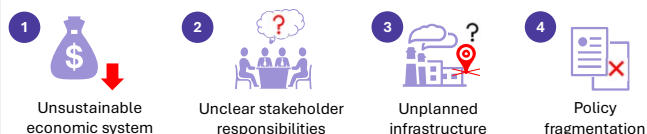


RESEARCH BACKGROUND AND MOTIVATION

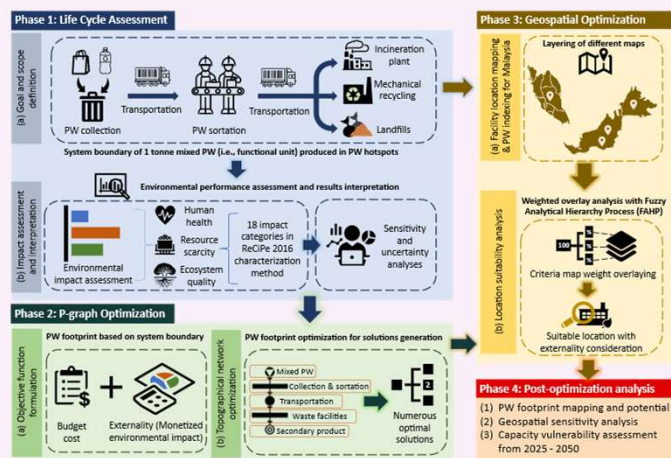
Global Plastic Treaty remains unimplemented despite being launched in 2022, while global plastic waste is expected to accumulate to **617 Mt/y** by 2040. Circular plastic waste (PW) economy under Extended Producer Responsibility (EPR) scheme can effectively alleviate plastic pollution.

Challenges for plastics circularity management



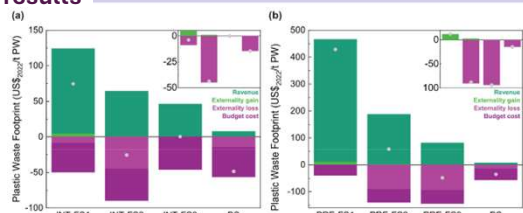
INITIAL APPROACH

Methodology: P-graph-life cycle optimization (P-graph-LCO)



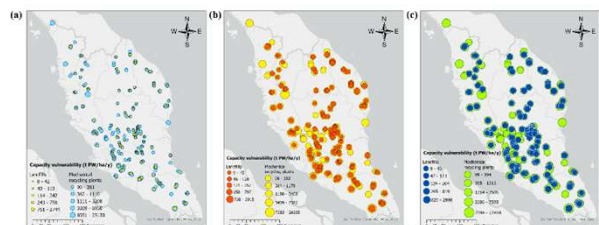
INTEGRATION of life cycle assessment, optimization modelling, and geospatial analysis to generate numerous optimal plastic waste configurations in Malaysia that fulfil both **geospatial and externality** (i.e., monetized environmental impacts) requirements.

Key results



Plastic waste footprint of feasible solutions in (a) integrated scenarios and (b) preferred scenarios.

➤ Only PRE-FS1 (i.e., 100% mechanical recycling) showing net externality gain.

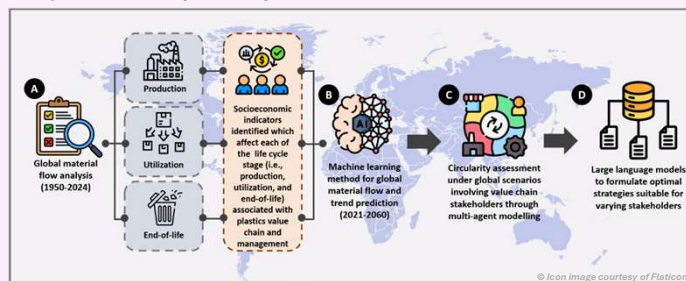


Facility capacity growth and distribution across 50 municipalities in (a) 2030, (b) 2040, and (c) 2050.

➤ Proposed landfills (with 12% PW composition) of minimum land size in 11 out of 50 local authority areas are anticipated to exceed or nearing the vulnerability threshold (22,557 t PW y⁻¹ ha⁻¹) by 2050.

NEW APPROACH

Methodology: Geospatial-Environment-Economic Forecasting & Optimization (GEEFO) Model



Functionality and scalability **ENHANCEMENT** of the initial approach. The new approach will investigate and project the future trend of the global circular plastic value chain under varying scenarios to identify viable solutions that fulfil Global Plastic Treaty ambitions, comprising **FOUR** main analytical tools:

- (1) Global life cycle environmental and economic assessment
- (2) Geospatial dynamic investigation of cross-border trading
- (3) Multi-agent modelling for stakeholder responsibilities allocation
- (4) Large language modelling to generate policy-adhering solutions

Technical strengths

The new approach shall demonstrate these **strengths** that are lacking in the P-graph-LCO framework:

- ✓ Broader inclusion of upstream and cross-border trading activities
- ✓ Geospatially characterized externality and infrastructure footprints in different regions
- ✓ Dynamic stakeholder interactions and interests are captured in each value chain
- ✓ Temporal changes and validity of the optimal solutions for risk assessment
- ✓ Auto-generation of scientifically sound and localized policy strategy formulation under the EPR governance from the environmental, economic, and geospatial databases of the plastic value chain

ULTIMATE GOALS



[1] Sustaining regional infrastructure resiliency with externality for plastic waste circularity via geospatially-enhanced P-graph-life cycle optimization framework. *Journal of Cleaner Production*

Organizers