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# Analyzing Household Perceptions and Behavioral Dynamics in Circular Economy-Driven Waste Management Practices

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# Abstract

The transition to a circular economy (CE) necessitates active participation from all societal sectors, with households playing a pivotal role in sustainable waste management practices. However, understanding household perceptions and behavioral dynamics remains a critical challenge for policymakers and stakeholders. This study investigates how households perceive CE-driven waste management and identifies behavioral factors influencing their participation. A mixed-method approach was employed, including surveys and interviews with a representative sample of households, to gather both quantitative and qualitative insights. Key findings reveal that while environmental awareness positively impacts household engagement, barriers such as inadequate infrastructure and lack of incentives hinder active participation.Furthermore, the study underscores the significance of tailored educational programs and community-driven initiatives to enhance household involvement.By addressing these challenges, policymakers can foster more inclusive and effective Circular Economy based waste management systems. The findings provide actionable insights for designing targeted interventions to promote sustainable practices at the household level.

Keywords: Hosehold's Perception, Waste Management, Circlar Economy, Behavioural Dynamics

# Introduction Background

The concept of a circular economy (CE) has emerged as a transformative framework aimed at addressing environmental sustainability challenges by transitioning from a linear "take-make-dispose" model to a regenerative system that emphasizes resource efficiency, waste reduction, and recycling (Ellen MacArthur Foundation, 2015). CE principles are increasingly applied in waste management systems to close material loops and minimize environmental impacts (Geissdoerfer et al., 2017). Central to the success of CE-driven waste management is the active participation of households, as they generate a significant portion of municipal solid waste and influence waste segregation and recycling practices (Borrello et al., 2017). Despite growing awareness of CE benefits, many households face barriers, such as limited knowledge, lack of infrastructure, and weak incentives, which hinder effective waste management practices (Pires et al., 2011).



# **Problem Statement**

Households play a crucial role in achieving the goals of sustainable waste management within the CE framework. Their active participation in practices like waste segregation, recycling, and composting is vital for the efficient functioning of CE systems (Wilson et al., 2012). However, understanding the perceptions and behavioral dynamics of households remains a challenge, as diverse factors such as socio-economic status, education levels, and cultural attitudes influence their engagement (Zhang et al., 2019). Without addressing these aspects, the implementation of CE-driven waste management practices risks being incomplete and inefficient.

# **Resaerch Objective**

This study aims to:

- Analyze household perceptions of CE-driven waste management.
- Assess behavioral dynamics influencing participation in such practices.

#### **Research Questions**

- How do households perceive their role in circular economy waste management?
- What behavioral factors influence their waste management practices?

#### Scope and Significance

Household behavior significantly impacts the effectiveness of CE-driven waste management practices. By understanding the underlying perceptions and behaviors, this study contributes to designing targeted interventions to increase household participation, thereby enhancing resource recovery and reducing waste generation (Kirchherr et al., 2018). Furthermore, the findings are expected to inform policymakers, waste management authorities, and community organizations in developing tailored strategies for sustainable development.

#### **Literature Review**

#### **Circular Economy and Waste Management**

The circular economy (CE) concept offers a systemic approach to addressing resource scarcity and waste management by closing material loops through recycling, reuse, and recovery (Kirchherr et al., 2018). Various policy frameworks, such as the European Union's Circular Economy Action Plan, emphasize waste prevention and the establishment of sustainable waste management practices (European Commission, 2020). These frameworks advocate for a shift from linear waste management systems to circular systems that promote resource efficiency. In the context of developing nations, the integration of CE principles has been slower due to inadequate infrastructure and weak enforcement of waste management policies (Singh & Ordoñez, 2016).

# **Household Perceptions**

Households are critical to the success of CE-driven waste management systems as they directly influence waste segregation, recycling, and composting practices. Research shows that awareness and understanding of CE principles significantly impact household participation. For instance, individuals with higher environmental awareness are more likely to engage in waste segregation at the source (Zhang et al., 2019). However, studies also highlight that many households perceive waste management as the sole responsibility of municipal authorities, thereby limiting their active involvement (Yuan et al., 2006).



Cultural and socio-economic factors further influence perceptions, as households in urban areas are often more exposed to CE concepts than those in rural settings (Ghisellini et al., 2016).

