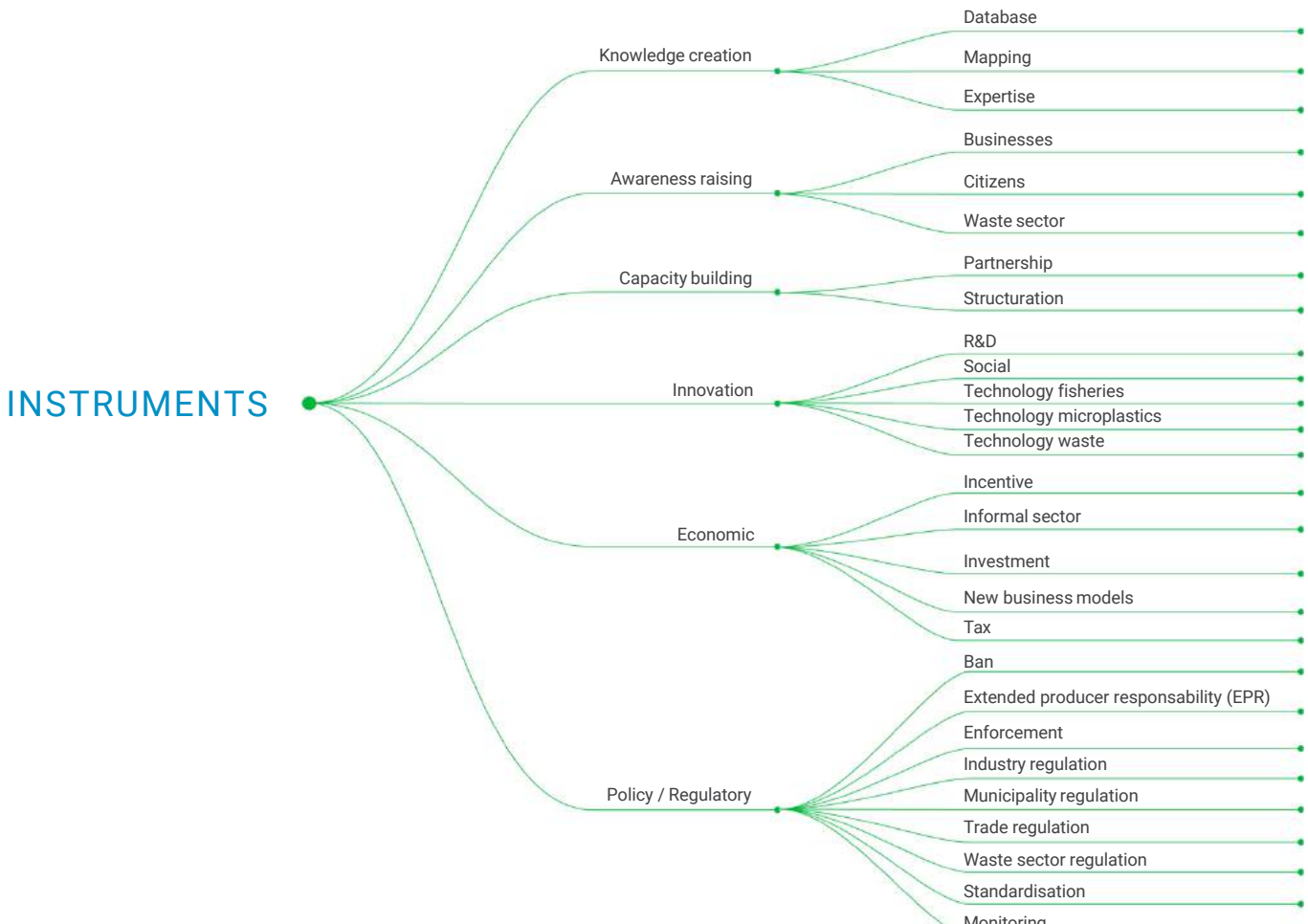


* **Feasability:** technical and socio-economic assessment of each instrument should be performed. We do not assert a method to perform the assessment as this is beyond the scope of the Guidance. The user can decide on the method to use based on resources available. A by default qualitative assessment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

