NATIONAL GUIDANCE **FOR PLASTIC POLLUTION HOTSPOTTING AND SHAPING ACTION**

FINAL REPORT FOR TANZANIA

January 2021

Implemented with ea + Quantis

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AUTHORSHIP

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Technical lead

Dr. Paola Paruta, EA
Alexandre Bouchet, EA
Dr. Margherita Pucino, EA
Dr. Julien Boucher, EA

Laura Peano, Quantis
Violaine Magaud, Quantis

Implementing lead

Peter Manyara, IUCN
Lynn Sorrentino, IUCN
Dr. Janaka da Sikva, IUCN

Methodological support

Dr. Feng Wang, UNEP
Ran Xie, UNEP

Reviewers

Dr. Lydia Gaspare Kanyairita
Peter Manyara, IUCN
Doyi Mazenzele, IUCN
Charles Oluchina, IUCN

Design

Martha Perea Palacios, ORO

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SUMMARY AT A GLANCE

Global view of plastic in Tanzania

96% Mismanaged rate

40% Collection rate

4% Collection for recycling

0.5% Domestic recycling rate

29 Kt Leakage

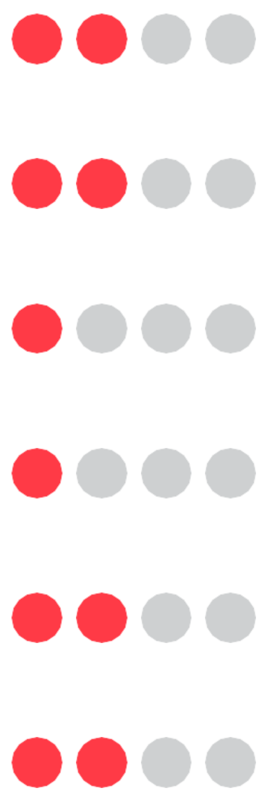
0.5 Kg Per capita leakage

Hotspots

Most critical Polymers

- PET
- PP
- HDPE
- Synthetic Rubber
- LDPE
- Polyester
- 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

Dar es Salaam is responsible for **71%** of the plastic leakage

Shaping action from the hotspots

9 Actionable Hotspots

6 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 PLASTIC POLLUTION HOTSPOTS

3

4

5

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.

A. Polymer Hotspots

B. Application Hotspots

C. Sector Hotspots

D. Regional Hotspots

E. Waste Management Hotspots

2.3 Actionable Hotspots

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

STRUCTURE AND OBJECTIVE OF THIS PRESENTATION

1
2
3

SHAPING ACTION

4
5

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.

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)

Learnings, that complement the key take aways with more details, of information that is not necessarily visible on the graph

Reference to the appendices

Limitations of the study, can be inaccurate data or gap in the modelling

Key take away as the main conclusion of a graph or result in a writen format

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

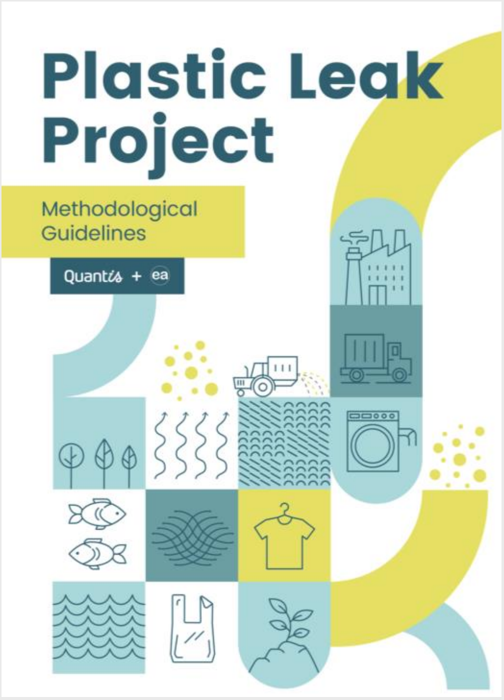
B By plastic impact we refer to a potential effect the leaked plastic may have on ecosystems and/or human health

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

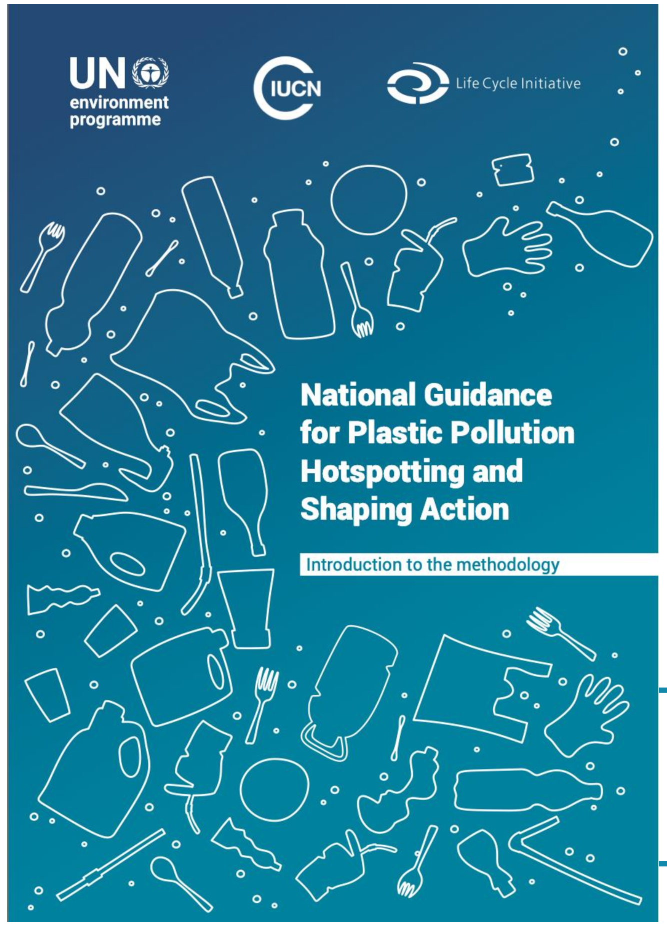
1 INTRODUCTION TO THE GUIDANCE

National guidance for plastic pollution hotspotting and shaping action

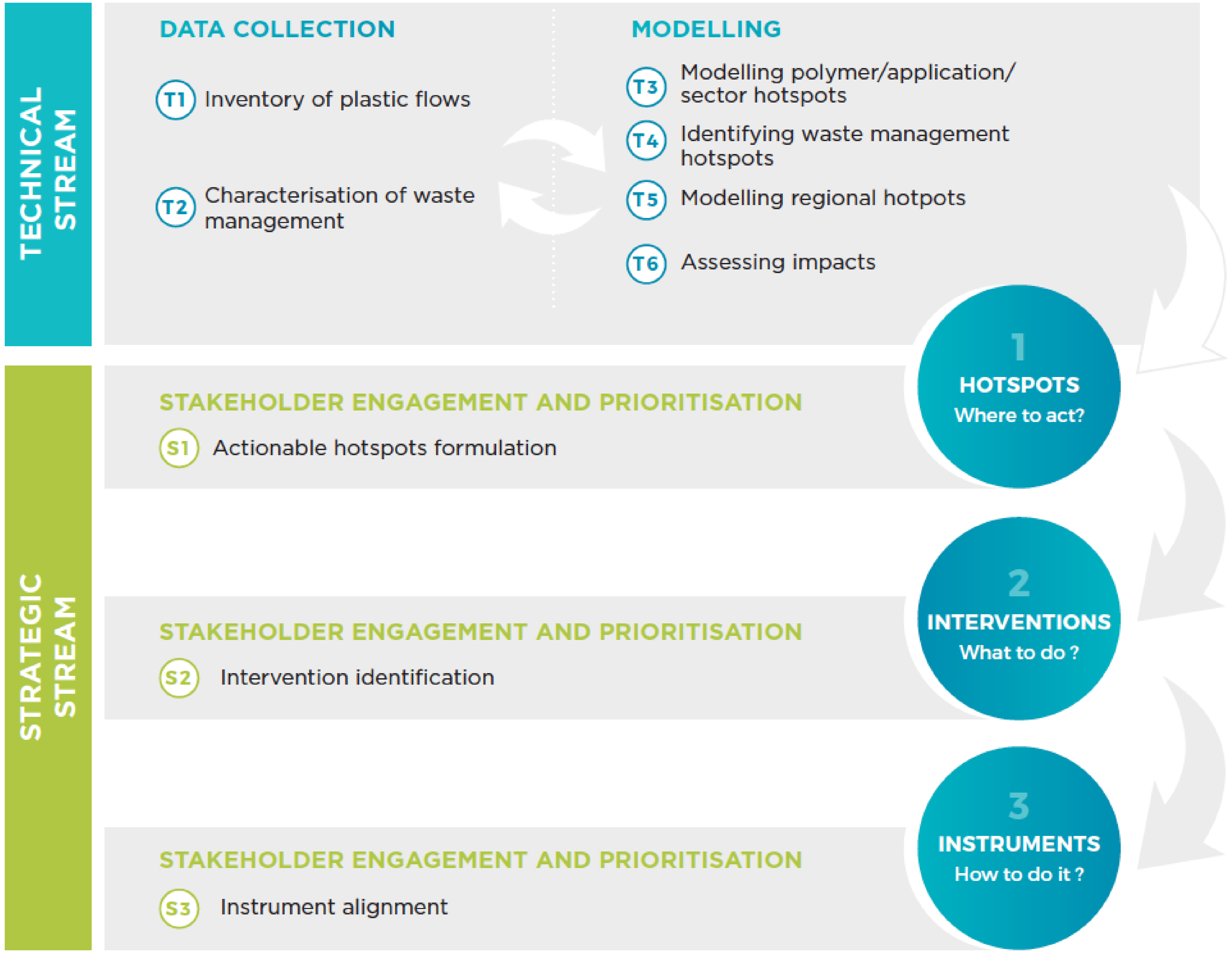
SCHEMATIC OF THE GUIDANCE

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

Hotspots

- Low recycling rate for flexible packaging
- Single-use plastic bags
- Low waste collection rate in rural areas

Interventions

- Implement better eco-design + chemical recycling
- Reduce plastic bag use in the country
- Increase waste collection

Instruments

- 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

MODULES	INPUT TOOLS	ASSESSMENT TOOLS			OUTPUT TOOLS
T1 INVENTORY OF PLASTIC FLOWS	T1.1 Inventory of data sources and data gaps; T1.2 Data collection templates; T1.3 Fisheries model canvas	T1.4 COMTRADE data extraction			A Raw data repository
T2 CHARACTERISATION OF WASTE MANAGEMENT	T2.1 Inventory of data sources and data gaps; T2.2 Data collection templates; T2.3 Waste model canvas				A Raw data repository
T3 MODELLING POLYMER/APPLICATION/ SECTOR HOTSPOTS	A	T3.1 Fisheries leakage calculation	T3.2 Polymer application/ sector MFA & leakage calculation	T3.3 MFA modelling quality assessment; T3.4 Polymer/application/sector hotspots prioritization canvas	B Project data repository
T4 IDENTIFICATION OF WASTE MANAGEMENT HOTSPOTS		T4.1 Waste management hotspot canvas			B Project data repository
T5 MODELLING REGIONAL HOTPOTS	T5.1 Waste data by archetype	T5.2 GIS model	T5.3 Leakage calculation	T5.4 GIS modelling quality assessment	B Project data repository
T6 ASSESSING IMPACTS		T6.1 Plastic application impact assessment			B Project data repository
S1 ACTIONABLE HOTSPOT FORMULATION	T3.4; B				C Actionable hotspots formulation
S2 INTERVENTION IDENTIFICATION	S2.1 Interventions library template	S2.2 Interventions selection	S2.3 Interventions prioritisation		D Final intervention and instrument pairing
S3 INSTRUMENT ALIGNMENT	S3.1 Instruments library template	S3.2 Instruments selection	S3.3 Instruments prioritisation		D Final intervention and instrument pairing

DISCLAIMER

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

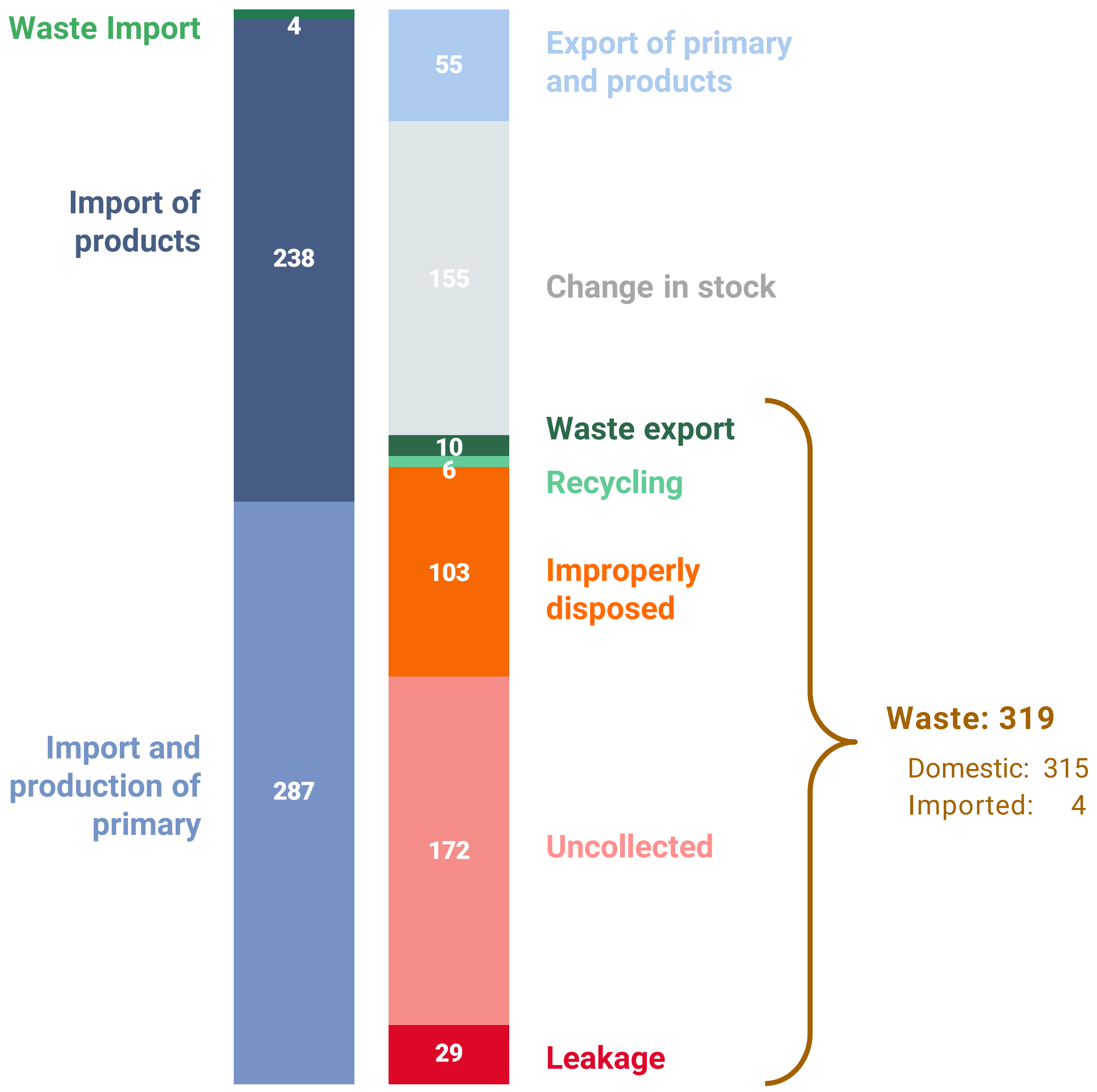
Additional information on the methodology and modelling process can be found directly in the **modules and tools** associated with the guidance and highlighted by this icon.

2 PLASTIC POLLUTION HOTSPOTS

2.1 COUNTRY OVERVIEW

COUNTRY PLASTIC MATERIAL FLOW [2018]

Summary of the results for all plastics in the country

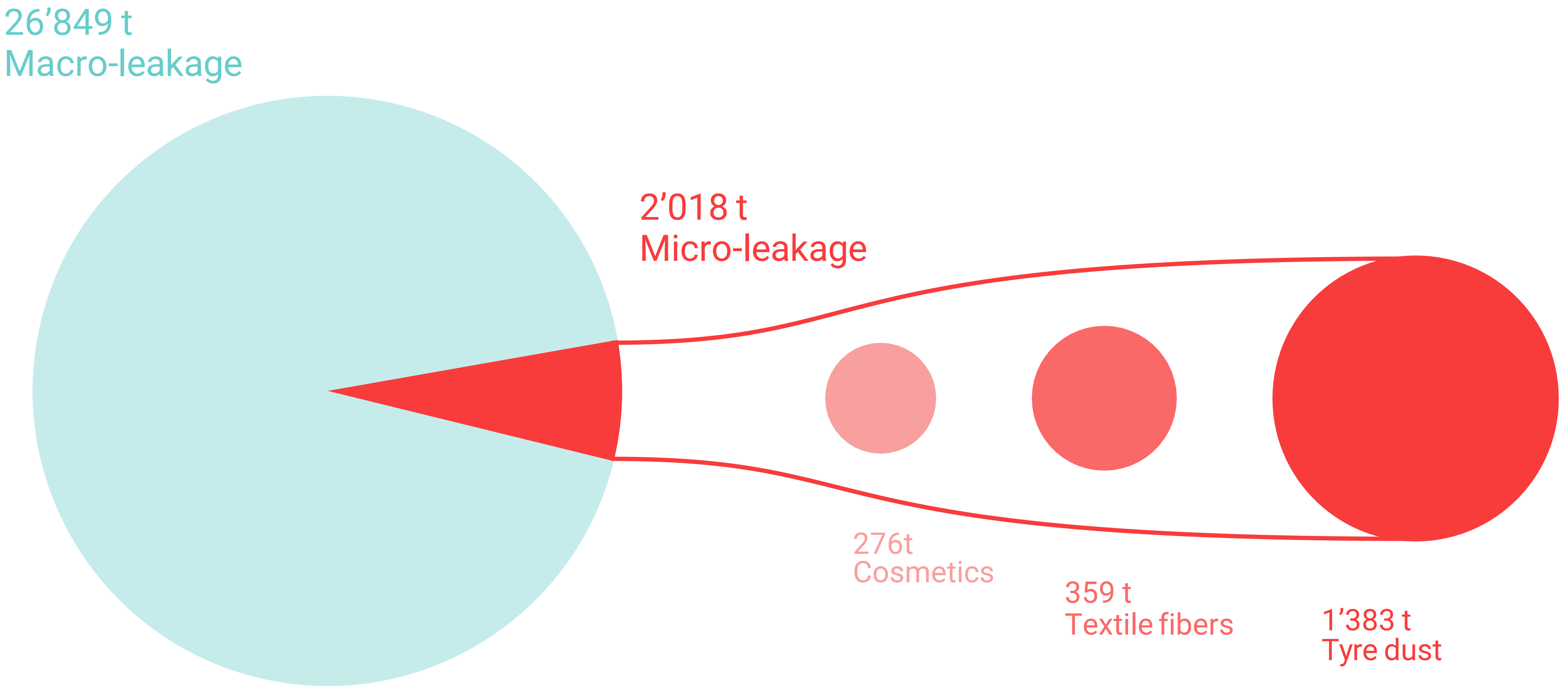


Note: For simplicity, in this figure, we removed a part of the "leakage" from the "improperly disposed" and "uncollected", so that the values displayed for these two metrics correspond to a post-leakage situation.

Key take-aways

- **315 thousand tonnes** of plastic waste were generated in Tanzania in 2018.
- Per capita plastic waste generation is around 5.6 kg/year which is lower than the world average of 29 kg/year.
- It is estimated that only 40% of the plastic waste is collected.
- 4% of the plastic waste is collected for recycling.
- Because there are no sanitary landfill and incineration facilities, there is no proper disposal of waste in Tanzania.
- 96% of the plastic waste is mismanaged and can potentially leak to the oceans, rivers and lakes of Tanzania.
- **29 thousand tonnes** of plastic leaked to ocean, rivers and lakes in 2018. That is around 9% of the waste generated.

MACRO-LEAKAGE VS MICRO-LEAKAGE [2018]



TO WATERWAYS AND OCEANS:

29 kt

Key take-aways

- **Micro-leakage contributes for 7% of the overall country leakage.** This is mainly driven by tyre abrasion during road transportation.

Learnings

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 have similar leakage in absolute terms. This is driven by low wastewater treatment levels (NESR, 2017) that provides little barrier to the release of primary plastic micro-particles in waterways and oceans. Contrary to other countries, Tanzania does not generate any leakage from primary pellets (due to losses during the production and transport process) since the country does not produce any primary plastic.

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 [2018]

304 kt

Total plastic mismanaged

42%

released into the air as noxious chemical substances through open burning

POLLUTION TO THE AIR:

129 kt

Key take-aways

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

Limitations

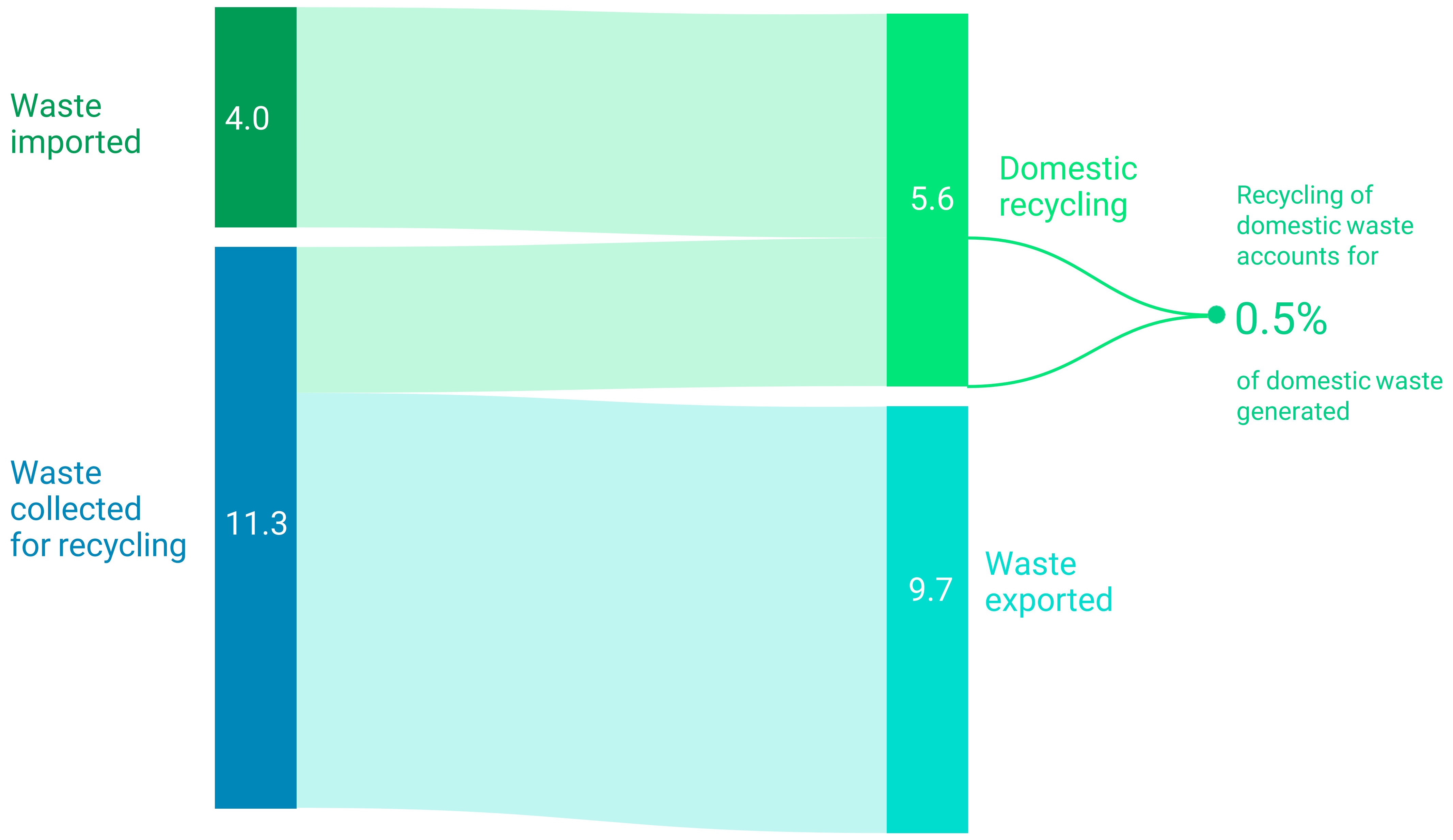
Although we do not have specific data on burning, we suggest a rough estimate of how much plastic could be polluting the air by using the assumptions made in the *Breaking the Plastic Wave* report (*Lau et al, 2020*): 60% of uncollected plastic waste and 13 % of plastic waste at dumpsites are burnt on average worldwide. In the case of Tanzania, it would translate into having 42% 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.