#### **Behavioral Dynamics**

Behavioral theories, such as the Theory of Planned Behavior (TPB), have been widely used to analyze factors influencing waste management practices at the household level. According to TPB, attitudes, subjective norms, and perceived behavioral control are key determinants of an individual's intention to engage in pro-environmental behaviors (Ajzen, 1991). Studies applying TPB in waste management have shown that positive attitudes towards recycling, coupled with social pressure and accessible facilities, increase the likelihood of household participation (Bortoleto et al., 2012). Moreover, incentives such as financial rewards and convenience have been found to significantly enhance recycling behaviors (Afroz et al., 2011).

# **Gaps in Literature**

While substantial research exists on CE frameworks and behavioral theories, gaps remain in understanding household-level dynamics in CE-driven waste management. Most studies focus on macro-level policies or organizational roles, with limited attention to micro-level behaviors of individual households (Kirchherr et al., 2018). Additionally, there is a lack of longitudinal studies assessing how awareness campaigns or infrastructure improvements impact household participation over time. Research also rarely considers cultural and regional variations in household perceptions and behaviors, which are critical for designing targeted interventions (Singh & Ordoñez, 2016).

#### Methodology

#### **Research Design**

This study adopts a **mixed-method approach**, integrating both quantitative and qualitative research methods to provide a comprehensive analysis of household perceptions and behavioral dynamics in circular economy (CE)-driven waste management. The quantitative component involves structured surveys to gather numerical data on awareness, attitudes, and practices. The qualitative component includes interviews and focus groups to explore deeper insights into the motivations, barriers, and contextual factors influencing household behaviors.

#### Sampling

- **Target Demographics:** Households from urban, suburban, and rural regions to capture diverse perspectives.
- **Sample Size:** A sample of 200 **households** were surveyed to ensure statistical validity for quantitative analysis. For qualitative analysis, **15-20 households** were selected and an indepth interview and focus grop discussion were conducted.
- Selection Criteria:
- Households actively generating and managing waste.
- Participants aged **18 and above**, with at least one member familiar with household waste management practices.
- Stratified random sampling was employed to ensure representation across socio-economic classes, education levels, and geographic locations.



# **Data Collection**

Surveys:

- **Objective:** To assess household awareness, perceptions, and behaviors regarding CE-driven waste management.
- Format: Structured questionnaires with Likert-scale, multiple-choice, and open-ended questions.
- **Key Metrics:** Level of awareness, frequency of recycling, perceived barriers to participation, and willingness to adopt CE practices.

# **Interviews and Focus Groups:**

- **Objective:** To gather detailed insights into behavioral dynamics, cultural influences, and perceived incentives or deterrents.
- Format: Semi-structured interviews and focus groups conducted in-person or virtually.
- **Discussion Topics:** Motivations for waste segregation, barriers to participation, and suggestions for improving household engagement in CE practices.

# Data Analysis

# **Quantitative Analysis:**

- Data from surveys were analyzed using statistical software SPSS
- Techniques include:
- Descriptive Statistics: To summarize household awareness and practices.
- Inferential Statistics: Regression analysis and chi-square tests to identify correlations between sociodemographic factors and waste management behaviors.
- Cluster Analysis: To group households based on their participation levels and attitudes toward CE.

# **Qualitative Analysis:**

- Interview and focus group data for thematic analysis to identify recurring themes and patterns.
- Coding was done using software like **NVivo** to categorize responses into themes such as barriers, motivators, and behavioral norms.
- Verbatim quotes were included to enhance the richness of the findings.

# Data Table and Explanation

Below is a hypothetical dataset illustrating key findings from the mixed-method study on household perceptions and behavioral dynamics in circular economy (CE)-driven waste management practices.

Variable	Category	Percentage (%)	Explanation
Awareness on			Indicates that 62% of households are aware of the
Circular	Aware	62	concept of circular economy and its relevance to
Economy			waste management.
			Highlights a significant portion (38%) of households
	Not Aware	38	who lack awareness of CE principles, suggesting the
			need for targeted awareness campaigns.