S3

LIST OF POSSIBLE INSTRUMENT CATEGORIES



S3

4 APPENDICES

4.1 DATA REPOSITORY

DETAILED SHARES BY POLYMER

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

- **Waste** = Collected + Uncollected
- **Collected** = Domestic recycling of collected + Export of collected + properly disposed + Improperly disposed
- **Mismanaged** = Improperly disposed + Uncollected

WASTE MANAGEMENT BY GEOGRAPHICAL ARCHETYPE

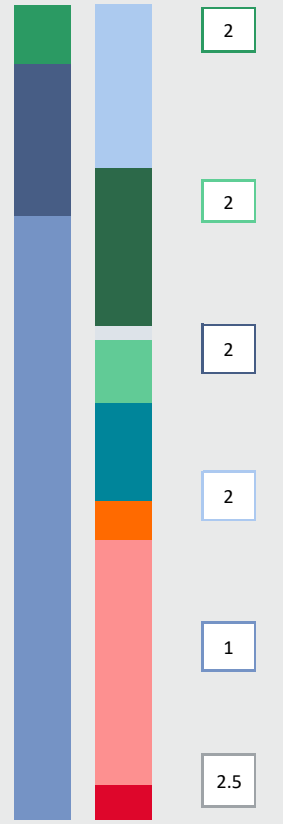
Archetypes	Population 2020	Generated t	Collected t	Collected for recycling t	Properly disposed t	Improperly disposed t	Uncollected t	Mismanaged t	Leaked t	Generated kg/hab	Collected for recycling kg/hab	Mismanaged kg/hab	Share of collected	Share of mismanaged
Mombasa	665449	19915	14275	3799	0	10475	5641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

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)

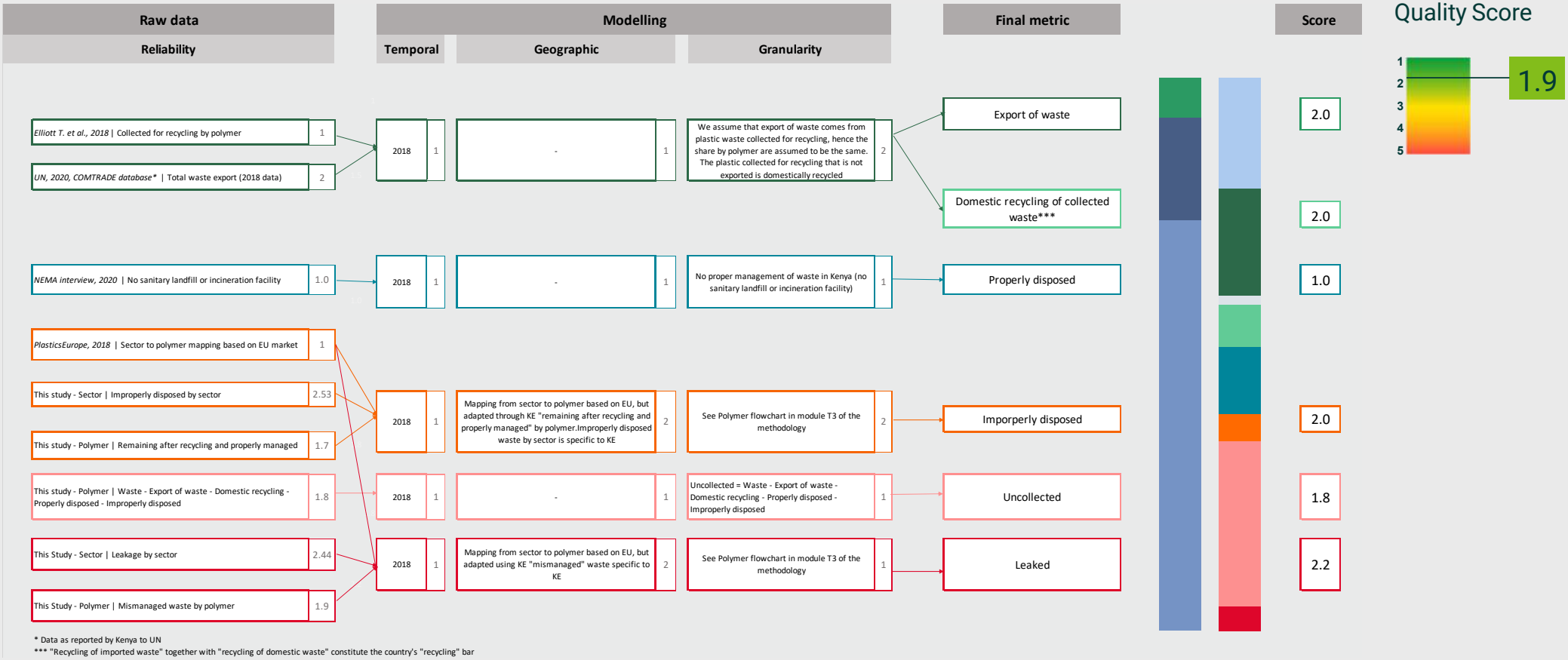
Raw data		Modelling			Final metric	Score
Reliability		Temporal	Geographic	Granularity		
*UN, 2020, COMTRADE database** | Total waste import (2018 data)	2	2018 1	- 1	Total import and export are given by comtrade code 3915. We assume that the waste is imported for recycling, and we fix the share of import by polymer based on the share of plastic recycled. 2	Import of waste	2
Elliott T. et al., 2018 | Share by polymer of plastic collected for recycling	1					
This study - Polymer | Import of waste by polymer	2	2018 1	- 1	Recycling of imported waste = Import of waste 2	Recycling of imported waste***	2
UN, 2020,, COMTRADE database * | Import products (sometimes polymer is known) (2018 data)	2	2018 1	When polymer is not specified: PlasticsEurope matrix used to assign polymer based on sector. 2	See Comtrade flowchart in modules T1, T3 of the methodology 2	Import of products	2
PlasticsEurope, 2018 | Polymers to Sectors correspondence matrix	1					
UN, 2020, COMTRADE database * | Export of products (polymer can be unknown) and primary (2018 data)	2	2018 1	For products for which the polymer is not specified: PlasticsEurope matrix used to assign polymer based on sector. 2	See Comtrade flowchart in module T1, T3 of the methodology 2	Export of primary and products	2
ICIS, 2020 | Production quantity per polymer (no rubber)	1	2018 1	- 1	Production of plastic by polymer coming from ICIS. We consider that there is no production of Synthetic Rubber 1	Import and production of primary	1
This Study - Sector | Change in Stock by sector	2.5	2018 1	Mapping from Sector to Polymer based on EU, but adapted through KE net input by polymer 2.5	- 1	Change in stock	2.5
This Study - Polymer | Net input**	1.8					