DOMESTIC RECYCLING AND TRADE OF WASTE

Quantities in thousand tonnes



Key take-aways

- Only **0.5%** of the 316 kt domestically generated plastic waste is eventually recycled.

Learnings

- Only 1.6 kt out of the 315 kt of plastic waste generated in Tanzania are recycled domestically.
- According to BACI database (Gaulier, G. et al., 2008) there are 4 kt of plastic import and 9.7 kt of plastic export.

Limitations

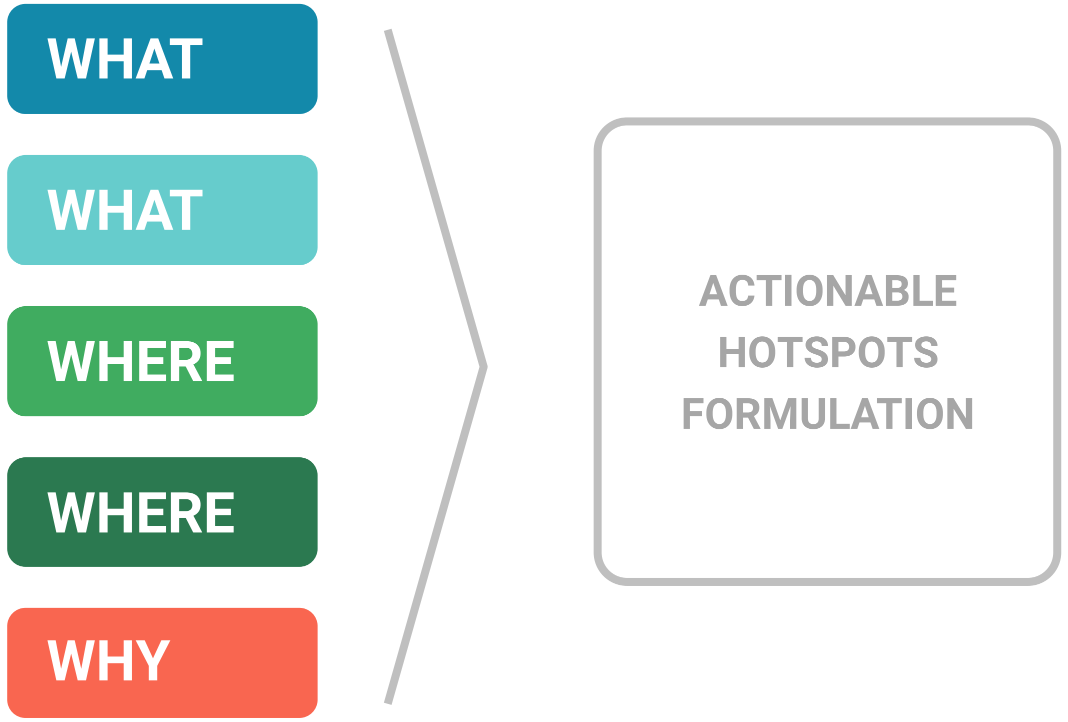
There is a lack of understanding of the fate of imported waste in Tanzania and on the origin of the exported waste. We also lack data on recycled quantities.

Unlocking limitations

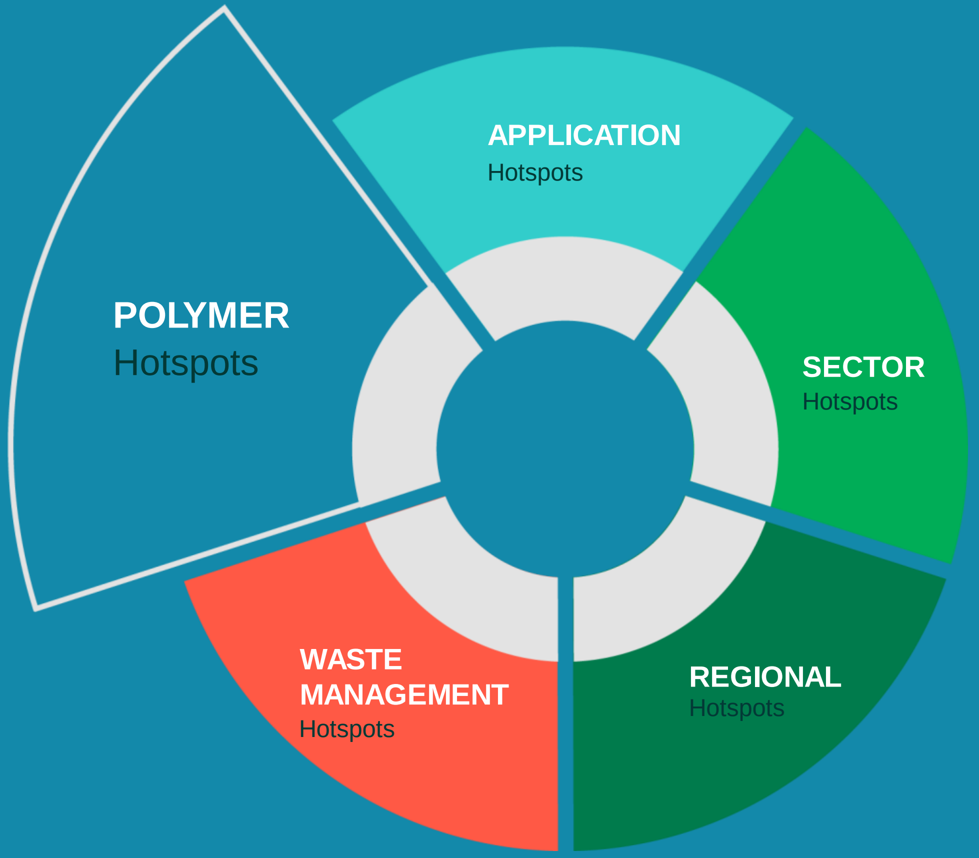
Contact customs authorities to gather insight on origin and fate of import and export of plastic waste. Contact local recyclers to have data on total recycling.

2.2 DETAILED HOTSPOTS RESULTS

5 CATEGORIES OF HOTSPOTS



A POLYMER HOTSPOTS

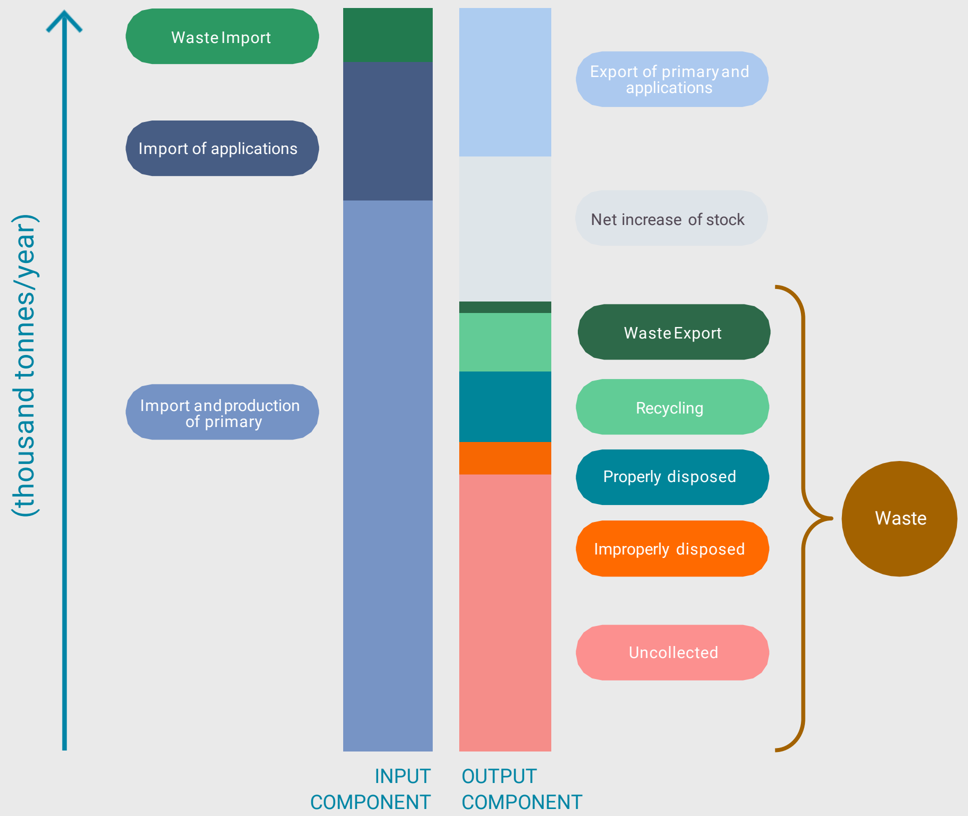


OBJECTIVE AND INSTRUCTIONS

Key question answered:

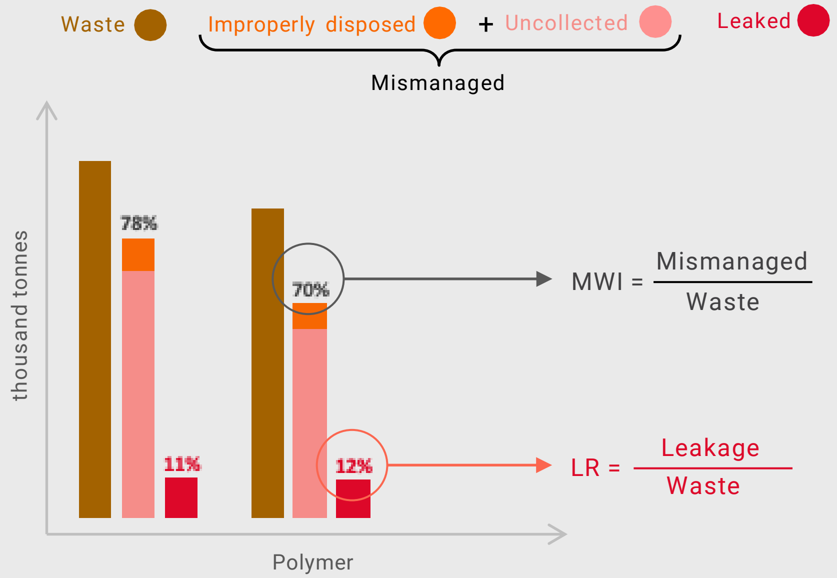
Which polymers are most critical in the country regarding plastic leakage?

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

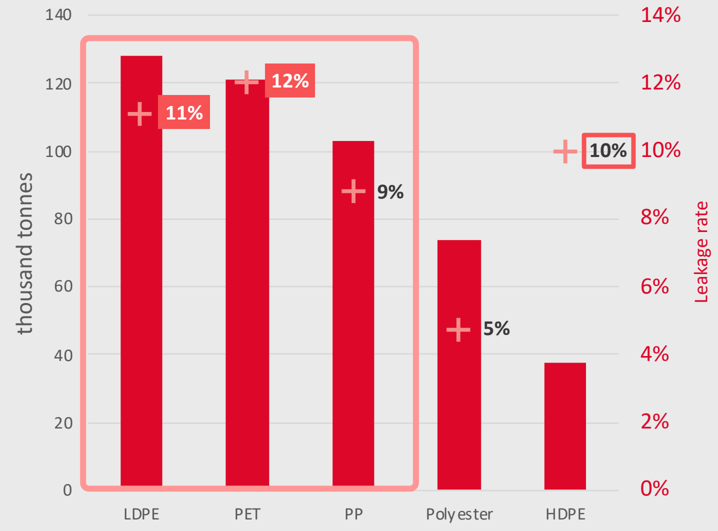


How to read the polymer hotspot graph?

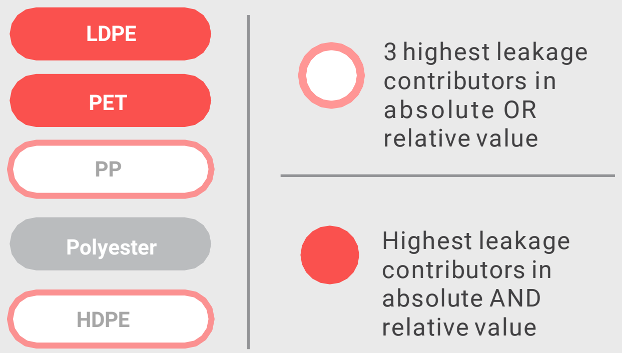
1. Determine leakage from mismanaged waste



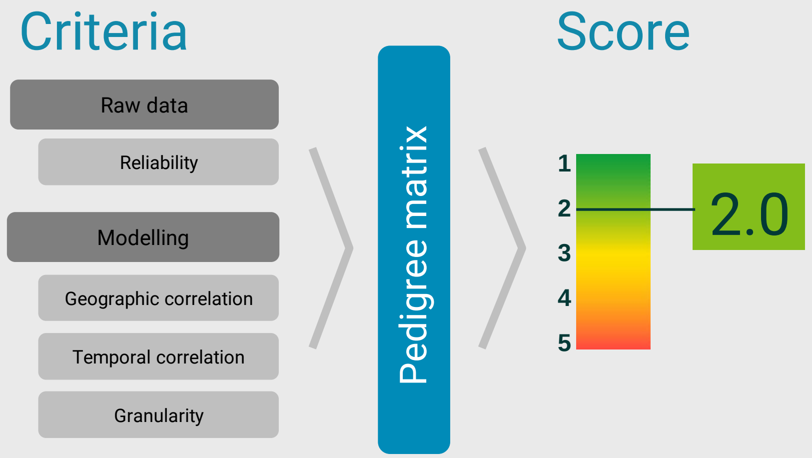
2. Focus on leakage and leakage rate



3. Select hotspots based on absolute and relative leakage



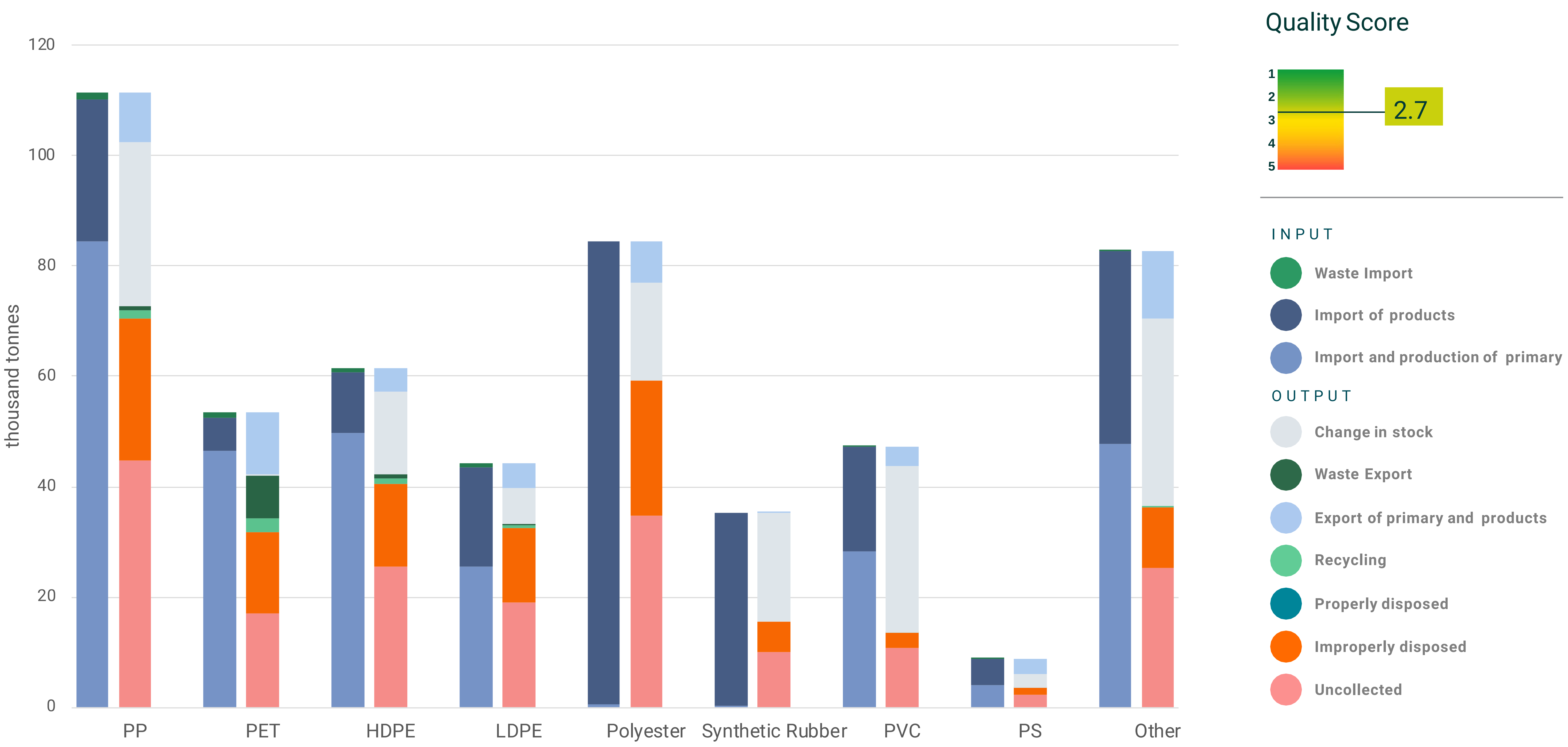
4. Assess the quality score of the results



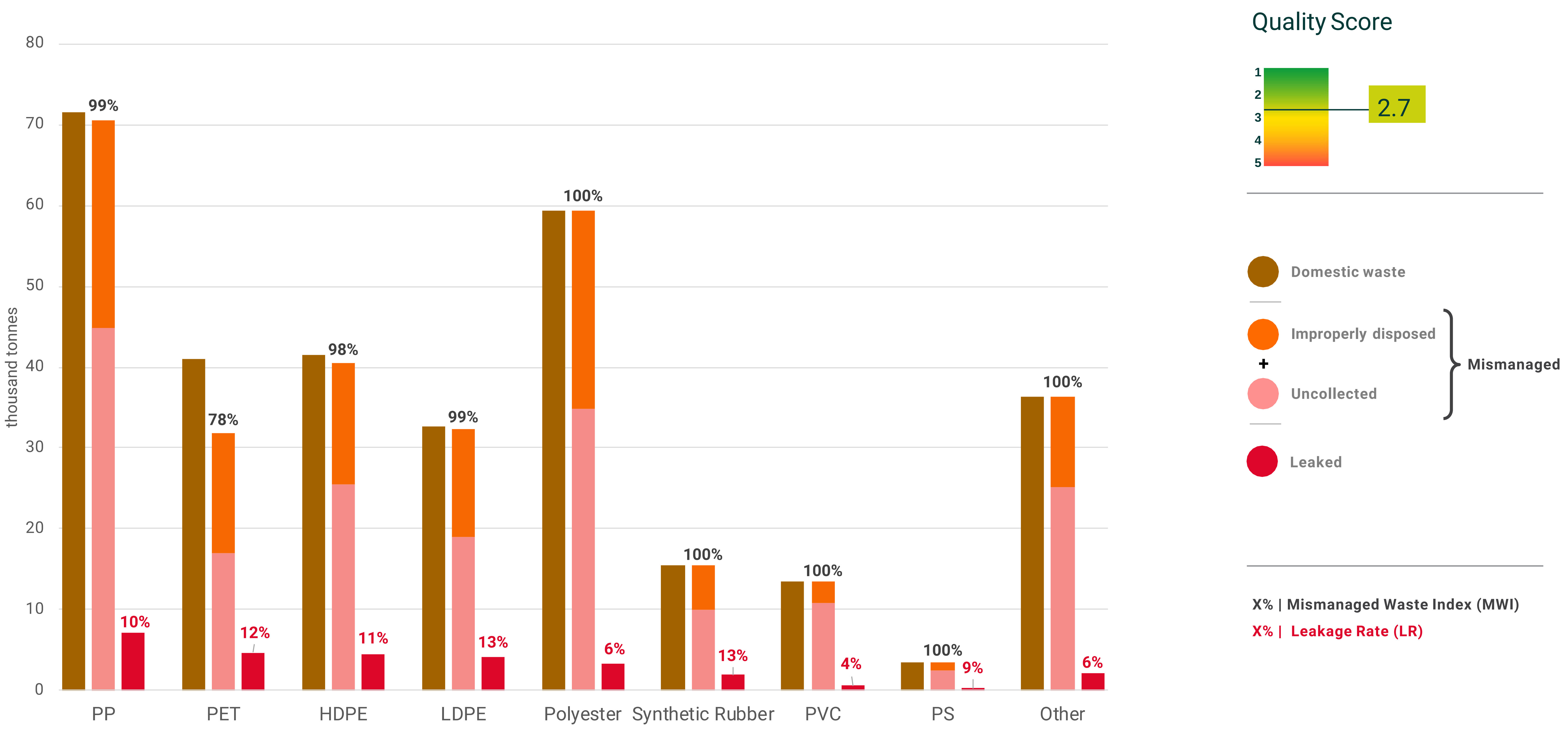
For more details, please read the Methodology

T3

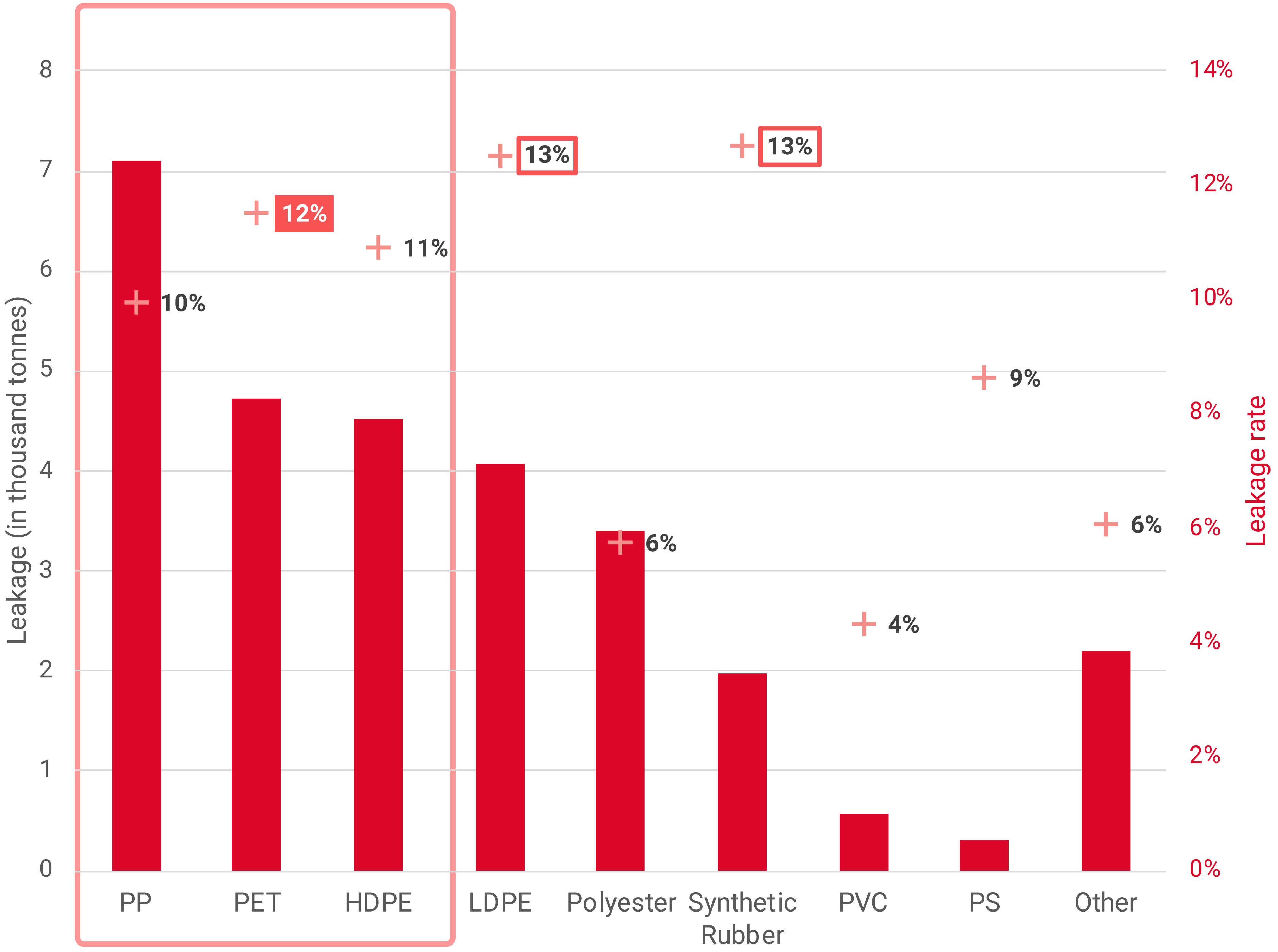
MASS BALANCE BY POLYMER [2018]

