Rethinking Urban Metabolism for an optimized waste management in the Global South

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PLASTIC WASTE IN URBAN AREAS

- Plastic waste is one of the most challenging problems in Indonesia
- It is estimated that, across the archipelago, **60%** of waste is uncollected: almost **50%** is burned, 5% is dumped on land and almost **10%** leaks into water bodies (Fig.1). In urban areas, plastic generation is much higher than in rural areas (Fig.2)

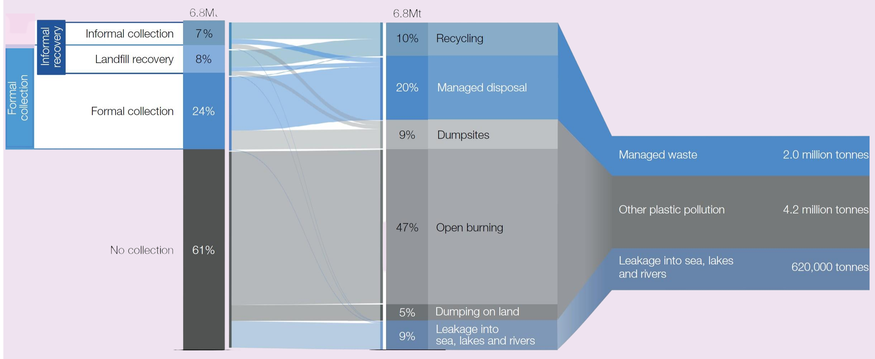

Fig 1: Material Flow Analysis for Plastic at the national level, Indonesia, 2017 [1]

- **Informal sector** workers (mainly waste pickers who collect and sell valuable waste to make a living) are the ones who contribute to recycling the most
- Lack of infrastructure and stakeholders' organization lead plastic to easily leak into the environment.

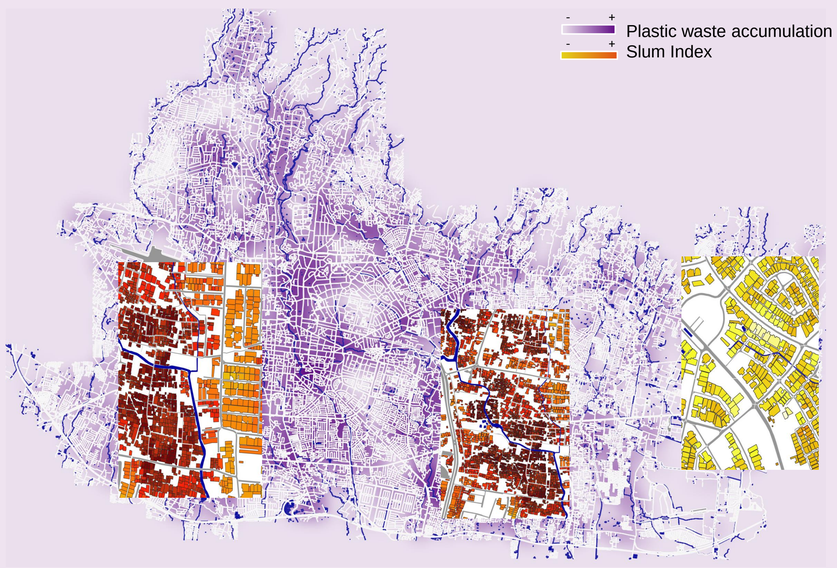

Fig.2: Case study: with its 26 sub-districts and 139 villages, the city of Bandung covers an area of 167 km2 and has a total population of about 2.3 million inhabitants. Waste is managed mostly by the informal sector, and and slum areas are scattered around the city [2]

Urban Metabolism (UM) studies how materials flow (e.g., plastic) and where they end up in the system, providing a clear environmental profile (e.g., waste flow quantities) of a whole city.

- In Indonesia, cities are characterized by informal governance and **unplanned urban sprawl**, which has a serious impact on plastic waste flow (Fig. 2).
- Understanding this heterogeneity within cities is essential to provide targeted and specific solutions for better waste management.

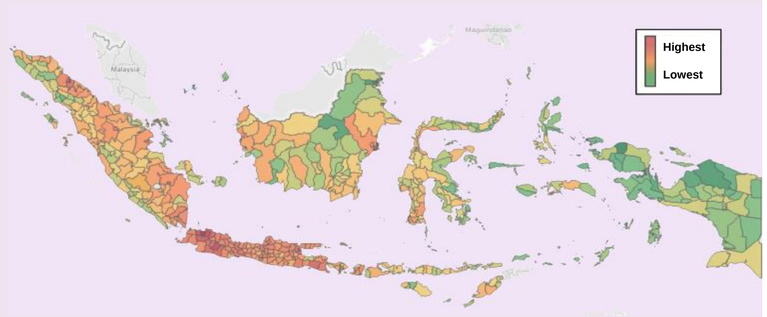

Fig 2. Plastic waste generation and accumulation across Indonesia [1]

RESEARCH GOAL

This research aims to analyse how urban landscape patterns and stakeholders' modus operandi relate to the way plastic waste circulate within a city.