Quality Score

* Data as reported by Kenya to UN
** Net input = 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" bar

POLYMER HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

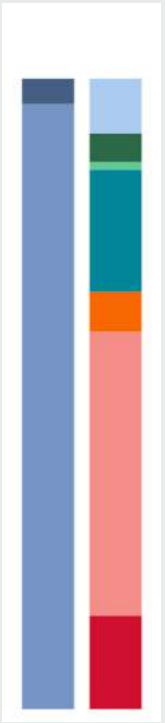


* Data as reported by Kenya to UN

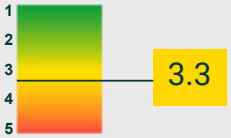
*** "Recycling of imported waste" together with "recycling of domestic waste" constitute the country's "recycling" bar

APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

Raw data		Modelling			Final metric	Score
Reliability		Temporal	Geographic	Granularity		
*UN, 2020, COMTRADE database** | Import and export of products	2	2018 1	- 1	See Comtrade flowchart in module T1, T3 of the methodology. Granularity is not as refined as necessary in order to inform action. 4	Import of products	4
					Export of products	4
This study – Sector | Waste from Packaging and Tourism sector	2.5	2018 1	- 1	For Packaging applications : Production = Waste + Export - Import. Waste = Waste from Packaging and Tourism * Share of import/export by application. For other application see additional notes 5	Production from primary	5
This study – Application | Share of import/export by application in Packaging sector	4					