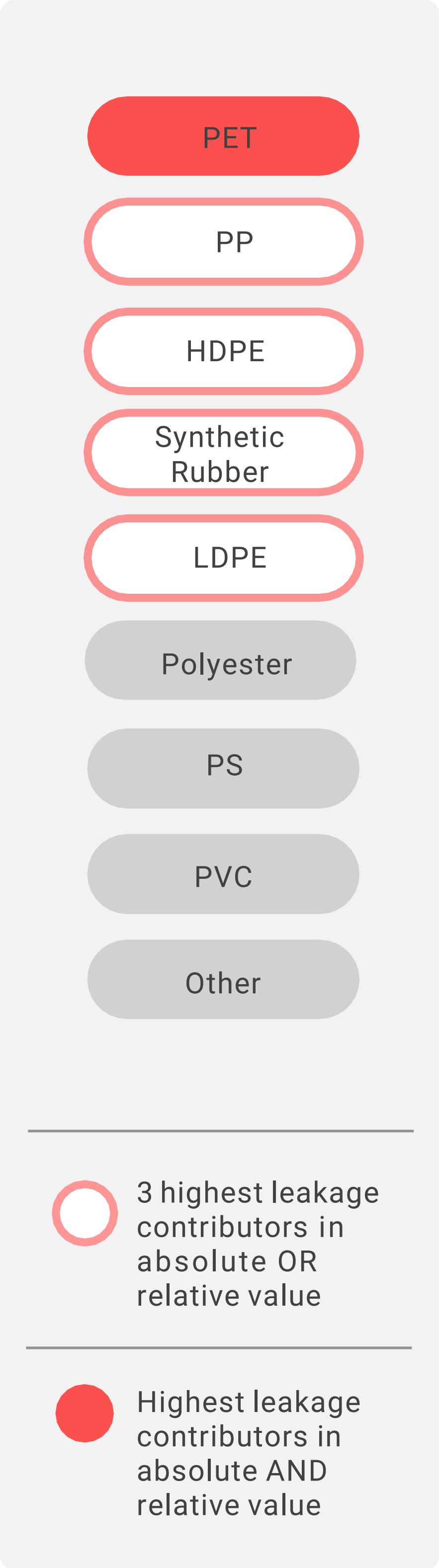


MISMANAGED WASTE AND LEAKAGE BY POLYMER [2018]

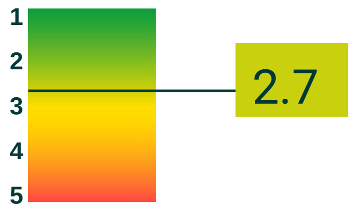


POLYMER HOTSPOTS [2018]





Quality Score



Key take-aways:

- **PP** is the top leaking polymer by absolute leakage with 7.1 kt of leakage.
- **PET** is the main hotspot because it has both a high absolute leakage (4.7 kt) and relative leakage (12%).
- **HDPE** is the third polymer by absolute leakage, with 4.5 kt of leakage.
- **LDPE** and **Synthetic Rubbe**r have the highest relative leakage.

POLYMER HOTSPOTS: INTERPRETATION AND LIMITATIONS

PP

Learnings

PP is the top polymer by absolute leakage with 7.1 kt. It is the polymer with the highest waste generation. There is only 1 tonne of PP that is collected for recycling, which corresponds to around 1% of the plastic waste generated. As a consequence, since there is no proper disposal of waste in Tanzania, 99% of PP is mismanaged.

Limitations

As we are missing data on recycling, we might be underestimating the quantity of PP that was in 2018 in Tanzania.

Unlocking limitations

Centralise information from all recyclers on recycling quantities by polymer.

PET

Learnings

PET is the second polymer by absolute leakage with 4.7 kt. As PET is one of the most recycled polymer with 9 kt collected for recycling, most of which is exported, it is less mismanaged than other polymers with a MWI at 78%. However, since PET is mostly used for on-the-go packaging items, it is very likely to be released into waterways and the ocean.

Polyester

Learnings

Polyester has the second most generated plastic waste with 59 kt in 2018. There is no recycling of Polyester, nonetheless, because Polyester is used in textile, automotive and engineering sector, its leakage rate is smaller than other polymers and ”only” 3.4 kt of Polyester leak to ocean and waterways.

POLYMER HOTSPOTS: INTERPRETATION AND LIMITATIONS

LDPE

Learnings

Contrary to what has been found for other countries through *the National Guidance, UNEP-IUCN (2020),* in Tanzania LDPE is not one of the top three polymers by absolute leakage. This could be explained by the ban on plastic bags that came into effect in 2019. Nonetheless there are still 4.5 kt of plastic leakage due to LDPE, corresponding to 13% of the amount going to waste.

Synthetic Rubber

Learnings

From 2 kt of synthetic rubber leaked, 1.4 kt are due to micro-plastics from tyre abrasion leaking into waterways and only 0.6 kt come from mismanaged tyres. The micro-leakage from tyre abrasion is the cause of the high leakage rate, which at 13% makes Synthetic Rubber the top polymer by relative leakage.

All polymers

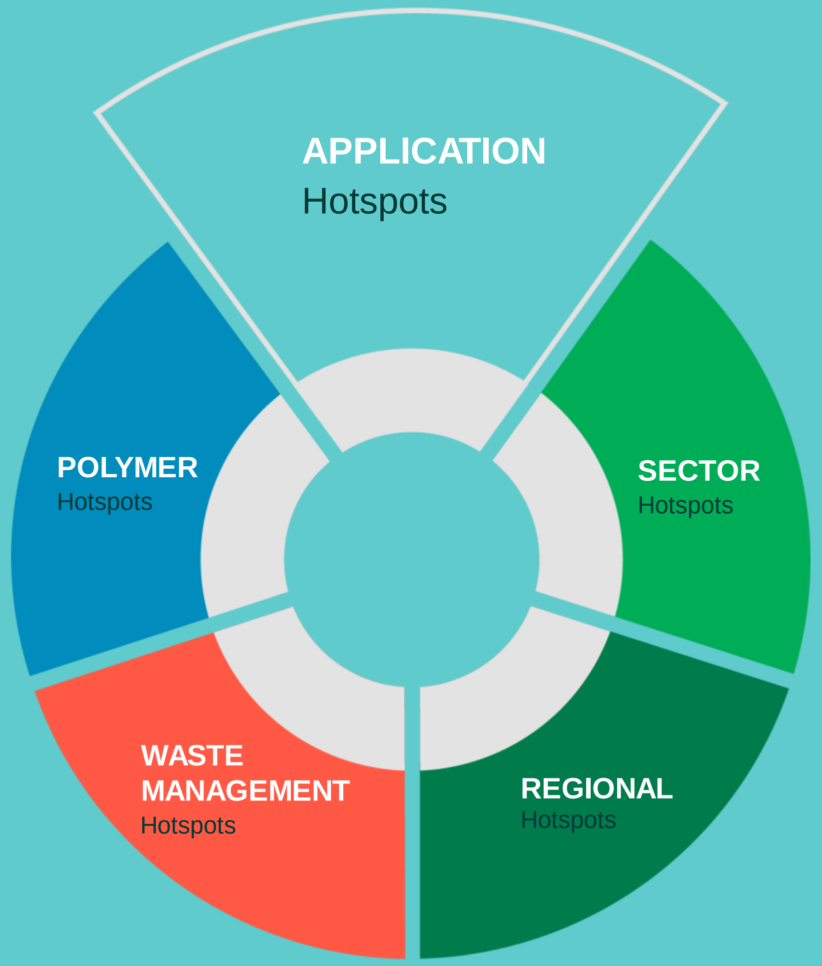
Limitations

- We are unaware of any domestic production of primary plastic in Tanzania.
- The low amount of per-capita plastic waste generated, raises doubts on whether there could be some plastic import that enters Tanzania illegally, without being recorded at customs.
- We are missing data on plastic recycling and only have a partial knowledge of the recycling activities occurring in Tanzania. This might impact the accuracy of mismanaged plastic waste quantities by polymer, and hence final leakage values.

Unlocking limitations

- Investigate on whether there is any primary plastic production in Tanzania.
- Contact customs authorities to have a better insight on the magnitude of illegal trade.
- Centralise information from all recyclers on recycling quantities by polymer.

B APPLICATION HOTSPOTS

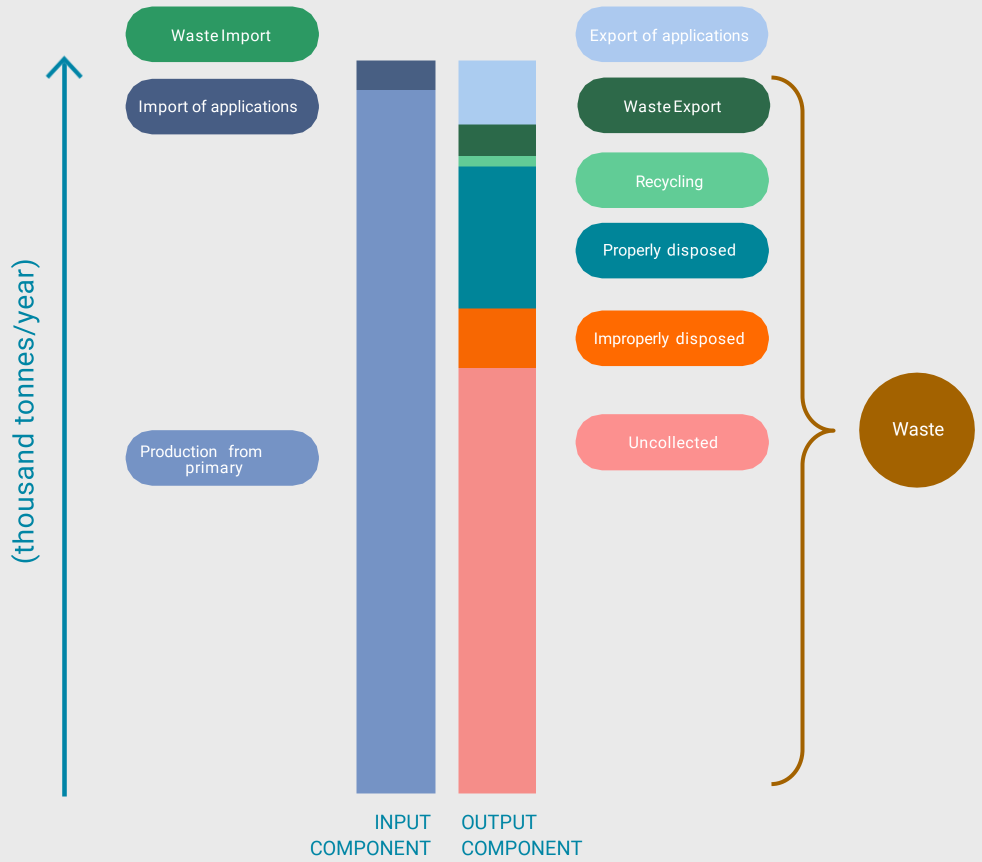


OBJECTIVE AND INSTRUCTIONS

Key question answered:

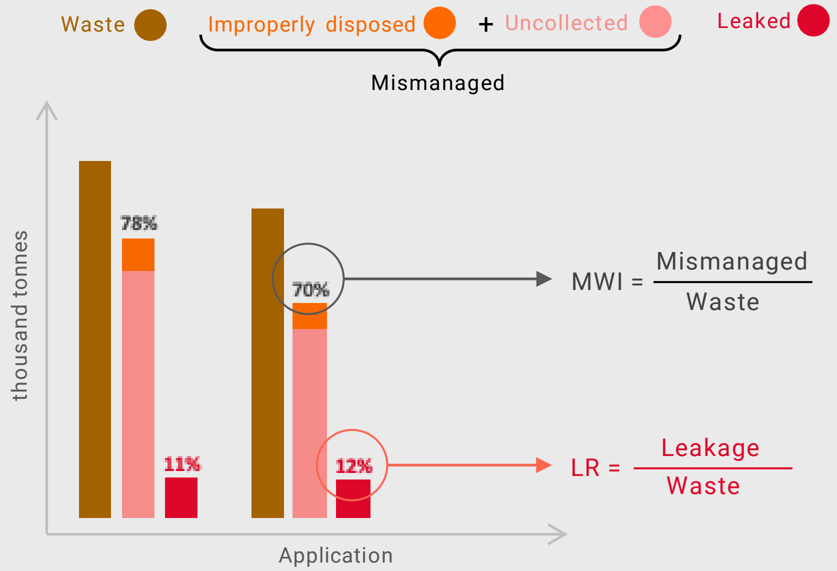
Which applications are most critical in the country regarding plastic leakage?

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

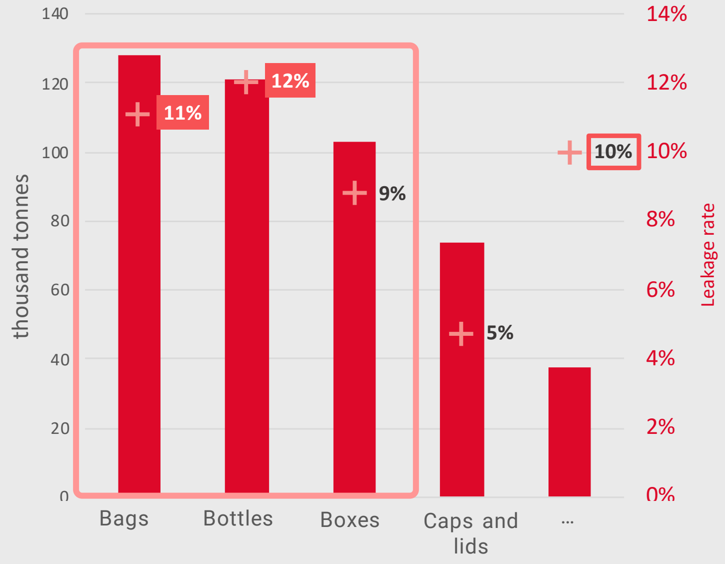


How to read the application hotspot graph?

1. Determine leakage from mismanaged waste



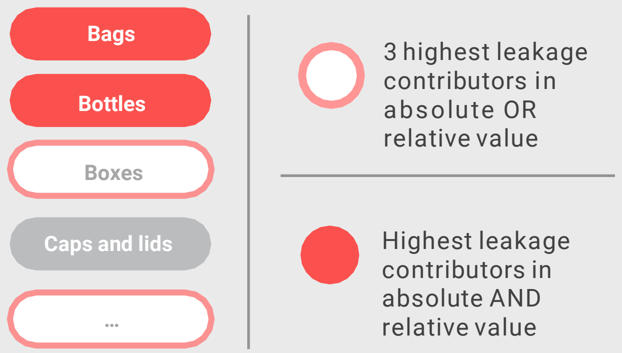
2. Focus on leakage and leakage rate



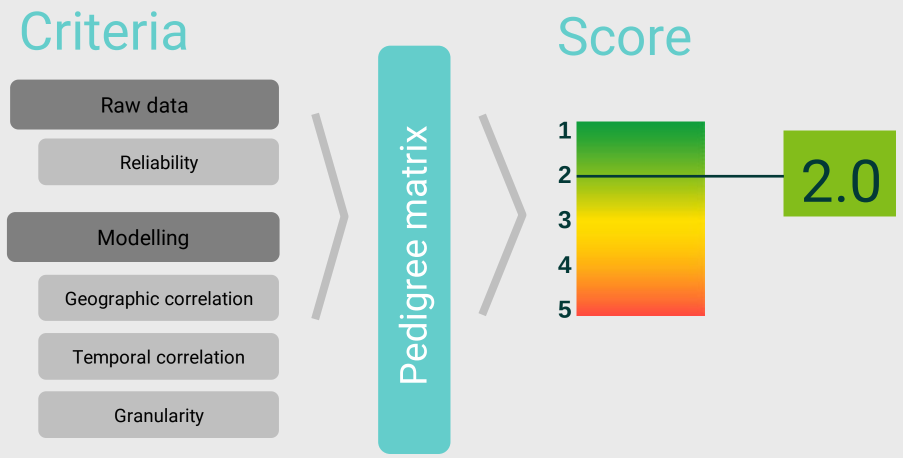
For more details, please read the Methodology

T3

3. Select hotspots based on absolute and relative leakage

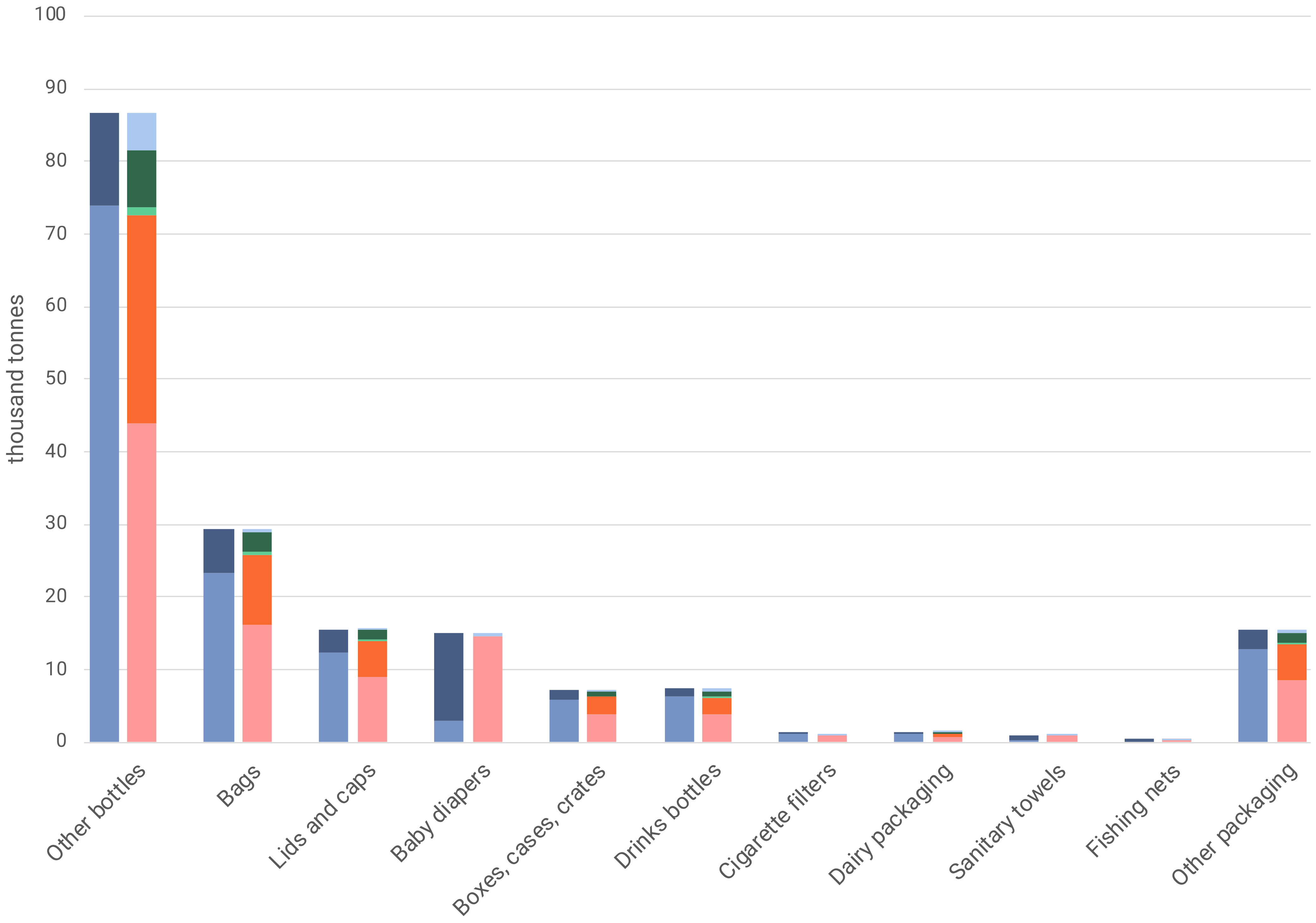


4. Assess the quality score of the results

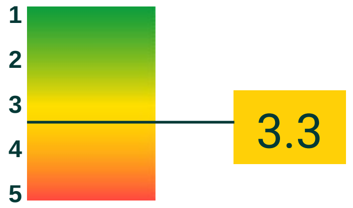


MASS BALANCE BY APPLICATION [2018]

The application analysis covers most of known short-lived products (mainly from the packaging sector), which corresponds to **54% of total plastic waste generated** in 2018.



