

Community of Practices (CoP) as a tool for successful waste management

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Abstract

Conventional approaches to waste management often struggle to address the complexity and interdependence of social, institutional, and environmental dimensions. The increasing complexity of urban waste systems and the transition towards circular economy models underscore the need for collaborative, knowledge-driven approaches. Communities of Practice (CoP) are widely recognised in literature as promising instruments for facilitating innovation and collective action in multiple actions and subject domains. This paper explores the potential of CoPs as a tool for sustainable waste management. It presents a literature review, conducted using the SCOPUS database, which resulted after screening in a final *corpus* of 9 articles that was used for in-depth analysis. A systematic analytical framework was applied to each article of the final *corpus* to map geographical location, the specific waste stream addressed (e.g., municipal, industrial, hazardous), the typology of actors involved (e.g., technicians, policymakers, residents, NGOs), outcomes and challenges. Eight CoP related to waste were identified, covering a broad geographical spectrum that included Asia, Africa, Europe, Latin America, and Oceania. These CoPs operated through diverse dynamics, ranging from grassroots community initiatives and hybrid digital–in-person interactions to formalised international expert networks. Learning processes combined peer exchange, experiential learning, and knowledge co-production across institutional and citizen groups. Thematic focuses varied from household and organic waste to hazardous, radioactive, and recycling systems. A temporal analysis reveals that applications of CoPs in waste management have expanded since 2019, mirroring the global rise of participatory and circular economy approaches. These reviewed cases illustrate the ability of CoPs to act as strategic knowledge infrastructures, aligning stakeholders, co-producing actionable solutions, and contributing to measurable gains such as higher recycling rates, reduced contamination, and improved regulatory coherence. The findings position CoPs as a promising instrument for participatory governance and collective problem-solving in the pursuit of sustainable waste management.

Keywords: Knowledge Sharing, Peer Learning, Collaborative Policy-Making, Waste Systems, Governance

1. Introduction

The world today faces an increasingly complex web of social, economic, and environmental challenges. Among them, climate change stands out not only for its direct impacts but also for how it amplifies other crises, threatening the very systems that sustain human life (IPCC, 2022). These global issues are deeply interconnected, shaping human health, biodiversity, economic stability, and overall well-being (WEF, PICR & CDP, 2025).

One of the most tangible expressions of these intertwined challenges lies in the way societies produce and manage waste (ISWA, 2024). Every year, more than two billion tonnes of municipal solid waste are generated worldwide, a number expected to rise by 73% by 2050, driven by urbanization, population growth, and rising consumption. Yet, much of this waste is still mismanaged: around 23% is never collected and 33% is openly dumped, with rates exceeding 90% in many low-income countries (World Bank, 2025). Such practices, as the ISWA (2024) and EEA (2024) emphasize, contribute to greenhouse gas emissions, jeopardizing environmental quality and public health.

Waste management is, by nature, a socio-technical challenge. It involves governments, industries, consumers, and informal workers, each with their own perspectives, constraints, and motivations. This diversity makes coordination difficult and exposes the limits of traditional, top-down policy approaches. Addressing such complexity calls for more integrated and participatory models of governance that connect science, society, and policy (EEA, 2024; European Union, 2020). In recent years, co-creation approaches, rooted in dialogue, shared learning, and collaboration, have gained recognition as promising ways to bridge these worlds and foster collective understanding and action (Maas et al., 2022).

Within this landscape, *Communities of Practice* (CoPs) offer a particularly relevant framework for organizing collaborative engagement (European Union, 2020; Maas et al., 2022). CoPs bring together people who share a concern or passion for a given topic and who learn through ongoing interaction and mutual exchange (Wenger-Trayner, 2015). They provide a space where diverse forms of knowledge, scientific, technical, and experiential, that can meet and evolve into collective intelligence, often leading to innovation and more grounded action (European Union, 2020; Maas et al., 2022; Wenger-Trayner, 2015).