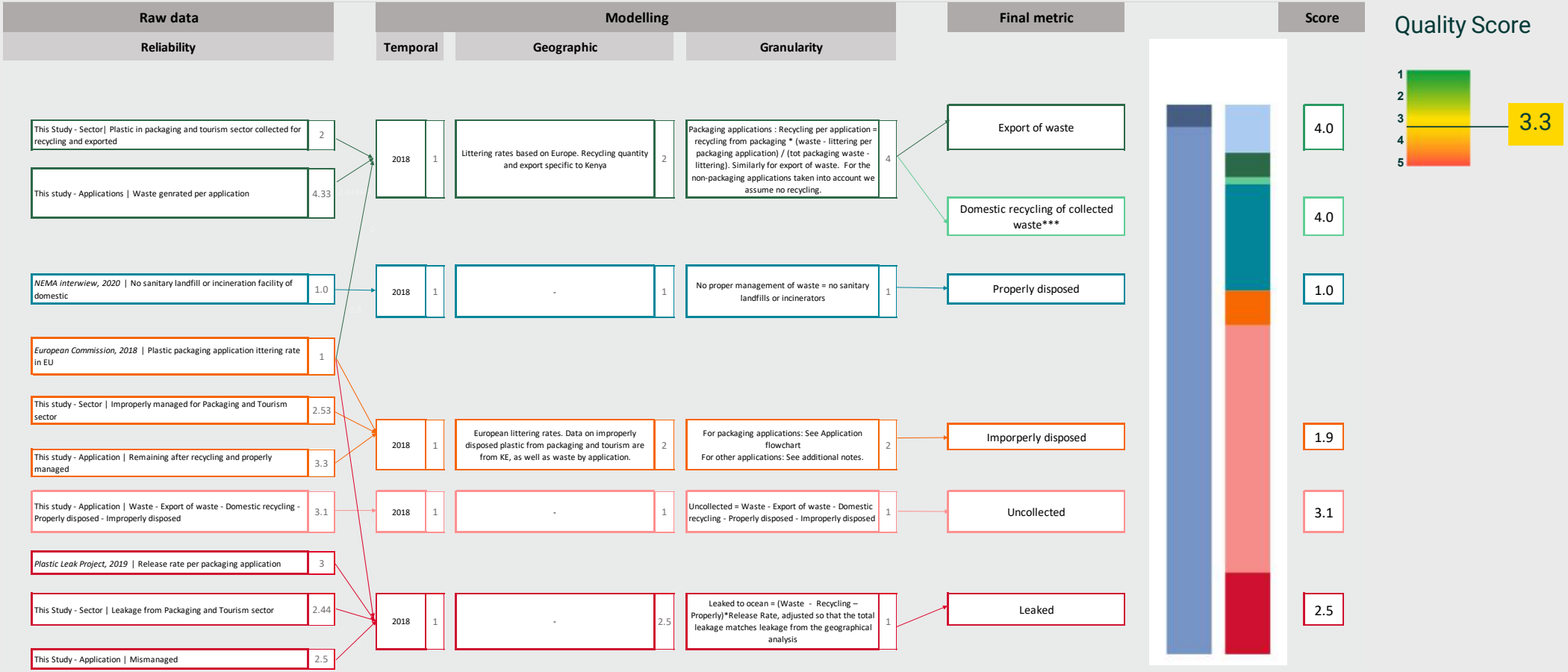


Quality Score



* Data as reported by Kenya to UN

APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)