Quality Score



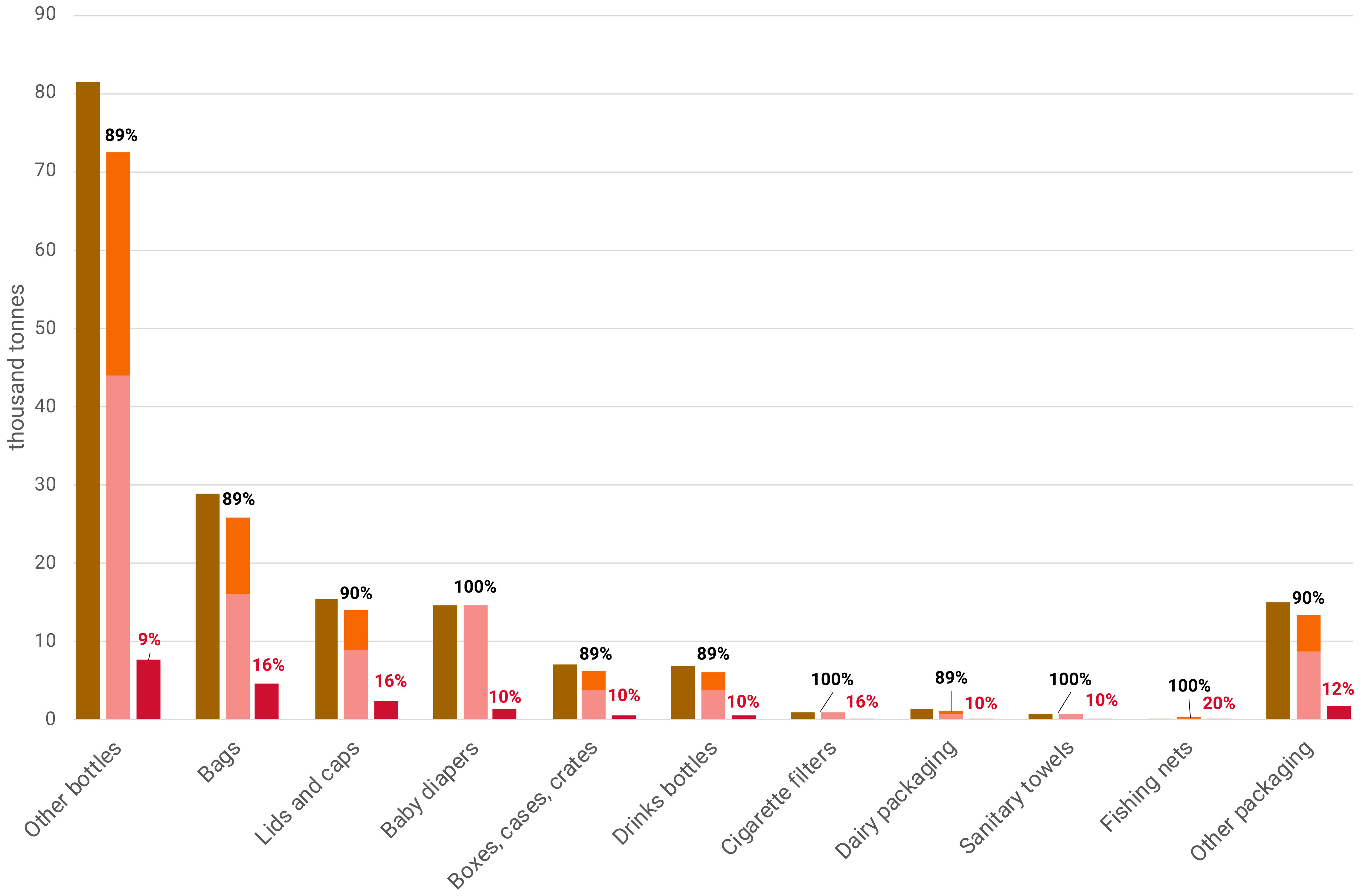
INPUT

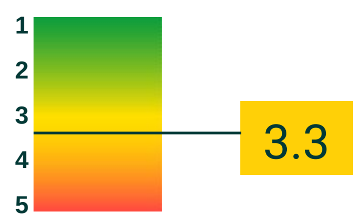
- Waste Import
- Import of products
- Production from primary

OUTPUT

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

MISMANAGED WASTE AND LEAKAGE BY APPLICATION [2018]





Domestic waste

Improperly disposed
+
Uncollected

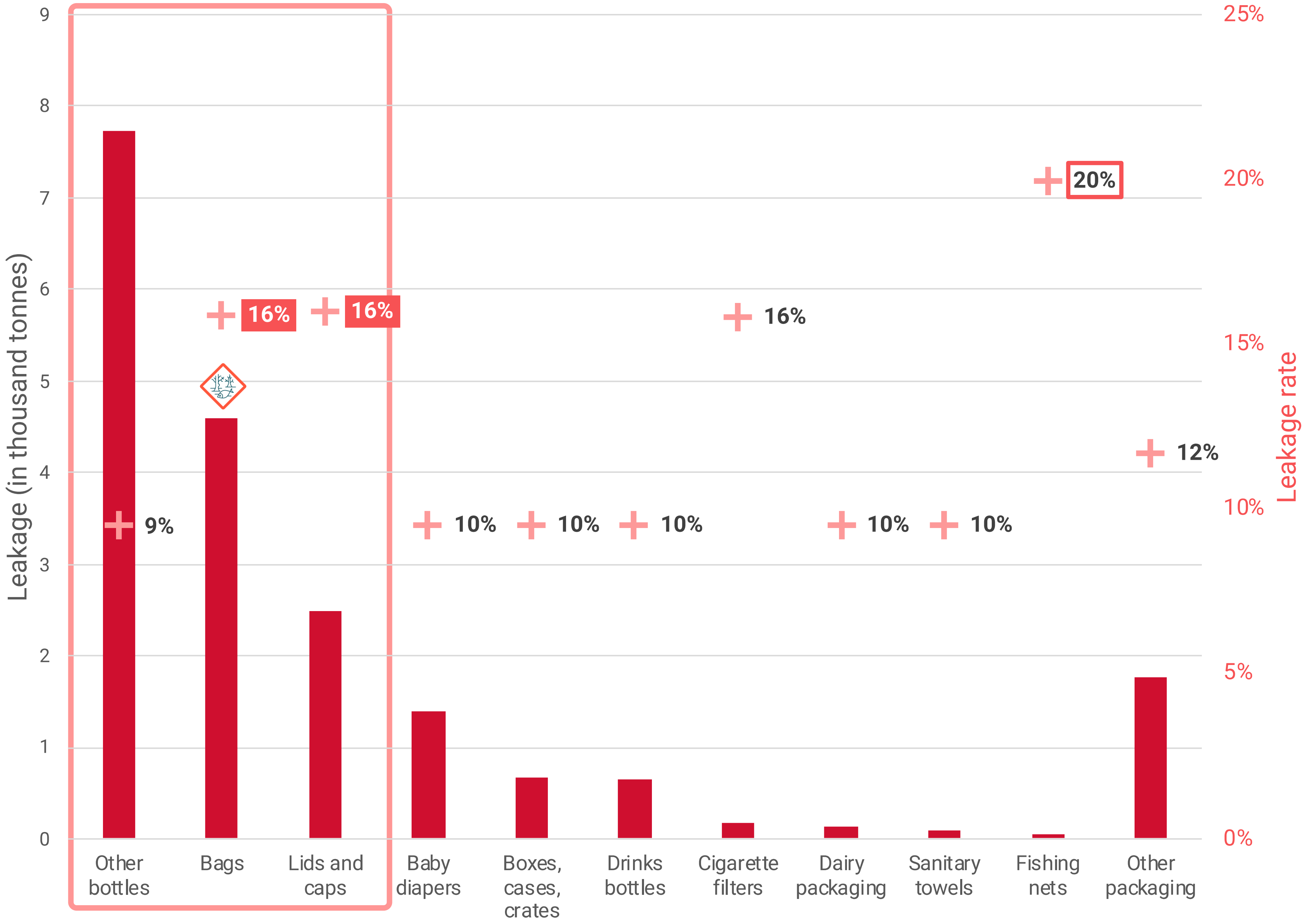
Mismanaged

Leaked

X% | Mismanaged Waste Index (MWI)

X% | Leakage Rate (LR)

APPLICATION HOTSPOTS [2018]



*The impact assessment uses data from the coastal clean-up report from *Ocean Conservancy (2019)*

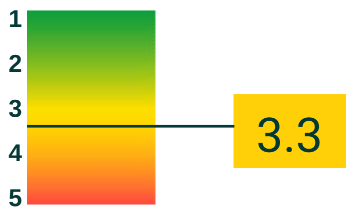
Harmful to marine life and ecosystems

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

3 highest leakage contributors in absolute OR relative value

Highest leakage contributors in absolute AND relative value

Quality Score



Key take-aways

- **Other bottles**, i.e. non-driking bottles, have the highest absolute leakage at 7.7 kt.
- **Bags** and **Lids and caps** come next with 4.6 and 2.5 kt of leakage respectively. They both have high leakage rate with 16% of the waste being leaked to the environment.
- **Fishing nets** have only a small contribution to the country plastic leakage (0.05 kt), but due to gear loss at sea, 20% of the fishing gears in use leak into the environment.

All packaging applications

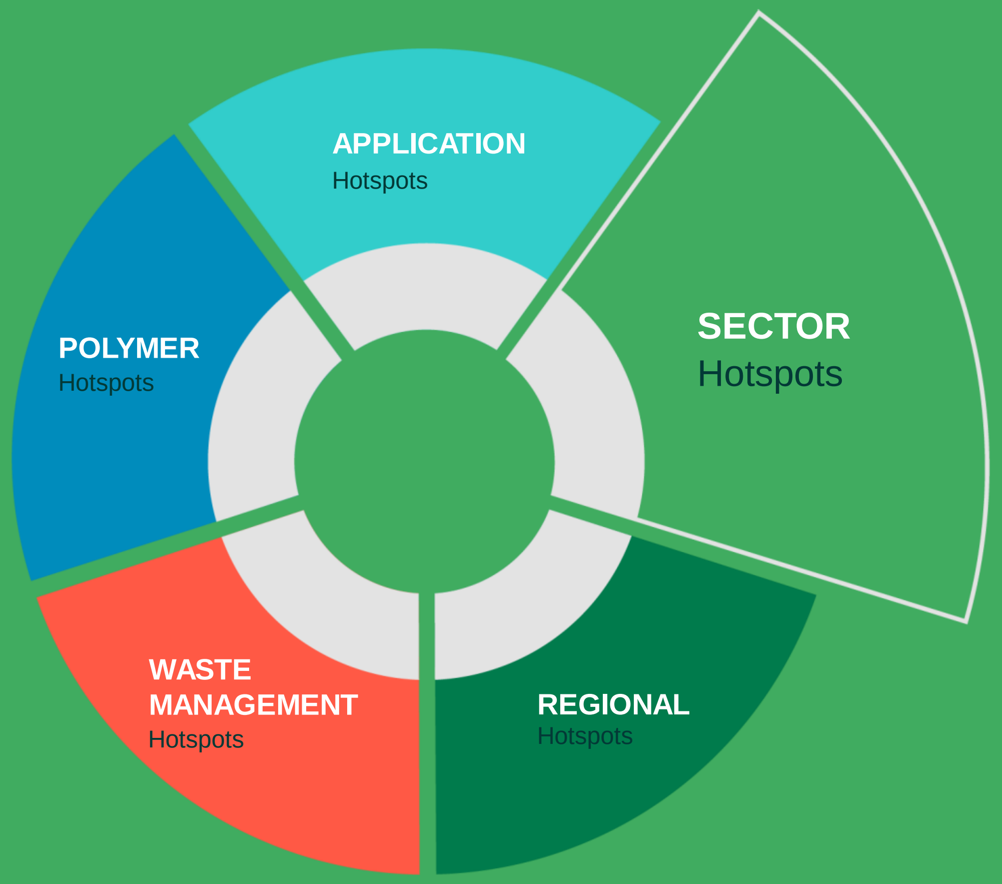
Limitations

For the applications targeted in this study, Tanzania 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 Tanzania, 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 total production from the packaging sector.

Unlocking limitations

Collect information on consumption quantities by packaging application in Tanzania, either by contacting manufacturers and retailers or by conducting a consumer survey.

C SECTOR HOTSPOTS

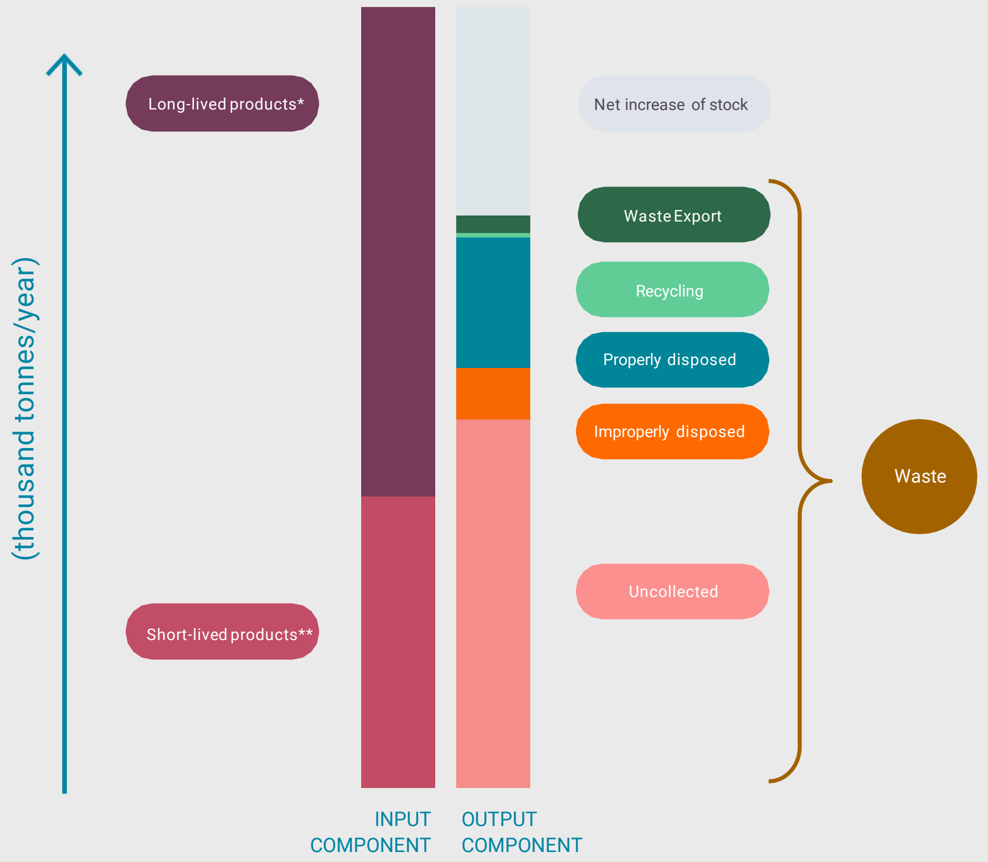


OBJECTIVE AND INSTRUCTIONS

Key question answered:

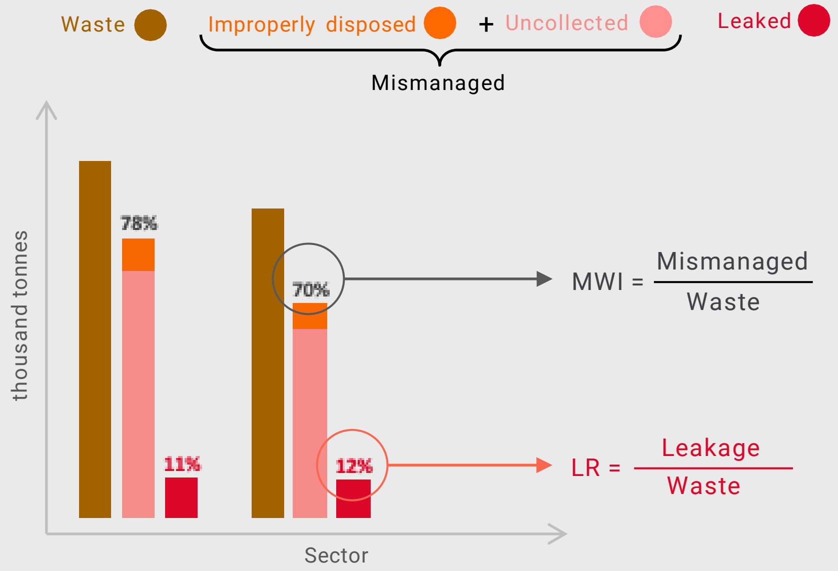
Which sectors are most critical in the country regarding plastic leakage?

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

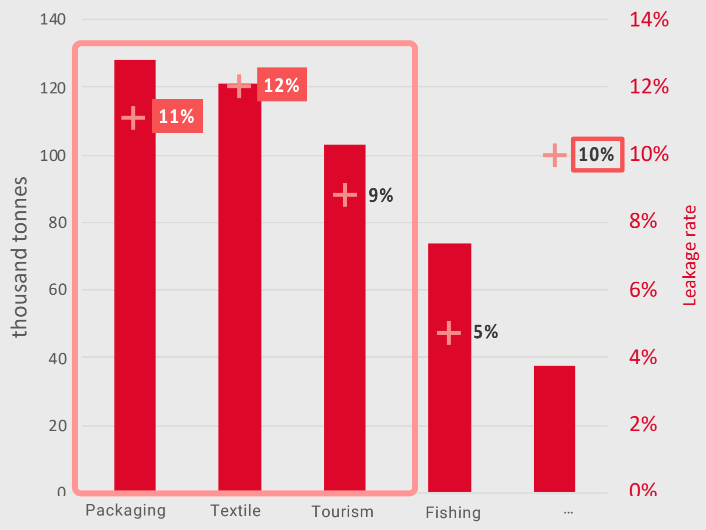


How to read the sector hotspot graph?

1. Determine leakage from mismanaged waste



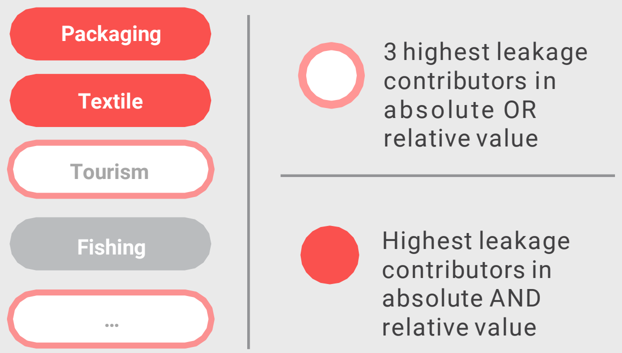
2. Focus on leakage and leakage rate



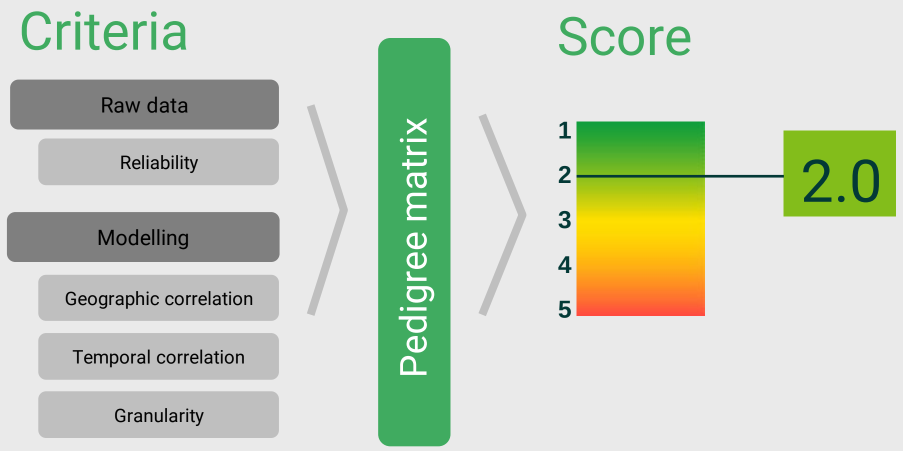
For more details, please read the Methodology

T3

3. Select hotspots based on absolute and relative leakage

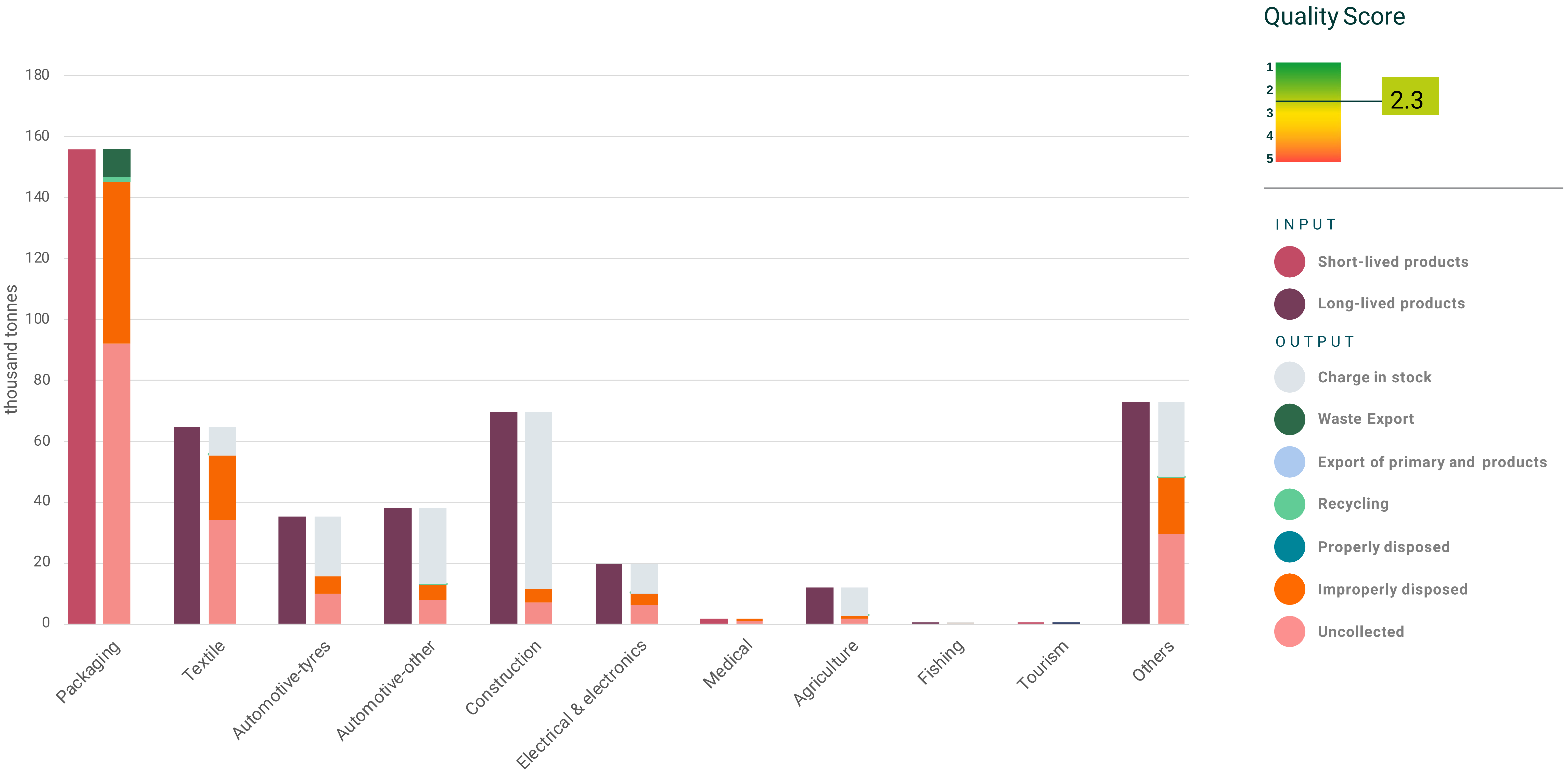


4. Assess the quality score of the results

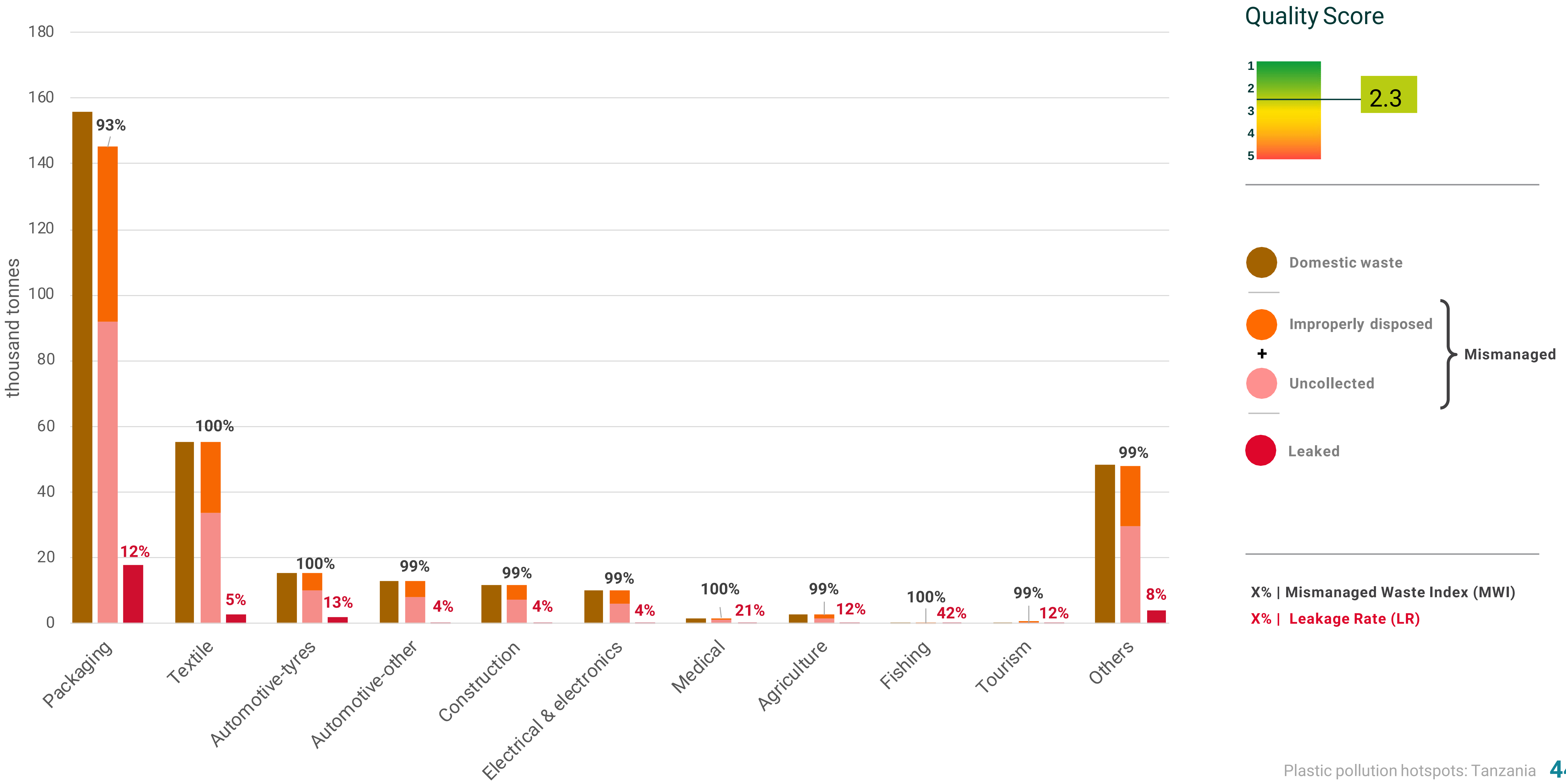


* **Short-lived products**: products that are disposed within the year of study (Life-time < 1 year)
** **Long-lived products**: products that are disposed after the year of study (Life-time > 1 year)

