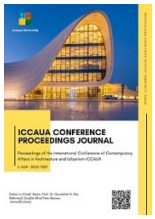

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Redefining the Concept of Waste: Implementation of Circular Economy for Bangkok Peri-Urban Low-Income Community

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A b s t r a c t

Globally, over 2.1 billion tons of waste are generated annually, with much of it improperly managed, leading to severe environmental and health risks. Thailand produces approximately 27 million tons of waste each year, with significant challenges in peri-urban low-income communities like Pathum Thani, where rapid expansion has outpaced waste management infrastructure. This study aims to redefine the concept of waste through circular economy (CE) principles and systems thinking to enhance waste management and generate economic opportunities. Using a qualitative approach, it employs semi-structured interviews, focus groups, and co-design workshops to engage stakeholders in developing community-driven solutions. Findings highlight the necessity of integrating informal waste collectors into formal systems, improving infrastructure, and creating long-term incentives for participation. The study concludes that redefining waste as a resource can foster sustainable practices and economic resilience. Its contributions offer scalable strategies for other fast-growing cities facing similar waste management challenges.

K e y w o r d s : Low-Income Communities, Circular Economy (CE), System Thinking, Waste Management Practices, Co-Design Method.

1. Introduction

1.1 Problem Statement & Background

Currently, Bangkok, the megacity capital of Thailand, produces approximately 12,282 tons of waste daily, amounting to about 368,460 tons per month, while Thailand's overall municipal solid waste generation is 1.00-1.49 kilograms per capita per day (World Bank, 2018). Poor waste management, particularly in low-income communities, highlights the urgent need for sustainable solutions.

In Bangkok's peri-urban areas, such as Pathum Thani, the challenges related to waste management are even more pronounced. Pathum Thani, a rapidly urbanizing province on the outskirts of Bangkok, generated approximately 219,365 tons of waste in 2022, with only 20% being recycled and the rest either burned or landfilled (Pollution Control Department, 2022). This situation is especially problematic in low-income communities, where inadequate infrastructure, limited access to waste management services, and a lack of public awareness exacerbate environmental and public health risks. Pathum Thani Model, a Community Organization Development Institute (CODI) relocated informal settlement community located opposite Thammasat University - Rangsit Campus, serves as an example of how secure housing initiatives and community-driven planning can foster improved living conditions, potentially serving as a foundation for better waste management strategies (CODI, 2022).

Figure 1. Previously living along the Khlong in Pathum Thani, Community moved to Medium-rise housing (Source: Adrian Lo).

The research focuses on how waste is currently managed in Bangkok's peri-urban low-income areas, particularly Pathum Thani. It identifies the main challenges these communities face and draws lessons from successful CE models internationally for their potential adaptation to Bangkok's context. The research engages residents to develop practical and culturally appropriate solutions through qualitative methods, including semi-structured interviews, focus groups, and community-driven co-design workshops.

1.2 Research Question

This research seeks to ask: How can systems thinking applied to circular economic principles be used to redefine the concept of waste, improve waste management, and generate economic opportunities for low-income communities in Peri-Urban Bangkok?

Findings show that circular economy-based solutions, such as waste banks, composting, and zero-waste programs, can help communities manage waste more effectively while also generating income. Waste banks, which have been successful in Indonesia and the Philippines, encourage recycling by offering financial rewards. Composting reduces landfill waste and can support urban farming, while public awareness campaigns help change behaviors and promote sustainable practices.

1.3 Research Aims & Objectives

This research seeks to demonstrate that transitioning from the traditional linear model to CE-based systems offers a sustainable framework to redefine waste as a resource. Using systems thinking, the research maps inefficiencies in current waste management systems identifies opportunities for circular practices and develops solutions for bridging gaps between informal and formal waste systems. This involves addressing infrastructural shortcomings and fostering long-term community participation, creating a more efficient and inclusive framework for waste management.

How can system thinking applied to CE principles be used to redefine the concept of waste, improve waste management, and generate economic opportunities for low-income communities in Peri-Urban Bangkok?

The research aims to explore workshop methodologies to co-design practical solutions for improving waste management and creating economic opportunities in Bangkok's peri-urban, low-income communities, focusing on the Pathum Thani Model through the application of CE principles. The objectives of this research are threefold, 1) to analyze current waste management practices in low-income communities, 2) to explore the potential for CE principles to enhance waste management and create economic benefits, and 3) through co-design, to develop strategies with the community to shift their perception of waste into a valuable resource

1.4 Methodological Approach

Instead of proposing a universal approach to Circular Economy (CE), this research aims to develop a workshop process that integrates systems thinking and a toolkit to collaboratively explore waste management solutions with low-income communities. This participatory approach ensures that solutions are context-specific and co-created with community members. The workshop and toolkit can then be adapted and scaled to support other communities in the region in designing their own CE strategies tailored to their unique needs and conditions.