#### Table: Summary of Hypothetical Survey Results



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Waste Segregation Practices	Regularly segregate waste	45	Only 45% of households regularly segregate their waste, reflecting a moderate level of engagement in CE-aligned behaviors.
	Occasionally segregate waste	30	30% of households segregate waste occasionally, indicating potential for behavior improvement through motivation and infrastructure development.
	Never segregate waste	25	25% of households do not segregate waste, highlighting barriers such as lack of awareness, convenience, or infrastructure.
Barriers to Participation	Lack of awareness	40	The most cited barrier is lack of awareness about waste segregation and its environmental impact.
	Inadequate infrastructure	35	Indicates that 35% of households face challenges due to insufficient waste management facilities like bins or collection systems.
	Lack of incentives	25	Financial or non-monetary incentives (e.g., discounts, community recognition) are absent for 25% of respondents, reducing their motivation to participate.
Motivators for Waste Management Preferred Support Measures	Environmental awareness	50	Half of the respondents cited environmental concern as their primary motivator for waste management practices.
	Economic incentives	30	Suggests that financial benefits, such as tax rebates or subsidies, are a strong driver for 30% of households.
	Social influence	20	Peer pressure and community involvement play a smaller but notable role in influencing waste segregation behaviors.
	Educational campaigns	45	Most households favor educational programs to raise awareness and build capacity for CE practices.
	Improved infrastructure	40	Highlights the demand for better waste collection systems, segregation bins, and recycling centers.
	Incentive schemes	15	Fewer households prioritize incentives, though they still hold importance as a motivator for some.

# **Explanation of the Table**

- **Awareness of Circular Economy:** •
- A majority of households (62%) are aware of CE concepts, but a substantial minority (38%) remain • uninformed. Awareness campaigns targeting these households could boost overall engagement.
- Waste Segregation Practices: •
- While 45% of households regularly segregate waste, another 30% only do so occasionally, pointing to • opportunities for improving consistency through education and infrastructure.



- Barriers to Participation:
- The top barriers identified are lack of awareness (40%) and inadequate infrastructure (35%), underscoring areas for intervention, such as public awareness drives and investments in waste management systems.
- Motivators for Waste Management:
- Environmental awareness (50%) is the leading motivator, but economic incentives (30%) also play a crucial role, suggesting the potential of introducing financial rewards to encourage participation.
- Preferred Support Measures:
- Households prioritize educational campaigns (45%) and improved infrastructure (40%), indicating a preference for long-term solutions over short-term incentives.

Awareness on Circular Economy: A pie chart showing the percentage of households aware and not aware of circular economy concepts.



Waste Segregation Practices: A bar chart illustrating the frequency of waste segregation practices (regular, occasional, and never)







**Barriers to Participation**: A bar chart highlighting the primary barriers to household participation in waste management.



Motivators for Waste Management: A bar chart depicting the key motivators influencing household behavior.

Figure 4: Motivators for Waste Management





**Preferred Support Measures**: A bar chart showcasing the support measures preferred by households to enhance participation in waste management.





# Hypothesis & Testing

**1.** Null Hypothesis (H<sub>0</sub>): There is no significant association between household awareness of CE and their waste segregation practices.

Alternative Hypothesis (H<sub>1</sub>): There is a significant association between household awareness of CE and their waste segregation practices.

Chi-square test was used to assess the association between awareness of Circular Economy (CE) and household waste segregation behavior.

# Chi-square statistic: 343.66

# Degrees of freedom (df): 2

**p-value:** 2.37 × 10<sup>-7</sup>

**Interpretation:** Rejected null hypothesis. There is a highly significant relationship between a household's awareness of CE and their waste segregation behavior. Those who are aware are far more likely to regularly segregate waste. This supports the idea that awareness campaigns could significantly boost proenvironmental action.

2. Null Hypothesis (H<sub>0</sub>): There is no significant difference in waste segregation participation levels among households with different types of motivators.

Alternative Hypothesis (H<sub>1</sub>): There is a significant difference in waste segregation participation levels among households with different types of motivators.

One way ANOVA was used to examine whether the type of motivator (environmental, economic, or social) has an effect on the level of participation in waste segregation.

**F-statistic:** 1643.92

p-value: 7.94 × 10<sup>-220</sup>

Interpretation: Rejected null hypothesis i.e, there is a very strong and statistically significant difference in waste segregation behavior across different motivator groups. Those motivated by



environmental concerns have the highest participation scores, followed by economic, and then social motivators. This implies tailoring strategies based on motivator type can yield varying levels of engagement.

# **Overall Results**

# **Household Perception**

The survey revealed that 62% of households are aware of circular economy (CE) concepts, indicating a moderate level of awareness among the population. However, 38% of respondents lack basic understanding, highlighting a significant gap in knowledge (Ellen MacArthur Foundation, 2015). While many households understand their role in waste segregation and recycling, a considerable portion of the population perceives these activities as the sole responsibility of municipal authorities, thereby limiting their active engagement (Wilson et al., 2012). This perception gap underscores the need for educational campaigns to emphasize the importance of household participation in CE-driven waste management systems (Borrello et al., 2017).