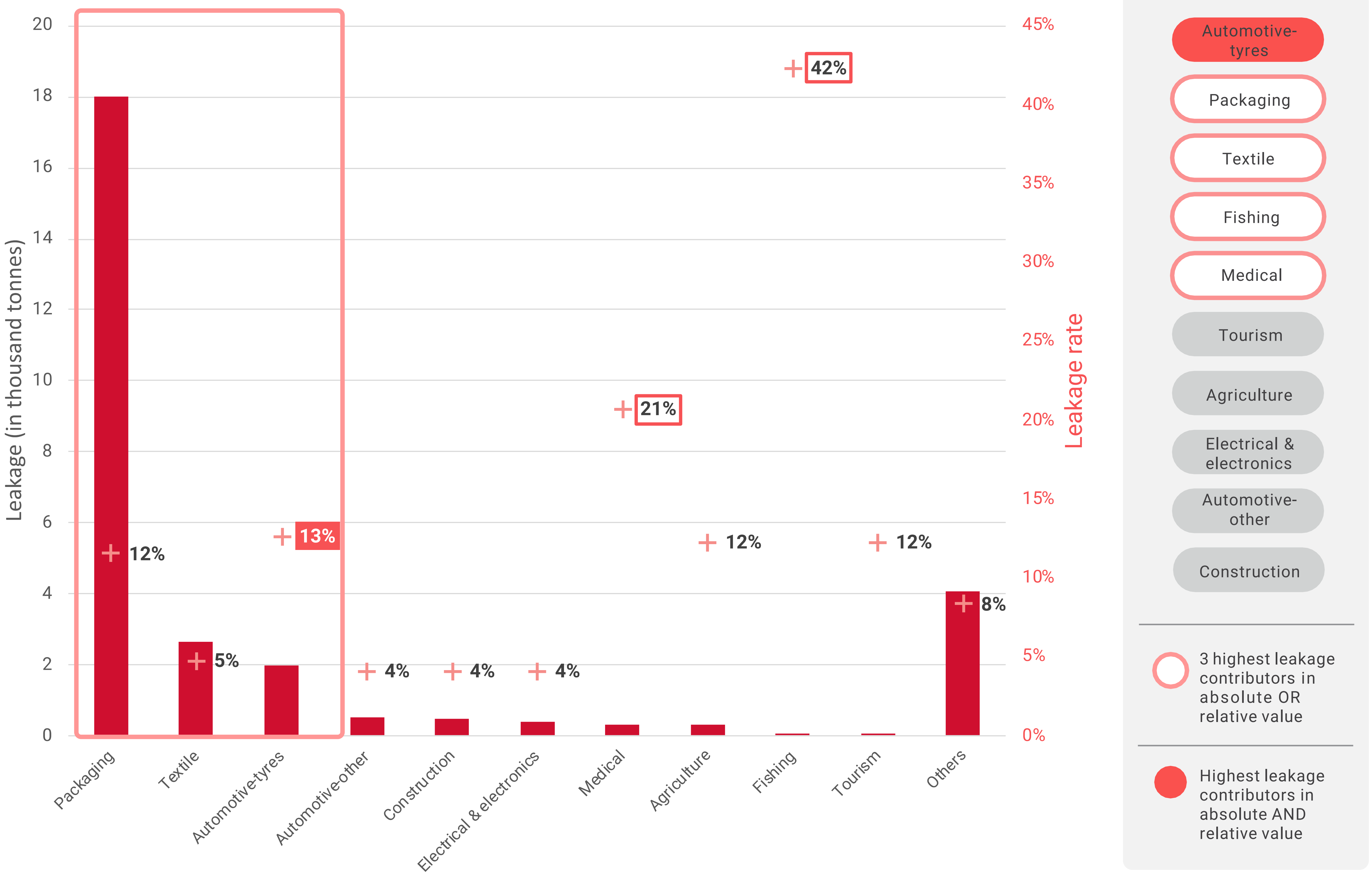
MASS BALANCE BY SECTOR [2018]



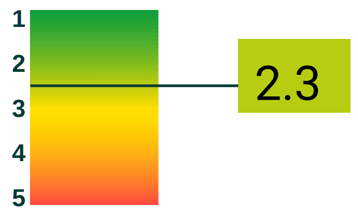
MISMANAGED WASTE AND LEAKAGE BY SECTOR [2018]



SECTOR HOTSPOTS [2018]



Quality Score



Key take-aways

- **The packaging sector** causes 62% of the total country leakage, with 18 kt.
- **Textile** is the second sector by absolute leakage with 2.6 kt.
- The **automotive-tyres** sector contribution of 2 kt of plastic leakage is partly due to tyre-abrasion. Its leakage rate is the third highest, at 13%.
- The fishing sector has the highest leakage rate, due to loss of fishing gear but also overboard littering of packaging items.

Packaging

Learning

Packaging is the sector with the highest absolute leakage, higher than 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. Secondly, although most of the plastic collected for recycling in Tanzania comes from the packaging sector, this represents only 7% of the entire plastic packaging production. Thirdly, plastics from packaging sector 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.

Unlocking limitations

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

Fishing

Learning

The fishing sector has a high relative leakage, but a very low absolute leakage. Leakage from fishing includes: leakage from gear loss at sea, leakage from overboard littering of packaging, and leakage from fishing gear mismanaged on land. Data on the number of fishing gears in use was found in the Fisheries Department frame survey prepared for the BILLFISH-WIO project (2019). Data on the number of fishermen by fishing area (including lakes and territorial waters) are projected from data available in the fisheries report by the Ministry of Agriculture, Livestock and Fisheries (2016).

Automotive-tyres

Learning

The Automotive-tyres sector is the third highest contributor to the total country leakage, with 2 kt of Synthetic Rubber leaking into lakes, rivers and the ocean in 2018. It encompasses both the mismanaged waste (discarded tyres) and tyre dust due to tyre abrasion from road vehicles. The high leakage rate (13%) is explained by the direct contribution of micro-leakage from tyre dust to the total leakage.

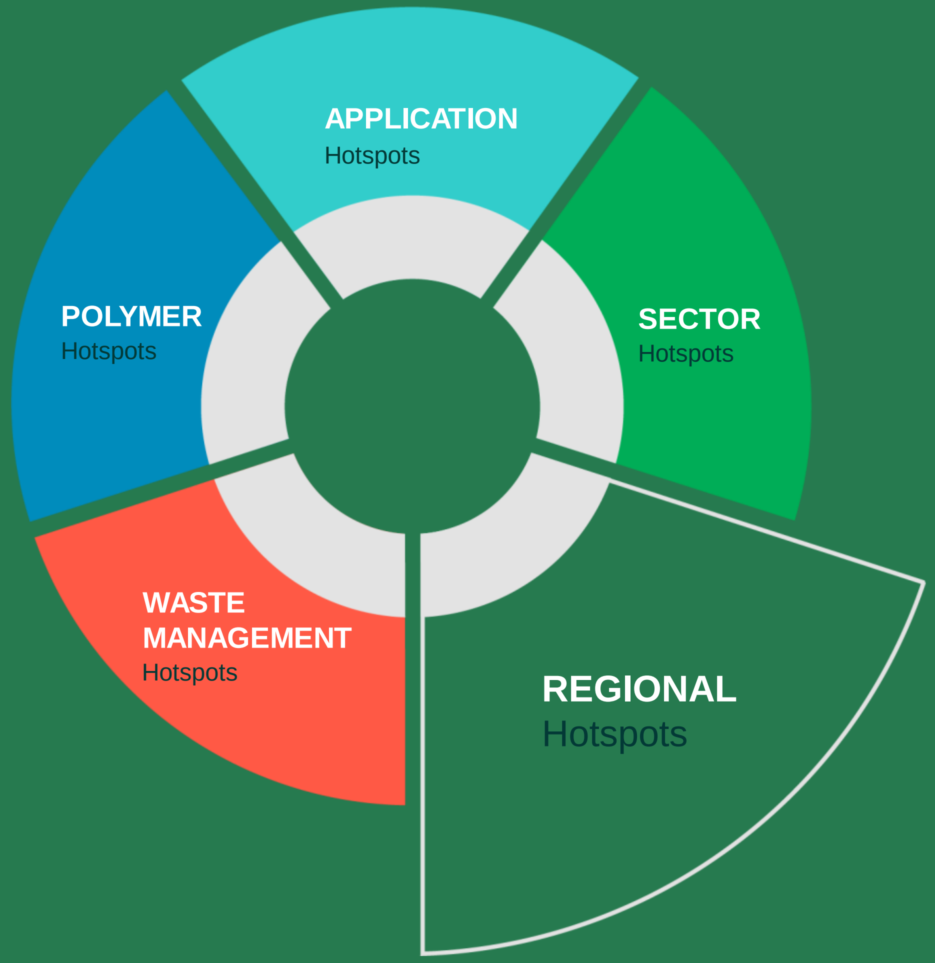
Limitation

We could not include in our analysis a quantification of the number of tyres that are either burnt in factory kilns, or reused through rethreading.

Unlocking limitations

Gather information on the amount of tyres being burnt in factory kilns (which would be considered as properly disposed in our study) and investigate whether there are reuse practices through rethreading in Tanzania, which would extend the lifetime of tyres.

D REGIONAL HOTSPOTS

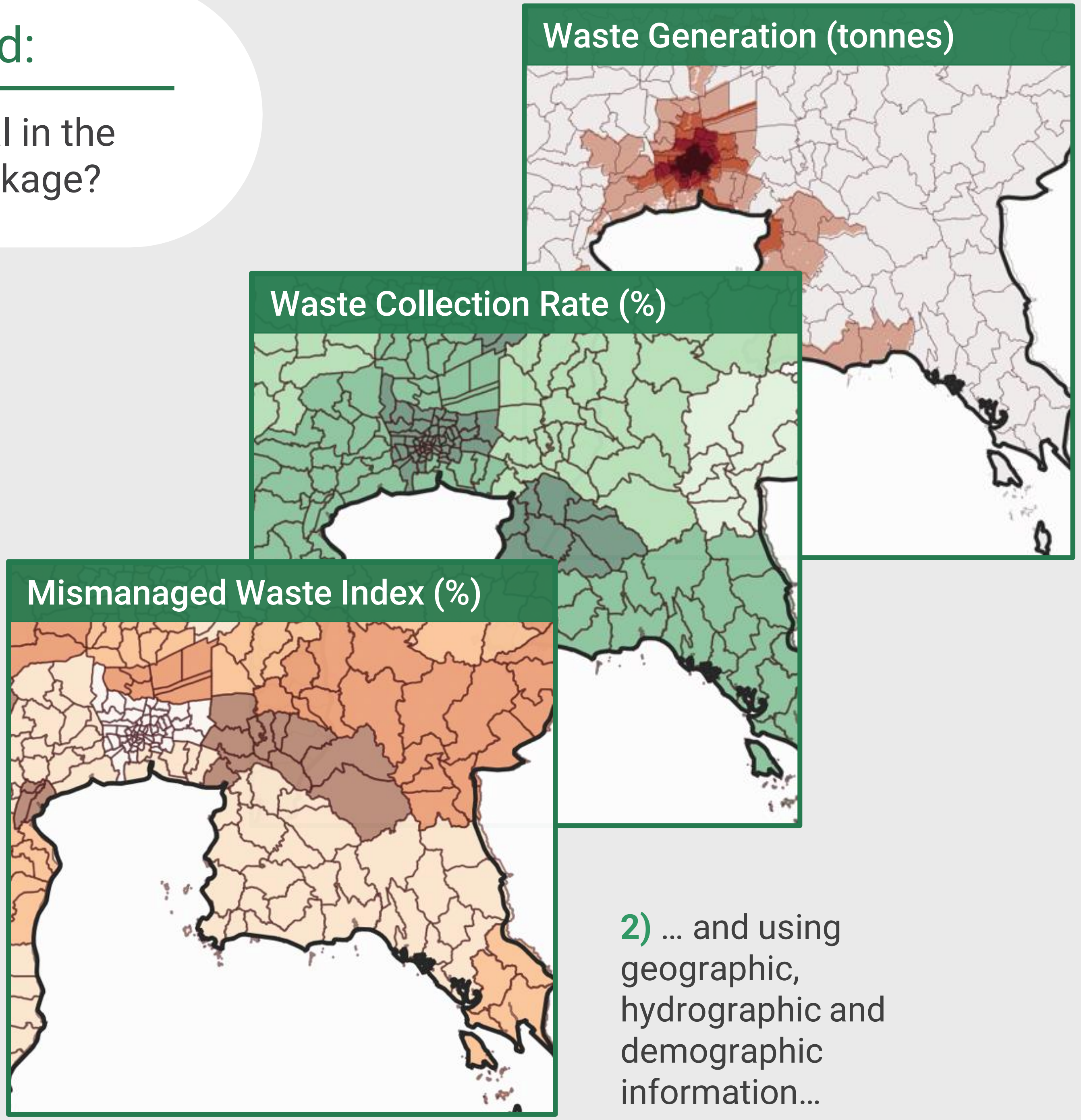


OBJECTIVE AND INSTRUCTIONS

Key question answered:

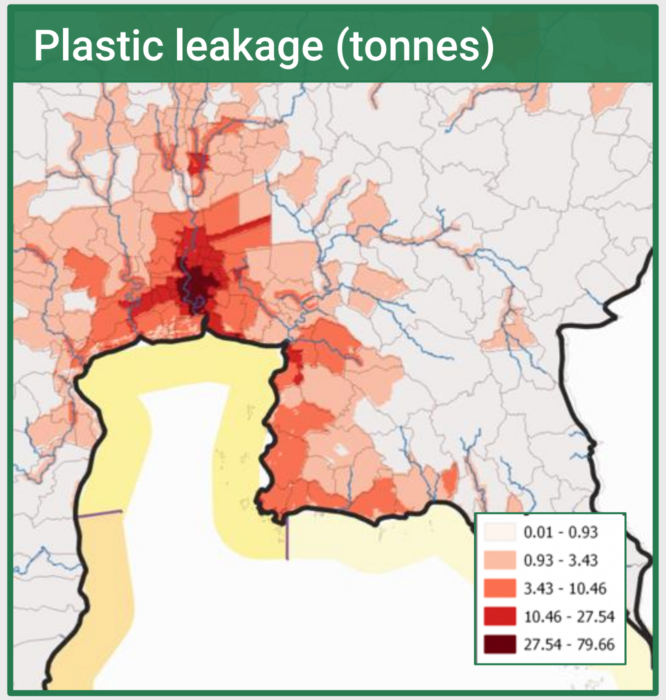
Which areas are most critical in the country regarding plastic leakage?

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

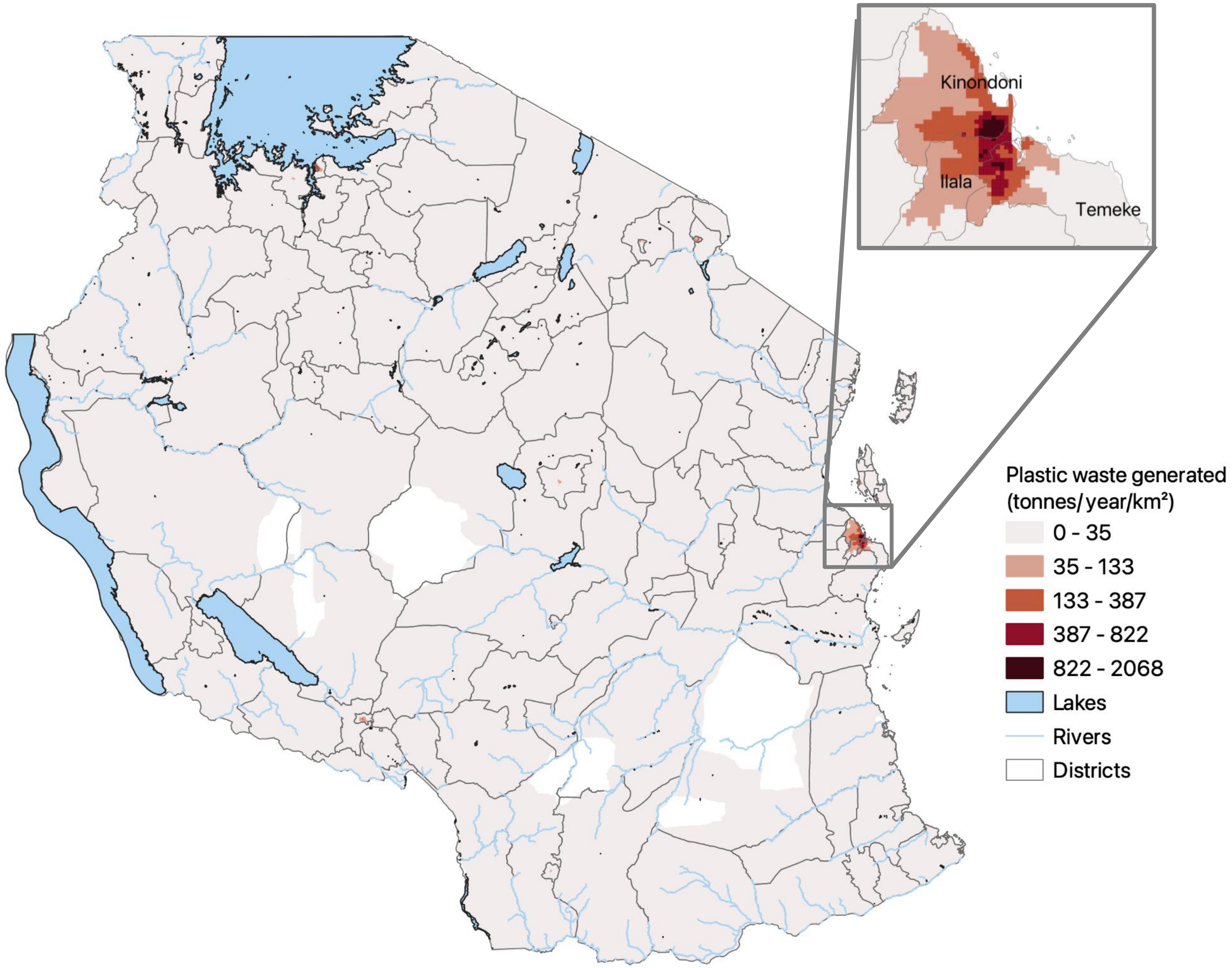


2) … and using geographic, hydrographic and demographic information…

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



WASTE GENERATION:
MAP AND INTERPRETATIONS [2018]



More details available in Appendices

Key take-aways

- Plastic waste generation is concentrated around Dar es Salaam, where the per capita plastic waste generation nears 30 kg/cap/year.
- The average per capita plastic waste generation is 5.7 kg/cap/year.

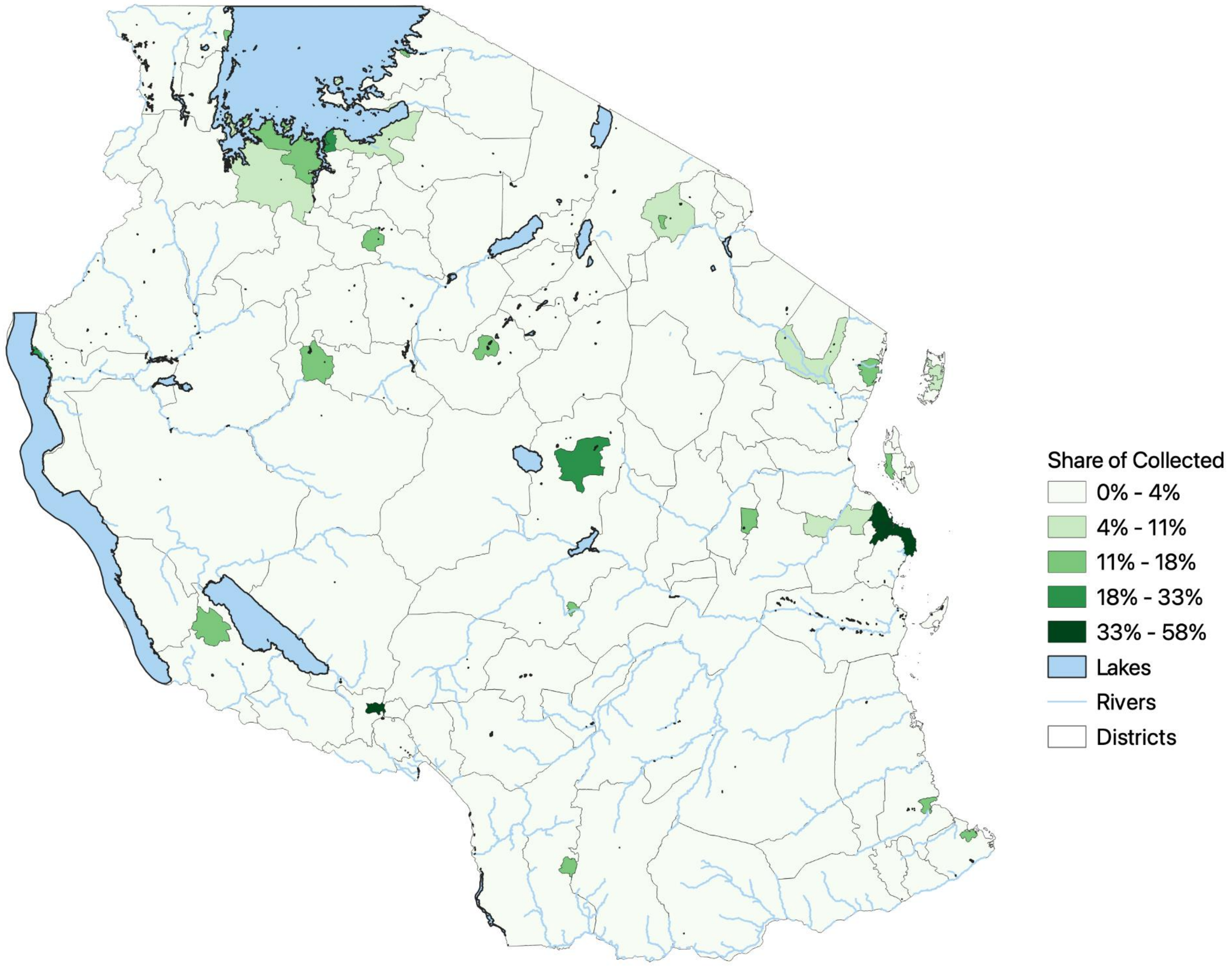
Limitations

We assume all cities to have the same per capita plastic waste generation pattern, except for some cities for which more granular data was available. Similarly, all rural areas have the same plastic waste generation pattern, although assumed very low compared to cities. No distinction was made between touristic and non-touristic areas.