This allows for rethinking UM to include spatial variations and drivers that govern waste flow within the city

RESEARCH GAPS

GOVERNANCE

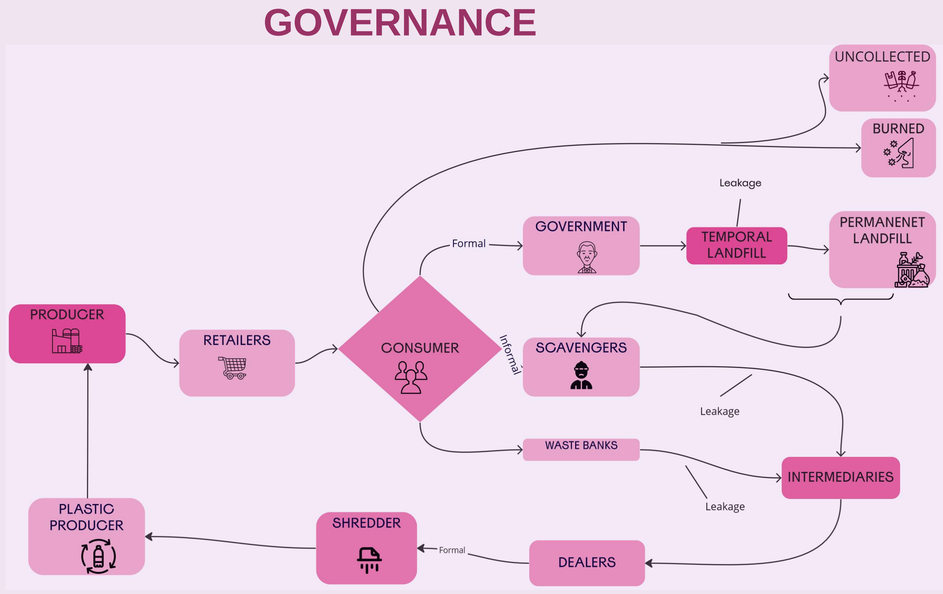

Fig.4. Stakeholders involved in plastic waste management in Bandung

How actors (Fig.4) operate in the system and in which locations have an impact on plastic waste flow

→ There is a need to understand actors' constraints and facilitators that lead to particular decisions on waste disposal and collection

RQ. How do actors' organization and governance influence the flow of plastic?

DATA

Data inconsistances: current methods and measurements differ per study, geographical area, and research group, and still a small proportion of UM research reports variations within the city

→ There is a need to understand how waste generation and collection change in different parts of the city and contribute to data collection on urban plastic waste flow

RQ. How does plastic flow vary in different neighbourhoods?

URBAN LANDSCAPE

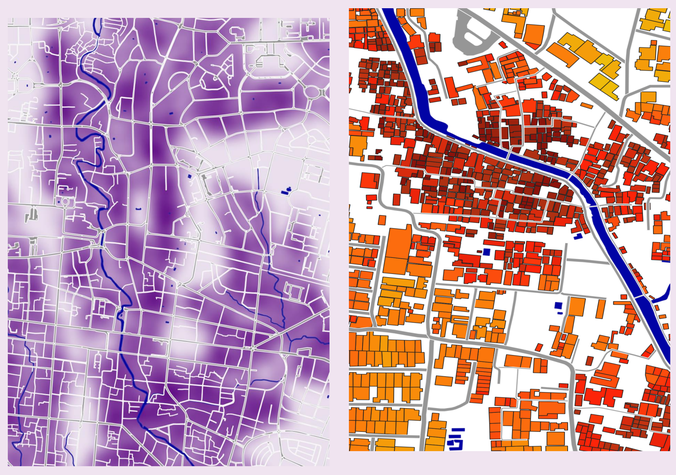

Fig. 5: Plastic waste accumulation and slum areas near the river in Bandung [2]

Different areas of the city present different challenges, demography and infrastructures. This has an impact on waste disposal choices and collection rates within the city (Fig. 5)

→ There is a need to understand which infrastructural, geographical and socioeconomic factors inhibit waste collection and lead to plastic leakage

RQ. Do the built environment and socioeconomic factors influence disposal choices and collection?

RESEARCH DESIGN

FRAMEWORK AND METHODOLOGY

1. STAKEHOLDERS ANALYSIS

- Identify key actors and their roles. Plastic waste that flows in the system circulates according to the decisions, interactions and constraints of stakeholders involved in the material flow chain.

Method:
- Semi-structured interviews
- Social Network Analysis

2. MATERIAL FLOW ANALYSIS FOR PLASTICS

- Quantifying plastic waste flow in the system and final destination at the neighbourhood level can reveal differences in consumption and disposal methods.

Method:
- Material Flow Analysis for plastic at the neighbourhood level.

3. URBAN LANDSCAPE

- Considering spatial structures and socio-economic factors underpinning metabolic flow/stock dynamics can contribute to the development of a systemic approach to improve waste management in urban systems.

Method:
- Geospatial and statistical analysis at the neighbourhood level

EXPECTED OUTCOME

1. Identification of drivers

Actors: understanding the relation between plastic leakage and where waste pickers work

Built environment: understanding the relation between plastic waste leakage and relevant urban features (i.e., slum areas, collection points, road access, unavailability/availability of green open spaces)

Socio-economic factors: understanding the relation between plastic leakage and income level

2. Local information on plastic quantity

Plastic waste quantification and destination at the neighbourhood level (i.e., % of uncollected waste and destination in the environment, recycled items)

3. New approach

Provide a more suitable approach for Urban Metabolism research for cities

References

[1]: «Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan National Plastic Action Partnership", Global Plastic Action Partnership in collaboration with the Indonesia National Plastic Action Partnership, 2020

[2]: Data retrieved from Sakti et al 2022 "Multi-Criteria Assessment for City-Wide Rooftop Solar PV Deployment: A Case Study of Bandung, Indonesia", *Remote Sensing* https://doi.org/10.3390/rs14122796 and Rinasti et al, 2022."Fate identification and management strategies of non-recyclable plastic waste through the integration of material flow analysis and leakage hotspot modelling", *Nature Portfolio* https://doi.org/10.1038/s41598-022-20594-w

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