Circularity Assessment Protocol
Dar es Salaam, Tanzania

University of Georgia

Circularity Informatics Lab

Final Report December 1, 2025

New Materials Institute
UNIVERSITY OF GEORGIA

The Circularity Informatics Lab at the University of Georgia is committed to information sharing, data analytics, empowering communities, and systems change related to circular materials management.

Published by:
The Circularity Informatics Lab (CIL)

Location:
New Materials Institute
University of Georgia
Athens, GA
US 30602
www.circularityinformatics.org

Contact:
Dr. Jenna Jambeck
jjambeck@uga.edu

Authors:
Rachel Johnson (CIL), Tajaeli Masaki (Nipe Fagio), Deborah Madden (CIL), Kaylee Tam (CIL), Jenna Jambeck (CIL)

Recommended Citation:
Circularity Informatics Lab, 2025. Circularity Assessment Protocol: Dar es Salaam, Tanzania, University of Georgia, Athens, GA, USA.

Photo Credits:
Cover: Arnold Tibaijuka – Own Work
https://commons.wikimedia.org/wiki/File:View_of_Panton_and_Dar_es_salaam_City_(City_center).jpg
Report Photos: CIL

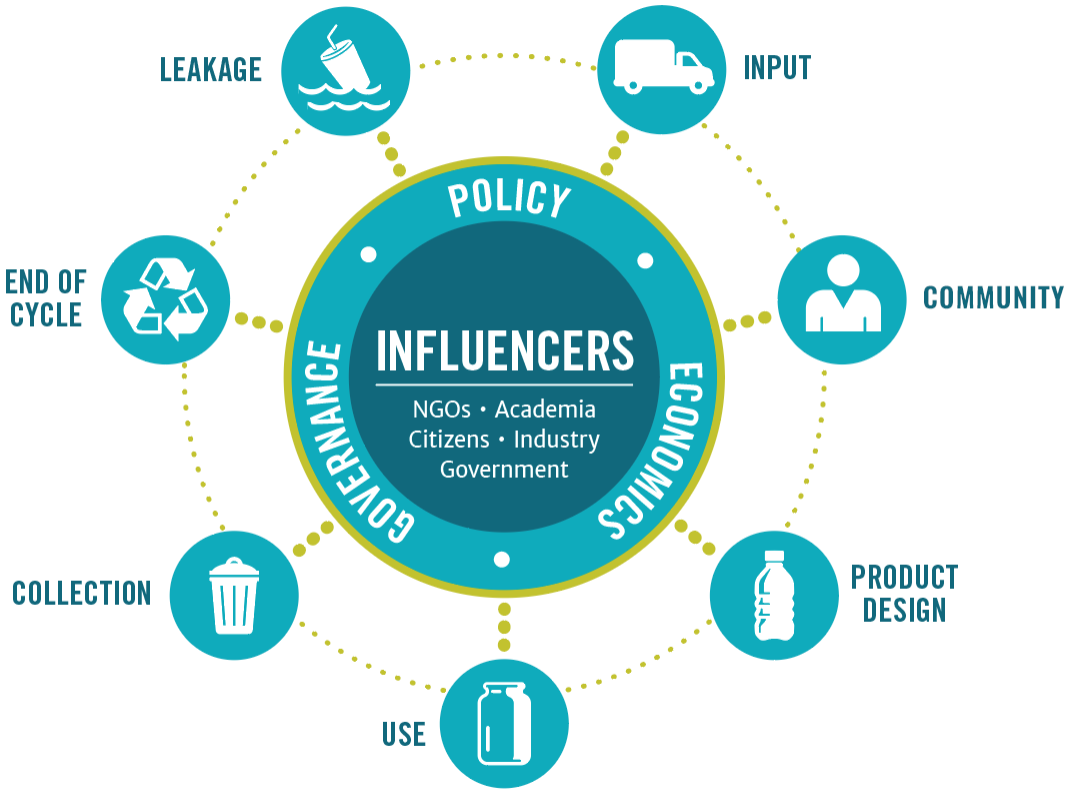
URL Links:
This publication contains links to external websites. Responsibility for the content of the listed external sites always lies with their respective publishers.

Maps:
The maps printed here are intended only for information purposes and in no way constitute recognition under international law of boundaries and territories. CIL accepts no responsibility for these maps being entirely up to date, correct, or complete. All liability for any damage, direct or indirect, resulting from their use is excluded.

Supported by funding from:
Prevented Ocean Plastic
https://www.preventedoceanplastic.com/

Executive Summary

Developed by the Circularity Informatics Lab at the University of Georgia, the Circularity Assessment Protocol (CAP) is a standardized assessment protocol to inform decision-makers through collecting community-level data on plastic usage. Grounded in materials flow and systems thinking concepts, the CAP uses a hub-and-spoke model to holistically characterize how consumer plastic flows into a community, is consumed, and flows out, either through waste management systems or leakage into the environment. The model, shown below, is comprised of seven spokes: input, community, material and product design, use, collection, end of cycle, and leakage. At the center, the system is driven by policy, economics and governance with key influencers including non-governmental organizations, industry, and government.



Field work was conducted by Nipe Fagio from July to September 2024. This CAP project was sponsored by Prevented Ocean Plastics (POP). The CAP report is split into the following sections, which include results and discussion of each: Input, Community, Product Design, Use, Collection, End of Cycle, and Leakage, followed by a comparison between Dar es Salaam and the city of Semarang, Indonesia (where POP also has a collection site and a previous CAP has been completed), and finally, Opportunities. The intent is for the data in this report to inform ongoing stakeholder engagement around solutions to strengthen the circular economy and waste management in Dar es Salaam.

Project Sponsor: Prevented Ocean Plastics (POP)

This study is funded by Bantam Materials UK Ltd, a global distributor of recycled plastic materials based in London, United Kingdom. In 2019 the company launched Prevented Ocean Plastic™ (POP), which is plastic that has been collected from coastal areas at risk of ocean plastic pollution. POP specializes in the collection of PET bottles (rPET) and most recently expanded its operations to include polypropylene (rPP)[1]. To support collection in underserved communities, POP also develops locally customized sorting and collection infrastructure. In June 2023, POP announced their goal of opening 25 collection centers by 2025 in Southeast Asia, South America, Sub-Saharan Africa, and the Mediterranean, regions historically lacking recycling infrastructure[2]. In November 2024, Bantam Materials UK Ltd opened its first Prevented Ocean Plastic collection center in Tanzania, making it the first on the African continent[3]. The 2000[2] facility is located within the Export Processing Zone in Dar es Salaam and is part of a wider network of Prevented Ocean Plastic collection centers operating in other regions, such as Southeast Asia.

Local Implementation partner: Nipe Fagio

An essential component of CAPs is that it is a collaboration with a compensated local implementation partner (LIP) who conducts field work and shares their expertise and experience in the community. For this research project, Nipe Fagio, which in English means "give me the broom", was the LIP. Nipe Fagio was founded in 2013 and aims to improve waste management and reduce urban pollution through data gathering, policy advocacy, and action to achieve systemic change [1]. Since 2018, Nipe Fagio has participated in Break Free From Plastic's (BFFP) global brand audits program, which was the audit's inaugural year. Nipe Fagio using BFFP data card and African Marine Litter Monitoring Manual developed by WIOMSA for the litter monitoring and waste assessment and Brand Audit methodology

Nipe Fagio has worked on promoting Single-use Plastic (SUP) Free policy and a Zero Waste Model in Tanzania and East Africa. Nipe Fagio is part of the Single-use Plastic Free East African Community (EAC) campaign, a joint initiative of GAIA members in East Africa advocating against SUPs. The EAC was reestablished in 2000 comprises the Burundi, Kenya, Rwanda, Uganda, and Tanzania while Democratic Republic of the Congo, the Federal Republic of Somalia and the Republics of South Sudan joined latter to form eight members of the community with its Headquarter in Arusha, Tanzania.The vision of the EAC is "to be prosperous, competitive, secure, stable, and politically united East Africa" [2]. Nipe Fagio along with other GAIA member are advocating for the EAC to create policies that reduce the use of SUP which includes straws, cups, bags, and other major sources of plastic pollution. The campaign also aims at promoting alternatives to SUP instead, such as reusable bags, containers, and utensils. Their collaborative efforts also expand to the global stage [3]. As members of GAIA, Nipe Fagio has also been present at the INC negotiations for the demand of a plastics treaty.

At a local level Nipe Fagio has been working on reshaping SWM in Dar es Salaam. In 2019, Nipe Fagio started the implementation of the first Zero Waste model in Tanzania and Africa and enabled the

[1] https://www.preventedoceanplastic.com/world-first-food-safe-recycled-polypropylene-for-european-markets/
[2] https://www.preventedoceanplastic.com/prevented-ocean-plastic-on-a-mission-to-open-25-collection-centres-by-2025/
[3] https://www.preventedoceanplastic.com/prevented-ocean-plastic-enters-east-africa/

establishment of the first Zero Waste Cooperative in Tanzania. The cooperative is located in Bonyokwa and is managed by local waste pickers in the community. The goal of the cooperative is to address the high cost of waste management and unreliability of waste services in Dar es Salaam and instead provide a decentralized and community-based solution that engages and educates the community. As a first of its kind solution in Tanzania, the cooperative and the surrounding area will also be a part of this projects research.

Key Findings

INPUT

Findings: Seventy-four fast-moving consumer goods (FMCG) were identified across 30 stores in Dar es Salaam. At least one item from beverages, candy, and tobacco was manufactured in Dar es Salaam, with candy still being manufactured in Tanzania. Thirty-three (33) beverages were sampled in Dar es Salaam, and 15 were identified as popular brands. Eleven of these brands have parent companies in Tanzania: African Fruit, Azam Cola, Azam Embe, Azam Energy, Hill Water, Masafi, Mo Xtra, Sayona Tunda, U-Fresh, and Uhai. Also, 75% of all beverages are manufactured in Dar es Salaam, and the remaining 25% are manufactured in other regions in Tanzania and other countries in Africa. Overall, 82% of all brands are manufactured in Africa, and 46% have parent companies in Africa. Over one quarter (28%) of products have parent companies in the United States.

Opportunities:

- Engage with the manufacturers and parent companies (both locally and internationally) about packaging that is problematic for use, recycling, or leakage.
- Suggest changes to packaging to local companies and/or promote Extended Producer Responsibility (EPR) as a policy to require or incentivize changes to packaging to reduce use of locally problematic materials or make the packaging more recyclable.
- For example, EPR legislation could disincentives or prevent the production of colored plastic beverage bottles to make them more valuable for recycling.

COMMUNITY

Findings: Twenty-six semi-structured stakeholder interviews were conducted with food vendors, hotel, recyclers and waste collection and recovery centers, private waste management representatives, informal waste management sectors, NGOs, and government officials. Interviews identified that improper collection of waste results in clogged sewers during the rainy season, polluting the environment. There was also discussion that the bag ban is not being effectively implemented because bags are still available. Interviewees also discussed the fact that colored plastic bottles have no

market, and as such, the products are not collected by waste pickers. Lastly, interviewees discussed wanting to improve education and specific topics included source separation of waste, promotion of plastic alternatives, effects of plastic, environmental conservation, and income opportunities from waste management. All these topics were deemed important in reducing waste generation and improving collection in Dar es Salaam.

Opportunities:

- Expanding awareness on source separation and alternatives to plastic items, including incentives for source separation (e.g., payment of materials if they are source-separated).
- Expansion of school programs similar to Nipe Fagio and Mazingira Plus that educate students and families about waste diversion and zero waste options.

PRODUCT DESIGN

Findings: Sixty-one (61) convenience items and 68 to-go foodware items were sampled from 30 stores and restaurants in Dar es Salaam area. Store surveys found that the weight of candy and chip products is 4 to 5 times less than that of US products, respectively, and as such, the packaging was lighter and could not be determined using the available scale. Plastic was the overall most common packaging material for all three convenience items. The primary materials for beverages were PET. Chips, and candy were both predominantly packaged in film/multilayer film, which is often polyethylene (PE) and polypropylene (PP). Glass and metal in the beverage category made up 1% and 0.33%, respectively. The most common packaging for staple products (rice, oil, flour, laundry detergent, shampoo, and tomato sauce) was primarily packaged in PET, HDPE, and PP. No alternative material besides paper/paperboard was identified, which was only observed in flour. The majority of restaurants offered reusable in-house. Fifty (50) of the 55 to-go items in-house were reusable. A survey of the restaurant to-go items found that 15 restaurants offered reusable to-go. The remaining to-go products are all single-use and predominantly made of plastic. No compostable to-go items were identified.

Opportunities:

- Elimination of colored plastic packaging in favor of clear or light blue PET packaging through EPR legislation, including eco-modulation.
- EPR legislation that imposes fines on products that do not meet requirements or subsidies to producers that do demonstrate their products meet standards of being more recyclable.

- Establishing a reusable foodware network to allow more customers to use the containers instead of single-use containers. Some examples include Perpetual Reuse and reCIRCLE.
- No alternative compostable containers were identified, but in order to manage these containers through composting, an expansion of composting infrastructure available to the city would be needed.
- Collaborate with businesses using black soldier flies (BSF) to ensure that compostable containers could be fed to the BSF to maximize circularity of containers.

USE

Findings: Sixty percent (60%) of stores surveyed had alternatives available, which included refillable beverages, bulk hand soap, and laundry detergent. The most cost-effective products identified were the beverages in large PET canisters, followed by the glass refillable bottles. Repacking was also identified in 70% of the stores; this included packaging rice or other staples. The bag survey found that SUP bags were available in all stores and cost between 40 to 50 TSH. The availability of these bags indicates that the ban on plastic bags is not highly enforced. Reusable bags are available, but the SUP bags are cheaper and provide no incentive for customers to spend more on a reusable bag.

Opportunities:

- There is an opportunity to continue to expand the availability of alternatives.
- Availability of bulk staple items such as rice and beans provides the foundation for the use of reusable containers during the purchasing of staple items.
- There is an opportunity to improve the implementation and enforcement of the SUP bag policy.

COLLECTION

Findings: Data summary

Limited collection of refuse collection charges (RCCs) and limited contracts hinder private companies' ability to purchase technology needed to improve collection. Colored plastic costs ~10x times less than clear plastics, and provides a lower incentive to collect the colored plastic compared to clear plastic. The Bonyokwa Zero Waste Cooperative is a local solution that is successfully collecting waste and recycling from participating households. By engaging local waste pickers, they were able to provide job opportunities and a SWM plan that focuses on reducing waste sent to the landfill.

Opportunities:

- Improving source separation to support recycling and composting initiatives by ensuring the appropriate separate bins are distributed to households as required by legislation.
- Expansion of deposit return schemes (DRS) for plastic bottles to improve plastic bottle collection.
- Establish more zero waste cooperatives in other regions of Dar es Salaam.
- Expand recycler transfer station locations to increase profits for waste pickers.

END OF CYCLE

Findings: Dar es Salaam currently only has a dumpsite instead of a landfill. Recycling and composting operations are limited, but companies and governmental initiatives are focusing on addressing the issue. Tanzania's National Solid Waste Management Plan addresses expanding recycling and composting services.

Opportunities:

- There is an opportunity to expand the collection and recycling of waste to reduce the use of the local dumpsite.
- There is an opportunity to improve the design and operation of the dumpsite, while being sensitive to the livelihood, health, and safety of the informal sector.
- Improve the working conditions of the informal sector to support their role in managing household waste.

LEAKAGE

Findings: Over ten thousand (10,147) litter items were logged from all 30 transects. Plastic comprised 65% of all litter found, with food-related plastic packaging being the most predominantly identified item. Plastic bottle cap and plastic bottles were the top two items in the litter transects, comprising 23% of all litter items. The overall average litter density is 3.25 litter items/sq-m. Only 2.5% litter item brands were identified, 11.7% of plastic bottles were identified, and Mo-Xtra was the most branded item identified. Only one waste bin was identified in all 30 transects, thus there is limited waste disposal options for residents.

Opportunities:

- Legislation could be created to require tethered bottle caps to beverage bottles to reduce bottle cap leakage.
- Further infrastructure and incentives for collecting and capturing plastic bottles could reduce their leakage.

- Other changes from the other spokes (e.g., Input, Product Design, etc.) could increase the value of packaging overall for collection and potentially reduce leakage.

Table of Contents

Introduction 10
Sampling Strategy 13
Input 14
Community 18
Policy Backdrop 18
Key Stakeholder Interviews 19
Product Design 23
Use 30
Collection 33
Private Companies 33
Informal Waste Sector 36
End of Cycle 38
Recycling 41
Composting 46
Leakage 49
Brands 52
Nipe Fagio Brand Audits 53
Bonyokwa Zero Waste Cooperative 54
CAP Results 56
Semarang and Dar es Salaam 60
Input 64
Product Design 60
Opportunities 66
Glossary 69
References 70
Appendix 73

Introduction

The United Republic of Tanzania is located on the coast of East Africa and faces the Indian Ocean. It shares its borders with Kenya, Uganda, Rwanda, Burundi, the Democratic Republic of Congo, Zambia, Malawi, and Mozambique. Tanzania (formerly known as Tanganyika) gained independence from the United Kingdom on December 9th, 1961. In April 1964, Tanganyika merged with Zanzibar, and in October of that year, the newly merged country adopted its current name, the United Republic of Tanzania. Tanzania is known for its beautiful nature, with almost a third of the country's nearly 950,000 sq-km land mass dedicated to National Parks. These include the Serengeti, Mount Kilimanjaro (Africa's tallest mountain), Ngorongoro Crater, and Lake Tanganyika (the second-largest lake in the World).

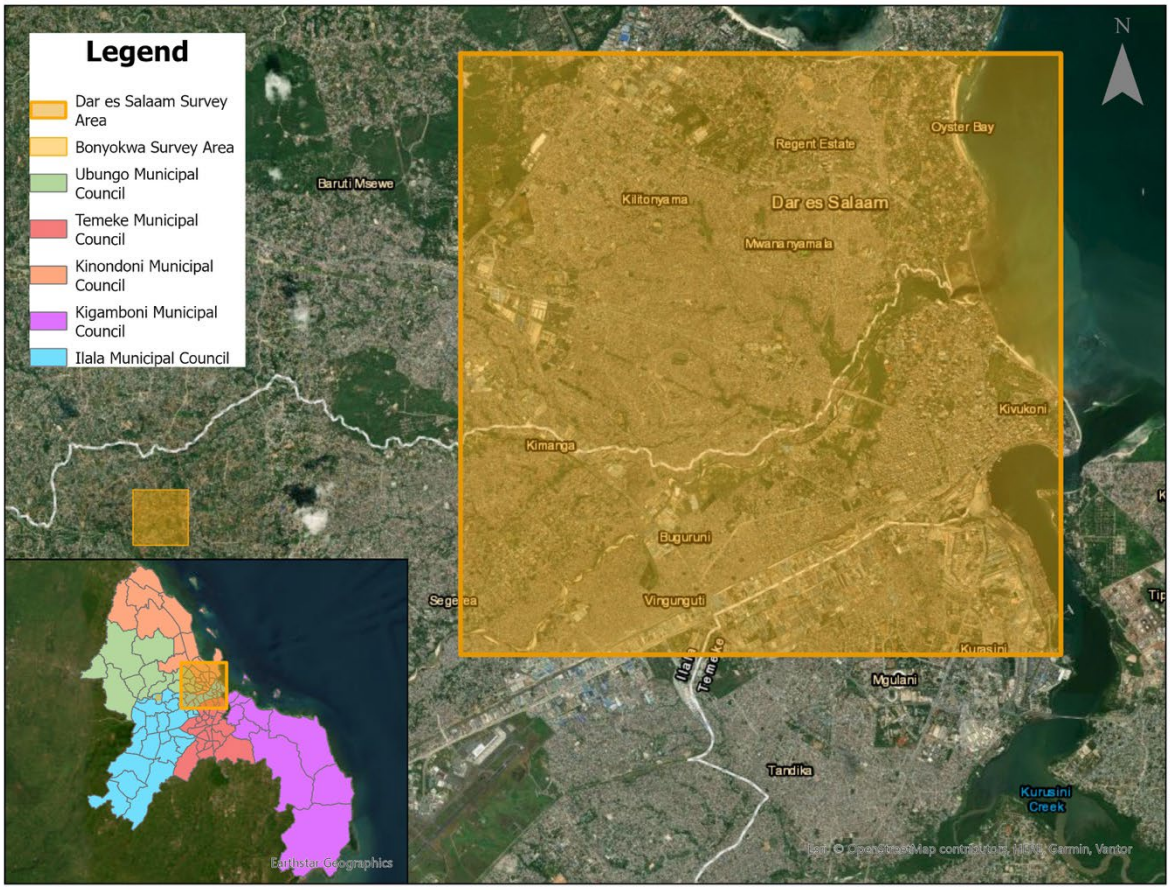
One of Tanzania's fastest-growing cities is Dar es Salaam, located on the country's coast; it was also the capital until 1996, when it was replaced by Dodoma. Since Dar es Salaam is located on the East Coast, it is also a cultural hub due to the migration of Indian and Arab immigrants before independence, along with regional migration to the city looking for economic opportunities. The city is estimated to become a megacity with a population greater than 10 million by 2030 [4]. Based on the 2022 census, Dar es Salaam has a population of 5,383,729, accounting for 8.7% of the country's total population [5]. World Population Review estimates that Dar es Salaam's population in 2022 was 7.4 million and estimates its population in 2024 was 8.2 million based on the United Nations World Urbanization Prospects [6]. Not only is Dar es Salaam Tanzania's biggest city, but it is also considered its economic hub. In 2023, the EAC reported that Dar es Salaam had overtaken Nairobi in trading of goods and services, and that if growth continues that Tanzania with dethrone Kenya as the biggest economy in the EAC [7]. The port of Dar es Salaam is a vital connection point for the country as it handles 95% of the country's international trade while also serving as a port for Zambia, Rwanda, and the Democratic Republic of Congo [8].