Unlocking limitations

- Conduct waste generation characterisation studies at household level in additional cities and rural areas.
- Identify touristic hubs in the country and carry out surveys to better understand plastic consumption patterns of tourists.

WASTE COLLECTION: MAP AND INTERPRETATIONS [2018]



More details available in Appendices

Key take-aways

- The average collection rate in Tanzania is 40%.
- Collection of waste varies greatly around the country, with the highest rate in Dar Es Salaam (58%) and the lowest in rural areas where there is no organised waste collection.

Learnings

The collection rate in urban areas ranges from 15% up to 58% in the Temeke district of Dar es Salaam.

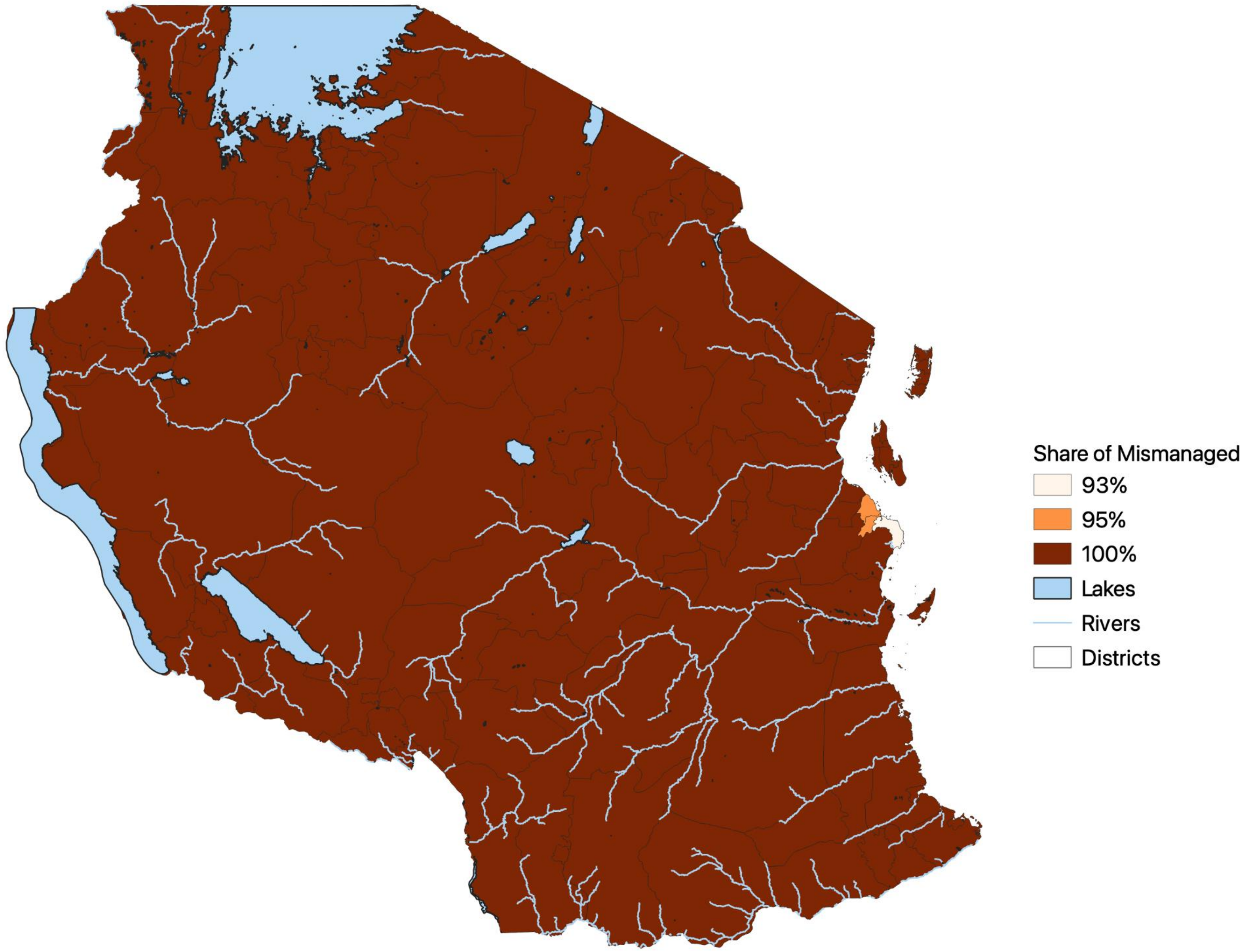
Limitations

The collection rate was only known some cities. For other urban areas we have set an average collection rate of 15% (*Nyampundu, 2020*). For rural areas, we assumed that the collection rate was 0%.

Unlocking limitations

Improve data granularity of waste collection rates across the country.

MISMANAGED WASTE INDEX: MAP AND INTERPRETATIONS [2018]



More details available in Appendices

Key take-aways

- MWI is 100% everywhere except for Dar Es Salaam where a small share (less than 5%) of the plastic waste is recycled.

Learnings

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

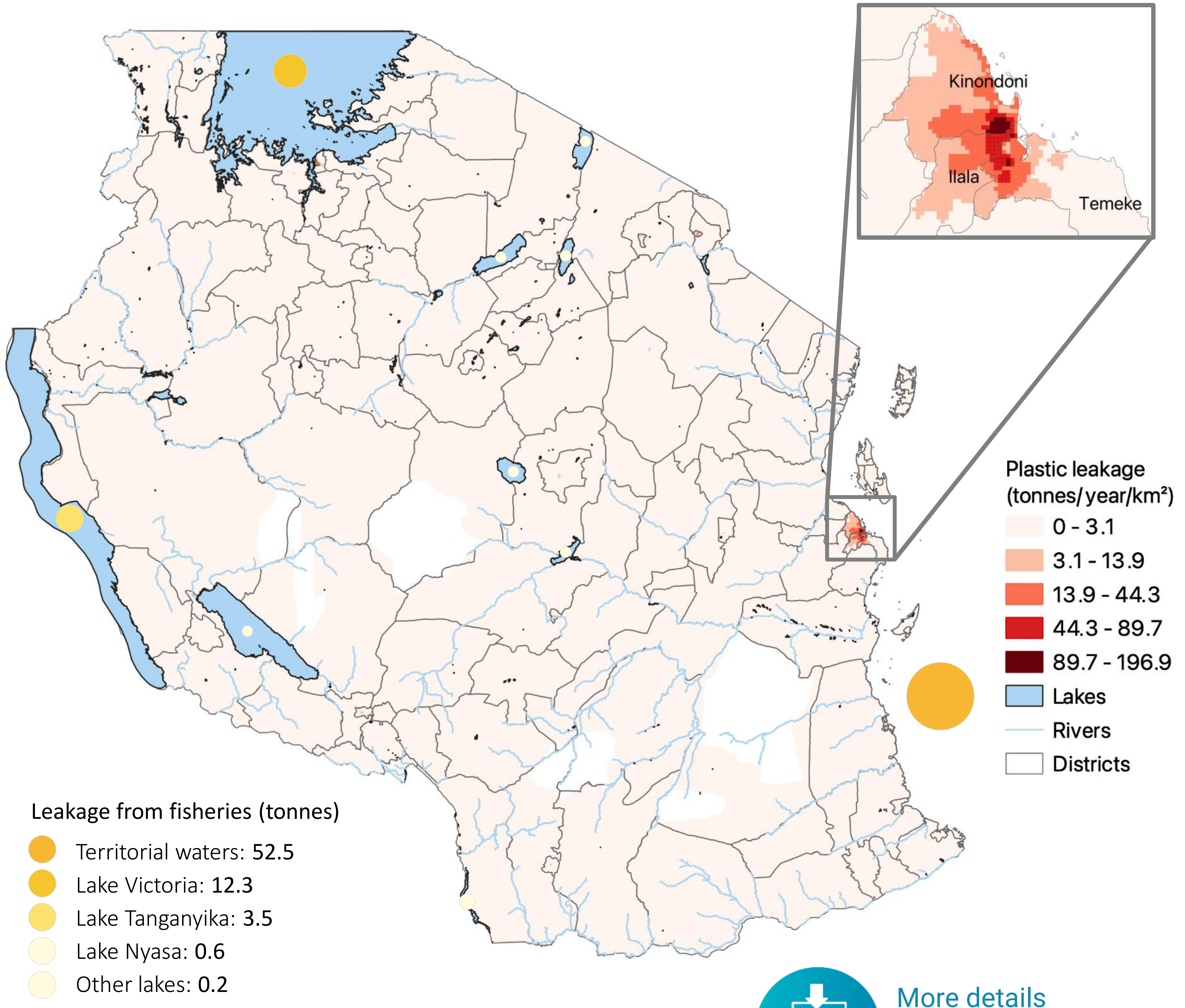
Limitations

We assumed collection of plastic for recycling to be limited to Dar es Salaam and its surroundings. However, the lack of data on recycling might lead to an overestimate of mismanaged plastic waste in areas where recycling occurs and that are currently not taken into account.

Unlocking limitations

Contact recycling companies and centralise data on recycling quantities as well as the origin of recyclable waste.

REGIONAL LEAKAGE:
MAP AND INTERPRETATIONS [2018]



More details available in Appendices

Key take-aways

- Annual leakage from mismanaged waste: 26'785 tonnes
- Annual leakage from mismanaged/lost at sea fishing gears and from overboard littering: 69 tonnes
- 71% of plastic leakage stems from Dar es Salaam districts (i.e. Kinondoni, Ilala and Temeke)

Learnings

Leakage pathways to lakes as well as fishing activities occuring on lakes were taken into account in our model.

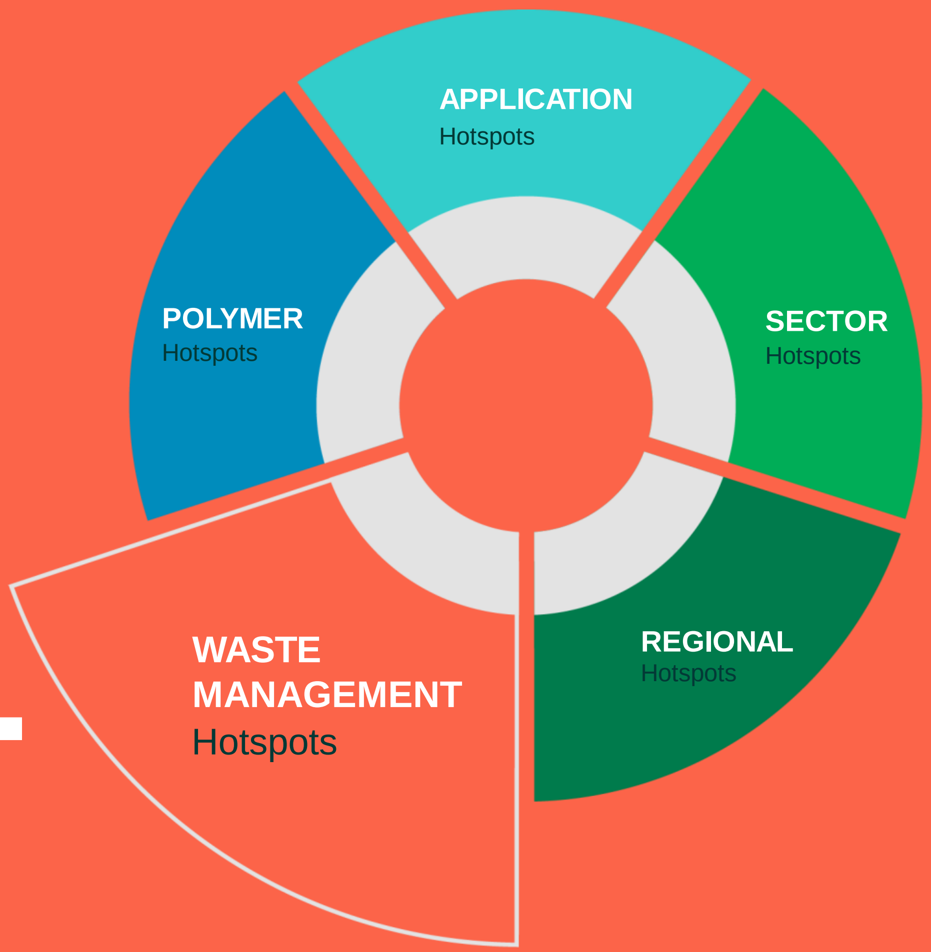
Limitations

As previously mentioned, we assigned a very low plastic waste generation per capita in rural areas, which in turn results in having a lower contribution to leakage from these areas. We are possibly missing some illlegal trade of plastics at borders that artificially lowers the total plastic waste generated.

Unlocking limitations

Contact customs authorities to have a better insight on the magnitude of illegal trade.

E WASTE MANAGEMENT HOTSPOTS



OBJECTIVE AND INSTRUCTIONS

Key question answered:

Which waste management stages are most critical in the country regarding plastic leakage?

1) We decided 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 hotspot		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% in 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 with this dashboard

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

T4

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
COLLECTION	WASTE **COLLECTION**	Formal collection of municipal waste	Formal collection of industrial waste	Value of recycled plastics	Value of non-recycled plastics
COLLECTION	LEAKAGE WHILE **WAITING FOR COLLECTION**	Design of waste bins	Frequency of collection	Climatic conditions	Other (e.g. animals)
COLLECTION	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
END-OF-LIFE	**POST-LEAKAGE** MANAGEMENT	Frequency of city cleaning and sweeping	Frequency of waterway cleaning	Frequency of coastal clean-up	Frequency of other clean-up activities
END-OF-LIFE	**WASTE WATER** MANAGEMENT	Management of run-off waters	Waste water collection	Waste water treatment efficiency	Fate of WWTP sludges

For more details and justifications, check tool T4.1

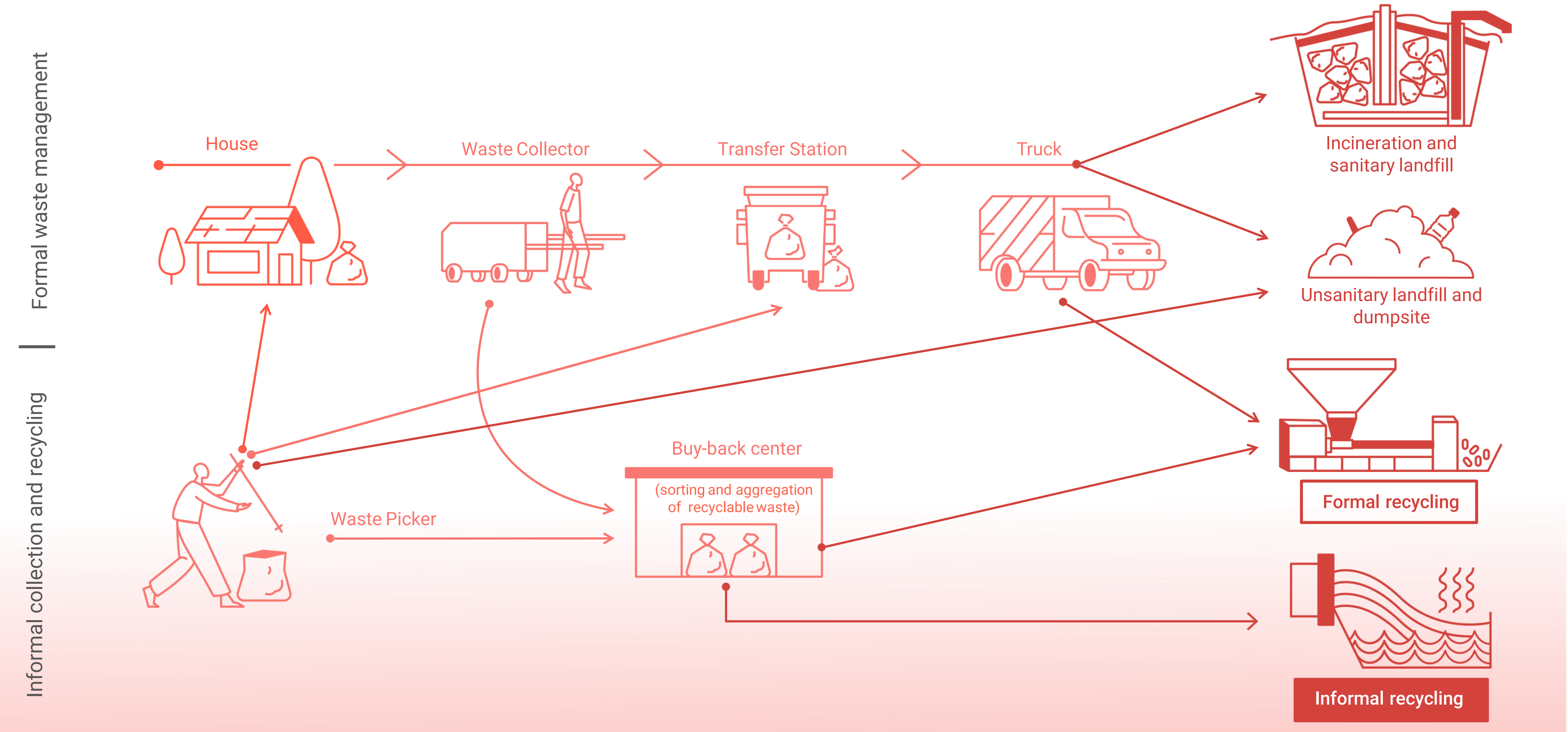
- **Negative contribution to the leakage**
- **Neutral contribution**
- **Positive contribution**
- **Not assessed**

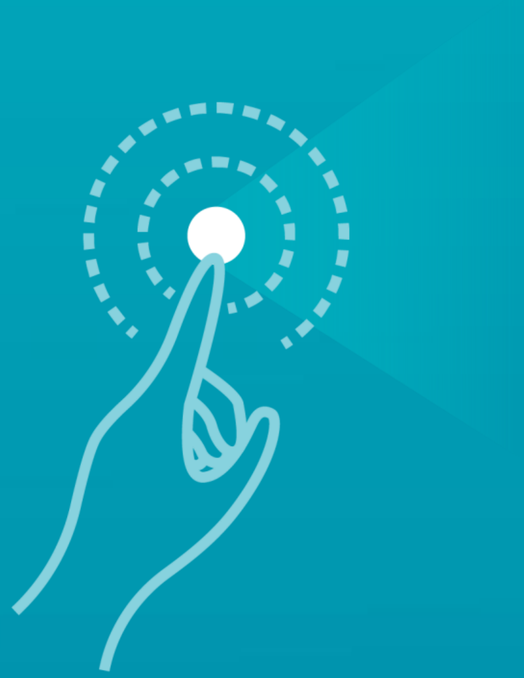
Key take-aways

- Plastic waste per capita generation (6 kg/cap/year) is below the average in Africa (14 kg/cap/year), which is a positive factor.
- Waste collection rate (40%) is below the 48% average in low-middle income countries.
- Value of recycled plastics for waste pickers seems higher than in some other African countries.
- Due to the absence of sanitary landfills and incinerators, there is no proper disposal of waste in Tanzania.
- Burning of waste is a widespread practice in Tanzania.
- Plastic recycling is not well understood and could not be properly assessed.

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

PLASTIC WASTE JOURNEY IN A NUTSHELL





2.3 ACTIONABLE HOTSPOTS

HOTSPOTS IN BRIEF

Polymer

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

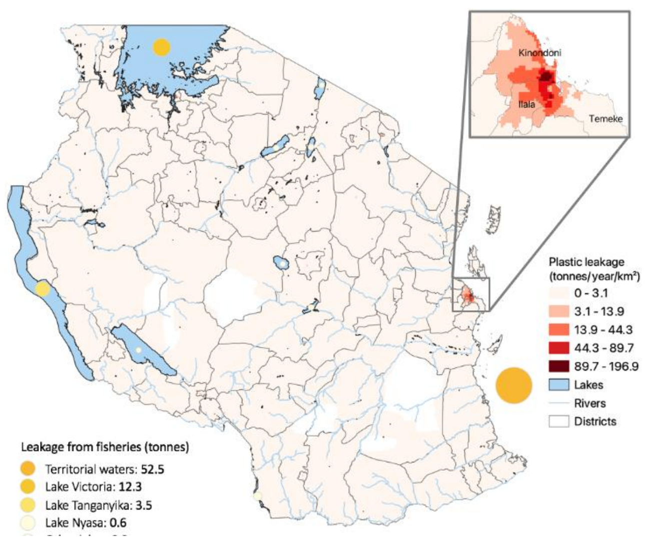
Application

- Bags
- Lids and caps
- Other bottles
- Fishing nets
- Cigarette filters
- Drinks bottles
- Boxes, cases, crates
- Dairy packaging
- Baby diapers

Sector

- Automotive-tyres
- Packaging
- Textile
- Fishing
- Medical
- Tourism
- Agriculture
- 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
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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

Positive contribution

Neutral contribution

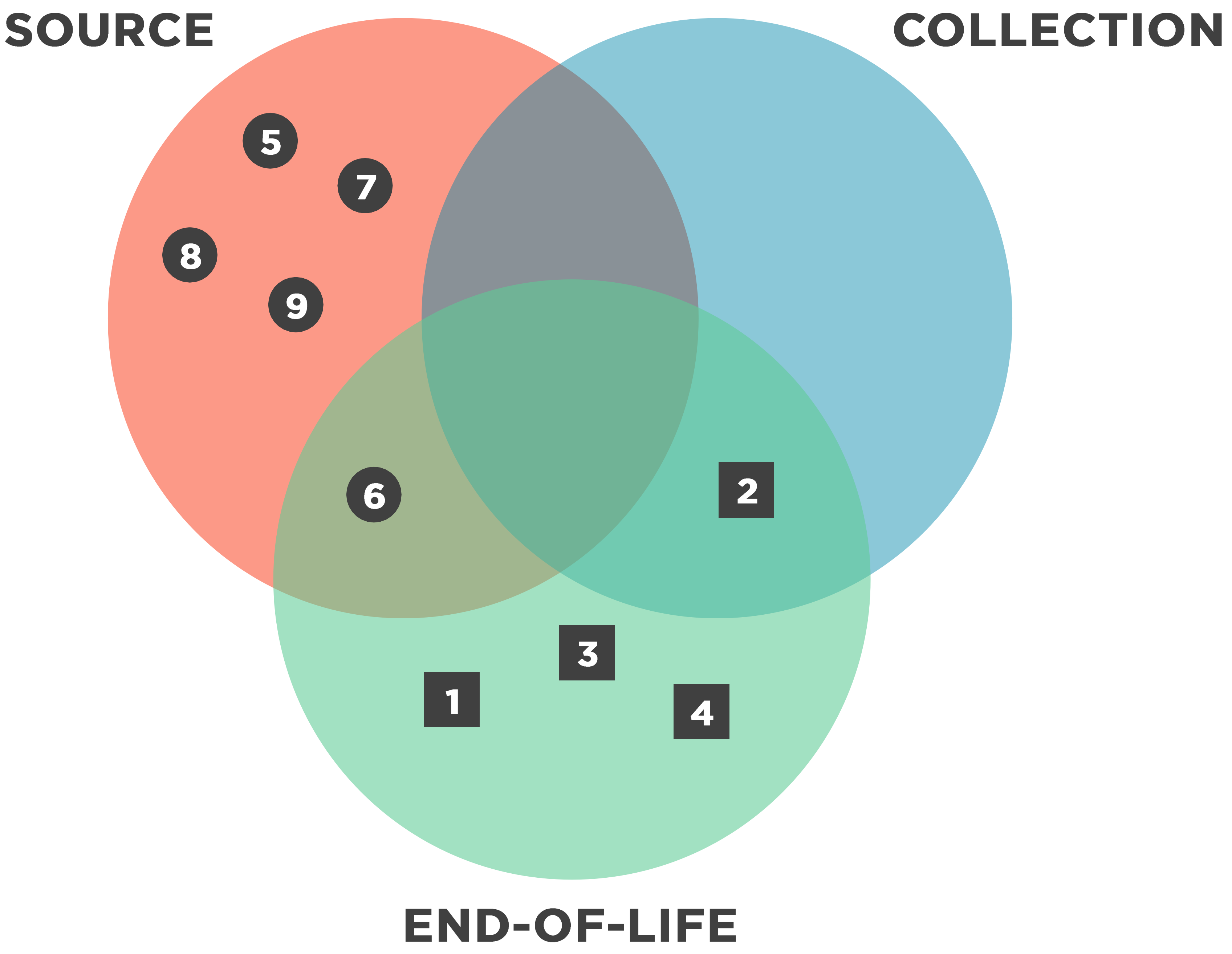
Not assessed

ACTIONABLE HOTSPOTS LIST

[#]	[ACTIONABLE HOTSPOT]	[■/●]
1	Plastic waste leaks in Tanzania because there is no proper disposal of waste in either sanitary landfills or incineration facilities, hence all collected waste that is not recycled accumulates in dumpsites.	■
2	Low collection rates across the country reduce the amount of waste available to recyclers and increase leakage.	■
3	The widespread practice of open burning reduces the amount of potentially recyclable plastic waste.	■
4	Dumping and littering practices reduce the amount of waste collected for recycling.	■
5	Plastic is leaking from cities due to a much higher plastic consumption than in rural areas, especially from Dar es Salaam.	●
6	Plastic products made of PP, PET and HDPE are leaking in Tanzania due to high consumption in the packaging sector and higher chances of leaking into waterways and the Ocean.	●
7	Plastic products in the packaging sector leak in Tanzania due to a higher consumption and a shorter lifetime than in other sectors.	●
8	Tyres made of synthetic rubber contribute to most of micro-leakage due to tyre abrasion while driving road vehicles.	●
9	The fishing sector has a very high relative leakage due to the extensive use of longlines in territorial waters, which have a high loss rate at sea.	●

■ **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 Tanzania calls for a set of actions focused on both the source of plastic and the end-of-life management of waste.