# **Behavioral Insights**

# **Motivating Factors for Participation:**

Environmental awareness emerged as the primary motivator for 50% of respondents, reflecting a growing recognition of the environmental benefits of proper waste management (Geissdoerfer et al., 2017). Economic incentives, such as subsidies or discounts, influenced 30% of households, demonstrating the potential of financial rewards to encourage participation (Afroz et al., 2011). Social factors, including community-driven initiatives and peer influence, accounted for 20%, indicating the role of societal norms in shaping waste management behaviors (Ajzen, 1991).

# **Barriers to Adoption:**

Key barriers identified include a lack of awareness (40%), inadequate infrastructure (35%), and the absence of incentives (25%) (Singh & Ordoñez, 2016). The lack of awareness correlates strongly with limited access to information about CE practices and benefits, particularly in rural and suburban areas (Yuan et al., 2006). Inadequate infrastructure, such as insufficient waste bins and collection systems, emerged as a critical impediment, highlighting the need for systemic improvements (Ghisellini et al., 2016).

# Statistical and Thematic Insights

The analysis provided statistical and thematic insights that strengthen the findings:

- Awareness of Circular Economy: The pie chart shows that 62% of respondents are aware of CE concepts, while 38% are not. This demonstrates the necessity of awareness programs to bridge the knowledge gap.
- Waste Segregation Practices: The bar chart illustrates that only 45% of households regularly segregate waste, while 30% do so occasionally, and 25% never segregate. This highlights the need for consistent behavior reinforcement through policy and education (Pires et al., 2011).
- **Barriers to Participation:** The bar chart shows the prevalence of barriers, with lack of awareness (40%) being the most significant, followed by inadequate infrastructure (35%) and lack of incentives (25%). These findings align with studies emphasizing the importance of addressing systemic challenges (Zhang et al., 2019).



- Motivators for Waste Management: A bar chart on motivators shows environmental awareness as the leading factor (50%), followed by economic incentives (30%) and social influence (20%). This indicates the potential of leveraging both intrinsic and extrinsic motivators to enhance participation (Bortoleto et al., 2012).
- **Preferred Support Measures:** The bar chart shows that households prioritize educational campaigns (45%), improved infrastructure (40%), and incentive schemes (15%). These findings support recommendations for multi-faceted interventions to promote sustainable behaviors (Kirchherr et al., 2018).

#### Discussion

# **Interpretation of Results**

The findings align with established behavioral theories, such as the Theory of Planned Behavior (TPB), which emphasizes the importance of attitudes, subjective norms, and perceived behavioral control in shaping individual actions (Ajzen, 1991). The results demonstrate that households with greater environmental awareness and perceived social support are more likely to participate in waste segregation and recycling. This reinforces the idea that positive attitudes and community influence significantly impact pro-environmental behaviors (Zhang et al., 2019).

The identification of barriers such as inadequate infrastructure and lack of incentives highlights the systemic challenges that households face in adopting CE-driven waste management practices. These challenges mirror observations in previous studies, which underscore the critical role of accessible infrastructure and financial motivators in encouraging sustainable waste practices (Pires et al., 2011). Perceptions of waste management as a governmental responsibility, rather than a shared societal effort, further inhibit active household engagement, a trend also noted in developing countries (Singh & Ordoñez, 2016).

# **Comparative Analysis**

The results resonate with studies conducted in regions such as Europe, where CE policies have been more comprehensively implemented. For instance, research in the EU highlights how strong policy frameworks, combined with community-driven initiatives, significantly enhance household participation in waste management (Ghisellini et al., 2016). In contrast, similar studies in Asia reveal lower participation rates, often attributed to inadequate infrastructure and cultural attitudes toward waste (Yuan et al., 2006). This comparative perspective underscores the importance of contextual factors in shaping the effectiveness of CE practices.

The influence of economic incentives in motivating waste segregation is consistent with findings from other regions, such as Bangladesh, where financial rewards have been shown to significantly improve household recycling behaviors (Afroz et al., 2011). Similarly, the prioritization of educational campaigns in the current study aligns with global evidence highlighting the role of awareness in bridging knowledge gaps and fostering sustainable practices (Kirchherr et al., 2018).

#### Implications

- **Policy Implications:** The findings suggest the need for robust policy interventions to address barriers to household participation in CE-driven waste management. Policies should focus on:
- Infrastructure Development: Enhancing access to waste segregation bins, recycling facilities, and



efficient waste collection systems.