Access to clean water is important to help reduce the demand for single-use plastic (SUP), and the city and country have been working on improving access. A 2009 Dar es Salaam City Profile report published by UN-Habitat stated that 25% of the city's residents had access to water managed by the Dar es Salaam Water and Sewage Authority (DAWASA), and the other 75% lived in unplanned and unserved areas. At the time, the water demand was 187 liters per capita per day and was projected to increase due to the growing population of Dar es Salaam. At the time of the UN-Habitat report, DAWASA was solely focused on Dar es Salaam, but since 2020, its service region has expanded to include towns in the coastal region surrounding Dar es Salaam, and this includes Mkuranga, Kisarawe, Kibaha, Mlandizi, Bagamoyo, Chalinze, and parts of the District Councils of Kibaha, Bagamoyo, and Morogoro rural [9]. The Energy and Water Utilities Regulatory Authority (EWURA) Water Utilities Performance Review for Financial Year 2023/2024 assesses the performance of the 82 Water Supply and Sanitation Authorities (WSSA) across Tanzania. The total water demand increased from 819.94 million cubic meters in the 2021/22 report to 858.05 million cubic meters 2023/24 report. Additionally, the water production capacity increased as well, from 685.43 million cubic meters to 735.7 million cubic meters. While the production capacity has increased, it is still a little over 100 million cubic meters short of fulfilling the demand for water for all of Tanzania. The report highlighted each WSSA's population served over the last 3 fiscal years 2021/22, 2022/23, and 2023/24. DAWASA reported that the proportion of the population living in the area with a water network increased from 89% to 92% to 93%. At the same time, the proportion of the population directly served with water decreased from 80% to

75% and increased to 78% [10]. As such, while the water network has increased, the population directly served has decreased. The report did not elaborate as to why there was a decrease in the population directly

Dar es Salaam's estimated per capita waste generation rate is between 0.8 to 1.0 kg/cap/day [11]. Based on Dar es Salaam's estimated 2024 population, Dar es Salaam generates 6,560 and 8,200 tons of waste a day. Additionally, Dar es Salaam reports that only 40% of all waste generated is collected and disposed of at the Pugu dumpsite, the only operational dumpsite in Dar es Salaam [12]. Five to ten percent of the waste is recycled and the remaining 55-50% is illegally burned, buried, or dumped. Thus, there are large quantities of waste that are not being properly managed in Dar es Salaam. The IUCN also found that plastic waste generation per capita in Dar es Salaam is 30 kg/cap/year, which is higher than Tanzania's average plastic waste generation per capita of 5.7 kg/cap/year [13]. In 2030, when Dar es Salaam has an estimated population of over 10 million, the city will generate 822 tons/day of plastic.

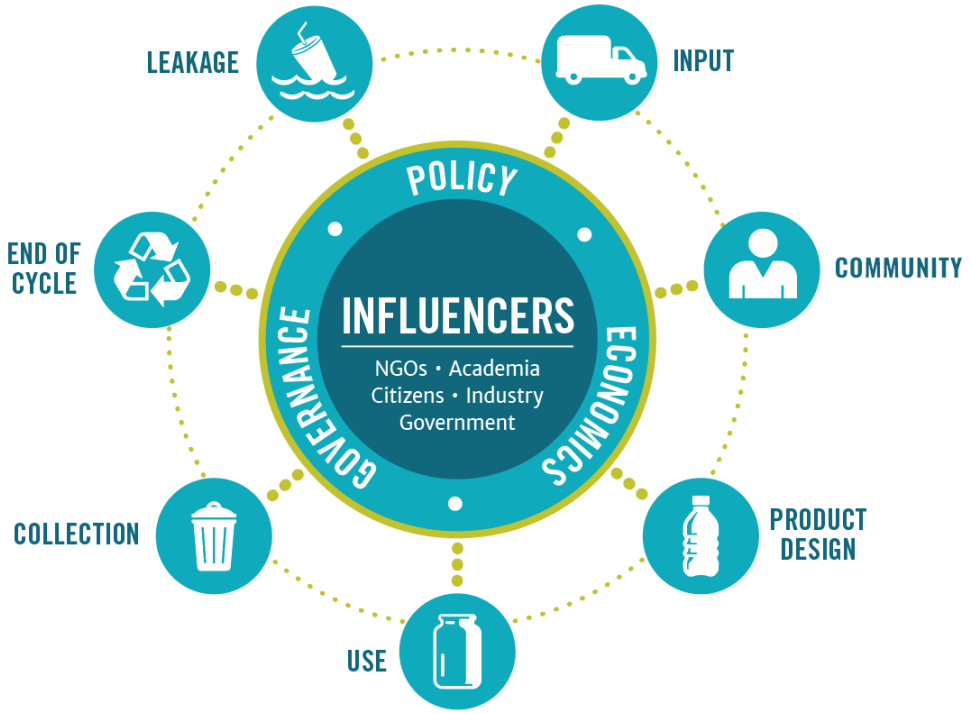
Figure 1: Overview map of survey area



The Circularity Informatics Lab (CIL) at the University of Georgia (UGA) developed the Circularity Assessment Protocol (CAP) in 2018, which is a standardized assessment protocol used to collect community-level data to inform decision-makers (Figure 2). The CAP characterizes seven community components:

1. **Inputs** – What products are sold in the community and where do they originate?
2. **Community** - What conversations are happening and what are the stakeholders' attitudes and perceptions?
3. **Product design** - What materials, formats, and innovations are found in products, particularly packaging?
4. **Use** – What are the community trends around use and reuse of product types?
5. **Collection** – How much and what types of waste are generated? How much is collected and what infrastructure exists?
6. **End-of-cycle** – How is waste disposed? What is the fate of waste once it is properly discarded? How is it treated?
7. **Leakage** - What waste ends up in the environment? How and why is it getting there?

Figure 2: Circularity Assessment Protocol (CAP) hub-and-spoke model.



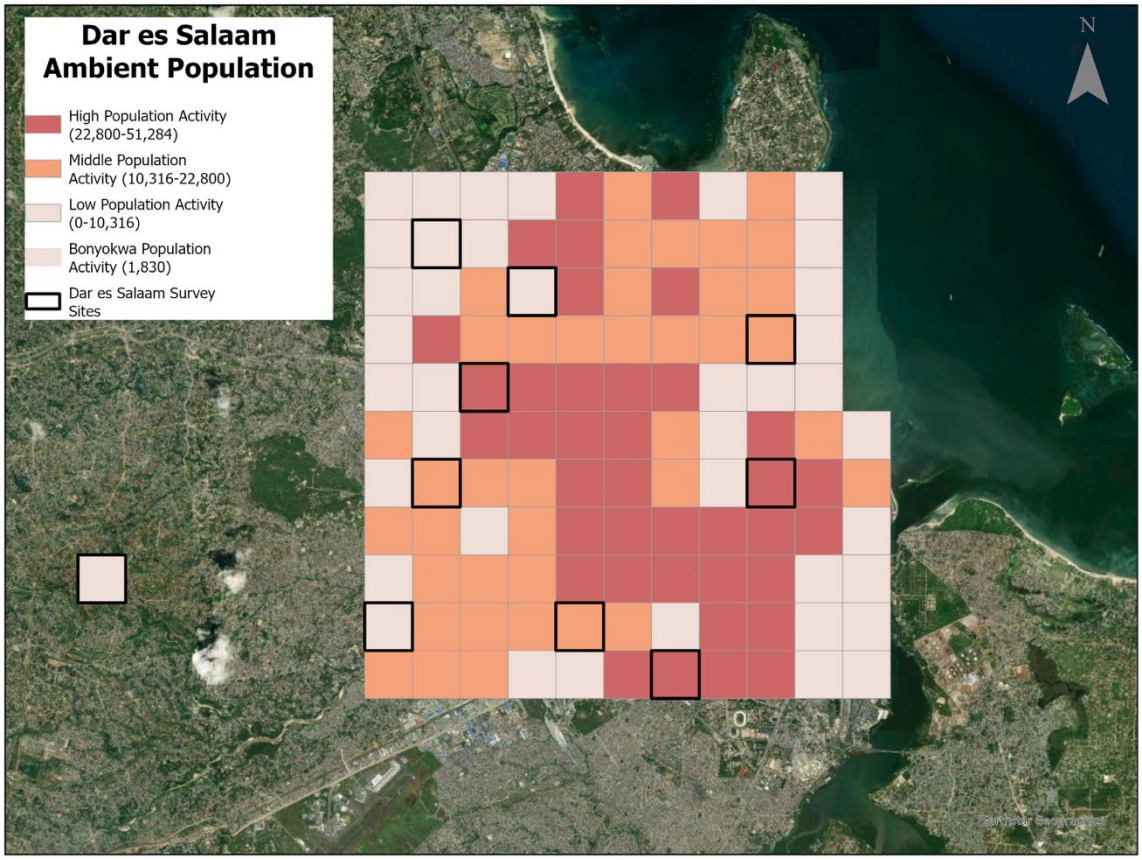
Field work was conducted by Nipe Fagio from July 2024 to September 2024. This CAP project was sponsored by Prevented Ocean Plastics (POP). The CAP report is split into the following sections, which include results and discussion of each: Input, Community, Product Design, Use, Collection, End of Cycle, and Leakage,

followed by Opportunities. The intent is for the data in this report to inform ongoing stakeholder engagement around solutions to strengthen the circular economy and waste management in Dar es Salaam.

Sampling Strategy

In order to randomly sample various locations in a city, the CAP typically identifies a 10 x 10km area over the city (with the center of the city in the center of the area). In this area, the ambient population is sectioned into tertiles (three groups) (Figure 3). Ambient population count can be described as "where people go" and "societal activity" - it is not population density of where people live. These three areas typically form samples of different land uses, etc.

Figure 3: Population tertiles and survey sites in Dar es Salaam



Typically, three 1 x 1 km areas for surveying are randomly selected within each population tertile using NOAA's Sampling Design Tool, resulting in a total of nine 1km2 areas for surveying. An additional 1x1km was selected in the Bonyokwa area which is the location of the Nipe Fagio Zero Waste Model operated by the Waste Cooperative. In total, 10 sites were surveyed, four in the low population count tertile and three each in both the high and mid population count tertile.

Input

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Dar es Salaam, samples of fast-moving consumer goods (FMCG) in four popular categories were taken within the nine 1 km^2 transects in Dar es Salaam. The team selected three convenience or grocery shops to sample within each $1km^2$ transect area, where shops were present and open at the time of surveying. In total, 74 unique brands of convenience products were collected and sampled, including 22 candies, 10 chips, and 33 beverages (Figure 4). Samples of identical brands were not collected multiple times, even when present in multiple stores. Common brands of tobacco products were also visually assessed in stores, although samples were not purchased; 9 brands of cigarettes are included in the input analysis.

Figure 4: Typical convenience store packaging in Dar es Salaam

For each of the top products documented, the team noted the type of packaging (including polymer, if possible), the brand, and the parent company. From there, the team was able to determine the manufacturing location, which was determined from manufacturing locations listed on product packaging or desktop research, as well as the headquarters location for the parent company of the brand (largely determined by desktop research). Manufacturer and parent company distances (Table 1) are intended to estimate the distance in kilometers between the city and the origin of each product.

Top brands of each category, based on a visual assessment of shelf space in a store, conversations with shopkeepers, and repeated occurrence across stores, included the following:

- **Beverages**: African Fruit, Afya, Azam Cola, Azam Embe, Azam Energy, Coca Cola, Fanta, Hill Water, Masafi, Mirinda, Mo Xtra, Pepsi, Sayona Tunda, Ufresh, Uhai
- **Candy**: Big Boom, BIG G, Boom, Dairy Milk, Ivori, Mabuyuz, Painter, Snickers
- **Chips**: Chama, Dorito, Lays, Sayona Boom, Simba
- **Tobacco Products**: Camel, Crescent & Star, Embassy, Marlboro Gold, SM, Sportsman, Winston

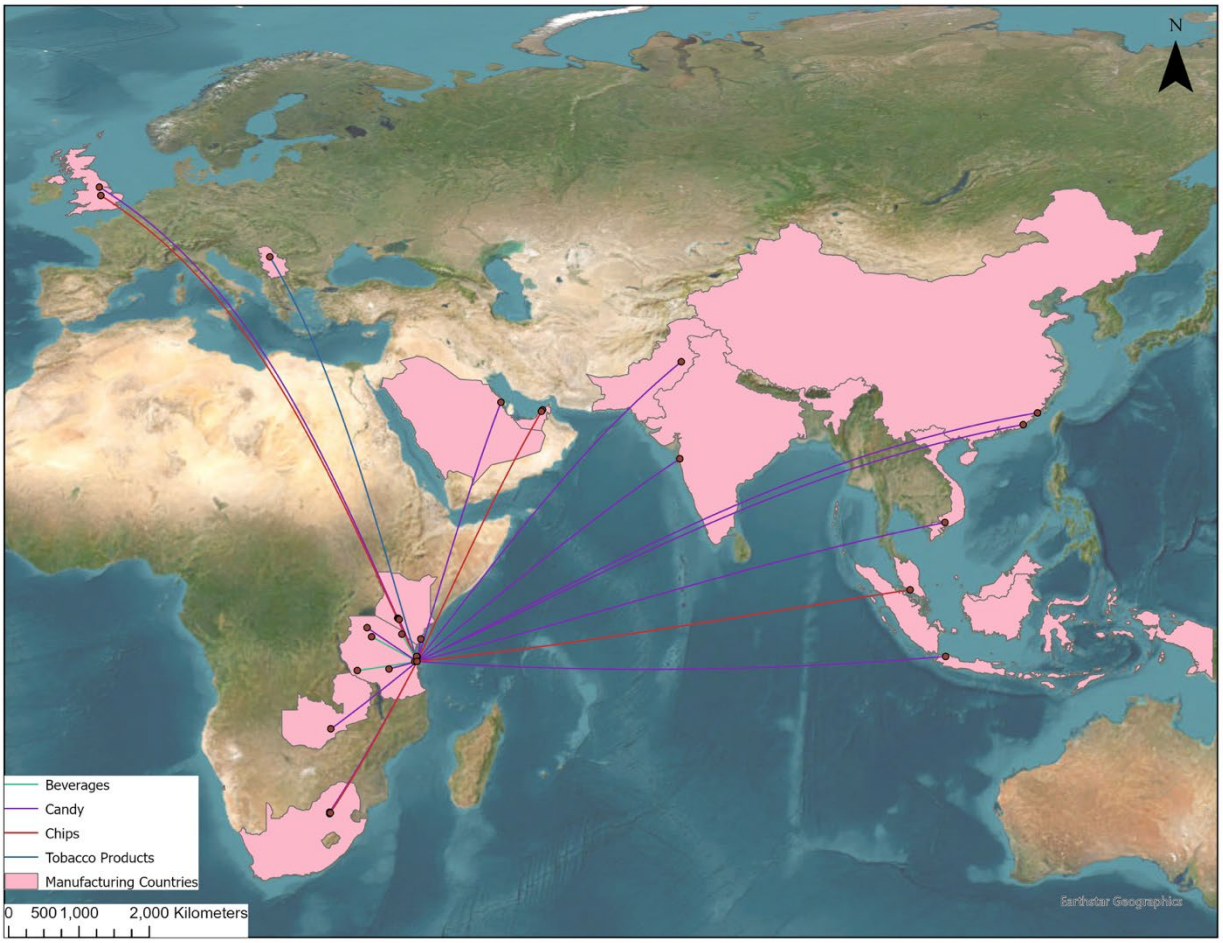
Table 1: Distances between Dar es Salaam and the manufacturer and parent company locations for FMCG convenience items

	Length Store to Manufacturer (km)			Length Store to Parent Company (km)		
	Minimum	*Maximum*	*Average*	*Minimum*	*Maximum*	*Average*
Beverages	0	861	72	0	13,825	4,510
Candy	350	10,073	3,467	350	14,069	6,678
Chips	0	8,063	3,167	0	14,539	7,717
Tobacco Products	0	6.445	716	0	13,568	9,762

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to the nearest km.