This qualitative study explores waste management and economic opportunities in Bangkok's peri-urban, low-income communities, focusing on the Pathum Thani Model. It employs case studies, semi-structured interviews (20-30 stakeholders), focus groups (5-6 participants), and co-design workshops to examine community dynamics and stakeholder engagement. Comparative case studies from Curitiba, Kamikatsu, and Pune inform adaptable circular economy (CE) strategies

The thematic analysis identifies patterns within the data. The study focuses on Pathum Thani's relocated communities under CODI, excluding high-income urban and rural areas for relevance. It highlights collaborative governance, stakeholder participation, and community-led solutions as key to CE success in peri-urban settings. More focus on co-design and the workshop

1.5 Research Significance

The study demonstrates that CE practices can significantly reduce waste, lower disposal costs, and generate income, benefiting local communities while supporting sustainable urban development. These findings align with key UN Sustainable Development Goals and highlight the proposed framework's scalability to other peri-urban areas, illustrating the transformative potential of rethinking waste as a valuable resource.

2. Literature Review

2.1 Waste and the Linear Economy

The United Nations Environment Program (UNEP) defines waste as any substance or object that is discarded, intended to be discarded, or required to be discarded under existing regulations. This highlights both the physical aspect of waste and the legal frameworks designed to ensure its safe management (UNEP, 2016). However, the idea of waste is more complex and ever-changing, shaped by cultural, regional, and socio-economic factors. On a global scale, waste is often thought of as materials or by-products that have lost their value or usefulness in their current form, leading to their disposal. However, waste is not just about what we see, it's also about how we value and use things within different social and economic contexts (UNEP, 2016).

Locally, in Thailand, the Pollution Control Department (PCD) builds on this global perspective by defining waste as any solid, liquid, or gaseous material that is discarded or managed for disposal. This definition is important in addressing specific waste challenges in Thailand, including municipal, hazardous, and industrial waste streams while guiding targeted management strategies (PCD, 2018).

Bangkok, like many urban regions globally, is confronted with the serious problem of waste management. The acceleration of urbanization has led to an increase in municipal solid waste (MSW) generation, placing strain on the existing waste management infrastructure. These issues are especially pronounced in low-income areas that lack adequate resources (Hoornweg&Bhada-Tata, 2012). Traditional waste management in these areas follows a linear economic model, resulting in large quantities of waste being dumped in landfills or open dumps. This practice has negative implications for ecosystems and public health, including landfills filling up rapidly and environmental contamination (Ghisellini, Cialani, &Ulgiati, 2016).

Waste management is projected to worsen in low-income countries. The World Bank (2016) estimates that by 2050, the total amount of waste generated in low-income countries will have more than tripled. Bangkok's high population density and urban growth further complicate waste management, particularly in peri-urban districts like Pathum Thani, where appropriate waste management facilities are scarce (Stockholm Environment Institute, 2024).

2.2 Circular Economy

The traditional linear economy, characterized by a 'take-make-dispose' model, has led to severe resource depletion, environmental degradation, and economic inefficiencies (UNEP, 2016). In response, the circular economy (CE) offers an alternative paradigm that emphasizes resource efficiency, waste minimization, and closed-loop systems, designing out the waste in production systems, and transforming waste into a valuable resource (Ellen MacArthur Foundation, 2017).

To give some examples, IKEA is implementing circular economy principles through take-back programs, resale services, and modular designs for easy repair and recycling. Petit Pli reduces textile waste with expandable children's clothing, while Adidas transforms ocean plastic into sneakers. These businesses show how rethinking resources leads to practical, sustainable solutions.

Bangkok's waste management systems can benefit significantly from CE, which supports sustainable development. Incorporating CE into urban planning and community engagement practices can facilitate this transformation (ICLEI, 2024).

