Journal of Circular Economy (2026) 4:1, 603-626
https://doi.org/10.55845/joce-2026-41268

RESEARCH ARTICLE

Institutional Readiness and Systemic Barriers to Circular Economy Transitions in Emerging Urban Economies: Evidence from a Rapidly Industrializing Gulf Metropolitan Area

Abdulkarim K. Alhowaish[1*]

Received: 16 January 2026 / Accepted: 5 March 2026 / Published: 27 March 2026

Abstract

Circular economy (CE) transitions are increasingly promoted as a pathway for sustainable urban development; however, their implementation in emerging urban economies remains constrained by institutional and governance-related challenges. This study examines institutional readiness for CE transitions at the metropolitan scale, using the Dammam Metropolitan Area (Saudi Arabia) as an empirical case of a rapidly industrializing urban region. Adopting an institutional and urban governance perspective, institutional readiness is conceptualized as the capacity of metropolitan institutions to coordinate, regulate, and operationalize circular strategies through coherent governance arrangements and effective service delivery. Drawing on an expert-based survey of 230 stakeholders from municipal authorities, industry, and academia, the study employs a sequential quantitative approach combining descriptive analysis, inferential tests, principal component analysis, and multiple regression modeling. The findings indicate that institutional readiness for CE adoption remains moderate and uneven, reflecting a persistent gap between policy ambition and implementation capacity. Governance fragmentation, regulatory gaps, and funding constraints emerge as interrelated systemic barriers; however, municipal waste management system effectiveness is identified as the strongest determinant of perceived readiness in the multivariate analysis. This result highlights operational capacity as a practical institutional mechanism through which broader governance conditions are experienced and assessed by stakeholders. Rather than advancing conceptual novelty, the study contributes to circular economy scholarship by providing a place-based, metropolitan-level empirical assessment of institutional readiness and by demonstrating how operational service performance shapes the feasibility of CE transitions in emerging urban economies. The findings offer policy-relevant insights for aligning governance reform and infrastructure investment to move CE strategies beyond strategic intent toward effective urban implementation.

Keywords Circular Economy · Institutional Readiness · Urban Governance · Systemic Barriers · Waste Management Systems · Emerging Urban Economies · Metropolitan Sustainability

1. Introduction

The circular economy (CE) has emerged as a prominent paradigm for addressing the intertwined challenges of resource depletion, waste generation, and environmental degradation in urban and regional systems. By moving beyond linear "take–make–dispose" models, CE promotes regenerative and restorative approaches that emphasize material circularity, resource efficiency, and systemic innovation across production and

[*] Corresponding Author: ahowaish@iau.edu.sa
[1] Department of Urban and Regional Planning, College of Architecture and Planning, Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.

consumption systems (Ghisellini et al., 2016; Kirchherr et al., 2018). While early CE discourse was largely framed as a technical or industrial strategy, recent scholarship increasingly conceptualizes CE as a governance-driven and institutionally embedded transition process, shaped by regulatory frameworks, coordination mechanisms, spatial planning, and socio-economic contexts (Murray et al., 2017; Williams, 2019; de Morais et al. 2021 ; Davies et al. 2024).

Despite its conceptual appeal and growing policy adoption, the implementation of CE remains uneven, particularly at the urban and metropolitan scales where material flows, infrastructure systems, and governance responsibilities converge. An expanding body of research emphasizes that CE transitions are not purely technological substitutions but are deeply conditioned by institutional arrangements, governance capacity, and place-specific dynamics (Moreau et al., 2017; Arfaoui et al. 2024; Torre & Bourdin, 2026). Cities play a pivotal role in CE implementation because they concentrate economic activity, infrastructure, and regulatory authority; however, urban CE initiatives frequently encounter systemic obstacles such as fragmented governance, overlapping mandates, regulatory ambiguity, and limited coordination across sectors including waste, construction, energy, and water (Williams, 2019; Calisto Friant et al., 2023).