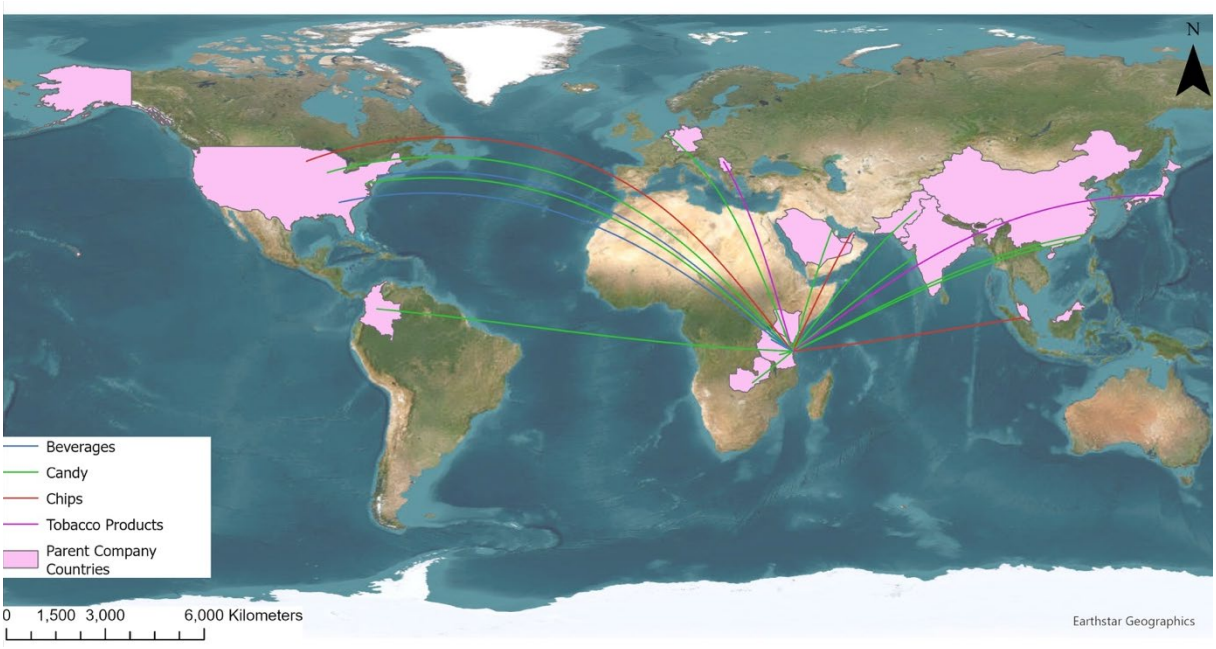
82% of the FMCG sampled are manufactured in Africa, between Tanzania (62%), Kenya (12%), South Africa (7%), and Zambia (1%) (Figure 5). Of the products in Tanzania, 48% are manufactured in Dar es Salaam. The remaining products are manufactured in the United Kingdom, United Arab Emirates, Pakistan, India, China, Vietnam, Malaysia, Serbia, and Saudi Arabia. At least one product for beverages, chips, and tobacco products was manufactured in Dar es Salaam. Beverages travel the smallest distance compared to other products (Table 1), because 75% are manufactured in Dar es Salaam, and the remaining 25% is manufactured in other regions in Tanzania or Zanzibar. Having one category of FMCG that is completely manufactured in a country offers the Tanzanian government a unique opportunity to explore extended producer responsibility (EPR) legislation.

Figure 5: World Map displaying manufacturing locations for convenience items in Dar es Salaam



Forty-six percent (46%) of products are manufactured by parent companies based in Africa, compared to 82% manufactured there (Figure 5 and 6). About 39% of all brands' headquarters are based in Tanzania, with 76% of those located in Dar es Salaam. The United States is the headquarters for 28% of the products, with parent companies such as The Coca-Cola Company (Coca-Cola, Fanta, Sprite, Zenjy, Kilimanjaro, Schweppes, and Dasani), Pepsi Co (Pepsi, Mirinda, 7 Up, Mountain Dew, Sensation, Dorito, Lays, and Simba), Mars Inc. (BIG G, Juicy Fruit, PK, Snickers), Mondelez International (Dairy Milk), and General Mills Inc. (Bugles).

Figure 6: World Map displaying parent company locations for convenience items in Dar es Salaam



Community

Policy Backdrop

The government of Tanzania and Dar es Salaam have passed various laws regarding the safeguarding of the environment, individuals' health, and proper methods for waste management. The 2018 National Solid Waste Management Strategy included fourteen different laws relevant to SWM in terms of land quality, pollution, health, workers, villages, industry, urban planning and energy. Table A.2 in the Appendix identifies five of the fourteen laws mentioned in the National Strategy that are relevant to Dar es Salaam and includes the ban on plastic carrier bags. Tanzania's Constitution provides an overarching precedence that individuals deserve to live in a healthy, non-polluted environment. Section 114 of the Environmental Management Act (EMA) requires that different containers be provided in order to ensure the separation of waste. The EMA Solid Waste Regulations require that efforts be made towards waste minimization. Lastly, plastic carrier bags, regardless of thickness, were banned in 2019 by the Tanzanian government and were amended in 2022 to include seals around plastic bottles. Overall, Tanzanian legislation requires that a safe, clean environment be created and that efforts be made to minimize waste generation while also ensuring effective capture and disposal of waste.

In August 2024, Tanzania joined the Global Plastic Action Partnership (GPAP) and established the Tanzania National Plastic Action Partnership (NPAP). The Global Plastic Action Partnership was established in September 2018 at the World Economic Forum's Sustainable Development Impact summit to bring governments, businesses, and civil society together to implement change on a national and global level. As of October 2025, the Global Plastic Action Partnership is working in 25 countries, 8 of which are African countries which include Ghana, Nigeria, Zambia, Tanzania, Gabon, Kenya, Angola, and Senegal. In Tanzania, the NPAP involves various government, private sector, international organizations, and civil society in its Steering Committee, listed in Table 2 and launched in September of 2025, who will provide strategic guidance and review progress to ensure transparent and inclusive action [14]. The partnership has established 2 task forces, the first a Metrics Task Force with is a group of local experts from 54 organizations to provide insight into Tanzania's plastic ecosystem and they will review data that will model the status of plastic waste in Tanzania. The second task force is the Gender Equality and Social Inclusion (GESI) Task Force, which will establish solutions that are inclusive of the people most affected by plastic pollution [14].

Table 2: Tanzania National Plastic Action Partnership (NPAP) Steering Committee

Government	Vice President's Office (VPO)
	National Environment Management (NEMC) Tanzania
	Marine Parks and Reserves Unit (MPRU) Tanzania
	Ministry of Health, Tanzania
	Ministry of Finance, Tanzania
	Tanzania Revenue Authority (TRA)
	President's Office – Regional Administration and Local Government (PO-RALG), Tanzania

Private Sector	Coca-Cola Kwanza Limited
	Media Council of Tanzania (MCT)
	CRDB Bank Public Limited Company (CRDB PLC)
	PETpro Tanzania
	Confederation of Tanzania Industries (CTI)
International Organization	Swedish International Development Cooperation Agency (SIDA)
	Worldwide Fund for Nature (WWF) Tanzania
	European Union to Tanzania (EU Tanzania)
Civil Society	Tanzania Recyclers Association (TARA)
	Media Council of Tanzania (MCT)

Source: [14]

Key Stakeholder Interviews

To understand current attitudes and perceptions of plastic waste, semi-structured interviews were conducted with 26 key stakeholders. Among those interviewed, 3 were government officials, 4 were from recyclers, 4 were from private waste company, 4 were from informal waste company, 3 from nonprofit organizations, 1 from hotel, and 7 from food vendors (Table 3).

Table 3: Summary of Stakeholder Interview List

Stakeholder Group	Number of Interviews
Government Officials	3
Recyclers	4
Private Waste Company	4
Informal Waste Company	4
Nonprofit Organizations	3
Hotel	1

Food Vendors	7

The consensus on plastic is that it is a significant problem in Dar es Salaam due to the harm it causes to the environment and living organisms. Plastic does not degrade; as such, it is ever-present in the environment, whether in its original form or as macro or microplastics. Its relentless presence in the environment raises concern among interviewees for soil and water health, as continual contamination can adversely affect humans. Interviews mentioned that plastic in the sewage system can become a breeding ground for mosquitoes that carry malaria and increase cholera. This is the result of plastic clogging drains that causes stagnant water. Plastic in drains can also eventually flow into the ocean. As a coastal city, plastic faces fewer barriers that could prevent it from reaching the sea. Plastic also poses safety risks, as dangerous sharp objects or chemicals can accumulate and injure an unsuspecting individual. Overall, interviewees were aware of plastic pollution in Dar es Salaam and its impact on the environment and the community's health and well-being.

> **"… plastic pollution is a problem in our community because normally plastic, it takes time to decompose. Normally plastic affects not only human beings but all the living things which are living in the community and at the ocean."**
>
> – NGO

When asked about policies, interviewees were most familiar with the nationwide ban on plastic carrier bags that had passed in 2019. When discussing the ban, they specifically stated that banning plastic bags did away with black bags, but not all bags, as the law states. Some interviewees mentioned that due to the ban, different types of single-use bags are appearing now and are polluting the environment like the black bags once did. These new blue bags were mentioned to be used in markets for goods, such as rice, tomatoes, or meat. Like the black bags, the new blue bags are beginning to appear in the environment, raising concerns about their impact. Interviews did mention the availability of reusable bags and their positive impact on doing away with black bags.

> **"If I recall back in 2019, the government announced a ban on the use of plastic bags, these black ones. But right now, there is another wave of other types of plastic bags that many people are using. We see them going to the markets, buying something, and using them to carry those items."**
>
> – Private Waste Management

> **"The biggest issue is the packaging. Packaging have now become the carrier bags. Instead of packing products like rice, nuts, vegetables or seeds, we have seen that it is being used more by people to carry. When someone goes to the market, tomatoes or fish is packed in the bag, then when they go to the butcher, they also put meat inside. They have a certain blue color. These are also single use. The biggest problem is that they are used once. Once used, they go into our environment. We have already started seeing their effects. If you walk in different places, in the estates, you see them floating around because they have no use, and no one is responsible for collecting them."**
>
> – NGO

Product design, not only of bags but of bottles, was cited in interviews as an issue during waste collection for recycling. Key issues were the colored bottles and smaller packaging. There is reportedly no market for colored bottles in Dar es Salaam, so they are rejected by recyclers when the bottles are brought to them. One item cited was the black Mo-Xtra bottles. Since these colored bottles aren't collected, they remain in the streets and pollute the environment. One NGO mentioned that these colored bottles are routinely found during beach clean-ups. Additionally, smaller packaging and the labels on bottles aren't recycled due to the difficulty. Larger bottles (1.5L) and non-colored plastic were the preferred packaging mentioned by recyclers.

> **"If it is colored bottles and there is no appetite, even massive campaign cannot help, you must phase it out completely. There is no way. Then with the same PET, you find that they have a lot of labels which are not recycled. It's not like 100% it's recycled, so you need to remove all that."**
>
> – Recyclers & Waste Collection and Recovery Center

When asked what changes interviewees desire to see, many highlighted the importance of education. Topics of education they felt should be emphasized included: source separation of waste, promotion of plastic alternatives, effects of plastics, environmental conservation, and income opportunities from waste management. One NGO interview highlighted green school projects, which aided in educating the students about waste separation. Source separation and income opportunities were mentioned together because they could provide employment opportunities for youth and income for families. In Dar es Salaam, residents pay a refuse charge for collecting waste. One recycler & waste collection and recovery center interview mentioned that if families learned to separate their waste at the source, they would pay the families for the materials. This could aid in garbage collection as the government and the private waste management interviewees mentioned that the payment of refuse charges is an issue. When individuals do not pay the refuse charge, the waste is not collected, resulting in illegal dumping, burying or burning of waste.

> **"To see how people get the education to separate their waste. People sometimes do not focus on waste separation because it does not give them any benefit. But if in the family you inform the family that you will separate the waste, we will come to collect this waste, we will pay you."**
>
> – Recyclers & Waste Collection and Recovery Center

Since Dar es Salaam is a coastal city, beach clean-ups were mentioned as a very common way for the community to help remove plastic from the environment. NGOs mentioned conducting community cleanups about eight times a year and others at least once every month. The predominant material found during the beach clean-ups is plastic items such as plastic bottles, foam pieces, food wrappers, flip-flops, plastic straws, nylon, glass bottles, plastic lids, plastic cups, and colored bottles. Engagement in these volunteer opportunities is noted as moderate, but people are taking away insight into how to reduce plastic pollution, which is viewed as a positive by the NGOs. One barrier to getting more volunteers is parents' concern for their children engaging in the beach cleanup due to dangerous materials such as syringes, which require more protective gear for the volunteers. Beach cleanups allow community members to actively engage in removing waste from the environment. Still, it was mentioned in one Private Waste Management that beach cleanups can't remove microplastics from the sea, which is an issue of grave concern.

> **"We talk about beach cleanup, but we see that beach cleanup is still not enough for the safety of the sea because we feel that there is a lot of waste, especially micro plastic, that goes directly to the sea. You then have to use a lot of resources to remove that waste, especially micro plastic, from the sea, which I think is the biggest problem."**
>
> – Private Waste Management

Product Design

To characterize material types used in common consumer products, samples of common convenience were obtained as described in the Input section. The CIL team sampled stores in each of the nine 1km^2 transects areas. Fifty-eight unique forms and brands were purchased to obtain packaging weights. The average weight of both the packaging and the product itself was collected for all samples (Table 4). Obtaining the average weight of chips and candy products proved challenging as the smaller packaging would weigh zero on the available scale.

Table 4: Average weight of products and their plastic packaging for common convenience items.

Product Type	Number of Samples	Average Weight of Plastic Packaging (g)	Average Quantity of Product (g or mL)
Beverages	25	23.2	718
Candy	23	Packaging too small to get weight	12.5
Chips	10	Packaging too small to get weight	20.6

More than thirty CAPs have been conducted across cities in the United States (US), and the Circularity Informatics Lab at UGA has generated an expansive database of products' weight and packaging weight. To understand why the weights were repeatedly weighed in at zero, the results from the CAP in Dar es Salaam were compared to the product database at the Circularity Informatics Lab (March 2025 version). It was found that the average product weight of US chip and candy products is much higher compared to Dar es Salaam. 350 different chip products have been sampled overall, and the average product weight is 83.0 g, with an average packaging weight of 5.06g. The ratio of chip product weight to packaging weight in the US is 16.3. The average chip product weight in Dar es Salaam is 20.6 g; thus, products in Dar es Salaam are 62.3 g less than products in the US. Also, the estimated average weight of chip packaging in Dar es Salaam based on the US ratio is 1.26 g. Similarly, 656 candy products have been sampled in the US, and the average product weight is 62.2 g, with an average packaging weight of 7.84 g. The ratio of product weight to packaging weight is 7.93. The average candy product weight in Dar es Salaam is 12.5, which would have an estimated average weight of 1.58 g. It should be noted that some candy brands in the US include toys and figurines or hard plastic for packaging, increasing the weight. Most candy packaging in Dar es Salaam is multi-layer film/film, a much lighter type of plastic, which means the actual weight of candy packaging in Dar es Salaam could be less than 1.58 g.

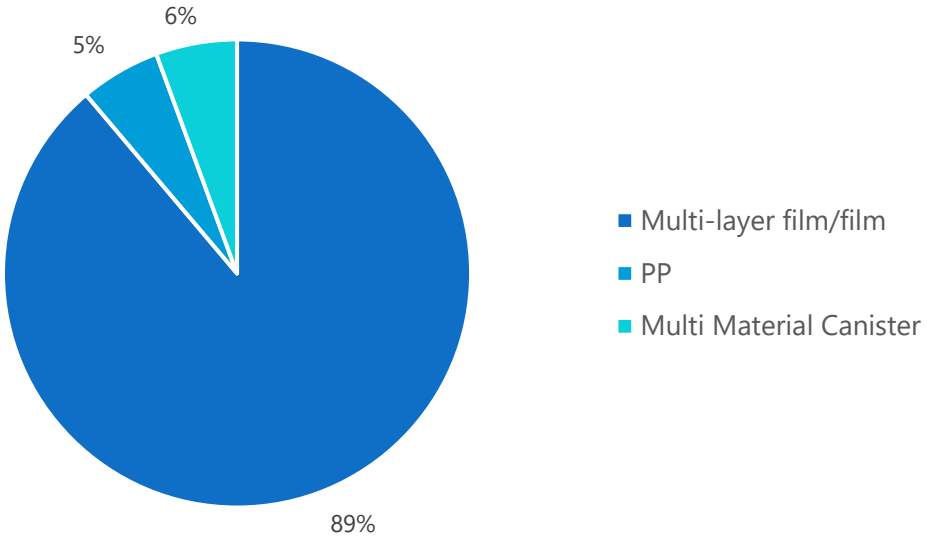
Overall, Dar es Salaam offers smaller quantities of candy and chips than the US, resulting in smaller packaging. This smaller packaging means that to buy the same quantity, one must buy more items and collect more of the smaller packaging. To consume the same amount in the US, one would need to buy four

chips or five candy packages. This lighter packaging can also make it easier for these products to leak as they can blow out of trash cans or during collection and transport. Smaller product sizes may lead to more frequent, less individually expensive purchases compared to larger product sizes, although there is often a "poverty tax" associated with these small packets compared to the price per quantity in larger sizes, in addition to the generation of more packaging weight in summation.

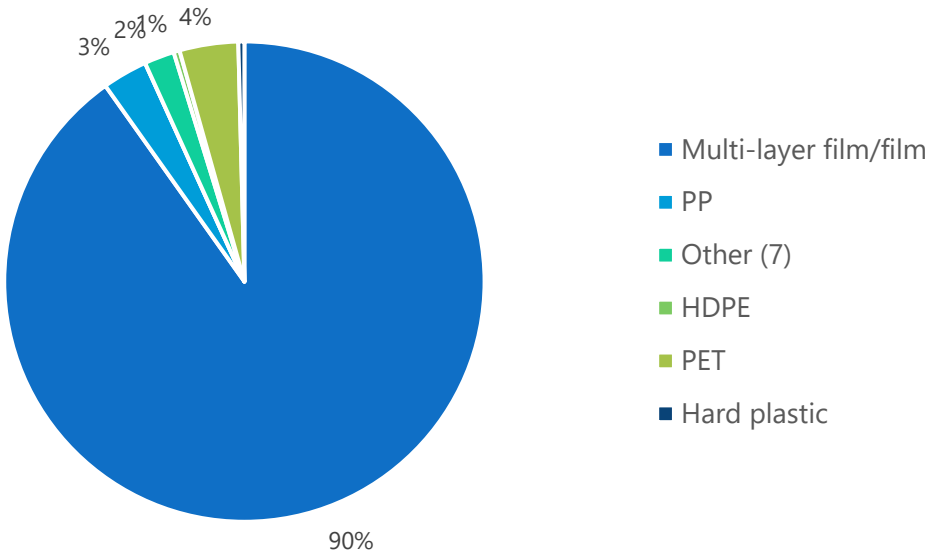
Cigarettes were excluded from our purchasing of samples in this case, but they are typically a standard size and we have previously found an average of about 10 g of plastic packaging to about 15 g of product. This relatively high plastic packaging to product ratio means cigarettes generate larger amounts of plastic waste per unit of product, which is likely driven by the cellulose acetate filters in cigarette butts, which typically weigh about a gram each. For each convenience item surveyed, the CIL team documented the polymer type (Figure 7). The primary material for chips was multi-layer film/film (89%), for candy multilayer film/film (89%), and for beverages PET (76%).