A systems thinking approach is needed to achieve a CE in order to understand the problems and potential solutions in urban settings. Waste must be seen not just as a byproduct of consumption but as a resource with economic value (Amasuomo& Baird, 2016). By turning waste into economic opportunities, CE practices can improve waste management in low-income communities. Programs like recycling and waste-to-resource can provide income for residents, reduce landfill burden, and minimize environmental impacts (Geissdoerfer et al., 2017). Additionally, the World Health Organization (2024) underscores the importance of solid waste management for public health, particularly in low-income areas where waste-related health concerns are prevalent.

2.3 Systems Thinking

Systems thinking, as defined by Meadows (2008), is "a way of thinking about the world as a set of interconnected components that influence one another, rather than isolated parts."

A systems thinking approach emphasizes the identification of leverage points key areas within a system of interdependent elements, such that small, strategic interventions can result in significant improvements (Meadows, 1999; Ellen MacArthur Foundation, 2017). By examining waste systems as systems of interconnected networks that encompass social, economic, and environmental dimensions, systems thinking facilitates a holistic understanding of the problem to be solved.

In waste management, systems thinking enables stakeholders to analyze material flows, resource dependencies, and the broader impacts of waste on communities and ecosystems. For instance, understanding the interconnections between waste generation, informal recycling practices, and socio-economic disparities can help policymakers design interventions that are both equitable and effective. Moreover, it allows for the evaluation of trade-offs and synergies, such as balancing economic growth with environmental sustainability (UNEP, 2016; Ellen MacArthur Foundation, 2017). Systems thinking offers a comprehensive framework for addressing the multifaceted challenges of waste management, particularly in the context of achieving a circular economy (CE).

2.4 Challenges in Low-Income Communities

Adopting CE in low-income areas comes with challenges, including the absence of recycling facilities, inadequate access to garbage collection infrastructure, and limited knowledge of the benefits of recycling (Wilson et al., 2013). Informal waste collectors are integral to waste management in these regions. Scheinberg, Wilson, and Rodic (2010) emphasize the critical role of informal workers in recycling, yet they are often overlooked in formal waste management systems. The lack of integration between formal and informal systems leads to inefficiencies and missed resource recovery opportunities. Additionally, individuals in these communities may not perceive waste management as a priority or be motivated to participate in recycling initiatives (Bickerstaff & Walker, 2003).

Prioritizing the most disadvantaged, like urban low-income communities can generate better urban environmental outcomes and performance particularly in key sectors like waste management and sanitation (UN-Habitat, 2020).Wongpanich and Srisontisuk (2016) highlight the importance of community involvement in sustainable waste management in Thai rural areas. Increasing awareness and engaging residents in decision-making fosters a sense of ownership in waste management. Implementing community-driven initiatives like trash banks, co-design, and zero-waste projects can enable sustainable management and create economic benefits (Stockholm Environment Institute, 2024).

2.5 Research Gap

Existing research has already explored the concept of CE and its benefits for waste management, but limited attention has been given to implementing these principles specifically in Bangkok's low-income peri-urban communities. Most studies have focused on general waste management challenges or high-income urban areas without addressing the socio-economic and infrastructural constraints faced by low-income communities. Research on community-driven CE approaches in Bangkok's peri-urban communities is also lacking, particularly regarding how financial incentives, public awareness, and community involvement intersect in waste management programs. This study aims to fill these gaps by providing community-driven sustainable solutions suited to the specific needs of low-income peri-urban areas in Southeast Asia.