Quality Score

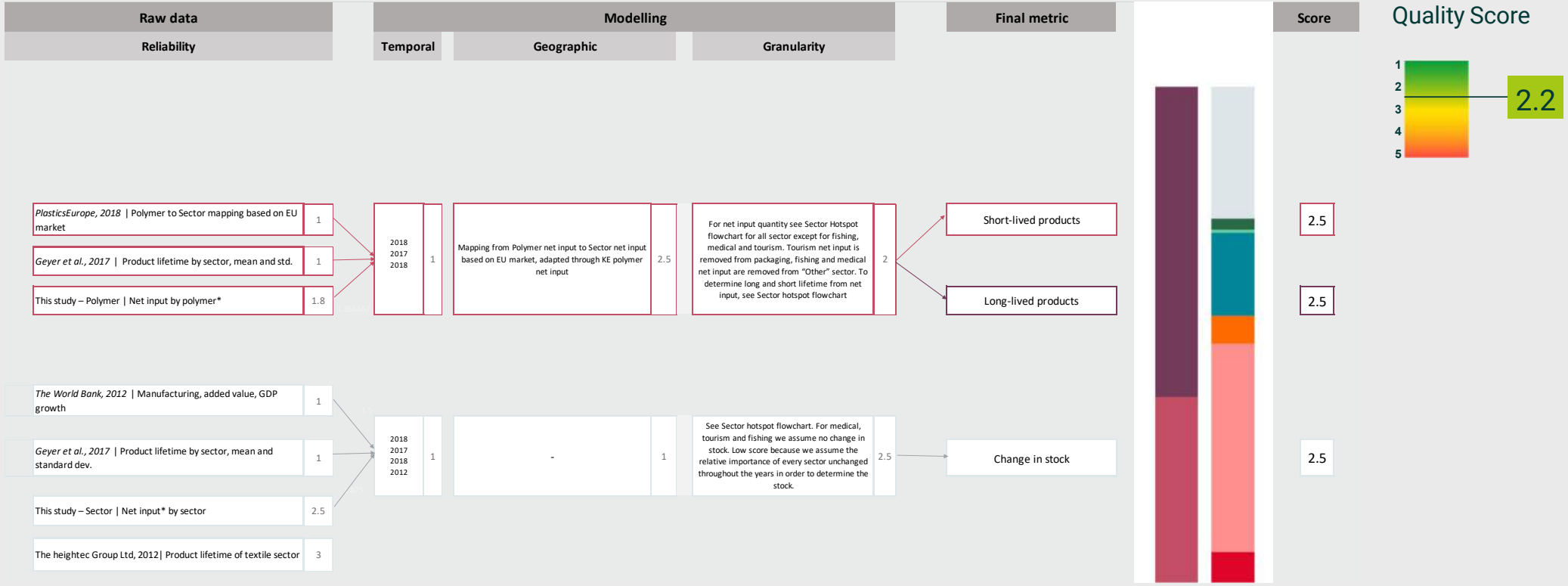
APPLICATION HOTSPOTS
MODELLING NOTES

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% (*EuropeanCommission, 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 de 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 21% (*EuropeanCommission, 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 de total leakage.

Baby diapers: To determine de waste generation we consider that the middle and high income population (55%) from 0-2 years old (half of the 0-4 pop 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 de total leakage

SECTOR HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

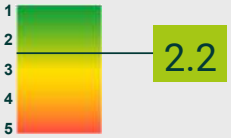


SECTOR HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Raw data		Modelling			Final metric	Score
Reliability		Temporal	Geographic	Granularity		
Elliott T. et al., 2018 | Plastic collected for recycling from packaging sector, and plastic collected for recycling from all other sectors	1	2018 1	- 1	Packaging: we use collected for recycling coming from Eunomia and we assume that export of waste comes from here (because it has most of the country's recycling). We assume that Synthetic Rubbers and Textiles are not recycled. For the remaining sectors we distribute the remaining recycling quantity from Eunomia based on the waste generated by sector. 2	Export of waste	2
*UN, 2020, COMTRADE database** | Total export of plastic waste (data 2018)	2					
This study - Sector | Waste generated by sector	2.5				Domestic recycling of collected waste***	2
NEMA interview, 2020 | No sanitary landfill or incineration facility in Kenya	1	2018 1	- 1	No sanitary landfill or incinerator facility -> No properly managed waste 1	Properly disposed	1.0
This Study - Sector | Micro-leakage by sector (see additional notes)	2.5	2018 1	Country specific littering habits are not accounted for 2	See Sector flowchart in module T3 of the methodology. 2	Improperly disposed	2.5
This study - Regional | Total plastic being improperly disposed	3					
This study - Sector | Waste - Properly managed - Recycled - Export of Waste	1.6					
Plastic Leak Project, 2019 | Littering rate by sector	3.0					
This study - Sector | Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	2.0	2018 1	- 1	Uncollected = Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed 1	Uncollected	2
This Study - Sector | Mismanaged	2.3	2018 1	- 1	For Micro-leakage computation see additional notes, for Macro-leakage see sector hotspot flowchart, except for fishing (see additional notes) 2	Leakage	2.4
Plastic Leak Project, 2019 | Release Rate by sector (base on product size and value for informal recyclers)	3					
This Study - Regional | Total macro-leakage from mismanaged waste	2					

** Net input = 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" bar

Quality Score



SECTOR HOTSPOTS
MODELLING 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 excessevely 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.