Figure 7: Material breakdown of top convenience items in Dar es Salaam

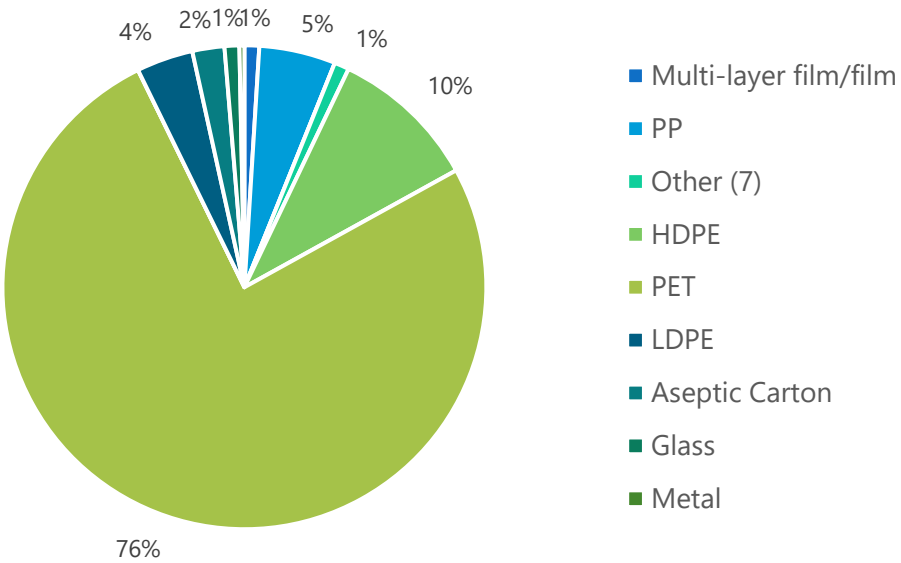
Chips:



Candy:

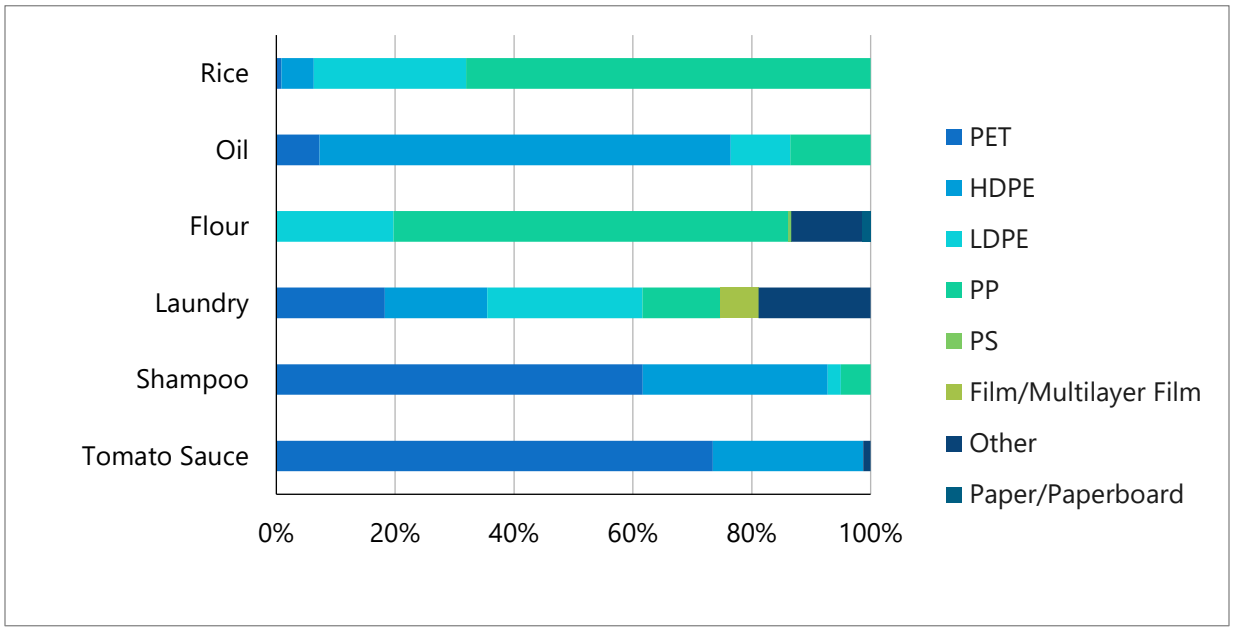


Beverages:



The packaging of staple items, specifically rice, oil, flour, laundry detergent, shampoo, and tomato sauce, was surveyed in the 30 stores. Figure 8 shows the overall material breakdown for all thirty stores surveyed (three in each 1 by 1 km area). Plastic packaging is the primary packaging material, with paper/paperboard being the only non-plastic packaging material observed at 1.39%.

Figure 8 Material breakdown of staple items in Dar es Salaam



In addition to surveying convenience and grocery stores, the CIL team surveyed restaurants in each of the nine 1 km^2 transects areas. Through visual assessments and discussions with restaurant owners, we assessed the material type for to-go food items like containers (including their lids), cups, utensils, and straws. In total, we characterized 68 items in 30 restaurants (Figure 9). Stores were also surveyed to identify if reusable items are used for in house dining. Twenty-nine out of 30 restaurants offered reusable utensils, plates, bowls, or cups (Figure 10). Cups were identified in 27 of the restaurants, and 25 were reusable. Plates or bowls were identified in 22 of 24 restaurants as reusable in-house. Straws were provided in 23 restaurants, but 22 were not reusable. Utensils were only identified in 6 of the restaurants.

Figure 9: Example to-go materials surveyed in Dar es Salaam

Figure 10: Example of in-house reusable items in Dar es Salaam

Table 5 lists all the materials for to-go items in the 30 restaurants. The table also identifies whether the material are single use or reusable. All items, except food containers, were single-use items. Only five to-go utensils were identified and were less available than the others. These items are also predominantly plastic, with one paper/paperboard cold cup. When possible, the to-go item's brand is noted. Straw brands and materials were identified because food vendors allowed surveyors access to the package in which the straws came in, which included the specific plastic type. Typically, this information is unavailable on the straw and is assumed to be unlabeled hard plastic. Common straw brands identified are Twiga Hygienic Drinking Straw

(4), Imperial Packaging Ltd (11), Hotpack (2) and 4 Season (4). Twiga and Imperial are local companies, while Hotpack is made in the United Arab Emirates and 4 Season in China.

Table 5: Products and material types surveyed in restaurants and food vendors.

Product	Material Type	Single-Use	Reusable
To-Go Containers (including lids if applicable)	PET	1	0
	HDPE	4	6
	PP	3	9
	Paper	1	0
	Aluminum	3	0
Cups	Coated Paper	1	0
	PET	7	0
	PS	1	0
	PP	6	0
Straws	PET	1	0
	PP	20	0
	PS	2	0
Utensils	Hard Plastic (unlabeled)	1	0
	PP	4	0

CAPs typically survey whether compostable to-go containers are available, but Nipe Fagio quickly found that some restaurants offered a return option for reusable to-go containers and no compostable containers. Of the 30 restaurants surveyed, 15 offered a reusable to-go container, six made of HDPE, and nine made of PP (Figure 12). The availability of reusable food containers is a circular system, and users can return the containers to the vendor. Efforts were made to interview the owners of these restaurants to understand how

the reusable to-go containers work; two restaurant owners agreed to be interviewed. Both interviews mentioned that the reusable containers were for regular customers who lived in the community and they knew would return the container to them. Customers who didn't live in the community would be offered single-use containers. One interview mentioned that some customers even bring their own containers instead of the single use or reusable containers the restaurant offers. Lastly, one interview mentioned that the reusable containers come at a higher cost than the SUP containers. The interviewee did not elaborate on the reason why the containers may be charged more, but in typical reuse or deposit-return schemes customers are charged a higher upfront cost also known as deposit which is returned once the item is returned. This is most likely due to the higher replacement cost associated with these cases.

> **"Regarding containers, as mentioned earlier, we use different utensils. There are strong plastic ones, and we also use metallic containers. Some plastic containers are reusable, and we specifically use these for our regular customers, especially those we are familiar with and deliver to, such as clients in nearby offices. We send the food in those containers, and they return them for reuse. However, other customers are just passing by, what we call walk-in or one-time customers. For them, we use non-reusable containers. Once we give it to them, they take the food and continue their journey, marking the end of the container's use."**
>
> – Food Vendor

Figure 12: Example of Reusable To-go Container

Use

During store surveys, alternatives to SUP packaging are observed. These items can include alternative materials, such as glass, metal, or compostable packaging, as well as items categorized as refillable, reusable, or bulk items. In central Dar es Salaam and Bonyokwa, 60% of the 30 stores surveyed had an alternative available, and 24 unique items were identified in three product types: beverage bottles, hand soap, and laundry detergent (Table 6). In Bonyokwa, two stores surveyed were noted as having alternatives available.

The most readily available alternative was the beverage bottle. They were glass bottles with soda and the large PET water bottles placed on top of dispensers (Figure 13). The glass bottles could be bought individually or in a plastic crate with 24 bottles for 12,000 to 13,000 TSH (4.54 or 4.92 USD). When the crate is returned with all bottles, a new crate can be purchased again at a discounted rate. These glass bottles are then sent back to be refilled. This refillable system creates a circular economy by eliminating the need for SUP bottles. The average cost difference is based on the cost/unit of each item. The average cost difference for the glass bottles is 64.29% cheaper than the SUP bottles. Even though it is more affordable in the long run, the upfront cost of purchasing these bottles can be more complex than the upfront cost of the SUP bottle. Similarly, the refillable water containers are 391.54% cheaper. However, this does not include the cost of purchasing the water dispenser. When these containers are full, they can be very heavy, making them difficult to transport. The promotion of the larger drinking water jugs and reusable water bottles was mentioned during interviews as an alternative to the SUP bottles.

Table 6: Cost comparison of alternatives and SUP products

Product	Alternative Type	Packaging Material	Average Cost of Alternative (Tanzanian Shillings and USD)	Average Cost in Single-Use Plastic Packaging (Tanzanian Shillings and USD)	Cost Difference for Alternative
Beverage Bottles	Refillable	Glass	1.49 TSH/unit $5.8E-4/unit	1.7 TSH/unit $6.6E-4/unit	-64.29% change
		PET	0.35 TSH/unit $1.4E-4/unit	0.7 TSH/unit $2.7E-4/unit	-391.54% change
Hand Soap	Refillable	HDPE	2.5 TSH/unit $9.7E-4/unit	4 TSH/unit $1.6E-3/unit	+16.67% change
Laundry Detergent	Bulk	PET	2 TSH/unit $7.8E-4/unit	4 TSH /unit $1.6E-3/unit	-50.00% change
		PP	4.25 TSH/unit $1.7E-3/unit	3.2 TSH/unit $1.2E-3/unit	+346.81% change

Note: Conversion rate 2,641.83 TSH to 1 USD

Figure 13: Example of Beverage Bottles

Store surveys also look for repacking items from a larger bag into a smaller SUP packaging. 70% of the stores surveyed were found to repack in Dar es Salaam. A primary case of repacking in Dar es Salaam was weighing rice from large bags (Figure 14) into smaller LDPE bags (Figure 15). This system of large quantities of rice and weighing the exact amount of rice a customer requests provides a foundation for developing the circular economy in Dar es Salaam. If customers brought an existing container and used that instead, the need for the SUP repacking bags would be eliminated.

Figure 14: Bags of rice that are repackaged into smaller plastic bags

Store surveys also look at the primary material of bags available, and if any alternatives to SUP bags are available. The most common material for a bag was LDPE, shown in Figure 15 (a), and cost 40 or 50 TSH (0.015 or 0.019 USD). Tanzania banned all plastic bags regardless of thickness; however, the survey found that SUP bags are still prevalent, as the LDPE bags were identified in all stores surveyed. All stores also offered reusable bag materials made of PP, as shown in Figure 15 (b), and cost 200 or 300 TSH (0.08 or 0.11 USD). Paper bags were also found in the surveys at no additional cost. The availability of alternative bags was mentioned during the interviews as an essential tool in implementing the 2019 ban on plastic bags, and many responded positively by actively reusing the bags. However, in two NGO interviews, the higher cost of the bag was cited as being difficult for people to afford, and as such, they will purchase the SUP LDPE bag.

Figure 15: SUP bags and Reusable Bags surveyed in Dar es Salaam

(a) Most Common Bag Material

(b) Reusable Bag Material

Collection

Private Companies

Before the establishment of public-private partnership (PPP) in 1995, waste was collected by the government. Today, waste is predominantly collected by the private sector, which includes private companies, NGOs, and community-based organizations (CBOs). The government still aids in collection, but at a smaller scale. The addition of private companies was to aid in increasing waste collection. In 1991, only 5% of the 1,400 tonnes of waste generated daily was collected, reportedly increasing to 48% of the 2,500 tonnes of waste generated in 2005 [15]. However, the most recent collection rate is 40%, indicating that while generation has increased, overall collection has not.

Dar es Salaam has five municipalities: Kinondoni, Temeke, Ubungo, Ilala, and Kigamboni. Each municipality is responsible for creating its own by-laws and refuse collection charges. Additionally, each ward can establish rules and select its provider for waste management. Before 2016, there were 73 wards, but with the addition of Kigamboni and Ubungo, it increased to 102. In 2010, the Dar es Salaam City Council identified that private companies serviced 44 out of the 73 wards (60%), and 23 private companies were registered. Some private companies will service more than one ward, hence the fewer companies than wards serviced. With 102 wards, if 60% are still covered, then 61 out of 102 wards have access to waste collection. Kirama and Mayo [16] identified 49 private companies: 15 in Ilala, 23 in Temeke, and 11 in Kinondoni. A more up-to-date number of companies and the ward coverage area could not be determined from desktop research, literature, or interviews. More than 70% of Dar es Salaam settlements are unplanned, creating narrower passageways that make it difficult for companies to collect waste. That is why private companies prefer high-income areas; they are planned resulting in more space for the necessary equipment to transport the waste [16].

Private companies operate based on contracts with a municipality or ward. These contracts last 1 to 2 years and must be renewed for companies to continue operating in their respective areas. Kirama and Mayo [16] through interviews with 20 private sector companies, identified that 65% of the companies had one-year contracts. These shorter durations make it difficult for companies to finance their business through loans, credits, and bonds as there is the risk of the contract not being renewed. In addition to the short durations, these contracts are typically ambiguous and lack essential details including [16]: excluded environmental requirements (enclosed truck bodies for the delivery of waste to the Pugu dumpsite); health and safety requirements (protective gear: gloves, respiratory protection, boots, and uniforms); and Refuse Collection Charge details not included (collection method, place, amount, timing, and sanctions against late or non-payment). Mpuya and Munishi [17] conducted 41 interviews, 36 interviews with individuals from 16 private companies and informal groups, and five interviews with ward executives. Similar to Kirama and Mayo [16], these interviews identified challenges with the contracts that create challenges for the private companies in implementing new technology to effectively manage the waste (Table 7).

Table 7: Current challenges for private companies in Dar es Salaam

Lack of Decision Making	• Lack of participation from all stakeholders in the decision-making process • Government communication regarding the date and time to discuss important SWM decision was lacking this included notification via call or text messages resulting in the government viewing the lack of participation as unwillingness from the company • Lack of participation and communication has resulted in the continual status quo of sending all waste to the landfills, even though there is a high amount of recyclables in the waste
Limited emphasis on sorting, reuse, recycling, and recovery	• Disconnect between engagement strategies and these sustainable SWM practices • Local authorities' prioritize SW collection and transportation was reported by all 16 private sector entities instead of sustainable SWM alternatives
Inefficiencies in Solid Waste Management Contracts	• Contracts are limiting and prioritize collection and disposal ○ Do not mention recycling or waste recovery • Limited to one- or two-year renewable terms • Prevalence of short-term contracts hampers the private sector's ability to invest in the technology and infrastructure required for effective waste management

Source: [17]

Overall, the short duration of the contracts, lack of involvement during the decision-making process, and more focus on disposal have limited the company's capabilities to invest in necessary technology or expand sustainable waste management practices. The existing infrastructure determines the collection methods and equipment utilized by the companies. Common methods include door-to-door collection or a common collection point, which are more common in areas with narrower passageways. In a 2005 survey of 300 households across the three municipalities, 57% said collection is done door-to-door, 13% use a common collection point, and 30% did not receive any services [15]. Kirama and Mayo [16] found 80% of the service providers utilized door-to-door collection only. Collection and transportation of waste is typically done between 7:00 am to 8:00 pm. The Pugu dumpsite is 30 km from the city center and traffic congestion can impact the collection efficiency and transportation costs. That is why 30% of private companies identified that they collect waste daily, whereas 70% collect waste 2 to 4 times a week [15]. Kamugisha, Ludete [18] identified that in Kinondoni the equipment available for collection included 28 trucks, six tractors, three trailers, 69 pushcarts, and 127 wheelbarrows, which can collect 42.2% of the solid waste generated in Kinondoni.

Refuse Collection Charges

In Dar es Salaam, refuse collection charges (RCC) were introduced alongside the privatization of waste management and are paid . Each household or business pays RCC's based on the municipalities and wards designated high-, middle-, or low-income levels. Wards can also negotiate with the contracted companies

for a lower rate. Table 8 identifies some RCC's reported in the literature. Desktop research was unable to identify RCC's from the municipalities or wards.

Table 8: Refuse Collection Charges

	Currency	[15]			[16]			[19]
		Low Income	Middle Income	High Income	Low Income	Middle Income	High Income	High Income
Ilala	TSH	700	1000	2000	500	1000-2000	NA	10,000 – 15,000
	USD	0.26	0.38	0.76	0.19	0.38 – 0.76	NA	3.79 – 5.68
Temeke	TSH	200 - 500	1000	NA	NA	NA	NA	NA
	USD	0.08 – 0.19	0.38	NA	NA	NA	NA	NA
Kinondoni	TSH	1000	2000	3000	5000	10,000	15,000	NA
	USD	0.38	0.76	1.14	1.89	3.79	5.68	NA
Ubungo	NA	NA	NA	NA	NA	NA	NA	NA
Kigamboni	NA	NA	NA	NA	NA	NA	NA	NA

Conversion rate: 2,641.83 TSH to 1 USD

Interviews stated that RCCs can start as low as 3,000 to 5,000 TSH (1.14 or 1.89 USD) for low-income areas and can go up to 10,000 to 15,000 TSH (3.79 or 5.68 USD) for high-income regions. Additionally, businesses will pay a different rate, as one interviewee mentioned restaurants paying 250,00 TSH (94.63 USD). Inadequate collection of RCC's is a significant hindrance to private companies, resulting in higher expenditures than the revenue. In 2006, the collection in high-income areas was 80% while low-income areas were 50% [15]. In 2016, the overall collection of RCC in Dar es Salaam was 55% [16]. Private companies must pay a percentage of the RCC to the municipality, in Kinondoni it's 10-15% [16] and in Ilala it is 20% [19]. RCCs are not included in other utilities such as water or electricity; they are collected by hand at the end of each month via door-to-door collection [20]. This method creates challenges such as individuals not being home when RCC collection is conducted, failure to provide notice of price changes, and inadequate billing history [20].

Private company contracts last 1-2 years. This limited time frame also limits companies from investing in necessary equipment. Pellatt and Palfreman [21] worked with Green WastePro Ltd. in Mchafukoge and Kisutu wards, located in the downtown area of Dar es Salaam, to implement Smart-TRAC for RCC collection from 2019 to 2021. Implementation of Smart-TRAC saw an increase in RCC collection, but Green WastePro Ltd.'s contract was not renewed, and consequently, progress was lost. The promotion of RCC collection via technology would help address issues discussed in Omar [20]. Overall, RCCs finance waste collection in Dar es Salaam, but poor collection of these fees impacts private companies and the environment. Interviewees in Private Waste Management mentioned that it can be a challenge to collect the RCCs, and residents will resort to improper waste management. Omar [19] reported that some residents give the waste to an informal collector who disposes of it in unauthorized locations. One Private Waste Management interview indicated that it was still occurring.

> **"You know when a citizen provides a service, at the end of the day they have to pay a waste fee. Now this is a difficult thing that we have been facing. Some say that they do not produce waste, and they do not have to pay a waste fee. But at the end of the day, the waste that they produce, they give to other people who we call-- some people collect waste from the streets, they give it to them, and then they go and throw it in places that they know."**
>
> – Private Waste Management

Informal Waste Sector

Globally, 2 billion people earn their livelihood through the informal economy [22]. In Dar es Salaam, the informal sector is crucial in collecting waste and recyclable materials not collected from the private sector. Waste pickers are often disrespected and devalued by the community, but they play a vital role in waste management. Waste pickers also put their health at risk by coming into contact with improperly managed waste every day. Their part in SWM in Dar es Salaam was included in the National Solid Waste Management Strategy, and their role in collecting recyclables was identified. The strategy also mentioned upscaling the informal sector to establish relationships with recyclers but didn't provide steps on how to do so. Nipe Fagio in collaboration with the Taka Ni Ajira Foundation has utilized the Zaidi App to register over 3,390 waste pickers, 2,572 males and 1,787 female waste pickers. In Dar es Salaam there are 1,670 waste pickers registered [23]. Nipe Fagio also worked on establishing the Tanzania Waste Pickers Association (TAWAPA) which was announced in July 2024 during the Global Alliance for Incinerator Alternatives (GAIA) Annual International Zero Waste Cities Conference [24]. The goal of TAWAPA is to advocate for waste pickers' rights and ensure that they are represented in local and national policy. Waste pickers collect the majority of the recycling in Dar es Salaam. Private companies predominantly focus on collecting waste for disposal at the Pugu landfill. In addition to the 3,390 waste pickers registered by Nipe Fagio there are an additional 450-600 waste pickers at the Pugu landfill collecting recyclable material [25]. Waste pickers also collect recyclable material from the streets.