2.6 Conceptual/Theoretical Framework

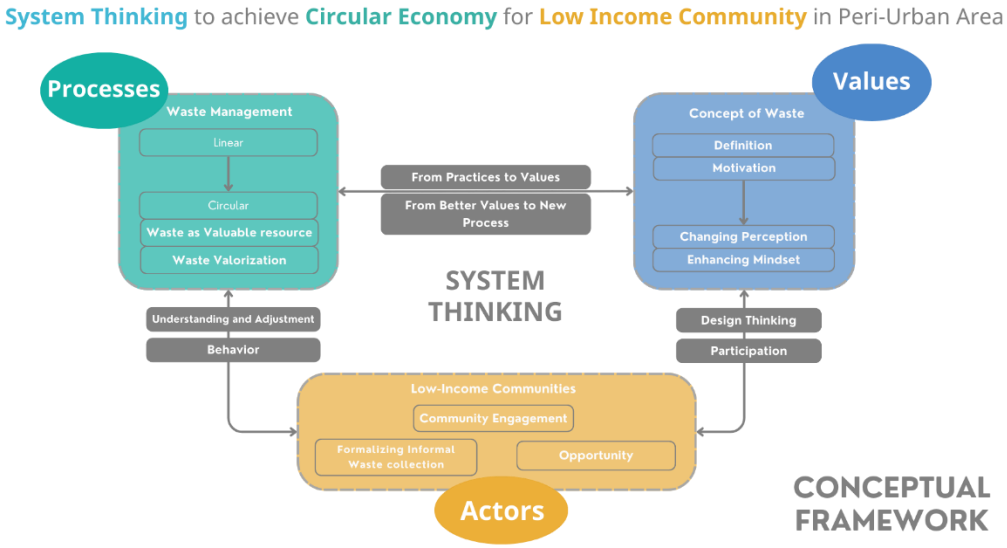

Figure 2. Adaptive Systems Thinking & CE Practices for Low Income Community (T. Gerdpratoom, Authur (2025).).

This research promotes the transition from linear to circular waste management systems in Bangkok's peri-urban low-income communities through the lens of systems thinking (Iacovidou, Hahladakis, & Purnell, 2017). Systems thinking allows for a holistic analysis of complex waste systems by understanding the interconnections between actors, processes, and values. The conceptual framework places low-income communities at the center, recognizing their role as key actors whose behaviors and perceptions influence waste practices and outcomes.

The framework initiates with understanding current waste management behaviors, levels of 3Rs (Reduce, Reuse, Recycle) awareness, and community interest or barriers in engaging with circular economy (CE) activities. Through semi-structured interviews and participatory engagement, data is collected to define the system and identify causal relationships. These insights guide the mapping of opportunities for circularity shifting the focus from waste disposal to waste valorization and redefinition of waste as a valuable resource.

The framework emphasizes a values-driven transformation, where changing perceptions and enhancing mindsets are essential to shifting from linear practices to sustainable circular processes. This is achieved through design thinking, co-design workshops, and community engagement, which foster participation and behavioural adjustments. Efforts such as formalizing informal waste collection, promoting waste banks, and exploring income-generating recycling initiatives are positioned as pathways to empower communities both economically and socially.

Ultimately, the expected outcome of this systems-based, community-cantered approach is to achieve systems change enabling a transition to a circular economy that enhances environmental sustainability, supports economic development, and strengthens community well-being in peri-urban low-income settings.

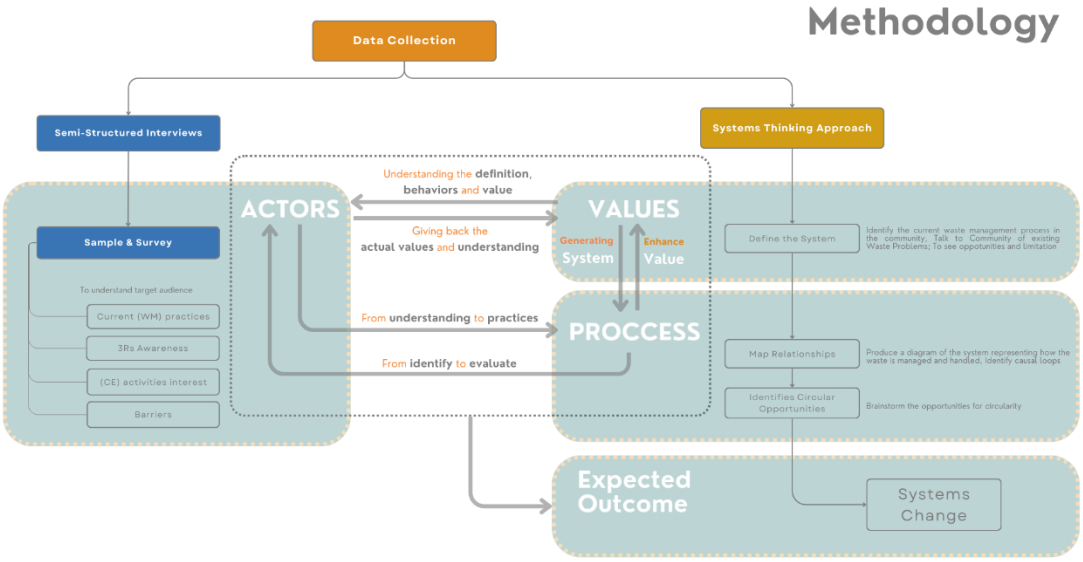

Figure 3. Conceptual Framework (T.Gerdpratoom, Author).