Within this context, institutional readiness has emerged as a critical yet insufficiently examined dimension of CE transitions. Institutional readiness refers to the capacity of public and private institutions to coherently design, coordinate, implement, and enforce circular economy policies through effective governance arrangements, regulatory instruments, and operational systems (Cramer, 2022; Davies et al. 2024). Importantly, institutional readiness extends beyond policy intent or strategic vision; it encompasses the practical ability of institutions to translate CE objectives into coordinated action through service delivery performance, infrastructure effectiveness, and institutional accountability. Evidence from advanced economies suggests that CE implementation is most effective where governance frameworks are integrated, policy commitments are sustained, and institutional roles are clearly aligned (European Commission, 2020; Circle Economy, 2023). Where such conditions are absent, CE strategies often remain aspirational rather than operational.

These challenges are particularly pronounced in emerging urban economies, where rapid urbanization and industrialization intensify resource pressures while institutional capacity often lags behind policy ambition. In this study, emerging urban economies are understood as rapidly urbanizing metropolitan regions characterized by accelerating industrial activity and rising material demand, but where governance coordination, regulatory coherence, and institutional capacity have not yet fully adapted to the scale and complexity of transformation. CE research in Global South and emerging-economy contexts consistently highlights governance fragmentation, regulatory gaps, limited financial instruments, and weak data and monitoring systems as major barriers to transition (Schröder et al., 2020; UN-Habitat, 2023; Davies et al. 2024). In such settings, CE is frequently embedded within broader sustainability, climate, or economic diversification agendas, yet its practical implementation is constrained by structural and institutional conditions.

Resource-dependent and rapidly industrializing urban regions, such as those found across the Gulf, illustrate these tensions with particular clarity (Alhowaish & Alkubur, 2025; World Bank, 2023a; Alnajem et al., 2021). National development strategies increasingly endorse CE principles in relation to waste diversion, climate mitigation, and economic diversification, yet metropolitan-level implementation remains uneven. Previous studies in the Gulf Cooperation Council (GCC) context report high policy ambition alongside persistent institutional fragmentation, continued reliance on landfilling, subsidized resource pricing, and underdeveloped secondary material markets (Alnajem et al., 2021; KAPSARC, 2022). Responsibilities for waste management, environmental regulation, industrial development, and urban planning are often distributed across multiple agencies, creating coordination challenges and implementation inefficiencies that constrain CE uptake.

Financial and investment constraints further complicate CE transitions in emerging urban economies. Circular infrastructure, such as material recovery facilities, recycling systems, and waste-to-energy plants, requires substantial upfront capital and long planning horizons. In economies historically shaped by extractive and linear production models, CE investments often struggle to compete with conventional infrastructure projects (World Bank, 2023a). Although policy instruments such as green financing, public–private partnerships, and extended producer responsibility schemes are increasingly discussed, their practical deployment remains limited and uneven (Alhowaish, 2025). In addition, social and behavioral dimensions, including public awareness, participation, and acceptance, play a significant role in shaping CE outcomes, particularly in relation to waste separation and recycling practices (de Morais et al. 2021; Pansera et al., 2024; UN-Habitat, 2023).

Despite the rapid expansion of CE scholarship, several gaps remain. First, there is limited empirical research that systematically measures institutional readiness for CE transitions at the metropolitan scale, particularly in emerging urban economies (de Morais et al. 2021; Cramer, 2022; Frendo & Packer, 2026). Second, while governance fragmentation is widely acknowledged as a barrier, few studies quantitatively examine its relationship with institutional readiness and operational implementation capacity (Deutz et al. 2024; Davies et al. 2024; Cramer, 2020; Hart et al., 2019). Third, existing research often considers regulatory, financial, technical, and social barriers in isolation, rather than examining their combined and interactive effects within an integrated institutional framework (Savini, 2025; Pansera et al., 2024).

In response to these gaps, this study addresses the following overarching research question: How do institutional readiness, systemic governance barriers, and enabling conditions interact to shape circular economy transitions at the metropolitan scale? To answer this question, the study pursues four specific objectives:

1. To assess the level of institutional readiness for circular economy transitions in a rapidly industrializing metropolitan region, focusing on governance capacity and operational service performance.
2. To identify and rank key systemic barriers, including governance fragmentation, regulatory gaps, funding constraints, technical capacity limitations, and public awareness, that constrain CE implementation in emerging urban contexts.
3. To examine the relationships between institutional readiness, systemic governance barriers, and enabling conditions (including operational capacity), using inferential and multivariate statistical techniques
4. To evaluate stakeholder expectations regarding CE-related policy measures and outcomes, and to assess how these expectations align with observed institutional conditions.