> **"For now, community they did not pay anything for recycling. Those waste pickers, they collect it on the street and then they're going to sell to those formal industries. In a very small amount, they sell them to them. Of course, recycling is, you cannot compare recycling and dumping. You say dumping, because recycling, you use the waste. Waste becomes another product so you get the profit."**
>
> - Government

Waste pickers see value in the materials they collect. The black plastics have been identified as having very low value compared to the colorless or clear plastics. Four interviews reported the price they pay waste pickers for the recyclable material they collect (Table 9). One kilogram of the black plastic bottles pays a waste picker 50 TSH (0.019 USD) compared to clear plastic that pays 400 to 450 TSH (0.15 to 0.17 USD). Waste Pickers walk 10-15 kilometers daily over 8-12 hours while carrying 5-7 kilograms per trip in Dar es Salaam [26]. All the material they recover is collected in a long non-woven plastic carrier bag. If waste pickers

only collected black plastic, they'd earn 250 to 350 TSH (0.09 to 0.13 USD) in one trip compared to 2,000 to 3,150 TSH (0.76 to 1.19 USD) that they'd earn collecting clear plastic bottles. Waste pickers would collect the same amount of product but be paid a lower price. In one trip, waste pickers would earn about 10x less if they had only collected black plastic. The lower price difference of black plastics provides minimal incentive to collect these when the individual's livelihood and family's well-being are important.

Table 9: Reported Price of Materials from Interviews

	What waste pickers get paid		What informal recycling transfer station sells it to recyclers for	
	TSH per kilo	USD per kilo	TSH per kilo	USD per kilo
Colorless Plastic Bottles	400 to 450	0.15 to 0.17	700 to 750	0.26 to 0.28
	450	0.17	600 to 700	0.23 to 0.26
Black Plastic bottles	50	0.019	150	0.06
Plastic	250	0.09	700	0.26
Cardboard boxes	NA	NA	200	0.08

Source: Interviews

As shown in Table 9, the value of the material sold to the recycler is more than what waste pickers earn. Waste pickers sell to "middlemen" who then have access to the recyclers. Recyclers establish their centers farther away, which can be challenging for waste pickers to travel to for direct selling of materials, given the distance and time. Figure 18 in the recycling subsection illustrates that many of the recycling centers are situated near the downtown area. This makes it difficult for waste pickers in the unplanned areas, which are farther from the downtown area, to reach these recyclers, requiring selling to the "middlemen". Transfer stations operated by recyclers could allow waste pickers to sell directly to the recycling centers for a higher profit margin. Another way to increase profitability for waste pickers requires organization via microenterprises and cooperatives [27]. Microenterprises are small businesses that employ fewer than 10 people. They are common in neighborhoods in the global south that lack access to municipal waste collection. A cooperative is a business or organization that is owned by its employees or members. The benefits and challenges of cooperatives are highlighted in the International Labour Organization report in 2019, which highlights the role that cooperatives have played in integrating waste pickers in formal waste management chains in Brazil, Argentina, Colombia, India, and South Africa [28]. This method of organizing waste pickers has been utilized in the Bonyokwa Zero Waste Cooperative, which is discussed later in the report and highlights its success in Dar es Salaam.

> **"Some consider them as people who are not aware of themselves. Others know their contribution to cleaning the environment. They know that they collect to earn an income and at the end of the day, to be able to afford living expenses. Because other women collect those bottles to sell, they earn an income, and at the end of the day, they even use the income to educate their children."**
>
> – Private Waste Management

End of Cycle

Dumpsite: Pugu

Since 1935 there have been nine operational dumpsites in Dar es Salaam, all of which were not zoned in the city's master plan (Table 10). These dumpsites were not selected based on technical or environmental suitability; they were chosen because they were close to collection areas. Four of the nine dumpsites were closed due to community action through the courts [25]. Before Pugu became the current dumpsite, Kigogo was an unofficially utilized by the city as preparations were underway for Pugu to become a sanitary landfill and ceased operation when Pugu became operational.

Table 10: Previous Dar es Salaam Dumpsites

Name	Years Operational	Life span	Size (hectares)	Characteristics
Mchikichini	1935 – 1954	19	NA	Open land in planned residential
Magomeni	1954 – 1964	10	NA	Open land closet to Jangwani river
Tabata	1964 – 1991	27	NA	Open land within industrial and residential area closet to Msimbazi river valley
Kunduchi and Mbagala	1991 – 1992	2	NA	Open land within unplanned residential area close to Indian Ocean
Vingunguti	1992 – 2001	8	6	Open land within unplanned residential area close to Msimbazi river valley
Mtoni	2001 – 2007	6	5	Degraded land within unplanned residential area close to Indian Ocean
Kigogo	2007 – 2009	2	7 – 18	Degraded land within unplanned residential area close to Msimbazi river valley
Pugu	2009 – present	16	65	Open land within unplanned residential area

Source: [25, 29]

In the early to mid-2000s, the Dar es Salaam City Council was committed to developing the Pugu site into a sanitary landfill. It had budgeted funding for an Environmental Impact Assessment (EIA), especially since EIAs are mandatory for sanitary landfill projects. The EIA included an examination of all project phases and

analysis of its potential impacts. Construction at the Pugu site was planned for two years after the EIA was completed in 2004. Depending on the chosen scenario, the landfill would have had a 5- to 13-year lifespan and was designed to include:

1) Designed cell development
2) Full leachate management
3) Full landfill gas management
4) A daily soil cover, a final soil cover, and a compaction process
5) A fence with a gate
6) A daily record of the volume, type, and source of waste and a waste scavenging plan

Of the different scenarios, the one that least environmentally impactful and most cost-effective choice was designing a sanitary landfill at Pugu and a composting plant at Msimbazi. This option would also indirectly offer recycling benefits.

The Pugu location never became a sanitary landfill and has been used as a dumpsite since 2009. It is located 30 km from the center of Dar es Salaam (Figure 16). The Pugu dumpsite was revisited in 2016 to assess the ongoing operations. The visit found that the waste is not covered daily or monthly but is compacted by a bulldozer once it has been spread out. The only covering utilized at the site is to provide a route for vehicles to dump the waste. A weighbridge is located at the entrance of the dumpsite. Drivers provide information about where the waste is coming from so that it can be logged for the respective ward and municipality. The dumpsite receives 800 to 1,500 tons of waste daily from the municipalities [25]. Thus, only 19% to 36% of the estimated 4,200 daily waste generation at the time was collected for disposal at Pugu. In 2016, there were reportedly 450 to 600 waste pickers at Pugu that would sort through the waste for recyclable materials. The common materials recovered included plastic, clothes, glasses, metals, and boxes [25]. In April 2017, construction on a fence began since much of the site was still open to people and animals. However, a 2023 news article reports no fencing at the site [30].

Figure 16: Location of Pugu Dumpsite

Figure 17: Pugu Dumpsite

Source: [30]

Recycling

Less than 10% of materials in Dar es Salaam are recycled [12]. A survey of 639 households across the three original municipalities identified that paper and cardboard, plastics, glass and metals all materials account for 38% of the waste generated (Table 11). These materials are all recyclable. Plastics were the most predominant material, followed by paper and cardboard. An IUCN study based on 2018 data found that the plastic waste generation per capita in Dar es Salaam is 30 kg/cap/year [13]. This amount is much higher than Tanzania's average plastic waste generation per capita of 5.7 kg/cap/year. Based on the IUCN rate reported in 2024 Dar es Salam produced 674 tons of plastic daily. If efforts are not taken to minimize plastic consumption, then in 2030, with a population projected population of 10 million Dar es Salaam will generate 822 tons/day.

Table 11: Waste Characterization in Dar es Salaam

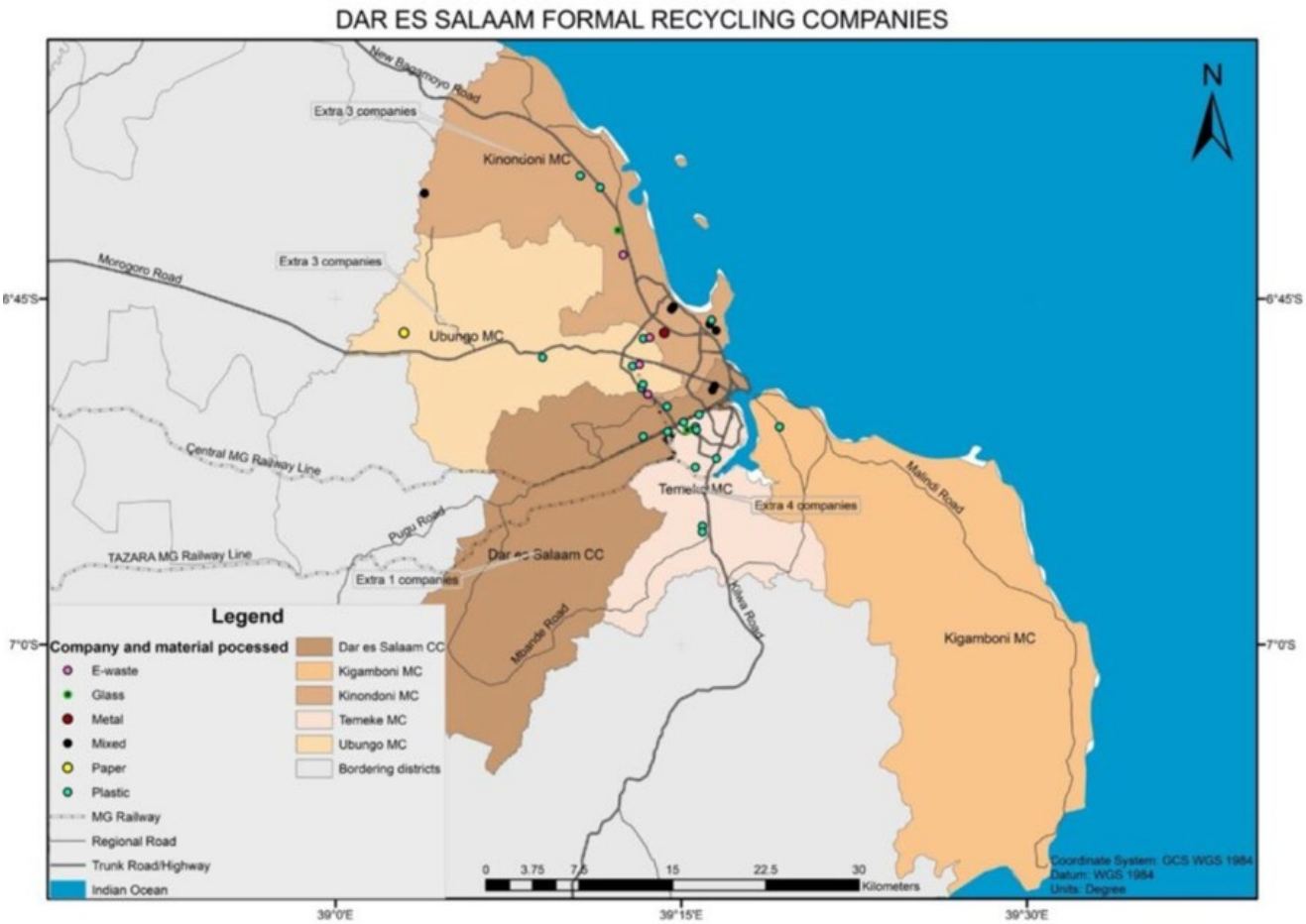
Type of Waste	Weight (kg)	Percentage
Organic Waste	64,494	58%
Paper and Cardboards	11,525	10%
Plastics	17,364	16%
Glass	10,269	9%
Metals	3,090	3%
E-waste	1,867	2%
Textiles	850	1%
Others	1,063	1%
Total	1,105,22	100%

Source: [31]

Materials are collected by private companies or informally by local waste pickers. Legislation in Tanzania requires that source separation happens at home in order to increase the collection of recyclables. Still, a survey of 450 found that 60% of respondents were unaware of waste separation and sorting for reuse and recycling [32]. Since recycling operations in Dar es Salaam are largely informal Kirama and Mayo [16] identified a few companies that were in the initial stages of recycling plastic and metal to minimize waste, and these companies included ECO limited, Mjimwema Environmental Care, and UMAWA. The Green Cities and Infrastructure Programme published a recent article on the Dar es Salaam Resilience Project (DURP) findings, identifying 47 formal recyclers in Dar es Salaam [33]. These companies handle plastic, paper, cardboard, glass, metal, and electronic waste. 68% of the companies predominantly treat PET bottles. 84% of these companies have fewer than 100 staff and handle less than 1 tonne of waste yearly. The study found that some recycling companies faced unstable conditions, including regularly moving locations, changing operations, and stopping activities [33]. The study also mapped the locations of the companies they

identified (Figure 18). Most of the recycling is localized to the more central portion of Dar es Salaam and is limited in more rural and informally settled areas.

Figure 18: Location of Formal Recycling Companies in Dar es Salaam



Source: [33]

Interviews identified a local recycler called Zaidi Recyclers. According to their website, they primarily focus on collecting paper but also collect plastics, glass bottles, and scrap metal. Zaidi recyclers utilize an app called the Zaidi App to connect with customers. This is the same app Nipe Fagio utilizes to register waste pickers. Waste pickers play an important role in the collection of recyclable materials because when a customer is ready to have their waste collected, the app will recommend waste pickers close by based on the customer's location [34].

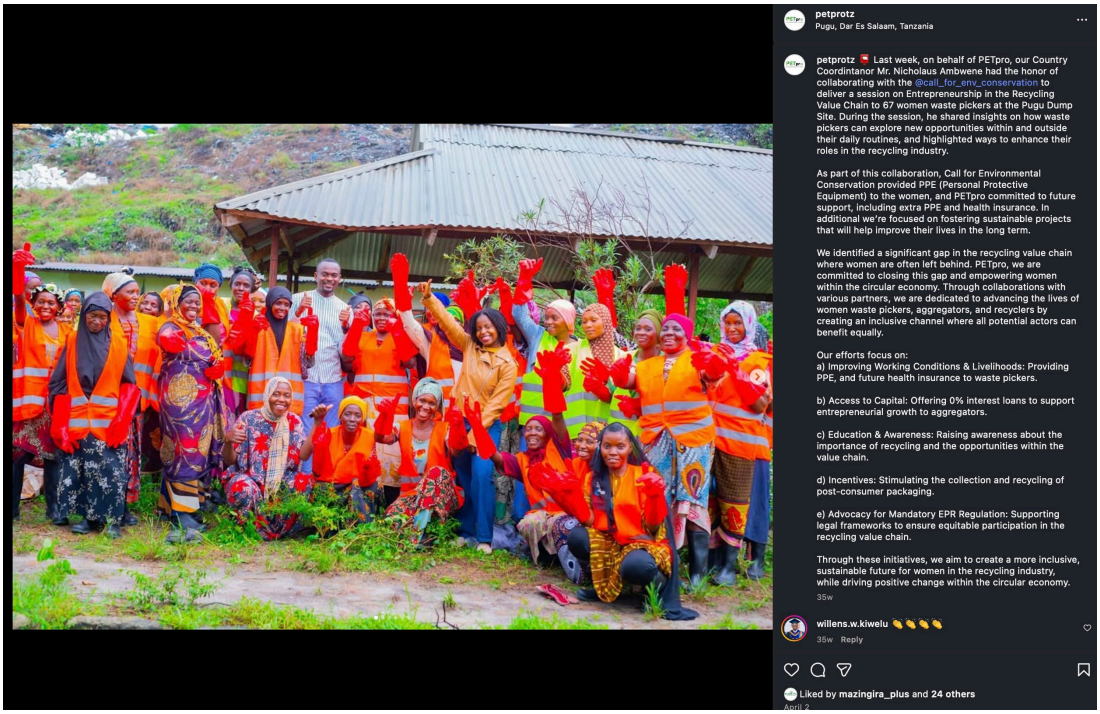
> **"Zaidi Recyclers we collect almost 90% of sorted recyclables. Once we come at your offices, we tell you that they need to be sorted or segregate these wastes so that we can collect. If we collect plastic, it's a plastic. If a nylon is a nylon. We do it at the source, then of the 20%**

> **remaining- or almost 80%, they are done in the sites, but 20% we do it at our site because we have also programs for awareness called Reward for Recycling."**
>
> – Recyclers and Waste Collection and Recovery Center

Another recycling company identified is The Recyclers. The Recyclers began operations in 2014 and reports that since then, they have recycled 13,108,890 kg and 10,480,855 plastic bottles, which has saved 4,884 cubic meters of space in the Pugu dumpsite [35]. The Recyclers collects paper, cardboard, brown paper, newspaper, cans and tin, plastic bottles (soda, water, shampoo, and oil), glass bottles, soft plastic (bubble wrap and nylon), PVC, and PP bags. The Recyclers does not accept dirty paper or cardboard, foil, dirty or rusted cans, Styrofoam or yogurt containers, or colored plastic bags. They collect electronic waste and waste oil, but customers must receive confirmation from the company first due to costs and safety measures [36]. The Recyclers offers two methods of collections. The Recyclers predominately works with commercial and retail businesses to manage their waste. If the business is large enough, they will place an employee who helps sort the waste into their respective categories before collecting it. For the general public they offer four collection points for common materials like glass, plastic, paper, and metal. They also offer a collection of recyclables from 16 schools and offices located in downtown, Masaki, and Oysterbay.

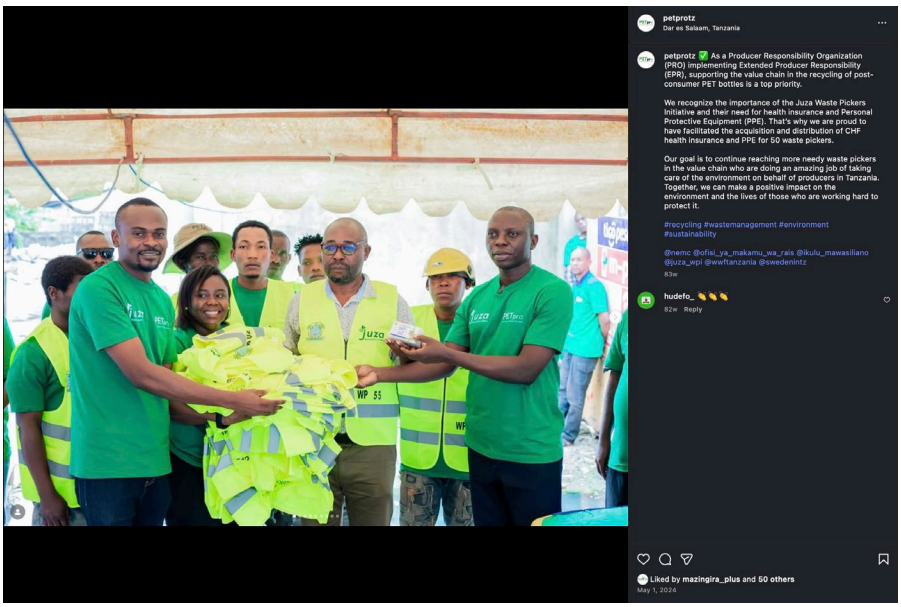
Beverage companies have also made a public statement to improve recycling. In 2022, PETpro Tanzania launched as a Producer Responsibility Organization (PRO) practicing voluntary extended producer responsibility (EPR) [37]. Founding members include Coca-Cola Kwanza Ltd, SBC Tanzania Ltd (Pepsi), Nyanza Bottling Co. Ltd, Bonite Bottlers Ltd, A-One Products & Bottles Ltd (MeTL Group), Sayona Drink, Cool Blue Pure Drinking Water, and Silafrica Ltd. PETpro is not a recycling company as they do not collect or process plastic, buy or sell plastic, or manufacture any packaging. Instead, they facilitate the collection and recycling of plastic by providing resources and information (e.g. protective equipment and health and safety information) to people in the recycling sector, including waste pickers, aggregators, and recyclers (see social posts Figure 19 and 20, below), and work with manufacturers to support and implement a system that holds companies responsible for the post-use of their products.