3. Material and Methods

Low-Income Community Case Study: Pathum Thani Model

This research focuses on Pathum Thani, a peri-urban, low-income community in Bangkok facing significant waste management challenges. It investigates how systems thinking can support the application of circular economy (CE) principles to redefine waste, improve waste practices, and create economic opportunities. The study aims to analyze existing waste management, explore CE-driven benefits, and develop strategies to shift community perceptions of waste as a valuable resource. By involving the community throughout the process, the research ensures practical, sustainable solutions that can inform broader urban development efforts.

3.1 Research Approach

This research aims to explore how Circular Economy (CE) principles can improve waste management and create economic opportunities for low-income peri-urban communities in Bangkok, focusing on the Pathum Thani Model. A qualitative research approach was chosen because it is well-suited for understanding complex social and environmental systems and exploring community dynamics. The methodology is divided into Three main components used in this research including case studies, interviews, focus groups, and co-design workshops, all of which aim to involve the community and stakeholders in identifying challenges and developing practical solutions.

3.2 Data Collection Methods& Analysis

To gather insights, the study includes semi-structured interviews community stakeholders to explore current waste management practices, focus groups to discuss challenges and solutions, and co-design workshops to ensure community voices shape decision-making.

3.2.1 Semi-structured interviews

To determine the appropriate sample size for semi-structured interviews, a formula for calculating sample size in qualitative research is applied. Given that the total population of the community consists of 182 households, the sample size is estimated using Yamane formula a method to determine sample size for research

$$n = \frac{N}{1 + N(e)^2}$$

Where:
N = Total population (182 households)
e = Margin of error (typically 0.167 for qualitative research)

$$n = \frac{182}{1 + 182(0.167)^2}$$

This calculation results in an estimated sample size of approximately 30 households, ensuring representation while remaining feasible for in-depth qualitative analysis. The range of 20-30 households is chosen to account for data saturation, where additional interviews may no longer yield significantly new insights (Creswell, 2014).

Participants will include community members to provide a holistic view of waste management challenges and opportunities within the peri-urban low-income community. This sample ensures diverse perspectives while maintaining depth in the collected data.

3.2.2 Focus Groups

Focus groups with 5-6 participants per session are derived from the semi-structured interview sample of 20-30 stakeholders, ensuring a balance between inclusivity and in-depth discussion. Using the formula:

$$n = \frac{N}{1 + N(e)^2}$$

where N=20N = 20N=20 to 303030, we determine the appropriate number of focus groups by:

$$Number\ of\ focus\ group = \frac{\text{Total interview sample size}}{\text{Participants per focus group}}$$

The calculation shows that with 6 participants per group, at least 3-4 focus groups are needed, while 5 participants per group require up to 6 focus groups. This ensures that collective discussions facilitate idea exchange, validate shared experiences, and co-develop solutions (Krueger & Casey, 2015). The small group size encourages participation while preventing dominance by a few voices. Additionally, research suggests that 3-6 focus groups are sufficient for data saturation, where no significant new insights emerge. This structured approach ensures that discussions effectively shape community-driven circular economic strategies, capturing diverse perspectives while maintaining depth and feasibility.

3.2.3 Data Analysis

Thematic analysis will help identify patterns in the data, offering a clear understanding of participant experiences and ideas. Ultimately, this research aims to create practical, community-driven waste management strategies that align with CE principles and support sustainable development in peri-urban areas.

This method involves identifying and analyzing patterns within the data, providing a systematic approach to understanding participants' experiences and suggestions for waste management, sorted and prioritized according to themes.

3.3 Case Studies of CE Approaches

A comparative analysis of successful CE initiatives from cities like Curitiba, Kami katsu, and Pune will serve as benchmarks for implementing similar strategies in Bangkok's peri-urban communities. International case studies from successful CE initiatives in Curitiba, Kami katsu, and Pune offer a comparative analysis of CE implementation and highlight key elements adaptable to the Pathum Thani Model or other low-income communities (Yin, 2018).

3.4 Co-Design Workshops

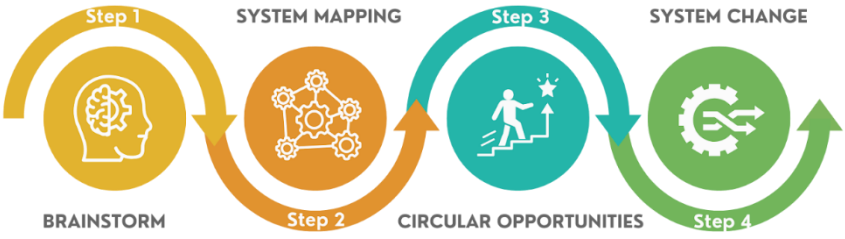

Figure 4. Community Workshop: Toolkit Design, (Gerdpratoom, Author).