SECTOR HOTSPOTS
MODELLING NOTES (2/2)

Micro-leakage contribution

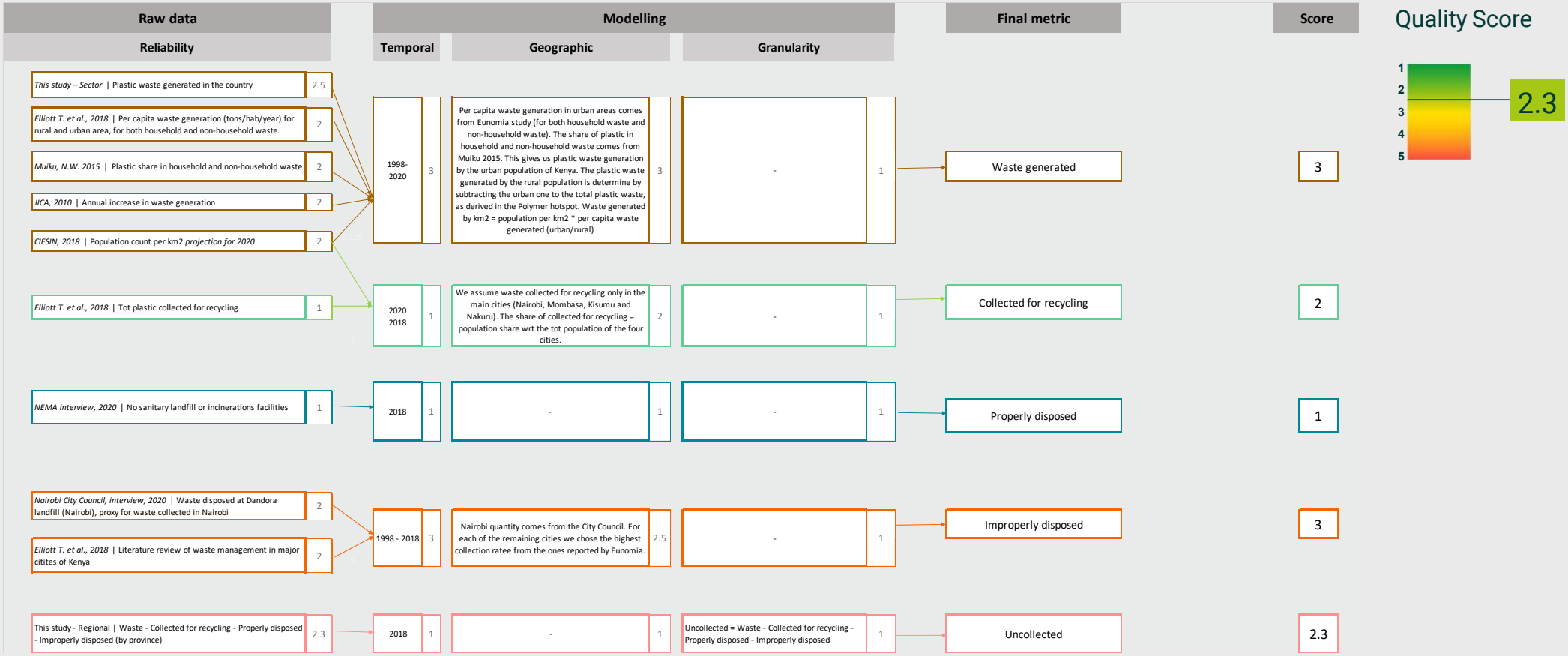
- **Tyre dust:** loss and leakage of synthetic rubbers particles from tyres to the marine environment is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in "Automotive-tyres". Data on vehicles numbers as well as average distance travelled are based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