The concept of CoPs originates from the work of Lave and Wenger (1991), who framed learning as a social process embedded in everyday practice. Wenger (1998) later defined CoPs as groups characterized by three key elements: a *shared domain* of interest that shapes their identity, a *community* of people who engage regularly, and a *shared practice* built over time through joint activities, tools, and experiences (Wenger, 1998; Wenger, McDermott & Snyder, 2002). CoPs thus operate as living social learning systems, flexible, evolving, and driven by their members.

Their relevance lies in their ability to facilitate bottom-up knowledge exchange and collective problem-solving, particularly in complex, multi-stakeholder fields (European Union, 2020; Frantzeskaki et al., 2019). CoPs help uncover and share tacit knowledge, the kind that is hard to formalize but essential for practice, and promote collaboration across institutional and disciplinary boundaries (European Union, 2020; McDonald & Mercieca, 2021). By connecting scientists, policymakers, practitioners, and citizens, they create bridges between systems and foster the emergence of more holistic, innovative solutions (Frantzeskaki et al., 2019; European Union, 2020). However, their success depends on maintaining engagement, balancing structure and informality, and finding meaningful ways to assess their impact (McDonald & Mercieca, 2021). In the field of waste management, these dynamics are particularly relevant (European Union, 2020). Effective solutions require coordination across sectors, trust among actors, and adaptation to local realities (Wenger, 1998; Wenger et al., 2002). CoPs can play a vital role in this process, providing a platform for dialogue, co-production of strategies, and the joint pursuit of circular economy goals (Kimble et al., 2010; Roux et al., 2006). Yet, despite their potential, few studies have systematically examined how CoPs are applied in the waste management sector, what outcomes they achieve, and what challenges they face.

This study therefore asks: *Can Communities of Practice serve as an effective mechanism for improving collaboration and knowledge exchange in waste management?* To answer this question, a literature review was conducted mapping how CoPs have been conceptualized and implemented in waste management.

The implementation of the concept of Communities of Practice (CoPs) has demonstrated significant operational flexibility since its initial formulation by Lave and Wenger (1991). This versatility is evident across diverse fields, from interprofessional networks of situated practice facilitating sustainability transitions in healthcare (Omer & Roberts, 2022) to university-based CoPs that foster intergenerational learning and eco-innovation (Piper-Wright & Jussa, 2024). This evolution reflects a broadening of the concept to encompass goals like sustainability, environmental justice, and cross-disciplinary collaboration.

2. Methodology

To systematically map the application of the CoP concept within waste management, a literature review was conducted (Figure 1). A search of the SCOPUS database in April 2025 using the string "Community of Practice" + "Waste" and variants (e.g. CoP) returned an initial corpus of 45 scientific articles (step 2).

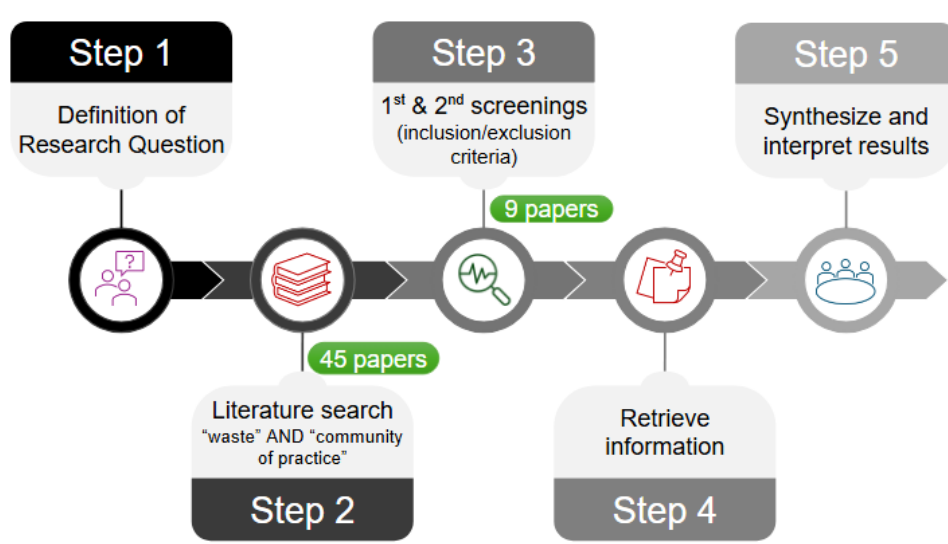


Figure 1 – Overview of the methodological framework adopted in this study, illustrating the main stages and analytical steps undertaken to address the research objectives.