The community workshop, a fundamental aspect of the co-design methodology, is expected to provide a collaborative framework for establishing a circular economy (CE) model for waste management in Bangkok's peri-urban communities. The Toolkit Design will be structured as an iterative process, guiding stakeholders through four essential stages to identify existing issues and develop practical, community-driven solutions.

The expected outcome is a participatory framework where community members actively contribute to waste management solutions, reinforcing a sense of ownership and long-term sustainability. It is anticipated that the co-design approach will enhance the likelihood of success and community acceptance, aligning with research suggesting that participatory design fosters greater commitment to proposed interventions (Sanders & Stappers, 2008). By embedding local perspectives into the toolkit, the expectation is that solutions will be culturally and contextually appropriate, enhancing the feasibility and practicality of waste management strategies

3.5 Research Scope and Limitation

Figure 5. Aerial Map Photograph of Pathum Thani Model, adapted from Google Maps, 2025 (Gerdpratoom, Author).

This research focuses on Pathum Thani's peri-urban, low-income communities, particularly the Pathum Thani Model, as it exemplifies the challenges and opportunities associated with waste management in rapidly urbanizing areas. Pathum Thani was selected due to its proximity to Bangkok, its transitional nature as a peri-urban area, and the pressing waste management issues observed, such as inadequate infrastructure and reliance on informal systems. The relocation of informal settlements to secure housing under the CODI initiative provides a unique platform to explore community-driven waste management strategies within a structured yet economically constrained setting.

Low-income communities are a critical focus because they are disproportionately affected by poor waste management practices and are often overlooked in policymaking, despite their potential to contribute significantly to circular economy practices.

Other areas were excluded to maintain a manageable research scope and ensure in-depth analysis of a specific context. High-income urban areas or rural settings were not prioritized because their waste management challenges differ significantly from those in peri-urban low-income areas, making them less relevant to the study's objectives. Furthermore, focusing on a single case allowed for a detailed exploration of community dynamics, stakeholder perspectives, and tailored solutions, which may not have been possible with a broader, more diverse sample.

Rather than coming up with a one size fits all approach to CE, the aim of the research is to develop a workshop process (employing systems thinking with a toolkit) and explore solutions to waste management problems in an involved and participatory manner with low-income communities. The workshop and toolkit can then be scaled up to assist other communities in the region to codesign or come up with their own site-specific CE solutions.

4. Results & Discussions

4.1 Community Workshop: Toolkit Design

The community workshop proposed in this research is a key element of the co-design methodology, aimed to collaboratively create a CE framework for waste management in Bangkok's peri-urban community. The workshop employs a Toolkit Design which includes four iterative processes to help stakeholders identify issues and develop feasible solutions. This workshop with toolkit emphasizes co-design, ensuring that community members participate in every stage of the process, by promoting ownership, which increases the chances of success and community acceptance (Sanders &Stappers, 2008). The four steps are 1) brainstorming, 2) system mapping, 3) identifying circular opportunities, and 4) system change.

4.2 Waste Management Brainstorming

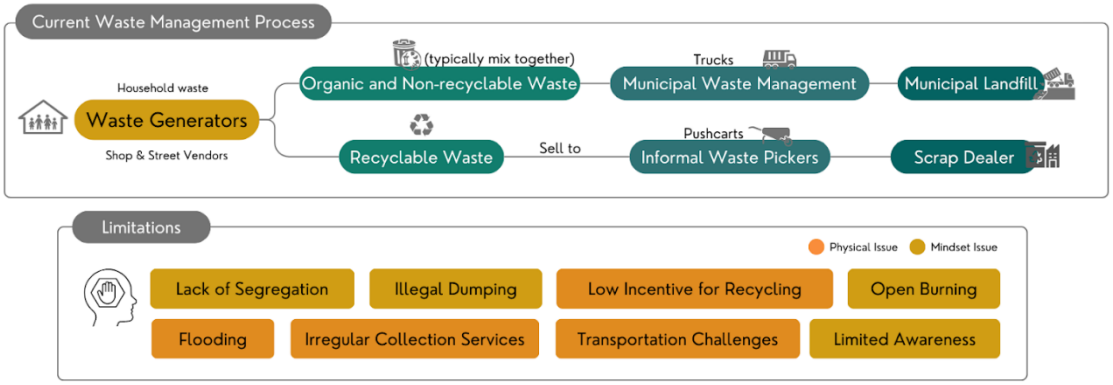

Figure 6. Identification of the current waste management process in the community by talking to Community, (Gerdpratoom, Author).