Drawing on expert-based survey data from the Dammam Metropolitan Area, this study advances a place-sensitive and governance-oriented understanding of circular economy implementation in emerging urban economies. By empirically linking institutional readiness, systemic barriers, and operational capacity, the study offers policy-relevant insights into how CE strategies can move beyond strategic intent toward effective institutionalization and implementation.

The remainder of the paper is structured as follows. Section 2 reviews the literature on circular economy transitions with a focus on institutional readiness, governance fragmentation, and metropolitan-scale implementation challenges, and presents the literature-based conceptual framework. Section 3 describes the study context, data collection, survey design, and analytical methods. Section 4 reports the empirical results, examining institutional readiness, systemic barriers, policy expectations, and the determinants of readiness using descriptive, associative, and multivariate analyses. Section 5 discusses the findings in relation to circular economy governance theory and evidence from other emerging and rapidly industrializing urban contexts. Finally, Section 6 concludes by summarizing key insights, outlining policy implications, and identifying limitations and directions for future research.

2. Literature Review

The circular economy (CE) is widely conceptualized as a systemic alternative to linear production and consumption models, aiming to decouple economic activity from resource extraction through strategies such as reuse, recycling, regeneration, and extended product lifecycles (Korhonen et al., 2018; Murray et al., 2017). Early CE scholarship was rooted primarily in industrial ecology and engineering perspectives, emphasizing technological efficiency, material flow optimization, and waste minimization (Ellen MacArthur Foundation, 2015; Geissdoerfer et al., 2017; Lieder & Rashid, 2016). While these approaches provided an essential technical foundation, subsequent research has demonstrated that technological innovation alone is insufficient to drive systemic transitions toward circularity. As CE initiatives moved from conceptual frameworks to implementation, scholars increasingly recognized that institutional arrangements, governance structures, and socio-spatial contexts play a decisive role in shaping transition trajectories.

More recent literature therefore conceptualizes CE transitions as institutionally embedded and governance-dependent processes, shaped by regulatory frameworks, organizational coordination, political priorities, and multi-level institutional interactions (De Jesus & Mendonça, 2018; Williams, 2019; Henry et al., 2020; Davies et al. 2024). From this perspective, CE implementation is understood not simply as the adoption of circular

technologies or practices, but as a transformation of the institutional systems that structure decision-making, resource allocation, and coordination across sectors and scales. This shift has brought institutional analysis to the forefront of CE research, particularly in urban and metropolitan contexts where governance complexity, sectoral interdependencies, and implementation responsibilities converge most visibly. Within this evolving body of scholarship, institutional readiness has emerged as a key analytical concept for explaining why CE transitions advance in some contexts while stagnating in others. Institutional readiness refers to the extent to which institutional systems possess the structural, regulatory, organizational, and coordination capacities necessary to translate CE principles into coherent and actionable policies and practices (de Morais et al. 2021; Cramer, 2022; Frendo & Packer, 2026). Importantly, institutional readiness is conceptually distinct from governance capacity and from implementation outcomes. Governance capacity typically denotes the ability of public authorities to steer and regulate collective action through formal instruments and administrative resources, while implementation outcomes refer to observable performance indicators such as recycling rates or waste diversion levels. Institutional readiness occupies an intermediate position, capturing the enabling conditions that allow governance capacity to be exercised effectively and that precede measurable outcomes. In this sense, institutional readiness represents neither policy intent nor performance itself, but a critical precursor linking the two.

Empirical evidence from advanced circular regions demonstrates that high levels of institutional readiness, manifested through policy coherence, regulatory enforcement, inter-agency coordination, and stable institutional mandates, are strongly associated with successful CE implementation (European Commission, 2020; Circle Economy, 2023). Conversely, where institutional arrangements are fragmented, weakly coordinated, or characterized by overlapping mandates, CE strategies tend to remain aspirational, with limited translation into operational change (Calisto Friant et al., 2023; Cramer, 2022). These findings underscore that institutional readiness is not a static condition, but a relational and context-dependent property of governance systems.