Figure 19: Supporting Female Waste Pickers through workshops and promoting protective equipment (Instagram post from April 2, 2025)



Source: [38]

Figure 20. Providing Health Insurance and equipment to waste pickers (Instagram post from May 1, 2024)



Source: [39]

In April 2024, PETpro published on Instagram that their pilot program to collect colored plastic bottles had collected 21,000 kg of colored plastic bottles [40]. The CEO of MeTL Group, the parent company of Mo-Xtra, Mohammed Dewji, also shared the news on his social media accounts, highlighting that during the COVID-19 pandemic, he purchased recycling equipment to utilize recycled material combined with virgin PET resin to create new bottles from old ones [41]. The 2023 Company Profile Report highlighted the MeTL Group's recycling plant as, at the time, the only large-scale plastic producer with its own recycling plant. The plant in 2023 was recycling 6,000 metric tons of plastic annually. Between 2015 to 2021 the report states that MeTL Group recycled about 40,000 metric tons. The recycled plastic is exported to South Africa, Europe, China and India to be processed into new plastic items. The report stated that the company would invest 500,000 euros over the next two years into new machines for the plant so that they could both collect the bottles and also process them into granules without outsourcing. Lastly, the report announced plans to establish a larger recycling plant that would be able to expand recycling beyond plastic bottles [42]. The plastic is collected via established collection centers at all of the company's depots, and they offer free transport and collection services to small recycling companies across Tanzania. The report and PETpro Instagram account have highlighted Mbagala Recycling Unit as a recycling company associated with MeTL Group. The PETpro Instagram showcased how the colored bottles are collected and recycled into plastic rope [43]. Mbagala Recycling Unit buys and processes colored plastic bottles that are brought to three of their collection centers located in Shekilango, Mbezi, and Mbagala [44]. Lastly, PETpro announced in August 2025 a partnership with the Tanzania Breweries PLC to pioneer the collection and recycling of nonreturnable glass bottles in Tanzania. As mentioned in the use section, there is a system in Dar es Salaam to return glass bottles for refilling. The Tanzania Breweries PLC 2024 Sustainability Report stated that in 2024 92.95% of the products in Tanzania were packaged in returnable packaging or made from a majority recycled content (more than 50%) [45]. The report also stated that the availability of recycled content is a challenge in increasing recycled content in packaging; this partnership with PETpro to improve the collection and recycling of bottles will allow the company to expand its packaging made from recycled material.

Materials are in use in Tanzania that are recyclable, and efforts must be made in order to increase the collection of these materials. Recycling operations are increasing and the collaboration between formal companies like Zaidi and waste pickers is a collaboration that continually needs to be explored. Waste pickers play an important role in the collection. Beverage bottling companies are also contributing towards increasing recycling by partnering with PETpro to help expand recycling in Dar es Salaam. Source separation also requires continual promotion not only to increase collection of recyclables but also to increase composting opportunities in Dar es Salaam.

> **"Also, recycling I think has become a very big initiative in this current period. Many people are collecting the plastic soda bottles for recycling. I see recycling, for this period, these recent years is happening on a very large scale, where it also helps us to reduce the amount of plastic waste."**
>
> – Food Vendor

POP Facility

In November 2024, Bantam Materials UK Ltd opened its first Prevented Ocean Plastic (POP) collection center in Tanzania, making it the first on the African continent. The 2000m^2 facility is located within the Export Processing Zone in Dar es Salaam. The collection center forms part of a wider network of Prevented Ocean Plastic collection centers operating in other regions, such as Southeast Asia, South America and the Galapagos Region, and the Mediterranean.

Operating close to the beginning of the supply chain, the primary function of this center is to purchase, quality control, sort and consolidate collected raw plastic material. The collection center is serviced by dozens of local suppliers, some of which are locally referred to as bulking stations. These consist of larger plastic collection points operated by individual collectors or organized groups of collectors. The collection center acts as one of the first points within the recycled plastics supply chain where material quality and traceability is systematically controlled. These practices have been established to meet the provenance and quality requirements determined by legislation for recycled plastic material.

This center currently processes post-consumer PET (Polyethylene Terephthalate) bottles, previously used for water or other beverage products. The bottles collected are blue and/or clear in color, to meet the material specification requirements of the recycled flakes market for food grade packaging. Up to 300 metric tons of PET bottles undergo processing at the collection center every month. Upon arrival, the bottles are weighed and sorted according to color and quality. If needed, caps and labels are removed by hand. This sortation process improves the quality and increases the yield of the final product. They are then compacted into bales which are required to consist of 95-99% of PET. The bales are then sold and exported to the next processor, a recycling facility, where the material is hot washed and ground into small flakes.

To meet Bantam's material quality and traceability standards, the collection center is operated by a skilled workforce. This consists mostly of female sortation workers, whose main role is to quality check and sort the PET bottles. Most of the work is carried out manually, with support from light machinery, including a conveyor belt and a baler. These machines are controlled by skilled operators to ensure safe usage. A back office of administrative workers, overseen by the general manager, process and monitor traceability and commercial documentation. Currently, the collection center employs 21 full-time, permanent workers. All the workers are Tanzanian, and a third of the workers are female. There is one 8-hour shift, and the facility is open 6 days per week.

Composting

According to the National Strategy, organic waste comprises 50-70% of MSW, but only 2-3% of it is being composted [12]. Composting offers the opportunity to divert significant waste from the Pugu dumpsite and reduce methane emissions. According to the World Bank's Climate and Development report Tanzania contributed 0.31% of global greenhouse gas (GHG) emissions in 2019, making it the 46th largest global emitter of GHGs [46]. From 2010 to 2020 emissions in the waste sector increased from 4.78 to 6.38 MtCO2e nationally. In Dar es Salaam, solid waste accounts for 55% of methane emissions and is expected to increase

by 90% between 2024 and 2040. However, it can be reduced by 80% if technological mitigation efforts are implemented [47]. Tanzania is one of 15 countries in the World Bank's global methane initiative to reduce methane emissions that will focus on reducing methane from agriculture and transportation nationally, and specifically in Dar es Salaam, it will focus on solid waste. Managing organic waste sustainably was also mentioned in the National Strategy. It proposed an 800-ton/day composting plant in Dar es Salaam that would require an investment of $1 million USD. It also proposed that organic waste be utilized to generate biogas. The proposed plant would generate 2 MW of electricity and require an investment of $5 million USD.

Current projects are underway to implement composting in Dar es Salaam, including a composting plant in Mwagepegande and the Bonyokwa Zero Waste Co-Operative. Composting businesses were also highlighted during the GAIA Zero Waste Cities Conference in July 2024 in Dar es Salaam, Tanzania: Chanzi and BioBuu. Both companies utilize black soldier fly (BSF) larvae that are local to Africa. They breed BSF and their larvae eat the organic waste. The larvae are dried and sold for chicken, pig, or fish feed. The larvae's feces can also be sold to farmers as a fertilizer, which can be up to 80% cheaper than synthetic fertilizer [48]. BSF needs 1 kg of organic waste to produce 50 grams of protein [49]. Compared to fishmeal or soy-based food used to feed animals, BSF produced 2,500 times more protein per acre per year while requiring less water [48]. Overall, this process reduces methane generation of organic waste at the dumpsite and reduces the need for fishmeal or soy-based food for animals.

Chanzi began operations in 2019 in Tanzania and today operates in five cities across East Africa: Arusha, Tanzania; Dar es Salaam, Tanzania; Zanzibar, Tanzania; Nairobi, Kenya; and Mombasa, Kenya [48]. Chanzi collaborates with local markets, farmers, and businesses to obtain spoiled food to feed the larvae. Chanzi reports collecting more than 10,000 tons of organic waste for all sites as of September 2024, or 2,000 tons per city [50]. Each site individually reduces methane emissions by 0.4 metric tonnes per day and 9.4 metric tonnes of CO2 per day [48].

BioBuu is a branch of The Recycler, a local recycling company in Dar es Salaam, that introduced BSF in 2015. Like Chanzi, they have at least one site in Tanzania and Kenya. During a BBC Smart Money segment in 2021, BioBuu reported that they processed 5 to 10 tons of organic waste a day or 1,825 to 3,650 tons a year. They produce 20 to 30 tons of fertilizer a month from the BSF larvae waste and 5 to 10 tons of larvae a month [51]. Organic waste is collected via household compost bins offered by The Recycler. The Recyclers have also announced plans to open a bio-gas plant near Dar es Salaam that would handle 400 tons of organic waste a day and produce about 5 MW.

Figure 21: Black Soldier Flies

One compost plant exists in Dar es Salaam in Mwagepande, in the Kinondoni Municipality. The composting plant began operations in 2022 and accepts 179 tons of organic waste from Kinondoni [52]. The plant reports to reduce 18,000 tons/year of waste equivalent to 10,000 tons of CO_2 eq/year [52]. The organic waste is collected from two city markets and taken to a compost plant in Mwagepande, in the Kinondoni Municipality.

> **"We also use like 25% of the waste to separate from the public places such as markets. We separate the waste and take the organic waste to our compost site in Mwagepande. We have a compost plant there which uses organic waste to produce compost."**
>
> – Government Official

Food vendors also mentioned that their organic waste, primarily potato peels, is collected and used for livestock feed. Overall, there are three different ways in which organic waste can be handled in Dar es Salaam. Offering opportunities to expand organic waste collection and treatment is a circular approach.

Leakage

In total, 10,147 items were logged in 30 transects (each 100m^2) characterizing 10 different square kilometer areas. Transect locations were selected using a stratified random sampling method, in which transects were randomly selected in ten square kilometers which were distributed across three groups of population count (upper, middle, lower) based on LandScan ambient population data. Litter items were recorded using the open-source Marine Debris Tracker app. A full list of items available in the app and their associated material categories can be found in the Appendix.

Plastic categories comprise 65% of all the litter found, with food-related plastic at 49%, other plastic at 11%, and plastic fragments at 5% (Figure 22). Plastic items continue to dominate the litter, with 8 of the 10 top items being items found under the food-related plastic packaging. Top 10 items found in the litter surveys were 1) Plastic Bottle Caps, 2) Plastic Bottles, 3) Trash Bags, 4) Plastic Food Wrapper, 5) Plastic Grocery Bag, 6) Straws, 7) Metal Bottle Caps or Tabs, 8) Cup Lids, 9) Cigarettes, and 10) Plastic cups. It should be noted that cigarettes have a plastic film inside; thus, 9 of the 10 top items have some plastic. Food-related plastic packaging was the most common material among all three population tertiles (Figure 24). It is also notable the near uniformity of the litter among all three population tertiles.

Figure 22: Litter Material Breakdown

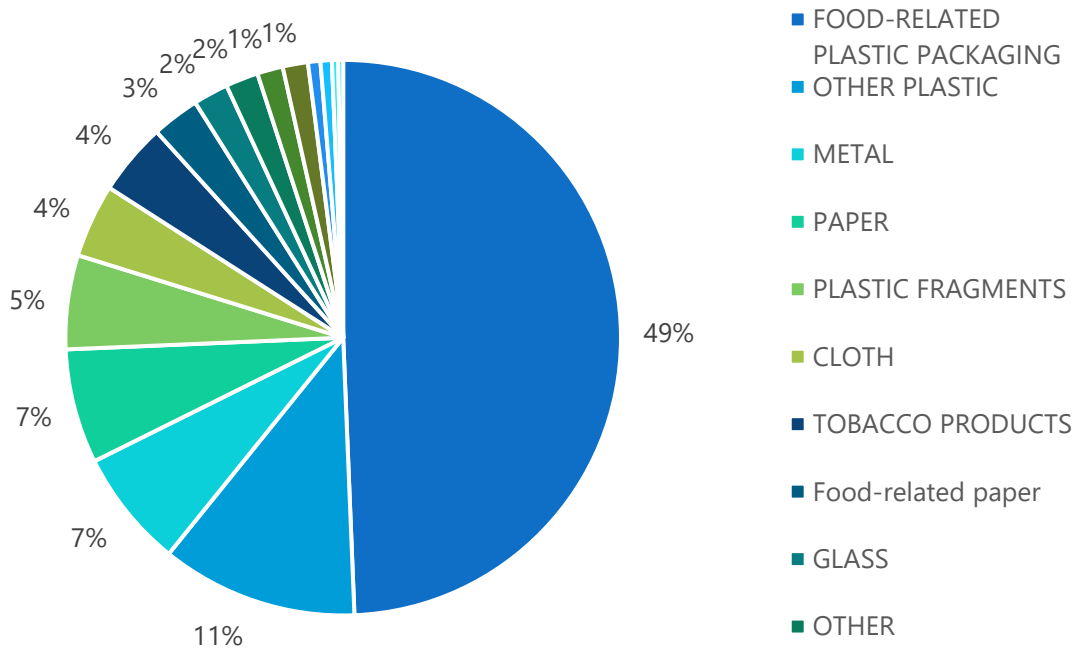


Figure 23: Litter Sites

Figure 24: Proportion of most common plastic items in low (inner), mid (middle), and high (outer) population count areas in Dar es Salaam

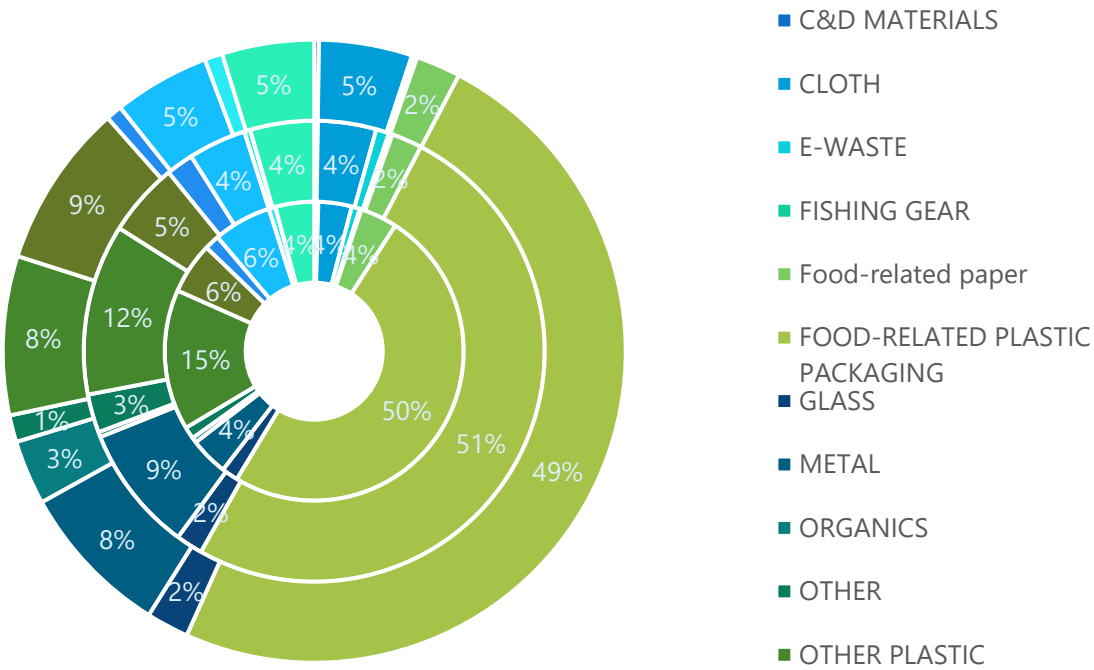


Table 12: Litter Density and Top Litter Items for Each Area of Population Count

Population Tertile	Top 5 Litter Items	Litter Density (count/m2)
Upper (22,800 – 51,284 persons/km^2)	1) Plastic Food Wrapper, 2) Plastic Bottle Cap, 3) Plastic Grocery Bag, 4) Metal Bottle Caps or Tabs, 5) Trash Bags	3.58
Middle (10,316 – 22,800 persons/km^2)	1) Plastic Bottle, 2) Plastic Bottle Cap, 3) Plastic Grocery Bag, 4) Trash Bags, 5) Straws	3.42
Lower (0 – 10,316 persons/km^2)	1) Plastic Bottle, 2) Plastic Bottle Cap, 3) Trash Bags, 4) Straws, 5) Plastic Grocery Bag	3.74

The average litter density of 30 transects is 3.25 items per sq-m. This means that you will find 3.25 liters of items in every meter. Dar es Salaam is the second CAP conducted in Africa, and the first on the mainland. The first CAP in Africa was conducted in Seychelles in 2019, with an average litter density of 0.97 [53]. The average litter density in the 1x1km transects in central Dar es Salaam ranges from 3.42 to 3.74, which are above the overall average litter density (Table 12).

Brands

257 items out of the 10,147 items logged on Marine Debris Tracker App had identifiable brands (2.5% identified). Best efforts are made to determine the brands of litter items. However, exposure to the elements can remove identifying features from items, and smaller items can be even harder to identify. Figure 25 demonstrates some of the conditions of sites when collecting litter samples.

Figure 25: Conditions during data collection

Source: Survey

The most identified item was plastic bottles (125 items). The most common brand was Mo-Xtra (Figure 26). It has been noted that Mo-Xtra bottles typically aren't collected due to their lower value, because of their color, black, compared to the clear bottles. As such, waste pickers often do not collect these bottles due to the effort and energy required to transport the bottles to the collection center. Items italicized in the plastic food wrapper row are labels from plastic bottles. Plastic bottles are typically identified by their film label or plastic bottle cap. If these identifying features are removed from the item by the elements or humans, it can be challenging to identify the brand on the bottle. As of July 3rd, 2024, the EU requires all beverage bottles under 3 liters to have a tethered cap to reduce the environmental impact of plastic bottle caps. The effect of the caps has still not been studied as it is a recent change. Still, a similar policy in Tanzania may be an avenue for the government to follow to reduce the exposure of bottle caps in addition to legislation about colored plastic.

Figure 26: Photo of Mo-Xtra

Source: Survey

Nipe Fagio Brand Audits

Since 2018, Nipe Fagio has participated in Break Free From Plastic's (BFFP) global brand audits program, which was the audit's inaugural year. The brand audit methodology was developed by Global Alliance for Incinerator Alternatives (GAIA), Mother Earth Foundation, Citizen consumer and civic Action Group (CAG), and Greenpeace Philippines in 2017. The training material is available for free in 15 different languages, along with an almost hour-long training video in 7 languages, which is also available on YouTube. The brand audits are cleanup and litter survey events that are conducted at local sites, depending on which site the participating organization determines is most relevant to the community, such as beaches, mountains, rivers, local parks, etc., and all information is logged on the provided brand audit log sheets [54]. The 2023 BFFP Brand Audit Report reported 250 brand audits from 41 countries and 25 audits from 9 African countries [55]. Nipe Fagio has published the data they collected in 2018, 2019, 2020, and 2021 on their website and analyzed 350,000 units of waste. The analysis found that 64% of the waste audited over the four-year period was plastic waste, and that in 2021, 76% of all waste collected was plastic. The common types of plastic found in the audits since 2018 are 33% Polyethylene terephthalate (PET), 31% Low-Density Polyethylene (LDPE), 5% High-Density Polyethylene, and the remaining 20% is made up of multi-layered, single-layered, polystyrene, and polypropylene. The brand audits have also found that 75% of the waste comes from local manufacturers and producers. The remaining 25% comes from foreign products [56].