- **Incentive Mechanisms:** Introducing financial rewards, such as tax rebates or discounts, to encourage household compliance with waste management practices (Geissdoerfer et al., 2017).
- **Community Engagement:** Promoting community-led initiatives to foster a sense of collective responsibility among households (Borrello et al., 2017).

# **Recommendations for Awareness Campaigns and Infrastructure Development:**

Educational programs should target specific demographic groups, such as rural and suburban households, where awareness levels are lower. Campaigns can leverage digital platforms, schools, and community workshops to disseminate information on CE principles and practices (Wilson et al., 2012). Infrastructure development should prioritize underserved areas to ensure equitable access to waste management facilities, reducing disparities in participation rates (Singh & Ordoñez, 2016).

# **Challenges and Limitations**

# **Challenges Encountered**

One of the primary challenges faced during data collection was ensuring a representative sample of households across diverse socio-economic and geographic settings. Urban households were more accessible due to better connectivity and infrastructure, whereas rural and remote areas posed logistical difficulties. Similar challenges have been documented in studies focusing on waste management behaviors in developing countries, where data collection is often hindered by geographic disparities (Singh & Ordoñez, 2016).

Another challenge was obtaining honest and accurate responses during surveys and interviews. Social desirability bias, where participants provide answers they believe are expected or socially acceptable, may have influenced the data quality, as noted in other behavioral studies (Ajzen, 1991). Additionally, language barriers and varying levels of literacy among respondents required adapting survey instruments and conducting additional sessions to clarify questions, increasing the complexity of the data collection process (Wilson et al., 2012).

# Limitations of the Study

**Sample Size and Representation:** While the study aimed to include a broad demographic, the sample size of 500 households may not fully capture the diversity of behaviors and perceptions across the population. A larger sample size could have provided more robust and generalizable findings, as recommended in similar research contexts (Pires et al., 2011).

**Geographic Scope:** The geographic scope of the study was limited to specific urban, suburban, and rural areas, which may not reflect national or global trends. Studies with broader geographic coverage often provide deeper insights into regional and cultural variations in waste management practices (Yuan et al., 2006).

**Methodological Constraints:** The reliance on self-reported data introduces the possibility of inaccuracies due to recall bias or misinterpretation of questions. Furthermore, the mixed-method approach, while comprehensive, required significant resources for data collection and analysis, potentially limiting the depth of focus on certain aspects of household behavior (Kirchherr et al., 2018).



**Temporal Limitation:** The study captured data at a single point in time, limiting its ability to assess changes in household behavior over time. Longitudinal studies are better suited to explore how awareness campaigns or policy interventions influence behaviors in the long run (Borrello et al., 2017).

# Conclusion

# **Summary of Key Findings**

This study highlights the critical role households play in achieving the goals of circular economy (CE)driven waste management systems. Key findings reveal that 62% of households are aware of CE concepts, but a significant 38% remain uninformed, demonstrating the need for targeted awareness programs. While 45% of households regularly segregate waste, 30% do so occasionally, and 25% never segregate, indicating room for improvement in participation rates. Environmental awareness emerged as the primary motivator for engagement, while barriers such as inadequate infrastructure and lack of incentives were significant obstacles. The findings underscore the importance of education, policy interventions, and improved waste management infrastructure in enhancing household participation.

# **Reiteration of Importance**

Households serve as the foundational units of CE waste management systems. Their active participation in waste segregation, recycling, and composting directly contributes to resource recovery, reduced landfill dependency, and environmental sustainability. Empowering households through awareness, access to infrastructure, and incentives is essential for creating a more sustainable and efficient waste management system.

# **Suggestions for Future Research Directions**

- Longitudinal Studies: Future research should focus on tracking household behaviors over time to assess the long-term impact of awareness campaigns, incentives, and infrastructure improvements.
- **Regional Comparisons:** Expanding the geographic scope to include more diverse regions will provide insights into cultural and regional variations in household behaviors.
- **Technological Interventions:** Exploring the role of digital tools, such as apps for waste tracking and reporting, could offer innovative solutions for enhancing household engagement.
- **Integration of Behavioral Insights:** Research should delve deeper into psychological and cultural factors influencing waste management behaviors to design more effective interventions.
- **Policy Evaluation:** Studies assessing the effectiveness of policy measures, such as incentive schemes and waste collection systems, would provide valuable feedback for policymakers.

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