Urban and metropolitan regions occupy a central position in CE transitions due to their concentration of material flows, infrastructure systems, economic activity, and governance responsibilities. The literature on circular cities emphasizes that effective CE implementation requires horizontal coordination across sectors such as waste management, construction, energy, and water, alongside vertical alignment between national strategies and local implementation capacities (Arfaoui et al. 2024; Bianchi & Cordella, 2023; Williams, 2019). From an economic geography perspective, CE pathways are shaped by place-specific conditions, including industrial structure, spatial organization, and institutional configurations, reinforcing the need for context-sensitive approaches to assessing readiness and transition potential (Bourdin & Torre, 2025). At the metropolitan scale, institutional readiness therefore depends not only on formal policy frameworks, but also on the alignment of roles, mandates, and operational responsibilities across multiple public and private actors.

Among the barriers most consistently identified in the literature, governance fragmentation emerges as a critical systemic constraint on institutional readiness. Governance fragmentation refers to the dispersion of authority and decision-making across multiple institutions with overlapping or poorly defined mandates, limited coordination mechanisms, and weak accountability structures (Deutz et al. 2024; Davies et al. 2024; Cramer, 2020; Hart et al., 2019). In CE contexts, fragmentation often manifests through disconnected responsibilities for waste management, environmental regulation, industrial development, and urban planning. Empirical studies in emerging urban and Global South contexts show that such fragmentation generates coordination failures, regulatory inconsistencies, and implementation delays, undermining the scalability of circular initiatives even where national strategies exist (Joshi & Ahmed, 2022; Niang et al., 2024; Suárez-Eiroa et al., 2019). Governance fragmentation thus operates not as an isolated barrier, but as a systemic condition that amplifies regulatory gaps, funding inefficiencies, and operational weaknesses.

Beyond governance fragmentation, the literature identifies a constellation of interrelated systemic barriers shaping CE transitions in emerging urban economies. Regulatory gaps and weak enforcement mechanisms reduce compliance incentives, while funding constraints limit investment in circular infrastructure such as recycling facilities and material recovery systems (de Morais et al. 2021; Schröder et al., 2020; World Bank, 2023b). Technological capacity limitations and skills shortages further constrain the adoption of advanced CE solutions, particularly where digital and smart systems are not supported by adequate institutional capacity (Bakıcı et al., 2021; van Stijn et al., 2021; Deutz et al. 2024). Social and behavioral dimensions also play a decisive role, as public awareness, participation, and acceptance influence waste separation behavior, recycling performance, and policy legitimacy (Joensuu et al., 2020; UNEP, 2022). In many emerging urban contexts, limited citizen engagement and the marginalization of informal waste actors weaken the social foundations of

CE transitions (Sugiura et al., 2021). Collectively, this literature emphasizes that institutional readiness is a multidimensional construct shaped by the interaction of governance, regulatory, financial, technical, and social factors rather than any single constraint.

However, recent critical scholarship cautions against equating circular economy transitions with incremental improvements in recycling or resource efficiency alone. Structural circularity requires systemic shifts in production, consumption, and value creation patterns, and may be constrained by rebound effects or "circularity traps" that reproduce linear dependencies under new labels (Savini, 2025; Sugiura et al., 2021; Joensuu et al., 2020). Accordingly, institutional readiness should not be interpreted as a guarantee of transformative circularity, but rather as a necessary enabling condition whose effectiveness depends on broader structural and economic dynamics.

Building on these theoretical insights, this study develops a literature-based conceptual framework to explain CE transitions in emerging urban economies (Figure 1). The framework synthesizes key contributions from circular economy theory, urban governance, and sustainability transition research, providing a structured basis for linking theory to empirical analysis (Geissdoerfer et al., 2017; Schröder et al., 2020; de Morais et al. 2021; Cramer, 2022; Niang et al., 2024; Deutz et al. 2024; Savini, 2025; Bourdin & Torre, 2025). As illustrated in Figure 1, institutional readiness constitutes the central analytical construct and is positioned as a precursor to effective CE implementation. Institutional readiness is shaped by systemic barriers, such as governance fragmentation, regulatory gaps, funding constraints, and limited technical capacity, while being supported by enabling conditions including waste management system performance, public awareness, and sectoral prioritization. The framework conceptualizes CE transitions as dynamic processes emerging from the interaction of these elements at the metropolitan scale. Although implementation outcomes such as recycling rates and resource efficiency are not modeled directly in this study, they provide the conceptual justification for focusing on institutional readiness as a critical intermediary between policy ambition and performance. Figure 1 therefore serves as an integrative bridge between the literature review and the empirical strategy, guiding variable selection, survey design, and the analytical models employed in the subsequent methodological section.