A two-stage screening process was applied (step 3). In the 1st screening stage, titles and abstracts were broadly reviewed to identify publications addressing solid waste management and containing at least preliminary or indirect references to Communities of Practice or similar collaborative learning approaches. This exploratory step aimed to capture a wide pool of potentially relevant studies rather than apply strict conceptual filters. This assessment resulted in the exclusion of 20 articles, and a total

of 25 articles were shortlisted for full-text retrieval and subjected to a more detailed eligibility assessment in the subsequent stage. In the 2nd screening, a thorough reading of the full texts was conducted. Articles were excluded if they did not report on a specific waste-related CoP (or a group classifiable as a CoP based on the core criteria of shared domain, community, and practice) or if the full text was not available for detailed analysis. This assessment resulted in the exclusion of 16 articles, yielding a final corpus of 9 articles for in-depth analysis. Among these, one article was a thematic review, while the remaining eight provided case study information of distinct CoPs applied to waste management.

A systematic analytical framework was employed to examine each article of the final set across four core dimensions:

1. Scope: documenting the geographical location, scale of intervention (local, national, transnational), and the specific waste stream addressed (e.g., municipal, industrial, hazardous).
2. Objective: identifying the primary functions of the CoP.
3. Members: analyzing the typology of actors involved (e.g., technicians, policymakers, residents, NGOs) and their sectoral representation.
4. Outcomes and challenges: cataloging concrete results, such as knowledge products or policy changes, and documented obstacles like difficulties in sustaining engagement.

A critical aspect of this analysis was the qualitative assessment to differentiate between studies that superficially invoked the CoP concept and those detailing communities with clear governance structures and facilitated interactions, thus ensuring a nuanced understanding of their development within the waste management sector.

3. Community of Practices in Waste Management

Table 1 summarizes the objectives, geographical context, waste focus, and main contributions of each article targeting a specific CoP (excluding the review article), providing a clear overview of the use of CoP in Waste.

Author(s) & Year	Geographical Context	Waste Stream / Focus	Main Findings / Contribution
Fagerholm et al. (2025)	Kamikatsu, Japan	Urban waste – source separation	Community routines and peer exchange sustain >80% recycling rates and strong alignment with municipal policies.
Ghazali et al. (2021)	Indonesia (8 communities) Bandung, Indonesia	Urban waste – separation, composting	CoPs engage residents, schools, NGOs to foster environmental culture and

Author(s) & Year	Geographical Context	Waste Stream / Focus	Main Findings / Contribution
			long-term behavioral change.
Ddiba et al. (2020)	Naivasha, Kenya	Circular sanitation & waste-to-resource systems	CoPs co-created socially are more keen to accept circular economy solutions; ensured local ownership of new infrastructure.
Odhiambo et al. (2021)	Sub-Saharan Africa (multi-country)	Hazardous laboratory waste (HIV testing)	LabCoP Waste CoP led to adoption of new national guidelines; improved hazardous waste management practices.
Beattie et al. (2022)	European Union	Radioactive waste management	Institutionalized CoPs preserve technical knowledge, promote intergenerational learning, harmonize safety standards.
Merson et al. (2010)	Australia	Organic waste (urban agriculture)	Highlights vulnerability of grassroots CoPs to policy and land-use constraints; stresses need for institutional support.
Sletto et al. (2019)	Los Platanitos, Dominican Republic	Urban waste & drainage management	Mesa de Concertación enabled co-production of drainage and waste solutions, despite power asymmetries and conflict.
Goeiman & Rink (2025)	Cape Town, South Africa	Informal recycling intermediaries	Identifies informal recyclers as a CoP with shared norms and rules; critical link in urban recycling value chains.