■ **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

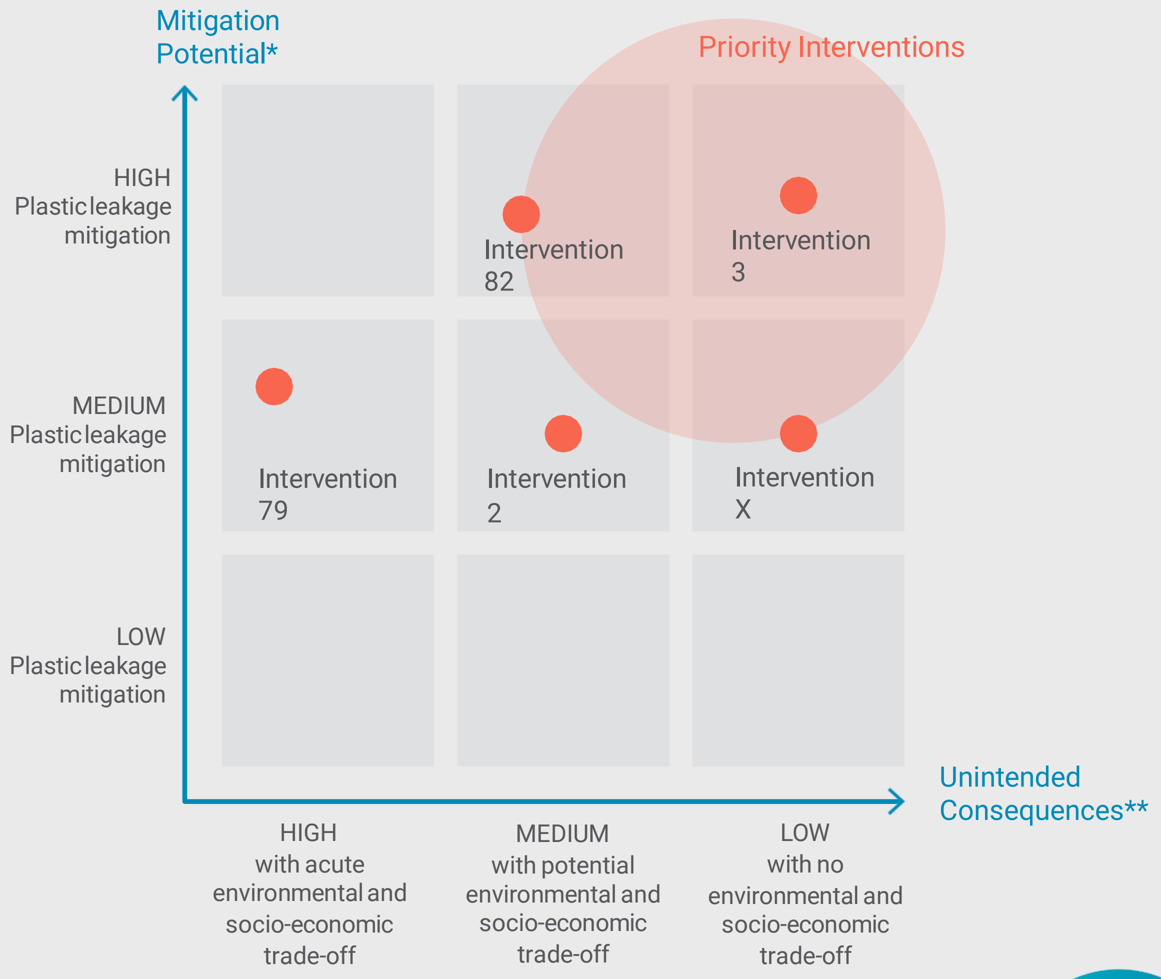
STEP 1: choose up to 3 interventions for each actionable hotspot

STEP 2: assess criteria levels for each chosen intervention

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

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

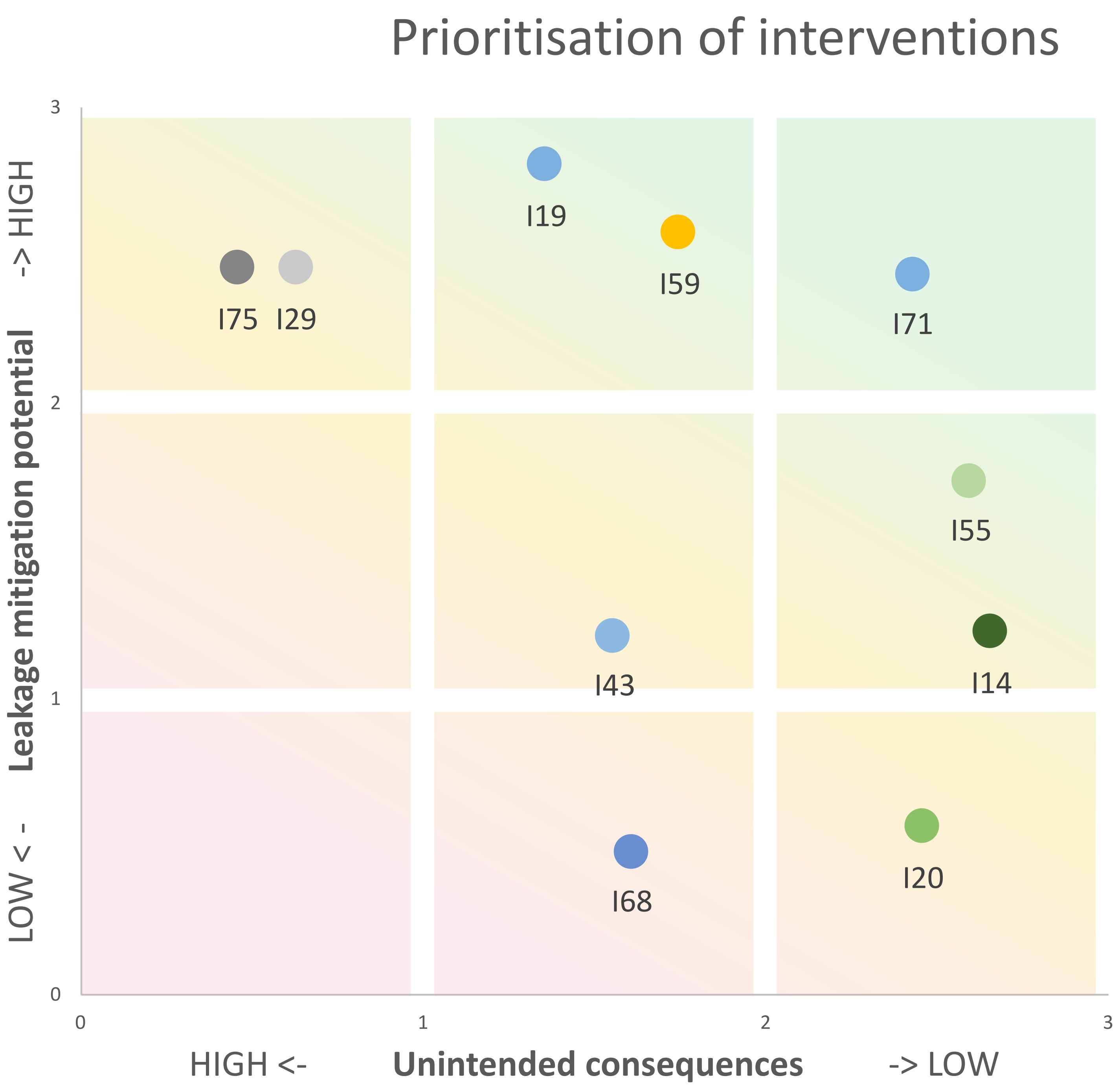
Interventions (I)	Leakage mitigation potential*	Unintended consequences**
I1		
I2	medium	medium
I3	high	low
I4		
I5		
…		
I79	medium	high
I80		
I81		
I82	high	medium
I83		



* **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



- I14: Reduce littering in urban areas
- I19: Reduce demand for, and use of, single-use, especially on-the-go, plastics
- I20: Reduce tyre abrasion
- I29: Avoid producing / importing plastic objects that do not benefit from a recycling solution in the country
- I43: Reduce open burning of plastic waste
- I55: Ensure recuperation of used fishing gears
- I59: Ensure plastic waste has enough value to cover collection costs (for all polymers)
- I68: Install system to collect road run-off water contaminated with tyre particles
- I71: Increase capacity for proper waste disposal (sanitary landfills if other upstream solutions cannot be applied)

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 authors 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.

RE-DESIGN	SUSTAINABLE PRODUCTION	Design plastic products with highly recoverable and recyclable materials while improving reusability and repairability, and rethink sustainable business models to minimise risks of plastic leakage	PRODUCT MANUFACTURING AND USE
REDUCE	SUSTAINABLE CONSUMPTION AND LIFESTYLES	Reduce demand for & use of problematic or unnecessary plastic materials and products	PRODUCT MANUFACTURING AND USE
RECUPERATE	WASTE COLLECTION SYSTEMS	Maximise collection of plastic waste	WASTE INFRASTRUCTURE AND MANAGEMENT
RENOVATE	WASTE INFRASTRUCTURE	Build capacity to increase efficiency of proper treatment and final disposal	WASTE INFRASTRUCTURE AND MANAGEMENT
RECYCLE	PLASTIC RECYCLING	Increase recycling rates through design and infrastructure that facilitate better segregation, collection, disassembly, recycling and recovery	WASTE INFRASTRUCTURE AND MANAGEMENT
REMOVE	CLEAN-UP SOLUTIONS	Post-leakage cleaning of the environment	POST LEAKAGE MANAGEMENT

S2

PRELIMINARY PRIORITY INTERVENTIONS LIST

[INTERVENTION CLASS]	[PRIORITY INTERVENTION]	[CODE]
SUSTAINABLE CONSUMPTION AND LIFESTYLES	Reduce littering in urban areas	**I14**
	Reduce demand for, and use of, single-use, especially on-the-go, plastics	**I19**
WASTE COLLECTION SYSTEMS	Reduce open burning of plastic waste	**I43**
	Ensure recuperation of used fishing gears	**I55**
	Ensure plastic waste has a enough value to cover collection costs (for all polymers)	**I59**
WASTE INFRASTRUCTURE	Increase capacity for proper waste disposal (sanitary landfills if other upstream solutions cannot be applied)	**I71**

3.2 INSTRUMENTS

METHODOLOGY FOR IDENTIFYING INSTRUMENTS

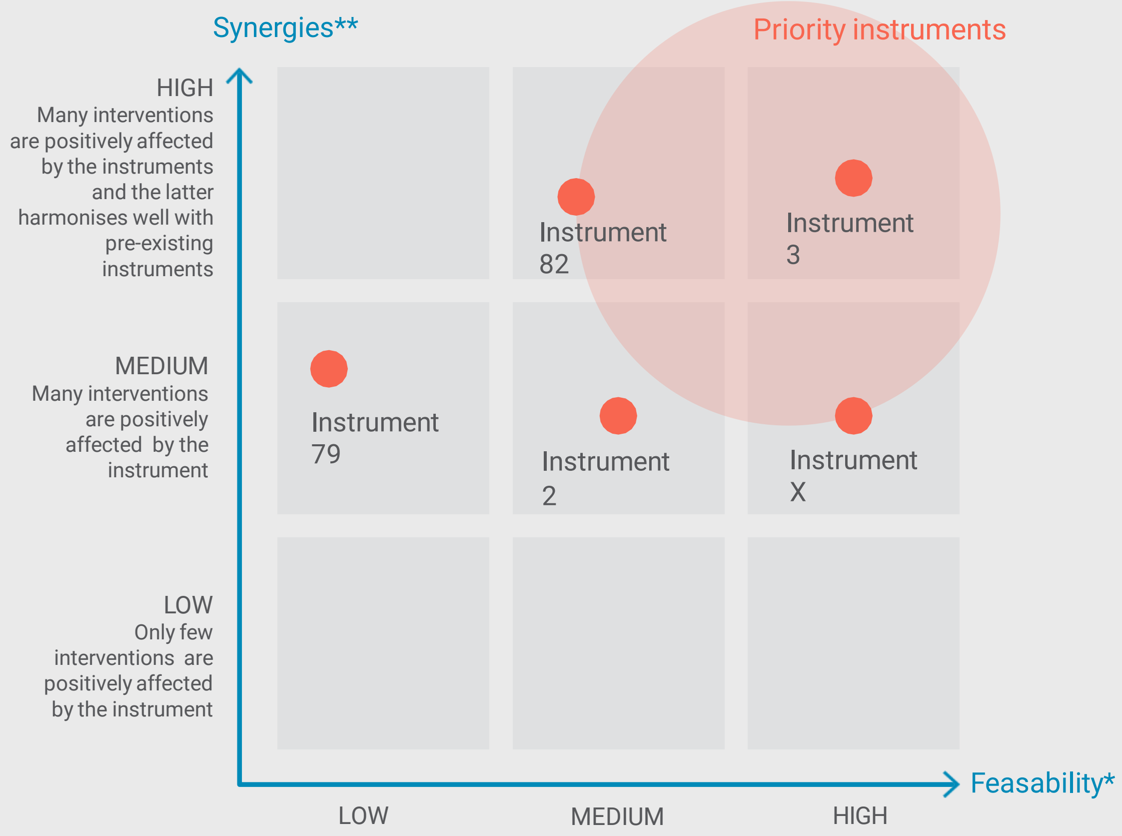
STEP 1: choose up to 3 instruments for each intervention selected in S2

Intervention (I)
I2
I3
...
I79
I82

STEP 2: assess criteria levels for each chosen instrument

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

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

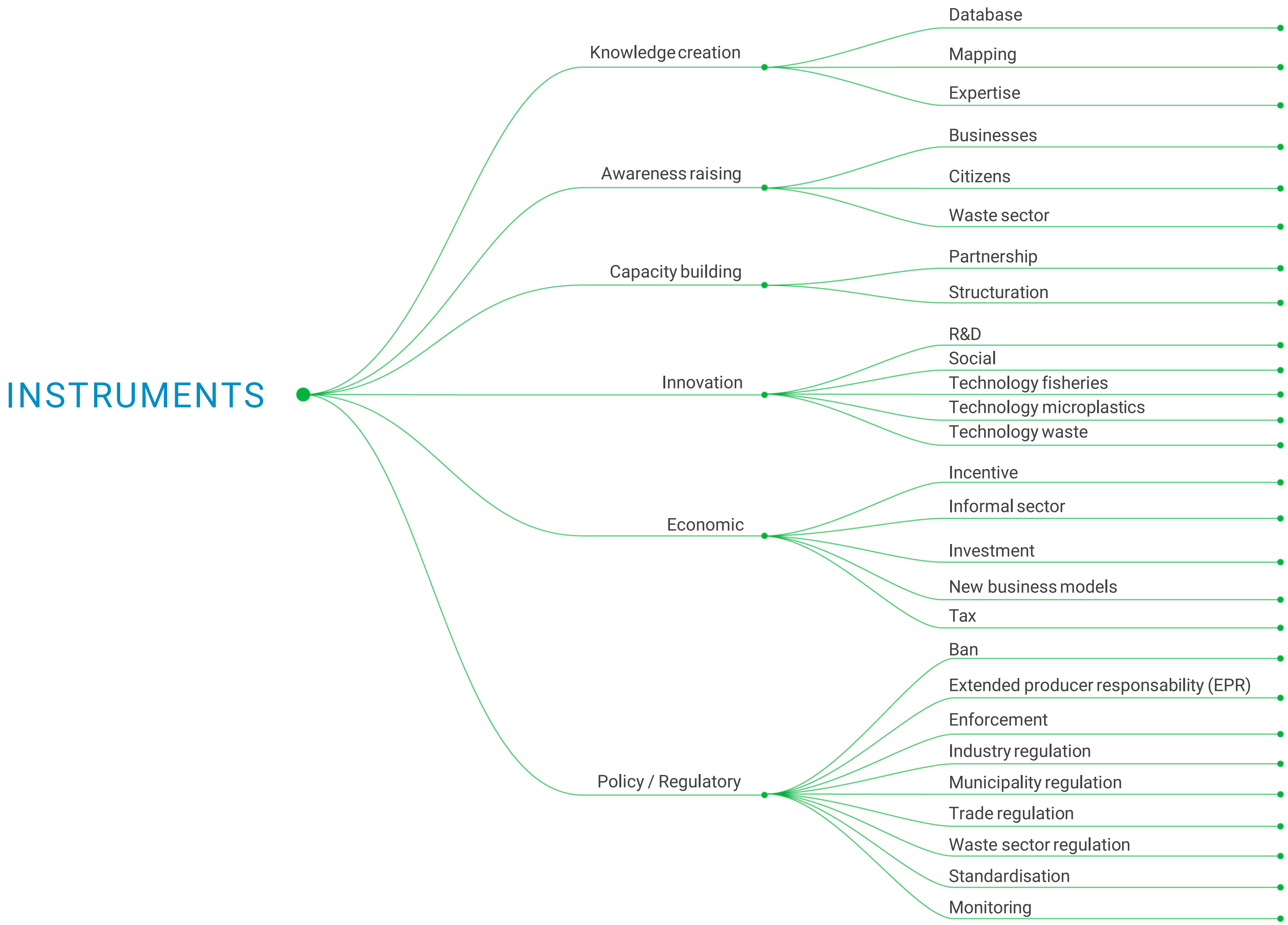


* **Feasability:** technical and socio-economic assessment of each instrument should be performed. We do not assert a method to perform the assessment as this is beyond the scope of the Guidance. The user can decide on the method to use based on resources available. A by default qualitative assessment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

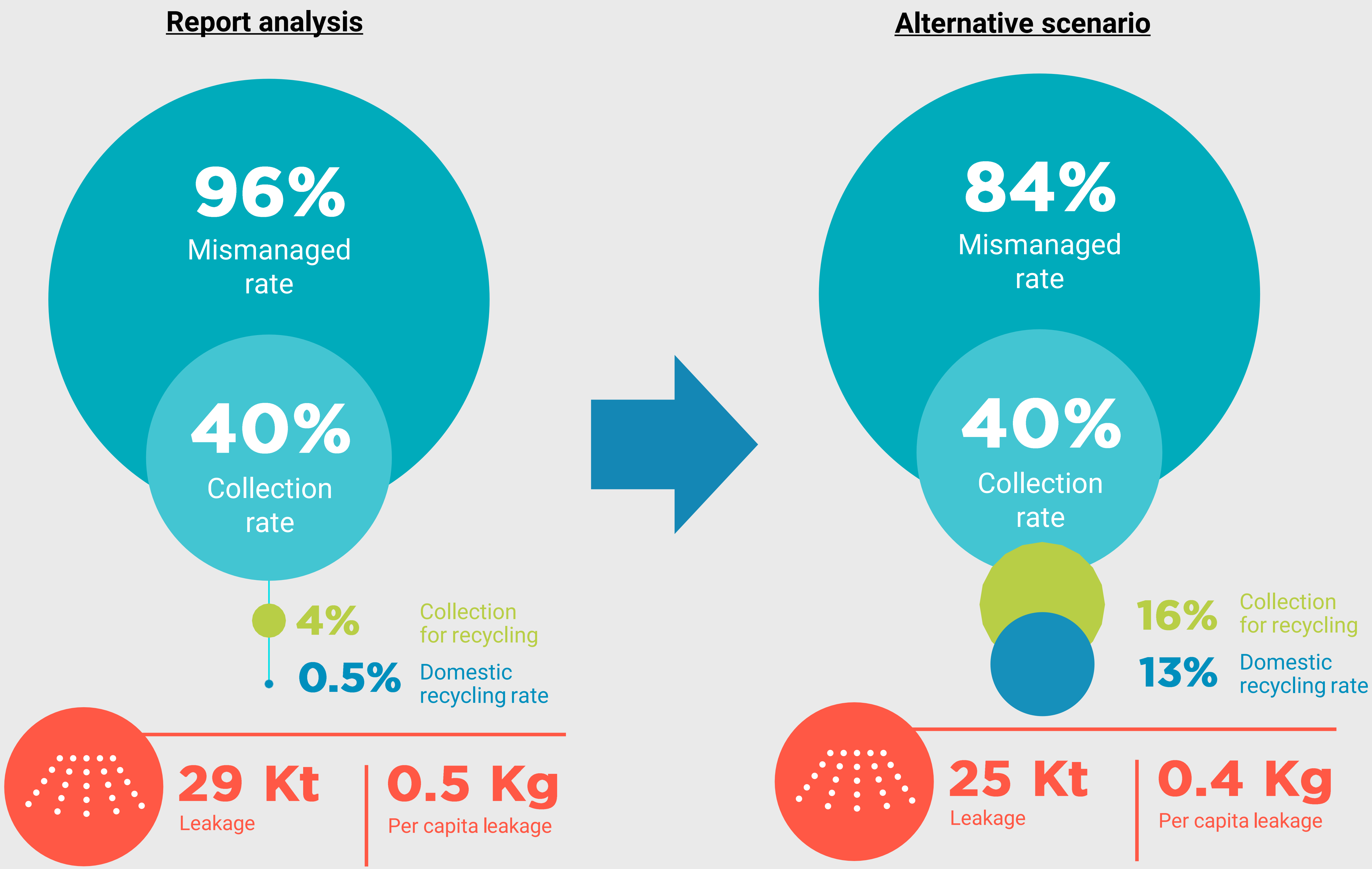
ALTERNATIVE SCENARIO

Data on recycling in Tanzania is lacking. Two sources of data are available:

- One provided by a local expert based on data from three recyclers with a recycling quantities by polymer [1.5 kt domestic recycling]
- The other from NESR (2017) which provides higher total value without specification by polymer [51 kt collected for recycling, incl. nylon]

We chose the first data source, because NESR (2017) is missing granularity by polymer and because there is a lack of insight on the fate of the plastic collected for recycling.

If we were to use the value from NESR (2017) instead, we would obtain an alternative scenario where the domestic recycling rate increases to 13% and the MWI drops to 84%. Eventually, plastic leakage would decrease going from 29 kt to 25 kt, but the order of magnitude for leakage would remain the same.