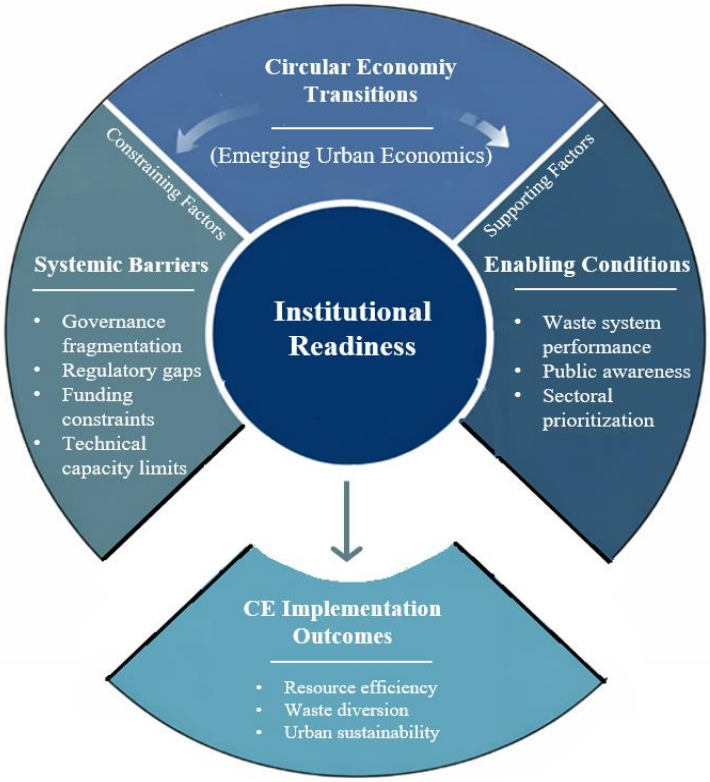

Figure 1. Conceptual Framework for Circular Economy Transitions in Emerging Urban Economies (Institutional readiness is positioned as the focal constructing mediating between systemic institutional barriers and enabling operational conditions at the metropolitan scale. The framework synthesizes insights from circular economy, urban governance, and sustainability transition literature. Source: Developed by the author)

3. Methodology

This study adopts a quantitative, cross-sectional research design to examine institutional readiness and systemic barriers shaping circular economy (CE) transitions in emerging urban economies. The methodological approach is grounded in an institutional and urban governance perspective, which conceptualizes CE implementation as a governance-dependent process conditioned by regulatory coherence, institutional coordination, organizational capacity, and stakeholder engagement, rather than as a purely technical or infrastructural intervention (Williams, 2019; Cramer, 2022). This perspective aligns with recent CE scholarship calling for empirical assessments of institutional conditions underpinning circular transitions, particularly at the urban and metropolitan scales where governance complexity is most pronounced (Henry et al., 2020; Calisto Friant et al., 2023).

The empirical analysis focuses on the Dammam Metropolitan Area (DMA), comprising the cities of Dammam, Khobar, and Dhahran (Figure 2). The DMA represents a rapidly industrializing urban region characterized by intensive industrial activity, high levels of resource consumption, and increasing pressure on municipal waste management and environmental systems (Alhowaish, 2015; Alhowaish & Alkubur, 2025; Alhowaish, 2026). These characteristics are typical of emerging urban economies where CE implementation is embedded within broader agendas of economic diversification and sustainability but constrained by institutional and structural conditions (Schröder et al., 2020; World Bank, 2023a). The DMA therefore provides a suitable and analytically relevant context for examining how institutional readiness and systemic barriers interact to shape CE transitions.