This first stage seeks to understand the existing waste management processes in the community, highlighting both opportunities and limitations. The expectation is that the engagement with community members through interviews and surveys will reveal key insights into waste practices, common challenges, and areas for improvement.

The anticipated findings suggest that waste generation stems from household activities and street vendors, contributing to both organic and recyclable waste streams. It is expected that organic waste and non-recyclable materials will often be mixed, leading to inefficient waste segregation and an increased burden on landfill sites. Challenges such as irregular waste collection, low incentives for recycling, limited awareness, and issues related to illegal dumping are expected to emerge. The expectation is that the community members will identify these constraints as primary factors contributing to waste mismanagement, underscoring the need for structured interventions. Given previous studies on waste management in similar settings, it is anticipated that informal waste pickers will play a significant role in reclaiming recyclables, yet their work may be unstructured and lack formal recognition within the broader waste management framework.

4.3 System Mapping

In the second stage, the system mapping exercise helped to understand the current waste management system as brainstormed by the community. System mapping is expected to yield a comprehensive diagram of the waste management system, detailing how waste is managed and identifying existing causal loops and inefficiencies. This exercise is anticipated to clarify the relationships between waste management practices, infrastructure, and community behavior.

Based on previous studies, it is expected that major deficiencies will include inadequate infrastructure, irregular waste collection services, and a lack of awareness about waste processing. These deficiencies are anticipated to contribute to persistent issues such as open dumping, environmental degradation, and limited engagement in recycling practices (Hoornweg&Bhada-Tata, 2012).

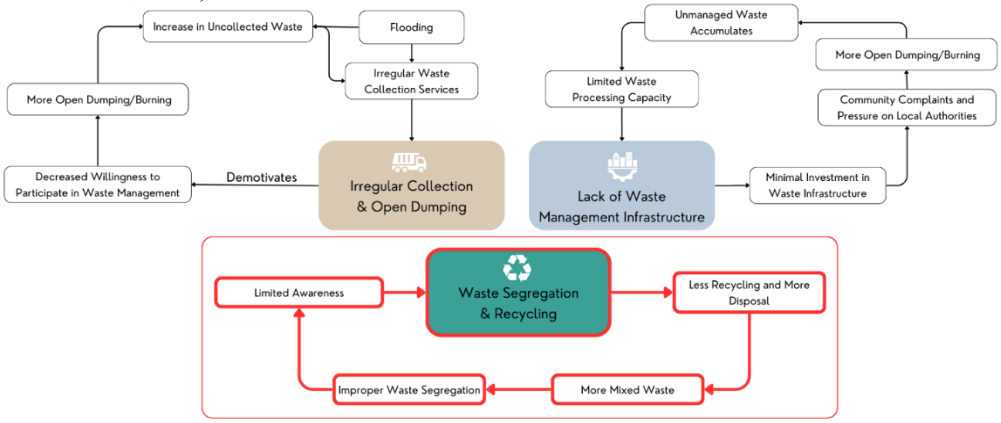

Figure 7. Producing a diagram of the waste management system map representing how the waste.

The mapping process is also expected to reveal how inefficient waste collection exacerbates negative environmental and social impacts. Irregular waste services will likely lead to accumulated waste in public spaces, contributing to sanitation issues and diminishing community engagement. Additionally, a lack of education on waste segregation is anticipated to be a key factor in low recycling rates, further perpetuating inefficiencies within the system (Wilson et al., 2015).

4.3 Circular Opportunities

The third stage, following the identification of key waste management challenges, the expectation is that circular opportunities will emerge as viable solutions. The anticipated outcome is that the brainstorming process will reveal community-driven solutions that align with CE principles, particularly those addressing the primary issue of limited awareness and improper segregation.

Composting initiatives that address organic waste management by reducing landfill dependence and creating compost for urban agriculture.

Waste banks encourage recycling through incentive-driven community participation, potentially leading to economic benefits for participants.

Upcycling projects by transforming waste materials into new products, promoting both environmental sustainability and economic empowerment.

Education and awareness programs foster behavioral change through community-led initiatives aimed at improving waste segregation and promoting circular practices.