Bonyokwa Zero Waste Cooperative

This section will discuss the Zero Waste Cooperative established by Nipe Fagio in 2019 as it highlights ongoing efforts to increase collection. The Wakusanya Taka Bonyokwa Cooperative, Tanzania's first Zero Waste Cooperative to manage the only materials recovery facility (MRF) in Bonyokwa and Dar es Salaam. The goal of the cooperative was to address the high waste management costs and unreliable services by implementing community-based source separation, cooperative-led collection, and decentralized waste management. The success of the cooperative has been replicated with its expansion in Zanzibar in 2024 and is in the implementation phase in Arusha. The goal is to expand this localized solution to other parts of Dar es Salaam and Tanzania.

The cooperative directly services the Bonyokwa area, which has a population of 12,000 from 2,998 households, and has had successful participation from 95% of the households and businesses. The cooperative supplies households with the necessary receptacles, to ensure source separation (Figure 27 b) and is collected daily via pulled wagons (Figure 27 a). All the collected waste is returned to the Bonyokwa MRF, where recyclables are sorted into their respective categories (Figure 28) and organic waste is composted or used for BSF farming (Figure 29). The compost produced also aids in local agriculture at the MRF (Figure 29). The cooperative income comes from waste collection fees and selling the recyclables, compost, BSF, and local produce grown next to the cooperative.

Figure 27: Waste Bins and Collection of Waste

(a) Collection Wagons

[57]

(b) Separate Waste Bins

(Source: Site Visit)

Figure 28 : Sorted Recyclable at the Bonyokwa MRF

Figure 29: Composting, Black Soldier Fly Maggot, and Local Farming at the Bonyokwa MRF

The estimated average waste generation per capita per day in Bonyokwa is 0.88 kg or 10.560 metric tonnes per day [57]. The reported annual average waste collected is 1,088.62 metric tonnes, comprised of 78% organic waste, 6.68% recyclable waste, 8.05% domestic hazardous waste, and 7.30% residual waste (Table 13). On average, 85% of the collected waste is either composted, recycled, or reused, which diverts waste from the Pugu dumpsite. This also reduces costs and emissions from transportation by providing a localized solution. The circularity of the system has resulted in the recovery of 16.4 metric tonnes of methane/year that would have been released if it had been sent to the landfill.

Table 13: Waste Collection from the Cooperative

	Collection Per Month (metric tonnes)	**Average Collection Per Year (metric tonnes)**
Organic waste	31.4	848.80
Recyclable	3.8	72.72
Domestic-Hazardous and Residual waste	6.45	167.10
Total	41.65	1,088.6

Source: [57]

Lastly, the Bonyokwa MRF employs 35 individuals from the community. The cooperative provides waste pickers with established income and a vital role in the community. One interview reflected positively on the cooperative's impact on its employees.

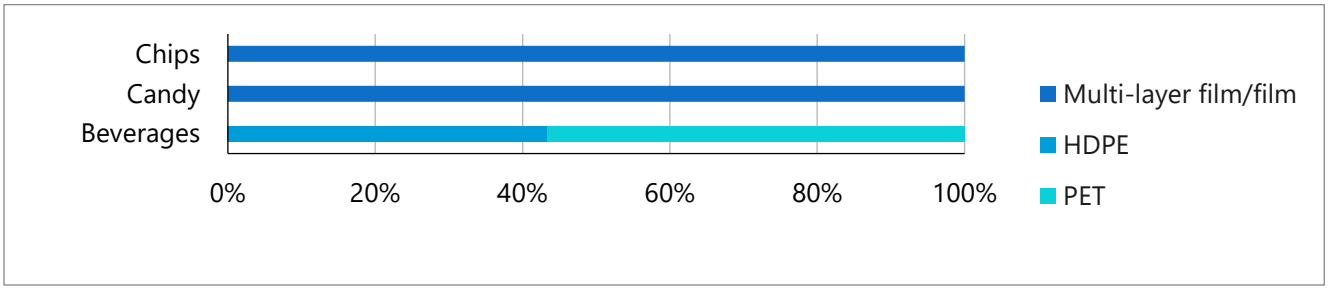
> **"We, the entire cooperative, and I have benefited from this system because we have become waste collectors. Unlike before, when we were waste pickers, we picked up and disposed of waste. Now, we are recognized as waste collectors with a system and acknowledged by the government. We even present our case to government bodies to ensure that waste management becomes sustainable."**
>
> – Recyclers and Waste Collection and Recovery Center

CAP Results

Product Design

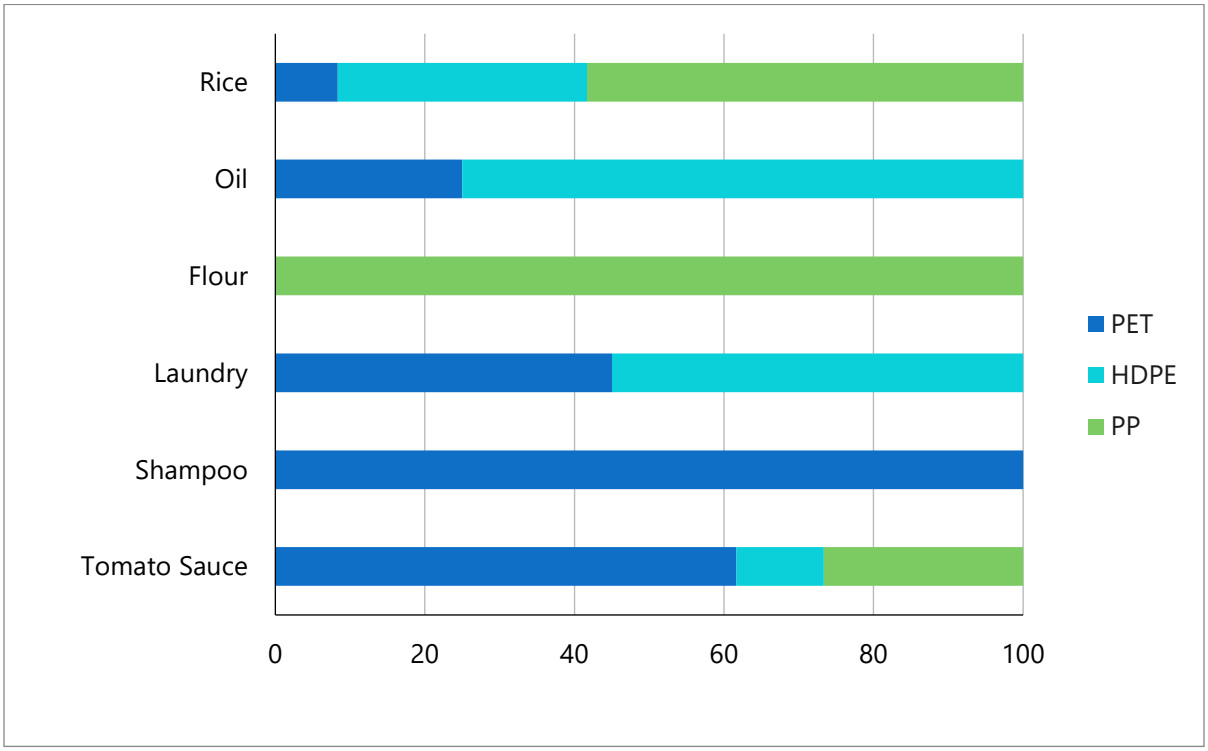
In Bonyokwa, 3 stores and 3 restaurants were surveyed. The surveys found that there was little variation in the materials available in Bonyokwa compared to the variability in the overall survey. For convenience products on three materials for chips, candy, and beverages were noted. The packaging is predominantly plastic packaging but the limited variation can offer the opportunity for more streamlined collection for recycling, as it limits the variation in materials (Figure 30).

Figure 30: Bonyokwa Convenience Products



Similar to the convenience products, the staple products were also only available in three packaging materials, including PET, HDPE, and PP (Figure 31). Notably, Flour and Shampoo were the only materials packaged only in in just one material whereas the other staples had three or two packaging materials.

Figure 31: Bonyokwa Staple Products



Use

Surveys for alternatives found that in 2 out of 3 stores surveyed, alternatives were offered. These alternatives were similar to those listed in the overall product design section. The survey also found that 2 out of 3 stores offered repackaged goods.

Since LDPE bags were identified in the overall survey as the only most common material bag the results are the same for the Bonyokwa stores. These bags also cost between 40 to 50 TSH, depending on the size.

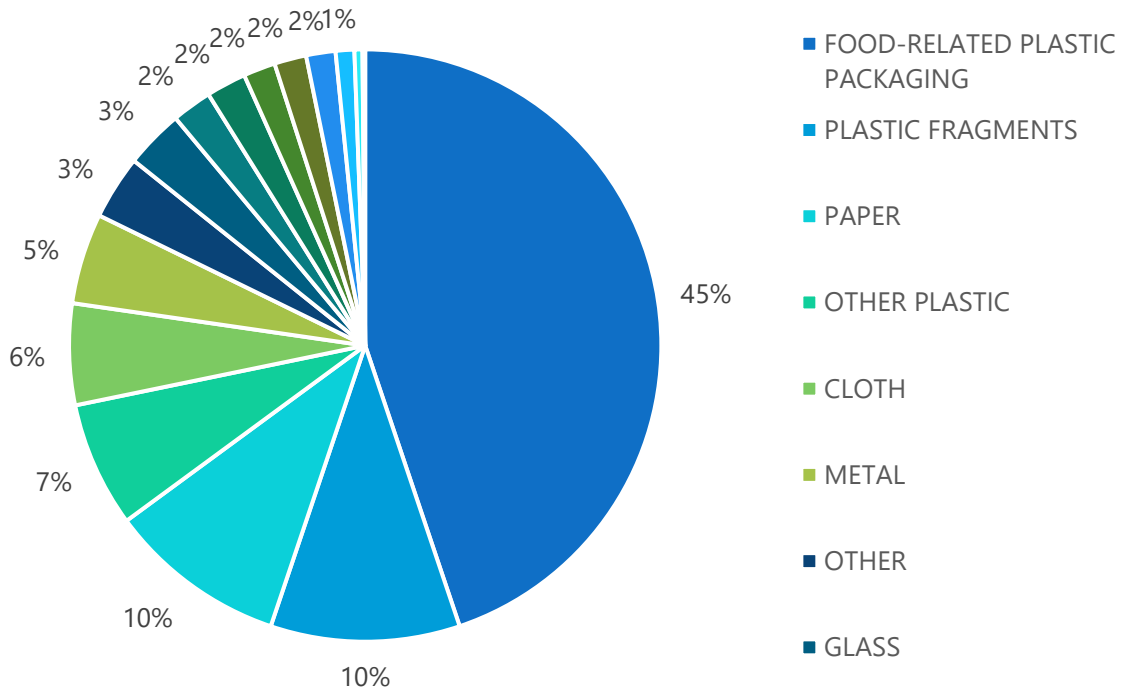
Alternatives were similarly available and cost between 200 to 300 TSH. And lastly paper/paperboard bags were also available.

Restaurant surveys found that only one of the three restaurants surveyed offered reusable to-go containers, but all three did offer reusables in-house.

Leakage

Leakage data was collected from 3 200x200m in the Bonyokwa area, and a total of 687 litter items were logged. Similar to the overall results food-related plastic packaging was the most common item logged, followed by plastic fragments. Overall, for Bonyokwa 62% of all the items logged fell under a plastic category (Figure 32). The top 5 items in Bonyokwa are plastic grocery bag, plastic bottle, plastic bottle cap, straws and tags, tickets, and receipts. The majority being plastic items, and similar to the overall result plastic bottles and plastic bottle caps were a significant item found.

Figure 32: Bonyokwa Litter Characterization



The litter density in Bonyokwa was logged at 2.29 items/m2 (Table 19). A t-test and a non-parametric statistical test was attempted to determine if the result was statistically different from the results in the 10x10 km survey area. The data is not normal and with the statistics conducted, was not shown to be significantly different.

Table 19: Litter Density and Top Litter Items in Bonyokwa

	Top 5 Litter Items	Litter Density (count/m2)
Bonyokwa	1) Plastic Grocery Bag, 2) Plastic Bottle, 3) Plastic Bottle Cap, 4) Straws, 5) Tags, tickets, and receipts	2.29

Case Studies: Semarang and Dar es Salaam

Since the Dar es Salaam facility began operations in November 2024, there has been limited access to clear or blue-tinted bottles (many are opaque colors as outlined in the Product Design Section). Semarang, Indonesia, has had an operational POP collection facility for several years, and a CAP was conducted in Semarang in 2020 for the Urban Ocean program. This section will compare the Input and Product Design categories of the CAPs with respect to the plastic bottles in Dar es Salaam and Semarang.

Product Design

Store surveys in Semarang found that 50% of drinks are packaged in PET, 30% in PP cups, and smaller percentages are packaged in paper, multilayer film, or kaleng (tin cups). In comparison to Dar es Salaam, where 77% of drinks are packaged in PET, 10% HDPE, 5.2% PP, 3.8% LDPE, and the remaining in Aseptic Carton, Multilayer film/film, Other, Glass, and Metal. Compared to Semarang, there is a higher percentage of PET packaging for beverages. Examples of the store shelves for Semarang and Dar es Salaam (Figure 33 and 34). In Dar es Salaam the colored bottles are noticeable. It should be noted that while there are green sprite bottles in Figure 33 in Semarang, after the CAP was conducted in 2020 Sprite announced that they were eliminating the green sprite bottles in favor of the clear plastic bottles to improve recyclability. The bottles while an important component of the sprite image, were eliminated due to limited market for recycling the green bottles. Notably, there is a green bottle in the Dar es Salaam store survey which is not a sprite bottle. This brand is Azam Swiss which is owned by the same company, Bakhresa Group, who also produces the Azam Energy Drink and Azam Malti (Figure 34). Mo Xtra is produced by MeTL Group's A-One Products and Bottlers Ltd. and is also bottled in colored plastic. As mentioned in the recycling section the MeTL Group in partnership with PETpro has made efforts to collect the colored bottles and recycle them, and adding virgin PET plastic. However there has been no announcement from either company to address efforts to eliminate the black or other colors from the plastic bottles.

Figure 33: Semarang Products

Figure 34: Dar es Salaam Products

A 2022 study assessed the challenges faced by manufacturing companies to implement a "green supply chain" (considering environmental issues in the context of supply chain management) by conducting 60 interviews with staff from the five different units of Bakhresa Food Products LTD, which includes 15 respondents from Azam Dairy Products, 15 respondents from Azam Ice Cream Division, 15 respondents from the water division, and 15 respondents from the Juice division and carbonated soft drinks division [58]. Bakhresa Food Products LTD is a subsidiary of Bakhresa Group which is a global company headquartered in Dar es Salaam and includes businesses in agriculture, food and beverage, media, transport and energy, leisure and hospitality, and financial technology. Beverages produced by Bakhresa Food Products LTD include the Azam products, which include beverages packaged in colored plastic. The 2022 study focused on challenges related to sourcing, manufacturing, transportation and distribution, and disposal (Table 20). While the study did not solely focus on plastic bottles, it highlights overall challenges faced in the sourcing and manufacturing of various products produced by Bakhresa Food Products LTD.

Table 20: Summary of Challenges the Bakhresa Food Products Ltd

	Challenges
Sourcing	• Shortage to buy adequate and environmentally friendly materials to undertake production (33.33% of respondents) • Poor commitment by top managers to source green materials (70% of respondents) ○ Non-green materials include nylon rolls packaging, plastic bottles with nylon labels, and non-disposable dairy packaging

Manufacturing	• Lack of demand for green manufactured products (65% of respondents)
	  ○ Green-manufactured products were more expensive, and customers prefer to use less expensive versions
	• Lack of equipment and tools to produce green goods or products
	• Lack of knowledge from workers on green manufacturing (73% of respondents)
	  ○ Combined with a lack of incentive from top management, respondents felt that they focused on manufacturing products that maximize the company's profits
	• 65% of the respondents confirmed a lack of public awareness of the environmental impacts caused by less "green" products

Transportation and Distribution	• Lack of legal enforcement by the government (35%) • Unreliable transportation and distribution (70%) by poor route planning and scheduling in business logistics • Poor vehicle maintenance (60%)
Disposal	• Lack of market for recyclable materials (70% of respondents), mentioned that potential customers, as the majority, did not prefer recyclable materials • Lack of information sharing between the firms and suppliers (66.67% of respondents) • Inadequate legal enforcement by the government specifically to protect the environment (60% of respondents) • Customers' behavior related to disposal of products (53.3% of respondents)

Source: [58]

Table 21 compares the weights of Dar es Salaam beverages to Semarang and the United States. It is notable that while Dar es Salaam packaging offers the most quantity of product, the ratio of packaging to quantity of product is relatively close at 0.03 and 0.04, respectively. In the US, the average weight of plastic packaging is higher than both Dar es Salaam and Semarang, while the average quantity of product is lower than Dar es Salaam. However the ratio of packaging weight to ml of product is higher than both Dar es Salaam and Semarang. Without any specific standards (that are enforced) in a country, it is often left up to companies to determine their plastic bottle design. EPR or other policies and legislation could provide avenues to create standards regarding the materials used, and/or the quality and quantity of plastic used in packaging.

Table 21: Average Weight of products and their plastic packaging for beverages in Dar es Salaam, Semarang, and the United States

Country	Number of Samples (n)	Average Weight of Plastic Packaging (g)	Average Quantity of Product (g or mL)	Ratio of Packaging weight (g) to 1 mL of product
Dar es Salaam	25	23.2	718	0.03
Semarang	78	12.04	298	0.04
United States	424	33.9	510	0.07

Input

A comparison of where these products are being manufactured was done to identify a possible explanation for the possible difference in product design due to possible differences in manufacturing practices. Table 22 shows the distances between each city and the manufacturer and parent company. In Dar es Salaam, 75% of beverages are manufactured in Dar es Salaam, and the remaining 25% is manufactured in Tanzania and Zanzibar. In comparison, only 29 of the 32 beverage (90%) brands surveyed in Semarang were manufactured in East Java, and 3 products were manufactured internationally. As for parent companies, 63% of parent companies were located in Tanzania, compared to Semarang with 84% of parent companies located in Indonesia. Thus, while Dar es Salaam and Semarang manufacture the majority of their beverages domestically, in regards to parent companies, fewer companies are headquartered domestically in Dar es Salaam.

Table 22: Parent Company and Manufacturing Distance for Beverages in Dar es Salaam and Semarang

	Length Store to Manufacturer (km)			Length Store to Parent Company (km)		
	Minimum	*Maximum*	*Average*	*Minimum*	*Maximum*	*Average*
Dar es Salaam Beverages	0	861	72	0	13,825	4,510
Semarang Beverages	31	34,603	817	39	38,844	5,668

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to the nearest km.

Opportunities

CIL found the following opportunities to expand and enhance circularity in Dar es Salaam based on the findings of this report. These opportunities are categorized based on the seven spokes of the CAP model. Stakeholder engagement with the partners of this project should take place to further expand, refine and prioritize these opportunities based on local context, impact, feasibility, and cost. It is important to note that the opportunities listed below are individualized based on the findings, but solutions cannot happen in a vacuum and are most impactful when strategically combined within a holistic system framework.

Input

- Engage with the manufacturers and parent companies (both locally and internationally) about packaging that is problematic for use, recycling, or leakage.
- Suggest changes to packaging to local companies and/or promote Extended Producer Responsibility (EPR) as a policy to require or incentivize changes to packaging to reduce use of locally problematic materials or make the packaging more recyclable.
- For example, EPR legislation could disincentives or prevent the production of colored plastic beverage bottles to make them more valuable for recycling.

Community

- Expanding awareness on source separation and alternatives to plastic items, including incentives for source separation (e.g., payment of materials if they are source-separated).
- Expansion of school programs similar to Nipe Fagio and Mazingira Plus that educate students and families about waste diversion and zero waste options.