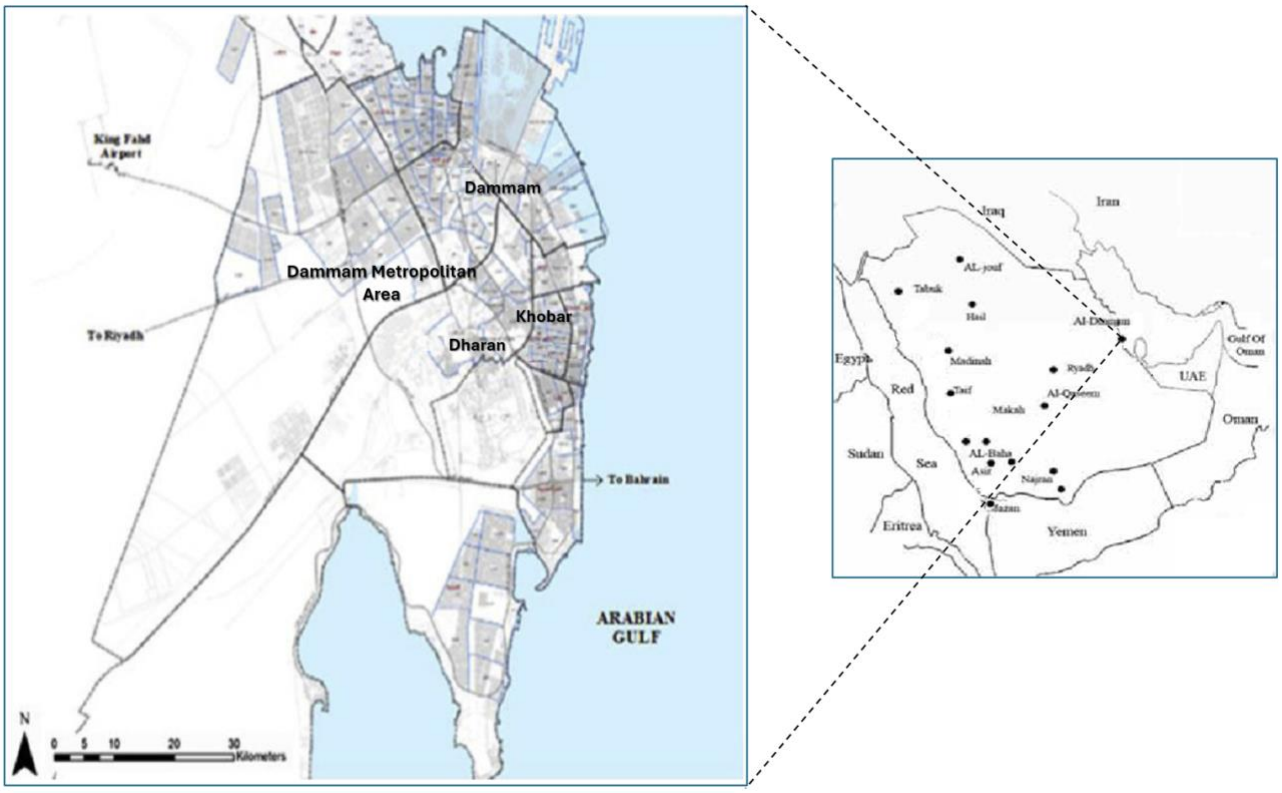

Figure 2. Geographical Location of Dammam Metropolitan Area, Saudi Arabia. Source: Author's GIS compilation based on municipal and national spatial datasets.

Data were collected through a structured, expert-based questionnaire administered electronically to stakeholders operating within the DMA. The survey design was explicitly informed by the literature-based conceptual framework (Figure 1) and operationalized the key theoretical constructs identified in the literature review. An expert survey approach was selected because CE governance in centralized and rapidly industrializing contexts is strongly shaped by policy elites, institutional actors, and sectoral decision-makers whose perceptions provide critical insight into institutional conditions (Etikan et al., 2016; Cramer, 2022; Moreau et al., 2017). The analytical constructs were deductively derived from established circular economy

governance literature and operationalized by the author prior to survey deployment. While respondents assessed these constructs through their professional experience, they did not co-design the measurement framework. This reflects a theory-informed, deductive research design.

A purposive expert sampling strategy was employed to ensure that respondents possessed direct professional experience with CE-related governance, planning, or operational processes. The target population consisted of 265 experts drawn from three main stakeholder groups: (i) municipal policymakers and regulators (including representatives from Dammam Municipality and the National Waste Management Center); (ii) industry leaders from the construction, oil and gas, and waste management sectors; and (iii) academics and non-governmental organizations specializing in urban sustainability. Eligibility criteria prioritized respondents with a minimum of five years of professional experience in CE-relevant fields, ensuring informed and contextually grounded responses.

