Impacts of Waste Charging Systems on Separately Collected Bio-waste: Insights from European Cities

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I. INTRODUCTION

- **Bio-waste** accounts for **approximately 34% of municipal waste** generated in the EU[1].
- It can be recycled into **compost or soil improvers**, contributing to soil health and climate change mitigation[2].
- Since 2024 EU Member States must **ensure separate bio-waste collection** and are encouraged to **use economic instruments**, including PAYT-based waste charges[3].
- **Effectiveness of PAYT systems** for waste reduction is widely supported[4], however their specific impact on bio-waste has received limited attention.

Pay-as-you-throw (PAYT)

Households are charged for (residual) waste collection according to the actual amount they dispose of, reflecting the polluter pays principle and creating a financial incentive to reduce waste and improve waste separation.

II. METHODOLOGY

Structured questionnaire completed by waste management authorities from 27 European municipalities (response rate of 35.5%).

Waste charging systems were classified into four groups[5]:

- **Flat-fee**
- **PAYT** (frequency, pre-paid bags or weight)
- **Flexible+** (container volume and collection frequency)
- **Flexible** (based on container volume only)

III. RESULTS

Figure 1: Average waste capture rates per capita

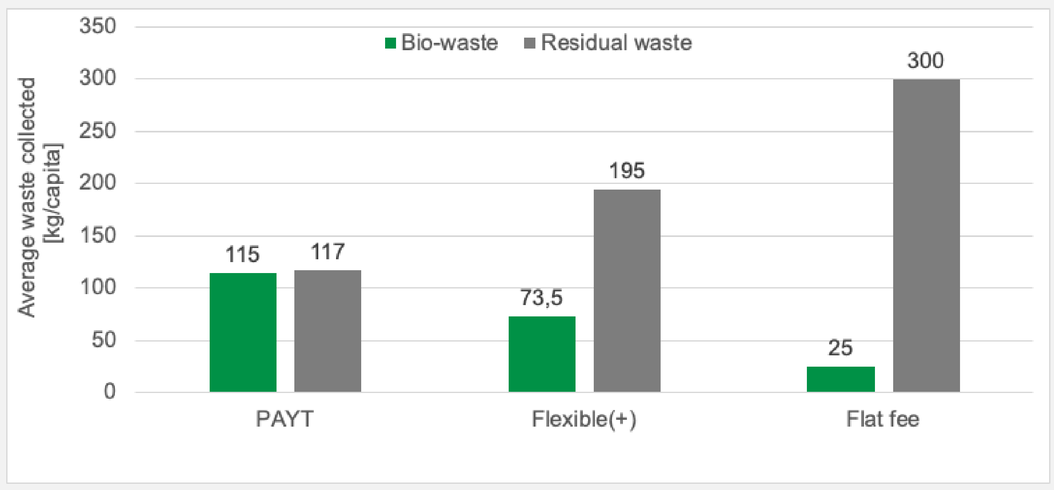
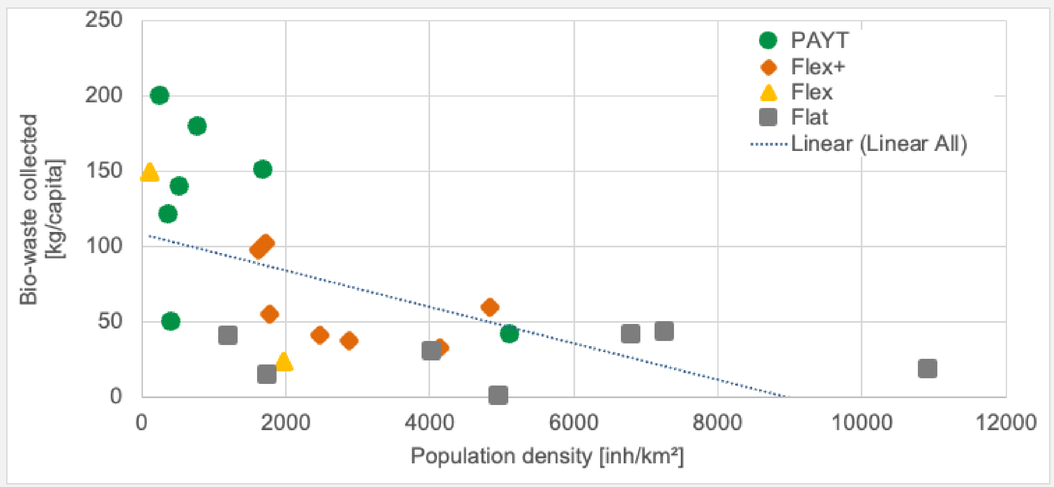


Figure 2: Bio-waste capture rates in relation to population density



Main Findings: Quantity of Separately Collected Bio-waste

- **PAYT** systems achieve the **highest average bio-waste collection rates** (115 kg/capita), significantly outperforming flat-fee systems (25 kg/capita). *(see Figure 1)*
- There is a **significant negative correlation** (r=−0,579) between population density (above 2,000 inhabitants/km²) and capture rates. *(see Figure 2)*

Collection and Charging Systems

- Separate bio-waste collection is implemented in 23 out of 27 surveyed municipalities.
- Door-to-door bin collection is the primary collection method.
- 17 municipalities use differentiated fees (PAYT or Flexible systems).

Quality of Bio-waste

- Lack of (comparable) data on the quality of the collected biowaste.
- Impurity levels at average 2%, but vary based on the maturity and collection system of the city's waste management history rather than the fee structure itself.

Perceived Effectiveness and Satisfaction

- Municipalities utilising PAYT report much higher satisfaction with their system's effectiveness (4.1/5 points) compared to those with flat-fee systems (1.1/5 points), showing a strong consensus that non-differentiated fees fail to provide any incentive.

IV. DISCUSSION & CONCLUSION

Recommended package of measures for the collection of high-quality bio-waste:

Effective and convenient infrastructure

- Door-to-door collection via bio-waste bins
- Removal of publicly accessible containers
- Regular communication interventions

Clear and binding regulation

- Such as strict thresholds for impurities in input material
- Regular controls with warning system providing feedback loop to citizens

PAYT-based waste charges

- Adapted to specific local conditions, such as population density and settlement structure

Literature

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Further Information

The complete study can be found published in MDPI Sustainability under "Using Differentiated Waste Fees to Encourage the Sustainable Reycling of Organic Waste"
by Prof. Dr. Henning Friege & Maike Hentschel