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	41	3%	19%	0%	36%	41%	100%	59%	78%	12%	42	6%
PP	72	0,2%	1%	0%	36%	63%	100%	37%	99%	10%	73	2%
Polyester	59	0%	0%	0%	41%	59%	100%	41%	100%	6%	59	0%
LDPE	33	0,1%	0,5%	0%	41%	58%	100%	42%	99%	13%	33	2%
HDPE	42	0,3%	2%	0%	36%	61%	100%	39%	98%	11%	42	2%
PS	3	0%	0%	0%	31%	69%	100%	31%	100%	9%	4	2%
Other	36	0%	0%	0%	31%	69%	100%	31%	100%	6%	36	0%
Synthetic Rubber	16	0%	0%	0%	36%	64%	100%	36%	100%	13%	16	0%
PVC	13	0%	0%	0%	20%	80%	100%	20%	100%	4%	14	1%
All	-	0,5%	3%	0%	36%	60%	100%	40%	96%	9%	35	2%

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

WASTE MANAGEMENT BY GEOGRAPHICAL ARCHETYPE

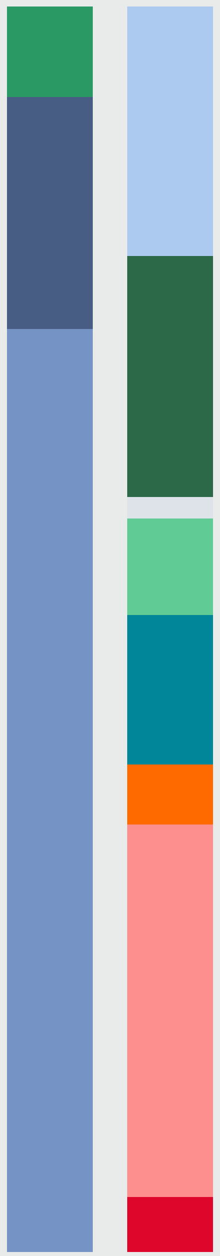
Archetype	Population 2020	Generated t	Collected t	Collected for recycling t	Properly disposed t	Improperly disposed t	Uncollected t	Leaked t	Generated kg/hab	Collected for recycling kg/hab	Mismanaged kg/hab	Share of collected	Share of mismanaged	Leakage rate
Dodoma Urban	482611	7793	2572	0	0	2572	5221	401	16.1	0.0	16.1	33%	100%	5%
Ilala	2018938	51626	28394	3161	0	25233	23232	4911	25.6	1.6	24.0	55%	94%	10%
Kigoma Urban	257902	1817	545	0	0	545	1272	121	7.0	0.0	7.0	30%	100%	7%
Kinondoni	2440078	96134	49028	4597	0	44431	47106	9195	39.4	1.9	37.5	51%	95%	10%
Mbeya Urban	488721	6592	2920	0	0	2920	3672	372	13.5	0.0	13.5	44%	100%	6%
Moshi Urban	205770	4342	0	0	0	0	4342	434	21.1	0.0	21.1	0%	100%	10%
Mwanza Urban	658070	21718	6950	0	0	6950	14768	1331	33.0	0.0	33.0	32%	100%	6%
Temeke	2249720	53998	31319	3545	0	27774	22679	4906	24.0	1.6	22.4	58%	93%	9%
Urban other	4458155	23494	3524	0	0	3524	19970	1789	5.3	0.0	5.3	15%	100%	8%
Rural	42643824	49664	0	0	0	0	49664	3326	1.2	0.0	1.2	0%	100%	7%

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 – Reliability		Modelling – Temporal		Modelling – Geographic		Modelling – Granularity		Final metric	Score
Gaulier et al., BACI database | Total waste import (2018 data)	2	2018	1	European polymer share in packaging sector used in place of a global one.	2	Total import and export are given by the HS code code 3915. We assume that the waste is imported for recycling, and we fix the share of import by polymer based on the share by polymer of plastic used in the Packaging sector.	3	Import of waste	3
PlasticsEurope, 2018 | Polymers to Sectors correspondence matrix	1								
This study - Polymer | Import of waste by polymer	3	2018	1	-	1	Recycling of imported waste = Import of waste	2	Recycling of imported waste**	3
Gaulier et al., BACI 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								
Gaulier et al., BACI 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
Gaulier et al., BACI database | Import of primary (2018 data)	2	2018	1	-	1	We assume no production of primary plastic in Tanzania	5	Import and production of primary	5
This Study - Sector | Change in Stock by sector	2.5	2018	1	Mapping from Sector to Polymer based on EU, but adapted through TZ net input by polymer	2.5	-	1	Change in stock	2.5
This Study - Polymer | Net input*	3								



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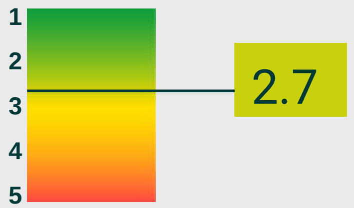
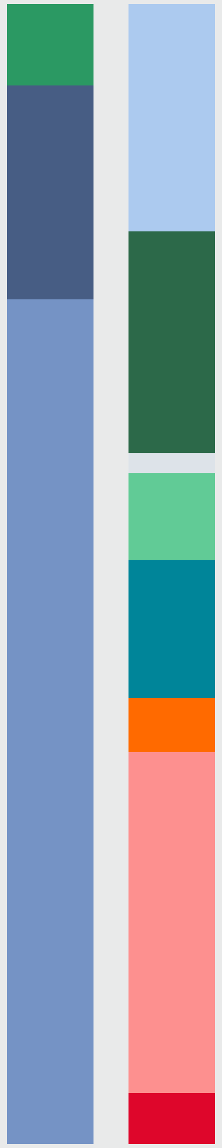


* Net input = Import waste - Recycling of import + import of products - Export of primary and products + Import and production of primary
** "Recycling of imported waste" together with "recycling of domestic waste" constitute the country's "recycling" bar

POLYMER HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Raw data – Reliability	Score	Modelling – Temporal	Score	Modelling – Geographic	Score	Modelling – Granularity	Score	Final metric	Score
Data collection IUCN | Recycled by polymer for some recyclers	4	2018	1	-	1	We assume that export of waste comes from plastic waste collected for recycling, hence the share by polymer are assumed to be the same. The plastic collected for recycling that is not exported is domestically recycled	2	Export of waste	3.0
Gaulier et al., BACI database | Total waste export (2018 data)	2							Domestic recycling of collected waste*	3.0
Kanyairita (2019) | No sanitary landfill or incineration facility	1.0	2018	1	-	1	No proper management of waste in Tanzania (no sanitary landfill or incineration facility)	1	Properly disposed	1.0
PlasticsEurope, 2018 | Sector to polymer mapping based on EU market	1								
This study - Sector | Improperly disposed by sector	2.94	2018	1	Mapping from sector to polymer based on EU, but adapted through TZ "remaining after recycling and properly managed" by polymer.Improperly disposed waste by sector is specific to TZ	3	See Polymer flowchart in module T3 of the methodology	2	Imporperly disposed	3.0
This study - Polymer | Remaining after recycling and properly managed	2.5								
This study - Polymer | Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	2.6	2018	1	-	1	Uncollected = Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	1	Uncollected	2.6
This Study - Sector | Leakage by sector	2.55	2018	1	Mapping from sector to polymer based on EU, but adapted using TZ mismanaged" waste specific to TZ	2	See Polymer flowchart in module T3 of the methodology	1	Leaked	2.7
This Study - Polymer | Mismanaged waste by polymer	2.8								



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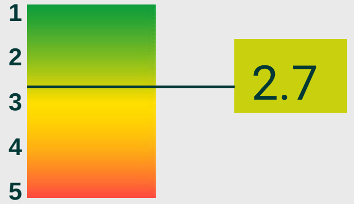
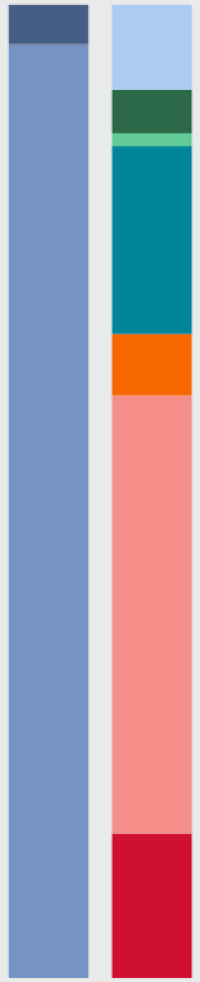


* "Recycling of imported waste" together with "recycling of domestic waste" constitute the country's "recycling" bar

APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

Raw data – Reliability		Modelling – Temporal		Modelling – Geographic		Modelling – Granularity		Final metric	Score
Gaulier et al., BACI 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 x 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								



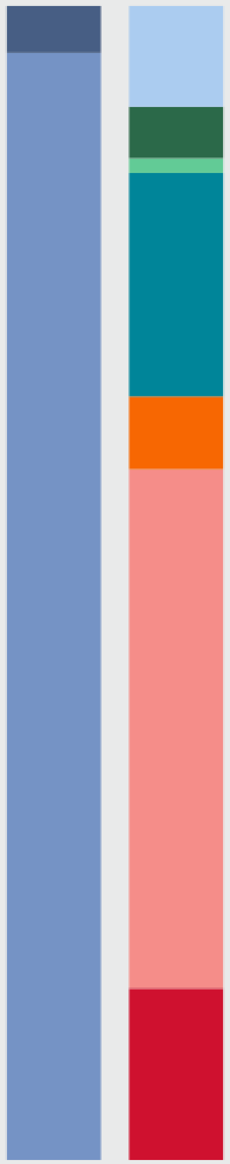
Quality Score

1
2
3
4
5

3.3

APPLICATION HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Raw data – Reliability	Score	Modelling – Temporal	Score	Modelling – Geographic	Score	Modelling – Granularity	Score	Final metric	Score
This Study - Sector| Plastic in packaging and tourism sector collected for recycling and exported	2	2018	1	Littering rates based on Europe. Recycling quantity and export specific to Tanzania	4	Packaging applications : Recycling per application = recycling from packaging * (waste - littering per packaging application) / (tot packaging waste - littering). Similarly for export of waste. For the non-packaging applications taken into account we assume no recycling.	4	Export of waste	4.0
This study - Applications | Waste genrated per application	4.33							Domestic recycling of collected waste*	4.0
Kanyairita (2019) | No sanitary landfill or incineration facility	1.0	2018	1	-	1	No proper management of waste = no sanitary landfills or incinerators	1	Properly disposed	1.0
European Commission, 2018 | Plastic packaging application ittering rate in EU	1	2018	1	European littering rates. Data on improperly disposed plastic from packaging and tourism are from TZ, as well as waste by application.	4	For packaging applications: See Application flowchart For other applications: See additional notes.	2	Imporperly disposed	2.4
This study - Sector | Improperly managed for Packaging and Tourism sector	2.94								
This study - Application | Remaining after recycling and properly managed	3.3								
This study - Application | Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	3.2	2018	1	-	1	Uncollected = Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	1	Uncollected	3.2
Plastic Leak Project, 2019 | Release rate per packaging application	3	2018	1	-	2.5	Leaked to ocean = (Waste - Recycling – Properly)*Release Rate, adjusted so that the total leakage matches leakage from the geographical analysis	1	Leaked	2.5
This Study - Sector | Leakage from Packaging and Tourism sector	2.55								
This Study - Application | Mismanaged	2.8								



Quality Score

1
2
3
4
5

3.3

APPLICATION HOTSPOTS MODELLING NOTES

Cigarette filters: We estimate the number of cigarette filters from cigarette consumption in 2019 from the GlobalData report on cigarettes in Tanzania (2019). The plastic weight of a cigarette filter is 0.17gr. From these data we obtain the waste generated. Trade data on import and export are determined through the BACI database (HS code: 240220). Recycling is set to zero. The share of properly disposed waste items 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%, based on European Commission littering report (2018). The share of improperly disposed is based on the average share of improperly disposed (sector hotspot), applied to cigarette filters not littered or properly disposed. The release rate is taken from PLP (2020) and applied to uncollected and improperly disposed to determine the total leakage.

Sanitary towels: import and export are determined through BACI database (HS code: 961900). Waste generation is estimated to be 3 sanitary towels/ day, 4 days/month, 12 month/year for all the female population from 15 to 55 years old (Index Mundi, 2020), with one sanitary towel weighting 2gr. Recycling is set to zero. The share of properly disposed waste items 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%, based on European Commission littering report (2018). The improperly disposed part is based on the average share of improperly disposed (sector hotspot), applied to sanitary towels not littered or properly disposed. The leakage rate is taken from PLP (2020) and applied to uncollected and improperly disposed to determine de total leakage.

Baby diapers: import and export are determined through the BACI database (2020). To determine the waste generation of baby diapers in Tanzania, we only consider the urban population (22%) of children from 0-2 years old (half of the 0-4 population in UN statistics database) using 4.16 unit of diapers/day (Mendosa et al., 2018). Average weight of a baby diaper is 29,1 gr, from which 33% made of plastic components (Espinosa et al. 2015). Recycling is set to zero. The share of properly disposed waste items is taken from the average share of properly disposed (sector hotspot), applied to the baby towels that are not littered. Littering rate is set to 21% (using sanitary towels as a proxy), based on the European Commission littering report (2018) The improperly disposed is based on the average share of improperly disposed (sector hotspot), applied to baby diapers not littered or properly disposed. The leakage rate is taken from PLP (2020) and applied to uncollected and improperly disposed to determine de total leakage.

SECTOR HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

Raw data | **Modelling** | **Final metric** | **Score**

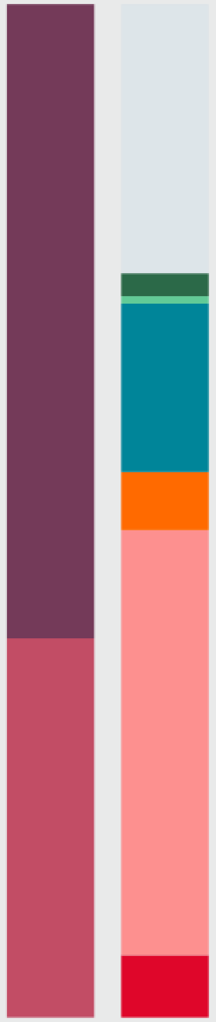
Reliability | **Temporal** | **Geographic** | **Granularity**

Quality Score

1
2
3
4
5

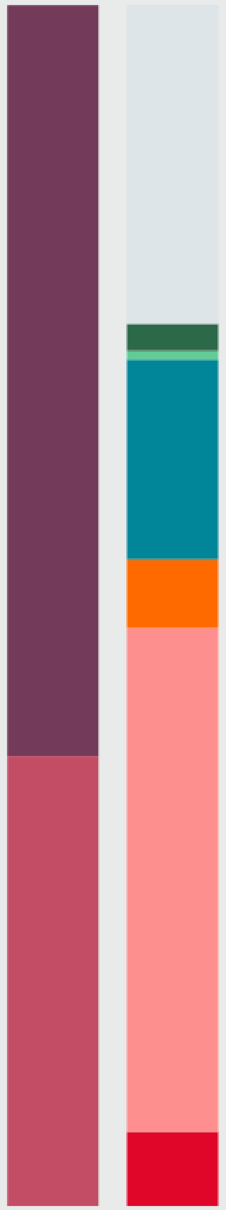
2.3

Raw data – Reliability		Temporal		Geographic		Granularity		Final metric	Score
PlasticsEurope, 2018 | Polymer to Sector mapping based on EU market	1	2018 2017 2018	1	Mapping from Polymer net input to Sector net input based on EU market, adapted through TZ polymer net input	2.5	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	2	Short-lived products	2.5
Geyer et al., 2017 | Product lifetime by sector, mean and std.	1							Long-lived products	2.5
This study – Polymer | Net input by polymer*	3								
The World Bank, 2012 | Manufacturing, added value, GDP growth	1	2018 2017 2018 2012	1	-	1	See Sector hotspot flowchart. For medical, tourism and fishing we assume no change in stock. Low score because we assume the relative importance of every sector unchanged throughout the years in order to determine the stock.	2.5	Change in stock	2.5
Geyer et al., 2017 | Product lifetime by sector, mean and standard dev.	1								
This study – Sector | Net input* by sector	2.5								
The heightec Group Ltd, 2012| Product lifetime of textile sector	3								

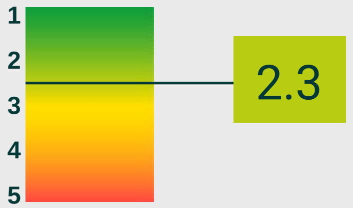


SECTOR HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Raw data – Reliability		Modelling – Temporal		Modelling – Geographic		Modelling – Granularity		Final metric	Score
Data collection IUCN | Recycled by polymer for some recyclers	4	2018	1	-	1	We assume that export of waste comes from plastic waste collected for recycling, hence the share by polymer are assumed to be the same. The plastic collected for recycling that is not exported is domestically recycled. 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	2.83
Gaulier et al. BACI database | Total export of plastic waste (data 2018)	2							Domestic recycling of collected waste**	2.83
This study - Sector | Waste generated by sector	2.5								
Kanyairita (2019) | No sanitary landfill or incineration facility	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	2.9
This study - Regional | Total plastic being improperly disposed	4								
This study - Sector | Waste - Properly managed - Recycled - Export of Waste	2.2								
Plastic Leak Project, 2019 | Littering rate by sector	3.0								
This study - Sector | Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	2.4	2018	1	-	1	Uncollected = Waste - Export of waste - Domestic recycling - Properly disposed - Improperly disposed	1	Uncollected	2
This Study - Sector | Mismanaged	2.7	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	2.6
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	2.03								



Quality Score



* 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

SECTOR HOTSPOTS MODELLING NOTES

Fishing: Data on number number of fishing gears comes from Fisheries Department frame survey 2019 (BILLFISH-WIO project, 2019). By default plastic weights by fishing gear type were derived from technical designs found in multiple publications including FAO and Nédélec et al., 1990. Combining these two pieces of information yields the net plastic input from fishing gears. By estimating the lifetime of a fishing net and by looking at the GDP growth of Spain, we estimate the amount of fishing nets going to waste from previous years.

Medical: In order to know the amount of plastic going to waste from the medical sector we combine the latest available number of hospital beds in Tanzania for 2010 (WHO, 2020) with the occupancy rate (131%), the amount of waste generated per bed per day (0.75 kg/bed/day) and the plastic share of medical waste (11%) provided by Manyele et al. (2006).

Tourism: Data on number of tourists is taken from the WorldBank database (2020) and the average stay length was found in the , *2017 International Visitors' Exit Survey Report* (NBS, 2018). We assume tourist and local population have the same daily plastic waste generation. The total plastic waste generated comes from the regional hotspot analysis.

Micro-leakage contribution

- **Automotive-tyres (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 vehicle numbers for 2018 is taken from MWTC (2018) and average distance travelled is based on the average in Kenya for 2018 (Notter et al., 2019).
- **Textile (Textile fibers):** loss and leakage of textile fibers to the marine environment is calculated based on the methodology described in the Plastic Leak Project (2020). Share of water collected and treated is set at 20% (NESR, 2017).
- **Others (Cosmetics):** loss and leakage of plastic micro-particles from cosmetics to the marine environment is calculated based on the methodology described in Plastic Leak Project (2020). Share of water collected and treated is set at 20% (NESR, 2017).
- **Others (Pellets):** loss and leakage the marine environment of plastic pellets during transportation and production stages is calculated based on the methodology described in Plastic Leak Project (2020). Share of water collected and treated is set at 20% (NESR, 2017).

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (1/2)

Raw data	Reliability	Modelling: Temporal		Modelling: Geographic		Modelling: Granularity		Final metric	Score
This study – Sector | Plastic waste generated in the country	2,5	2008-2017	3	Per capita waste generation in urban areas comes from various sources for some cities. The share of plastic in waste comes from Kazuva et al (2019) for Dar es Salaam, from Mgimba et al. (2016) for other urban areas, and from minimum value in CCAC (2015) for rural areas. Waste generated by km2 = population per km2 * per capita waste generated (urban/rural)	3	-	1	Waste generated	3
CCAC, 2015 | waste generation and collection rates in Dar es Salaam districts.	2								
Kazuva et al. 2019 | Plastic share in household and non-household waste for Dar es Salaam	2								
Mgimba et al, 2016 | Waste generation, collection rate and plastic share in Mbeya city	2								
Nyampundu et al., 2020 | Waste generation and collection rate in Dodoma city	2								
Wilson et al, 2012 | Waste generation in Moshi city	2								
Kanyairita L., interview | Waste generation and collection rate in Mwanza city	5								
Babijes, 2016 | Waste generation and collection rate in Kigoma city	3								
CIESIN, 2018 | Population count per km2 *projection for 2020*	2								
Partial data collection, IUCN | Recycled by polymer for few recyclers	3	2020 2018	1	We assume waste collected for recycling only in the Dar es Salaam. The share of collected for recycling = population share wrt the tot population of the districts in Dar es Salaam.	2	-	1	Collected for recycling	3
Kanyairita (2019) | No sanitary landfill or incineration facility	1	2018	1	-	1	-	1	Properly disposed	1
various sources cited above | Waste collected then disposed at dumpsites	2,5	1998 - 2018	3	For some cities, a specific collection rate is available. For other urban areas, we use an average of uncollected from *Nyampundu et al. (2020)*. Collection rate for rural areas is set to 0.	4	-	1	Improperly disposed	4
This study - Regional | Waste - Collected for recycling - Properly disposed - Improperly disposed (by province)	2,8	2018	1	-	1	Uncollected = Waste - Collected for recycling - Properly disposed - Improperly disposed	1	Uncollected	2,8

Quality Score

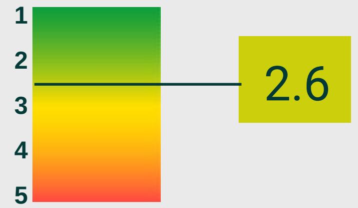
1
2
3
4
5

2.6

REGIONAL HOTSPOTS
DATA QUALITY ASSESSMENT (2/2)

Raw data – Reliability		Modelling – Temporal		Modelling – Geographic		Modelling – Granularity		Final metric	Score
This Study - Regional | Mismanaged = Uncollected + Improperly managed by disctrict	3.4	2018	1	-	1.0	Share of mismanaged by district = Waste mismanaged by province / waste generated by district	1	Share of Mismanaged	3.2
This Study - Regional | Waste generated by district	3.0								
This study - Regional | Collected = Collected for recycling + Properly disposed + Improperly disposed	2	2018	1	-	1	Share of collected = Waste mismanaged by province / waste generated by province	1	Share of Collected	2
Richardson et al., 2019 | Loss rate by fishing gear type	2	2019 1990 2018	2.5	See additional notes	2	See additional notes (Sector Quality assessment)	2	Leakage from fishing sector	2.5
Nédélec et al., 1990 | Drawings of various fishing gear	2								
Fisheries Department, 2019 | Number of fishing gear per typein Tanzania	2								
This study - Regional | MWI by province	3.2	2020 2019 2017 2015	2	For each km^2 pixel: assign it to a watershed (based on its location) to know the runoff [R], compute the distance to shore or river (>10cms)[D], compute RR matrix*. Leakage of pixel = population of pixel x MWI of province x RR	2	-	1	Macro-leakage from land	2.0
NASA - SEDAC population count | GIS Population on 1kmx1km grid	1.5								
WWF HydroRivers | Country rivers	2								
WWF HydroSHEDS | Country watersheds	1								
Lebreton et al., 2017 | Catchment run-off of watersheds	2								
Boucher et al., 2019, IUCN | Release Rate matrix based on distance to waterbody and surface runoff	2.5								
Jambeck et al., 2015 | Central estimate for maximum release rate	2								

Quality Score



*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

Fishing:

Leakage from lost/mismanaged fishing gear & overboard litter is estimated not only for the coastal areas but also for major lakes in Tanzania mainland:

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 is taken from *The Tanzanian fisheries sector challenges and opportunities.* (Ministry of Agriculture, Livestock and Fisheries, 2016)

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