Table 1 – Overview of Selected Articles on Communities of Practice in Waste Management.

The 8 CoP found span across a spectrum of geographical and socio-economic contexts, from high-income countries such as Japan, Australia, and Western Europe to low- and middle-income regions, including Sub-Saharan Africa, Southeast Asia, and Latin America (Figure 2).

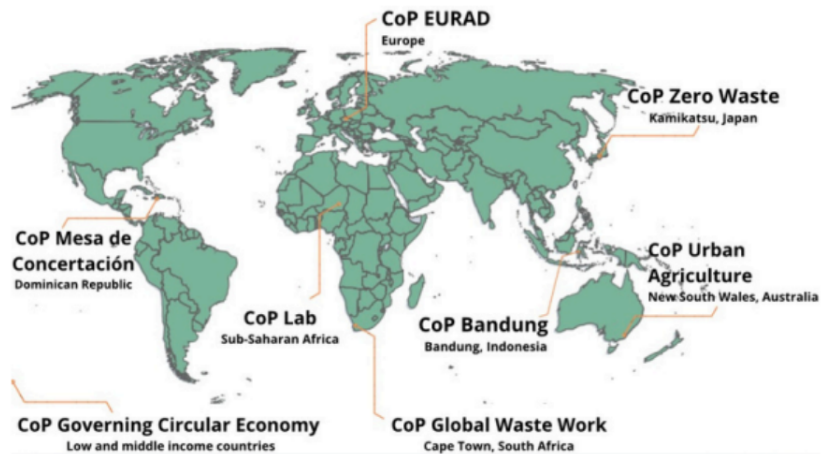


Figure 2 – Map showing the location and distribution of the single Communities of Practice (CoPs) identified in this study, reflecting the diversity of contexts in which they have been implemented.

The operationalization of CoPs similarly spans a spectrum, from highly formalized, institutional models to informal, grassroots initiatives.

The earliest study dates back to 2010 (Merson et al.), but a marked growth in publications is observed after 2019, coinciding with the broader surge in participatory governance initiatives and the global shift towards circular economy thinking. Even though only a few studies were found, this upward trajectory suggests that CoPs are growing institutional and academic interest in collaborative governance and circular economy approaches and are increasingly recognized as relevant instruments for tackling complex socio-environmental challenges, particularly in sectors where top-down solutions have historically proven insufficient.

Thematic diversity was another salient feature of the reviewed sample. Applications ranged from household waste separation and composting in community settings (Ghazali et al., 2021; Sunarti et al., 2024), to hazardous laboratory waste in HIV programs (Odhiambo et al., 2021), radioactive waste management within a transnational program (Beattie et al., 2022), and informal recycling value chains in African cities (Goeiman & Rink, 2025). Urban agriculture and land management were also represented, as seen in studies from Sydney (Merson et al., 2010) and the Dominican Republic (Sletto et al., 2019), where CoPs became platforms for co-producing water drainage and waste solutions in socially vulnerable neighbourhoods.

Member composition and operationalization varied substantially across cases. Institutionalized CoPs such as EURAD and LabCoP involved highly specialized technical experts, government representatives, and international agencies, supported by digital infrastructures and formal governance arrangements. These communities were established with clearly defined membership criteria, facilitation strategies, and regular knowledge-sharing events, indicating a mature and institutionalized use of the concept. At the opposite end of the spectrum, grassroots CoPs such as those in Bandung (Ghazali et al., 2021) mobilized residents, community leaders, schools, NGOs, and local authorities,

often relying on voluntary participation and peer mentoring. Cases like Kamikatsu in Japan (Fagerholm et al., 2025) and Los Platanitos (Sletto et al., 2019) describe emergent, informal CoPs that arose organically through the daily interactions of residents and practitioners, underscoring the capacity of the CoP model to evolve spontaneously in response to local needs.