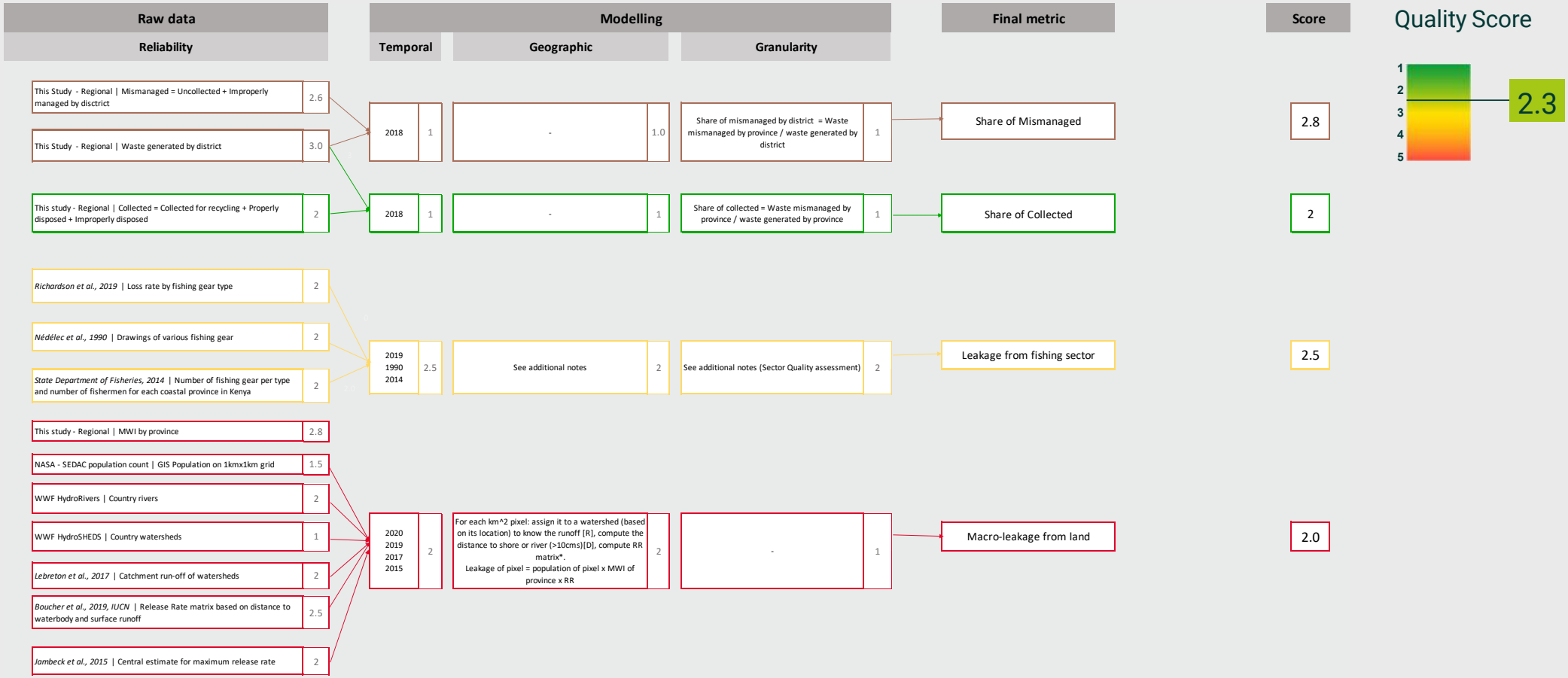
- **Pellets:** loss and leakage the marine environment of plastic pellets during transportation and production stages is calculated based on the methodology described in *PLP (2019)*. Its contribution to leakage is included in "Others".

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)



Quality Score

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)



*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)

REGIONAL HOTSPOTS
MODELLING NOTES (2/2)

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)

Boopendranath, M. (2012). Basic principle of fishing gear desing and classification.

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

Center for International Earth Science Information Network - CIESIN - Columbia University. 2018. Population Estimation

Service, Version 3 (PES-v3). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4DR2SK5.

Clean Virginia Waterways, Longwood University (2008). Cigarette butt litter. Available at: http://www.longwood.edu/cleanva/cigbutthowmany.htm

Elliott, T., Ettlinger, S., Blacklaws, K., Kibara, S., Ndirangu, E., & Chege, W. (2018). Plastic Packaging Waste Flows in Kenya. Eunomia Research & Consulting Ltd, 37.