Drawing from previous case studies, it is expected that these interventions will enhance waste recovery and reduce environmental impact while promoting economic resilience within the community (Wilson et al., 2015). Furthermore, the implementation of these circular opportunities is anticipated to foster a culture of sustainability, where waste is viewed as a resource rather than a burden.

4.5 System Change

The fourth and final stage involved systems change to transition from isolated interventions to a holistic waste management model for a given community. Key components included improving infrastructure, investing in processing facilities, and promoting community engagement to foster long-term sustainability. Collaboration between authorities, experts, and residents was emphasized for effective systems change. Educating community members on waste segregation was a critical element for fostering a culture of sustainability. The role of policy and governance is also expected to emerge as a critical factor in sustaining these systemic changes.

4.5.1 Case Studies

A comparative analysis of CE initiatives from Pune (SWaCH), Kami Katsu (Zero Waste), Curitiba's waste management model, and Thailand's Trash Lucky and Farm to Table programs is expected to provide valuable insights into practical implementation strategies.

It is anticipated that these case studies will illustrate community-driven waste management models. For instance, SWaCH Pune's integration of informal waste pickers into a formalized system is expected to demonstrate a scalable approach for Pathum Thani (Chikarmane, 2012). Zero-waste practices such as Kamikatsu's sorting center model in Japan are anticipated to highlight the importance of rigorous waste separation and strong community compliance (Aizawa et al., 2020). Additionally, Trash Lucky's reward-based recycling system in Thailand is expected to showcase how financial incentives can effectively encourage community participation and behavior change (Trash Lucky, 2023). These findings will likely confirm that integrating informal waste workers, incentivizing recycling, and embedding community engagement are essential elements for successful circular economic implementation (Wilson et al., 2015).

4.5.2 Expected Circular Economy Approach and Selected Solution

Based on the comparative analysis, the expected outcome is that selected CE solutions will focus on waste banks, resource recovery, and structured recycling systems.

Waste banks as a tool to encourage community involvement and create financial benefits through systematic recycling. Incentive-based recycling models promoting higher participation and waste sorting compliance. Educational programs to shift perceptions and embed waste management practices into everyday behaviors.

4.5.3 Challenges and Limitation

Figure 8. Community Interview and Understanding the current pattern of the sample household (Gerdpratoom, Author).

Despite these expected outcomes, certain limitations are anticipated. Data representation biases the perspectives of children and the elderly may be underrepresented, limiting the study's comprehensiveness regarding household waste practices. Uneven participation working adults may be overrepresented, leading to findings that do not fully capture the views of all community members. Scalability concerns the Pathum Thani Model, shaped by CODI's relocation initiatives, may have unique institutional support that is not replicable in other low-income peri-urban areas.
These expected challenges highlight the need for future research that delves deeper into household consumption patterns and expands data collection across diverse demographics to ensure inclusive waste management strategies.
The findings highlight the importance of community engagement, improved infrastructure, and stakeholder collaboration to foster sustainable waste practices. This research aligns with SDGs 8, 11, 12, and 13, promoting economic growth, sustainable cities, responsible consumption, and climate action. This research proposal also addresses critical gaps in waste management for peri-urban low-income communities, offering scalable, practical solutions tailored to local contexts. By integrating informal waste workers and leveraging community participation, the research provides a replicable framework for other urbanizing areas. The emphasis on participatory, culturally relevant strategies advances the discourse on sustainable urban development, supporting resilient and inclusive cities global

5. Conclusions

This study demonstrates how adopting circular economy (CE) principles can transform waste management in Bangkok's peri-urban low-income communities, focusing on the Pathum Thani Model. By shifting from a linear to a circular approach, waste is redefined as a valuable resource, creating economic opportunities, reducing environmental impacts, and enhancing community well-being. Through co-design workshops, community-driven initiatives like waste banks and composting, and insights from global case studies, practical strategies were developed to address waste management challenges.
The findings highlight the importance of community engagement, improved infrastructure, and stakeholder collaboration are needed to foster sustainable waste practices. This research aligns with SDGs 8, 11, 12, and 13, promoting economic growth, sustainable cities, responsible consumption, and climate action. This research helps to address critical gaps in waste management for peri-urban low-income communities, offering scalable, practical approaches towards solution-finding tailored to local contexts. By integrating informal waste workers and leveraging community participation, the research provides a replicable framework for other urbanizing areas. The emphasis on participatory, culturally relevant strategies advances the discourse on sustainable urban development, supporting resilient and inclusive cities globally.

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Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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