Modes of interaction varied considerably across the reviewed CoPs. Fully face-to-face communities were reported in territorially anchored cases such as Kamikatsu in Japan (Fagerholm et al., 2025), Los Platanitos in the Dominican Republic (Sletto et al., 2019), and the Australian urban agriculture initiatives (Merson et al., 2010), in which physical co-presence was essential to collective problem-solving and knowledge exchange. By contrast, several institutionalized or transnational CoPs adopted hybrid models, combining digital platforms with periodic in-person workshops or technical meetings. Examples include the EURAD program (Beattie et al., 2022) and the LabCoP Waste sub-community (Odhiambo et al., 2021). Hybrid configurations were also observed in community-driven initiatives such as Bandung (Ghazali et al., 2021) and the neighborhood-level program described by Sunarti et al. (2024), which blended local gatherings with digital messaging groups.

A cross-cutting observation concerns the **role of knowledge brokers and facilitation infrastructures**. Where convening capacity, communication routines, and minimal resources were present, communities sustained participation and converted tacit exchanges into actionable guidance (Beattie et al., 2022; Odhiambo et al., 2021). Where these elements were absent or episodic, participation fluctuated and communities reverted to sparse information sharing with limited cumulative learning (Sletto et al., 2019). This pattern recurs across institutionalized, hybrid, and grassroots configurations and points to facilitation as an enabling condition rather than an optional add-on (European Union, 2020).

Reported **impacts** were predominantly positive and included tangible environmental and social outcomes as well as softer, process-oriented results. Fagerholm et al. (2025) documented recycling rates above 80% in Kamikatsu, directly linked to daily cooperative practices. Odhiambo et al. (2021) reported that the LabCoP waste sub-community contributed to the formal adoption of hazardous waste guidelines at national level, significantly improving laboratory safety. Sunarti et al. (2024) described reductions in organic waste flows alongside gains in social trust and the emergence of local environmental leaders. Beattie et al. (2022) emphasized the value of EURAD CoPs in preserving institutional memory and aligning technical practices across member states. Goeman & Rink (2025) found that informal waste intermediaries gained visibility and recognition, strengthening advocacy for their inclusion in formal waste governance.

The literature also highlights **recurring challenges that threaten the sustainability and transformative potential of CoPs**. Chief among them are difficulties in maintaining long-term participation once initial funding or project cycles end, dependence on charismatic leaders whose departure may lead to collapse, and the absence of robust impact measurement frameworks. Power asymmetries can limit genuine participation, with technical or political elites dominating decision-making unless deliberate facilitation is provided.

4. Concluding Remarks

This work set out to examine the potential of Communities of Practice (CoPs) as instruments for strengthening collaboration, fostering social learning, and accelerating innovation in municipal waste management.

From a methodological standpoint, the review approach applied here offers advantages in transparency, replicability, and conceptual depth. It supports structured coding of contexts, member typologies, and outcomes, enabling a comparative reading across disparate cases. However, it is highly likely that many more Communities of Practice are active in the waste sector than those captured by this sample. International initiatives and practitioner platforms repeatedly highlight local, regional, and virtual CoPs focusing on organic waste, plastics, food loss, and recycling. Programmatic families such as WasteLessEU (2023), Plastic Smart Cities (2025), and the Greentech Knowledge Hub (2023) indicate growing uptake across Europe and globally, yet much of this activity remains outside standard academic indexing and is often informal or transient. A mixed-source strategy (Saja et al., 2017) combining database searches with grey-literature scanning, practitioner interviews, and programme documentation would likely yield a more comprehensive mapping of CoPs in waste management. Regardless of these limitations, this literature review confirmed that CoPs have been successfully deployed in diverse contexts, ranging from community-based recycling initiatives in Asia to cross-jurisdictional coordination mechanisms for hazardous waste management in Europe. These cases illustrate the ability of CoPs to act as strategic knowledge infrastructures, aligning stakeholders, co-producing actionable solutions, and contributing to measurable gains such as higher recycling rates, reduced contamination, and improved regulatory coherence.

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