Espinosa-Valdemar, R. M et al. (2015). Assessment of gardening wastes as a co-substrate for diapers degradation by the fungus Pleurotus ostreatus. Sustainability, 7(5), 6033-6045.

European Commission (2018). Plastics: Reuse, recycling and marine litter, final report. ICT, Eunomia.

FAO (2015). Marine Fisheries Management Plan of Thailand: A National Policy for Marine Fisheries Management 2015-2019. Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand.

Geyer, R. et al. (2017). Production, use, and fate of all plastics ever made. Science advances, 3(7), e1700782.

ICIS, Independent Commodity Intelligences Services. Plastic production in Kenya for 2018. https://www.icis.com/explore/

Jambeck, J. et al.. (2015). Plastic waste inputs from land into the ocean. Science, 347(6223), 768-771.

JICA, Japan International Cooperation Agency (2010). Preparatory survey for integrated solid waste management in Nairobi city in the republic of Kenya.

Kaza, S. et al (2018). What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050. Urban Development;. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/30317 License: CC BY 3.0 IGO.

Kishan, W. et al. (2018). Design characteristics and technical specifications of mackerel gill nets of Sindhudurg, Maharashtra. Journal of Experimental Zoology, India, 21(1), 373-378.

KNBS, Kenya National Bureau of Statistics (2018). Statistical Abstract 2018.

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.

Lau, W. W. et al. (2020). Evaluating scenarios toward zero plastic pollution. Science, 369(6510), 1455-1461.

Lebreton, L. C et al. (2017). River plastic emissions to the world's oceans. Nature communications, 8, 15611.

Lehner, B. et al. (2008): New global hydrography derived from spaceborne elevation data. Eos, Transactions, AGU, 89(10): 93-94. Data is available at www.hydrosheds.org.

BIBLIOGRAPHY (2/3)

Mendoza, J. M. F. et al. (2019). Improving resource efficiency and environmental impacts through novel design and manufacturing of disposable baby diapers. Journal of Cleaner Production, 210, 916-928.

Mukui, N. W. (2015). Mass balance of plastics: case study for Nairobi city (Doctoral dissertation, University of Nairobi).

Nédélec, C., & Prado, J. (1990). Definition and classification of fishing gear categories (No. 222). FAO.

Notter et al. (2019). Updated Transport Data in Kenya 2018: An Overview. GIZ TraCS project.

PlasticsEurope (2018). Plastic - the Facts 2018.

PLP (2019). Plastic Leak Project. (https://quantis-intl.com/metrics/initiatives/plastic-leak-project/).

Prado, J. et al. (1990). Fisherman's workbook. Fishing News Books.

Queirolo, D. et al. (2009). Improved interspecific selectivity of nylon shrimp (Heterocarpus reedi) trawling in Chile. Latin American Journal of Aquatic Research, 37(2), 221-230.

Richardson, K. et al. (2019). Estimates of fishing gear loss rates at a global scale: A literature review and meta-analysis. Fish and Fisheries, 20(6), 1218-1231.

State Department of Fisheries (2014). Marine artisanal fisheries frame survey 2014 report.

The heightec Group Ltd (2012). Lifespan of textile products. Retrieved from: https://www.heightec.com/app/uploads/Lifespan-of-textile-products.pdf

The World Bank, World Development Indicators (2012). Industry (including construction), value added (annual % growth). Retrieved from https://data.worldbank.org/indicator/NV.IND.TOTL.KD.ZG

Udofia, E. A., & Nriagu, J. (2013). Health-care waste in Africa: A silent crises. Global Health Perspect, 1(1), 3-10.

UN Environment (2018). “Table A3. Use share of polymer resin production according to plastic application” in Mapping of global plastics value chain and plastics losses to the environment (with a particular focus on marine environment). Ryberg, M., Laurent, A., Hauschild, M.(2018) United Nations Environment Programme. Nairobi, Kenya

United Nations (2018). Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2019 Revision. (Medium variant). Kenya population age structure.

United Nations (2020). COMTRADE database. Import and export data 2018. Retrieved from https://comtrade.un.org/data/

Watamu Marine Association, http://www.watamu.biz/index.php

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Kenya
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**Published in December 2020,
with results for year 2018**

Implemented with ea + Quantis

Supported by the Swedish International Development Cooperation Agency Sida