Product Design

- Elimination of colored plastic packaging in favor of clear or light blue PET packaging through EPR legislation, including eco-modulation.
- EPR legislation that imposes fines on products that do not meet requirements or subsidies to producers that do demonstrate their products meet standards of being more recyclable.
- Establishment of a reusable foodware network to allow more customers to use the containers instead of single-use containers. Some examples include Perpetual Reuse and reCIRCLE.
- No alternative compostable containers were identified, but in order to manage these containers through composting, an expansion of composting infrastructure available to the city would be needed.

- Collaborate with businesses using black soldier flies (BSF) to ensure that compostable containers could be fed to the BSF to maximize circularity of containers.

Use

- There is an opportunity to continue to expand the availability of alternatives.
- Availability of bulk staple items such as rice and beans provides the foundation for the use of reusable containers during the purchasing of staple items.
- There is an opportunity to improve the implementation and enforcement of the SUP bag policy.

Collection

- Improving source separation to support recycling and composting initiatives by ensuring the appropriate separate bins are distributed to households as required by legislation.
- Expansion of deposit return schemes (DRS) for plastic bottles to improve plastic bottle collection.
- Establish more zero waste cooperatives in other regions of Dar es Salaam.
- Expand recycler transfer station locations to increase profits for waste pickers.

End of Cycle

- There is an opportunity to expand the collection and recycling of waste to reduce the use of the local dumpsite.
- There is an opportunity to improve the design and operation of the dumpsite, while being sensitive to the livelihood, health, and safety of the informal sector.
- Improve the working conditions of the informal sector to support their role in managing household waste.

Leakage

- Legislation could be created to require tethered bottle caps to beverage bottles to reduce bottle cap leakage.

- Further infrastructure and incentives for collecting and capturing plastic bottles could reduce their leakage.
- Other changes from the other spokes (e.g., Input, Product Design, etc.) could increase the value of packaging overall for collection and potentially reduce leakage.

Glossary

BSF: Black Soldier Flys

CAP: Circularity Assessment Protocol

CIL: Circularity Informatics Lab

CBO: Community Based Organization

EPR: Extended Producer Responsibility

EPS: Expanded polystyrene

FMCG: Fast moving consumer goods

HDPE: high density polyethylene

MRF: Material Recovery Facility

MSW: municipal solid waste

NGO: Non government Organization

PET: polyethylene terephthalate

PP: polypropylene

POP: Prevent Ocean Plastics

RCC: Refuse Collection Charge

SUP: single-use plastic

UGA: University of Georgia

References

1. Nipe Fagio. *About Us*. 2025 [cited 2025; Available from: https://nipefagio.co.tz/about-us/.
2. EAC. *Overview of EAC*. 2025 [cited 2025; Available from: https://www.eac.int/overview-of-eac.
3. Ana Rocha. *HARMONIZING THE USE OF SINGLE-USE PLASTICS IN THE EAST AFRICAN COMMUNITY*. 2022; Available from: https://actionnetwork.org/petitions/harmonizing-the-use-of-single-use-plastics-in-the-east-african-community?source=direct_link&referrer=group-single-use-plastic-free-east-africa-community.
4. United Nations, *World Urbanization Prospects. The 2014 Revision*. 2014: New York, USA: United Nations, Department of Economic and Social Affairs.
5. Ministry of Finance and Planning, *The 2022 Population and Housing Census: Initial Results*. 2022, National Bureau of Statistics and President's Office – Finance and Planning, Office of the Chief Government Statistician,Zanzibar.: Dodoma, Tanzania.
6. World Population Review, *Dar es Salaam Population*. 2025.
7. Njiraini, J., *Tanzania: East Africa's New Powerhouse*, in *Global Finance*. 2024.
8. Delegation of the European Union to the United Republic of Tanzania and the East African Community, *Global Gateway: EU and Tanzania Sign Agreement to Improve Port Performance and Enhance Trade Connectivity*. 2024.
9. DAWASA. *History*. Available from: https://www.dawasa.go.tz/pages/background.
10. EWURA, *WATER UTILITIES PERFORMANCE REVIEW REPORT FOR FINANCIAL YEAR 2023/24*. 2025.
11. DCC, *Dar es Salaam City Master Plan 2016-2036*. 2016.
12. URT, *UNITED REPUBLIC OF TANZANIATHE NATIONAL SOLID WASTE MANAGEMENT STRATEGY*. 2018.
13. IUCN-EA-QUANTIS, *National Guidance for plastic pollution hotspotting and shaping action, Country report Tanzania*. 2020.
14. Global Plastoc Action Partnership. *Tanzania*. 2025 [cited 2025 October]; Available from: https://www.globalplasticaction.org/tanzania.
15. Kassim, S.M. and M. Ali, *Solid waste collection by the private sector: Households' perspective—Findings from a study in Dar es Salaam city, Tanzania.* Habitat International, 2006. **30**: p. 769-780.
16. Kirama, A. and A.W. Mayo, *Challenges and prospects of private sector participation in solid waste management in Dar es Salaam City, Tanzania.* Habitat International, 2016. **53**: p. 195-205.
17. Mpuya, G.J. and E. Munishi, *Private Sector Challenges in Sustainable Solid Waste Management, Dar es Salaam City, Tanzania.* International Journal of Management, Accounting and Economics, 2024. **11**(6).
18. Kamugisha, P., J. Ludete, and S. Mhanga, *Public private partnerships for successful solid waste management and prospects for reducing public health risks in Kinondoni Municipality-Dar es Salaam, Tanzania.* Environmental Research and Technology, 2019. **2**(3): p. 141-157.
19. Omar, H., *IMPLICATION OF REFUSE COLLECTION CHARGES PRACTICES ON WASTE COLLECTION SERVICE IN SELECTED URBAN AREAS IN TANZANIA.* Global Scientific Journal, 2020. **8**(3).
20. Omar, H., *Assessment of the Refuse Collection Charges in Covering Waste Management Cost: The Case of ILALA Municipality -Dar Es Salaam, Tanzania.* International Journal of Innovative Science and Research Technology, 2020. **5**(7).
21. Pellatt, J. and J. Palfreman, *Smart technology solution for a cleaner city: a case study of Dar es Salaam, Tanzania.* GeoJournal, 2023. **88**.
22. ILO, *Women and Men in the Informal Economy: A Statistical Picture Third Edition*. 2018.

23. Nipe Fagio. *Igniting "Unsung Heroes" Waste Picker's Movements in Tanzania: Advocating for Essential Recognition*. 2024; Available from: https://nipefagio.co.tz/igniting-unsung-heroes-waste-pickers-movements-in-tanzania-advocating-for-essential-recognition/.
24. Nipe Fagio. *"Unified Waste Pickers voice"- Launching of the Tanzania Waste Pickers Association (TAWAPA)*. 2024; Available from: https://nipefagio.co.tz/unified-waste-pickers-voice-launching-of-the-tanzania-waste-pickers-association-tawapa/.
25. Yhdego, M., *FROM SANITARY LANDFILL TO A DUMP SITE. PUGU KINYAMWEZI COMMUNITY CURSE IN DAR ES SALAAM, TANZANIA*. 2017
26. Palfreman, J., *A study about waste pickers in Dar es Salaam, Tanzania*. 2015.
27. Medina, M., *The informal recycling sector in developing countries - Organizing waste pickers to enhance their impact*. 2008, Grid Lines.
28. Cooperatives Unit Enterprises Department, *Waste pickers' cooperatives and social and solidarity economy organizations*, in *Cooperatives and the World of Work*. 2019, International Labour Organization.
29. Mapunda, D.W., *Towards safe waste disposal sites: Examining the siting processes and social - environmental impacts of dumpsites in Dar es Salaam city, Tanzania*. 2007. p. 90.
30. Singh, R., *Dar-es-Salaam's waste management needs a complete revamp*, in *Down to Earth*. 2023.
31. Senzige, J.P., et al., *The potential for solid waste recycling in Urban Area of Tanzania: The case of Dar Es Salaam.* International Journal of Environmental Protection and Policy, 2014. **2**(5).
32. Monella, J. and V. Leyaro, *Determinants of Households Willingness to Participate In Solid Waste Separation for Reduce, Reuse and Recycle: The Case of Dar es Salaam.* Tanzania Economic Review, 2013. **3**(1).
33. Bella, V.D. *DURP produces first-ever map of Dar es Salaam's formal recycling sector*. 2025; Available from: https://ukgreencitiesandinfrastructure.org/resource/durp-produces-first-ever-map-of-dar-es-salaams-formal-recycling-sector/.
34. Zaida. *Zaida Recyclers*. 2024; Available from: https://zaidi.co.tz/.
35. The Recyclers. *The Recyclers*. 2024; Available from: https://www.recycler.co.tz/our-impact.
36. The Recyclers. *The Recyclers Recycling Guide*. 2024; Available from: https://static1.squarespace.com/static/53e6b408e4b0cc1fd4cb6a46/t/5e3d5a5df1b1ba0da18f11f1/1581079138051/Recycling+Guide+2020+complete.pdf.
37. PETpro Tanzania. *Who We Are*. [cited 2025 October]; Available from: https://petpro.co.tz/who-we-are/.
38. petprotz. 2025; Available from: https://www.instagram.com/p/DH8VyiGtbF6/?utm_source=ig_web_button_share_sheet&igsh=MzRlODBiNWFlZA==.
39. petprotz. 2024; Available from: https://www.instagram.com/p/C6a-zTbNc1O/?utm_source=ig_web_button_share_sheet&igsh=MzRlODBiNWFlZA==.
40. petprotz. 2024 April 23; Available from: https://www.instagram.com/p/C6G9FpltVuz/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA==.
41. moodewji. 2024 June 5; Available from: https://www.instagram.com/reel/C71AlCYIgt7/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA==.
42. MeTL Group, *2023 Company Profile*. 2023.
43. petprotz. 2024; Available from: https://www.instagram.com/reel/C-SncBrNlQ4/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA==.

44. Mbagala Recycling. 2021 April 16; Available from: https://www.facebook.com/share/17QGWCmh8r/.
45. Tanzania Breweries PLC, *Sustainability Statement*. 2024.
46. World Bank Group, *Tanzania Country Climate and Development Report*, in *CCDR Series*. 2024, Washington, DC: World Bank Group.
47. World Bank Group, *Tanzania's greener future: Reducing methane in waste and livestock sectors*. 2024.
48. Chanzi. *Chanzi About Us*. 2025; Available from: https://www.chanzi.co/about-us.
49. BioBuu. *BioBuu About Us*. 2025; Available from: https://www.biobuutz.com.
50. McGuckin, R. and S. Sarma, *3 Businesses Transforming Food Waste into Profit*. 2024.
51. BBC, *Using Larvae To Convert Food Waste Into Animal Feed*, in *Smart Money* 2021.
52. Kölsch, F. and K.G.-u.U. GmbH, *Private sectoroperation model for a composting plant*. 2024.
53. World Bank Group, *Seychelles - Circularity Assessment Protocol : Plastic Leakage Results and Recommendations - A Report to the World Bank (English).* 2019: Washington, D.C. .
54. #BreakFreeFromPlastic. *Brand Audit Training*. 2025 [cited 2025; Available from: https://brandaudit.breakfreefromplastic.org/brand-audit-training/.
55. #BreakFreeFromPlastic, *#BreakFreeFromPlastic Brand Audit Report 2023*. 2024.
56. Nipe Fagio. *Waste Assessment and Brand Audits (WABA)*. 2025 [cited 2024; Available from: https://nipefagio.co.tz/waste-assessment-and-brand-audits-waba/.
57. Nipe Fagio and gaia, *Zero Waste Model Dar es Salaam Case Study*. 2024.
58. Khamis, A.A., E.J. Munishi, and I.M. Issa, *Challenges Faced by Manufacturing Companies in Implementation of Green Supply Chain: Evidence from the Bakhresa Food Products Limited in Dar es Salaam - Tanzania.* International Journal of Social Science Research and Review, 2022. **5**(7): p. 69-81.
59. National Environment Management Council, *THE ENVIRONMENTAL MANAGEMENT (PROHIBITION OF PLASTIC CARRIER BAGS AND PLASTIC BOTTLE CAP SEALS) REGULATIONS, 2022*. 2022.

Appendix

Table A1: Full List of Debris Tracker Litter Items and Associated Material Categories

Material	Items
C&D Materials	Aggregate & Brick Bolts, Nails, and Screws Building Materials Lumber Other C&D
Cloth	Clothing Towels or rags Fabric Pieces Other Cloth
E-Waste	Batteries E-Waste Fragments Wire Other E-Waste
Fishing Gear	Buoys and Floats Fishing Line Other Fishing Gear Plastic Net or Net Pieces Plastic Rope
Glass	Glass Bottle Glass or Ceramic Fragments Other Glass
Metal	Aluminum Foil Aluminum or Tin Cans Foil to-go container

	Metal Bottle Caps or Tabs Metal Fragments Other Metal
Organic Waste	Food Waste Other Organic Waste
Other	Other Popsicle or lollipop Stick
Other Plastic Products	Bulk Bags Flip Flops or shoes Plastic String, Tape, or Packing Straps Rubber Bands Trash bag Tires Balloons Plastic toys or balls Car Parts Hard plastic jugs or containers Other Plastic
Food-Related Paper	Paper cups Paper food box or container Paper plates or bowls Compostable paper cups Paper food wrapper Compostable food box or container Napkins Other Food-Related paper

Paper	Office paper and newspaper Tags, tickets, and receipts Corrugated Cardboard Paper fragments Other Paper
Personal Care Products	Blister Pack or other pill packaging Cotton Buds Ear plugs Personal Care Product Sachet or packet Toothbrushes Toothpaste or Other Product Tube Flossers Feminine products Needles and syringes Other Personal Care Product
Food-related plastic	Foam cups Plastic cups Compostable plastic cups Cup Lids Plastic Bottle Aseptic cartons Mini alcohol bottles Plastic Bottle Cap Plastic Food Wrapper Condiment packet or container Plastic Grocery Bag Sandwich or snack bags Plastic Utensils

	Straws Foam to-go container or clamshell Plastic to-go container or clamshell Compostable plastic container or clamshell Other Food-Related Plastic
Plastic Fragments	Film Fragments Foam Fragments Hard Plastic Fragments Rubber/ tire fragments Other Fragments
PPE	Disinfectant Wipes Disposable Gloves Face Masks Other PPE
Tobacco Products	Cigarette Packaging Cigarettes Tobacco Sachets or packets E-cigarettes and vaping Plastic cigar/cigarillo tips Lighters Cannabis-related waste Other Tobacco Product

Table A.2 Laws and Policies in Tanzania and Dar es Salaam

Constitution of the United Republic of Tanzania, 1977	Article 14: every person has the right to live and to the protection of his life by the society in accordance with the law Article 27 (1): every person has the duty to protect the natural resources of the United Republic
Environmental Management Act (EMA), 2004	Section 114: (1) For the purposes of ensuring minimization of the solid waste in their respective areas of jurisdiction, local government authorities shall prescribe: (a) for different types or kinds of waste or refuse or garbage to be separated at the source; (b) for standards to guide the type, size, shape, colour and other specifications for refuse containers used; and (c) for mechanisms to be put in place to involve the private sector and Non-Governmental Organisations on planning, raising awareness among producers, vendors, transporters, manufacturers and others on the need to have appropriate containers and enhance separation of waste at source. (2) The local government authorities shall, with respect to their areas of respective jurisdiction: (a) cause to be conducted appropriate Environmental Impact Assessment for all new major activities leading to proper management of solid waste; (b) manage solid waste generated in accordance with sustainable plans produced by respective local government authority; and (c) ensure the appropriate sorting of waste is made right at the source and in accordance with standards or specifications prescribed by the local government authority concerned. Section 119: The local government authorities shall in choosing the best method of solid waste disposal for their areas of jurisdiction consider the following matters: (a) climatic conditions; (b) economic ability; (c) interest of the community; (d) environmental, hygienic and social benefits; and (e) availability of tipping sites. Section 134: (1) Each local government authority shall, with respect to its area of jurisdiction, ensure that: (a) standards prescribed for the hazardous waste management are in place and operational at all the time; (b) premises producing hazardous wastes are adequately ventilated and are in compliance with prescribed standards; (c) waste effluents are treated or are so modified as to comply with prescribed standards before final disposal; and (d) hazardous liquid wastes are treated to conform with prescribed environmental standards at factory or on site before their discharge into public sewers or municipal oxidation ponds or in an open land or into receiving water bodies.
Land Act No. 4, 1999	The Ministry of Lands, Housing and Human Settlement Development is responsible for implementing the Act. The Land Act provides for: particular areas to be designated as "hazardous land", the development of which is likely to pose a danger to life or lead to the degradation or destruction of the environment on a site or on land adjacent to the site. Hazardous land includes: mangrove swamps coral reefs wetlands offshore islands land designated or used for dumping of hazardous wastes land within 60 m of a riverbank, shoreline of an inland lake, beach or coast

	land on slopes with a gradient exceeding acceptable angle land specified by appropriate authority as fragile nature or of environmental significance the protection of hazardous land Landfill facility may not be constructed in sensitive sites
Public Private Partnership Act, 2010	The Act give effect to the public-private partnership policy; to provide for institutional frameworks for the implementation of public-private agreements between public sector and private sector entities; to set rules, guidelines and procedures governing public-private procurement, development and implementation of public private partnership and to provide for other related matters. Public Private Partnership Co-ordination Unit shall deal with promotion and co-ordination of all matters relating to public-private partnership projects undertaken within the Mainland Tanzania. (g) Environment and Waste Management (section 6 (3))
Environmental Impact Assessment and Audit Regulations, 2005 and 2018 amendments	First schedule on the projects category type A that are mandatory to undertake Environmental Impact Assessment (20). WASTE TREATMENT AND DISPOSAL: Toxic and Hazardous waste: Construction of Incineration plants; Construction of recovery plant; Construction of waste water treatment plant; Construction of secure landfills facility; and Construction of storage (temporary) facility. (b) municipal solid waste: construction of Municipal Solid Waste landfill facility (c) municipal sewage: construction of sewage sewer system
Environmental Management (Solid Waste) Regulations, 2009	The Regulations: detail the requirements and responsibilities for managing solid waste in Tanzania highlight waste minimization and cleaner production principles alongside the duty to safeguard the public health and the environment from adverse effects of solid waste detail permitting requirements (Part III), notably that any person dealing with solid waste as collector, transporter, waste depositor or manager of a transfer station will apply to the LGA for a permit. The local authority will also issue licences to individuals or companies qualified to operate solid waste disposal sites, i.e., a permit is required to operate a LGA waste disposal site.
Environmental Management (Prohibition of Plastic Carrier Bags and Plastic Bottle Cap Seals) Regulations 2022	Section 230 (2) (f) Part III: 5. All plastic carrier bags, regardless of their thickness are prohibited from being imported, exported, manufactured, sold, stored, supplied and used in Mainland Tanzania. 6. A person shall not import, export, manufacture, store, distribute, supply, sell or offer for sale beverages with plastic bottle cap seals. 7. A person shall not sell or offer for sale beverages or commodities wrapped in plastic unless the nature of such commodities requires wrappings by plastics. 8. Licensing authority shall not register or issue a license or permit to any person intending to import, export, manufacture, distribute or sell plastic carrier bags or

	beverages with plastic bottle cap seals that have been prohibited by these Regulations. Part V: 15. Local government authorities shall, in addition to their roles and functions on waste management provided for in the Act and in the Environmental (Solid Waste Management) Regulations- be responsible for ensuring compliance and enforcement of these Regulations; conduct public education and awareness programs on the implementation of these Regulations; and prepare and submit bi-annual report on implementation of these Regulations to the Director of Environment.

Modified from: [12, 59]