The required sample size was calculated using Cochran's formula with a 95% confidence level and a 5% margin of error. Based on comparable expert surveys conducted in Gulf Cooperation Council (GCC) contexts, an expected response rate of 70–80% was anticipated (Alnajem et al., 2021; Alhowaish & Alkubur, 2025; Alhowaish, 2026). The study achieved an 87% response rate, yielding 230 valid responses, which constituted a robust dataset for institutional and governance analysis.

The survey instrument captured four interrelated analytical dimensions, each grounded in the CE governance literature. First, institutional readiness was operationalized through indicators assessing perceived preparedness for CE adoption and the effectiveness of existing municipal waste management systems. This approach reflects the literature's emphasis on institutional readiness as a precondition linking governance capacity to implementation outcomes, rather than as an outcome measure itself (Cramer, 2022).

To enhance methodological traceability, a construct operationalization table is provided in Appendix A, linking each survey item to its theoretical source in the CE governance literature. The survey instrument was pre-tested with a small group of subject-matter experts to ensure clarity, relevance, and contextual validity prior to full deployment. Internal consistency reliability was assessed using Cronbach's alpha for each analytical dimension, with all constructs exceeding the commonly accepted threshold of 0.70 (Hair et al., 2019). Principal component analysis (PCA) factor loadings are reported in Appendix B, along with KMO and Bartlett's test results confirming sampling adequacy and construct validity.

Second, sectoral priorities and strategic pathways were assessed to examine variation in the perceived relevance of CE across key urban sectors, consistent with urban CE studies emphasizing sectoral differentiation in circular transition pathways (Williams, 2019). Third, systemic barriers were measured using Likert-scale indicators capturing governance fragmentation, regulatory gaps, funding constraints, technical capacity limitations, and public awareness deficits, barriers frequently identified in studies of emerging and resource-dependent urban economies (Schröder et al., 2020; de Morais et al. 2021). Fourth, policy expectations and outcomes captured stakeholder perceptions regarding the feasibility of achieving CE-related policy targets, linking current institutional conditions to forward-looking expectations.

Governance fragmentation was measured in two complementary ways. First, it was captured as a perceptual barrier within the systemic barriers battery. Second, respondents were asked to identify the single most critical institutional barrier, from which governance fragmentation was operationalized as a binary indicator in the regression analysis. This binary operationalization was adopted to isolate the perceived dominance of fragmentation as a constraint when compared to other barriers. However, this approach necessarily simplifies a multidimensional phenomenon. Accordingly, interpretive caution is applied in the regression analysis, and governance fragmentation is discussed as a broader systemic condition rather than a narrowly defined causal variable.

Quantitative analysis was conducted using SPSS software following a sequential analytical procedure consistent with the study's methodological framework and Figure 3 (Hair et al., 2019; Creswell & Clark, 2018). Descriptive statistics were first used to summarize institutional readiness levels, sectoral priorities, and the relative importance of systemic barriers. One-way analysis of variance (ANOVA) was then applied to examine differences in perceptions across stakeholder sectors and professional roles, while chi-square tests were used to explore associations between governance-related variables and readiness indicators.

To identify latent institutional dimensions underlying CE readiness and systemic barriers, principal component analysis (PCA) with Varimax rotation was employed, following established practice in institutional and governance research (Cramer, 2022). Sampling adequacy was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's Test of Sphericity, confirming the suitability of the dataset for multivariate analysis (Hair et al., 2019; Tabachnick & Fidell, 2019).

Finally, a multiple regression model was estimated to assess the joint influence of governance fragmentation, regulatory gaps, funding constraints, technical capacity, public awareness, and waste management system effectiveness on overall institutional readiness for CE transitions. This analytical strategy responds directly to calls in the CE literature for integrated quantitative assessments of how multiple institutional and systemic factors interact to shape circular outcomes in urban contexts (Schröder et al., 2020; Calisto Friant et al., 2023). The modest explanatory power of the model is interpreted as consistent with the complexity of governance-driven transitions, and limitations related to variable operationalization are explicitly acknowledged.

Participation in the study was voluntary, responses were anonymized, and all procedures complied with institutional ethical guidelines for research involving human participants. Figure 3 summarizes the mixed-methods research design, illustrating the logical progression from conceptual framing to data collection and sequential quantitative analysis. Detailed reliability statistics and factor loadings are reported in the supplementary appendices to ensure transparency and replicability.

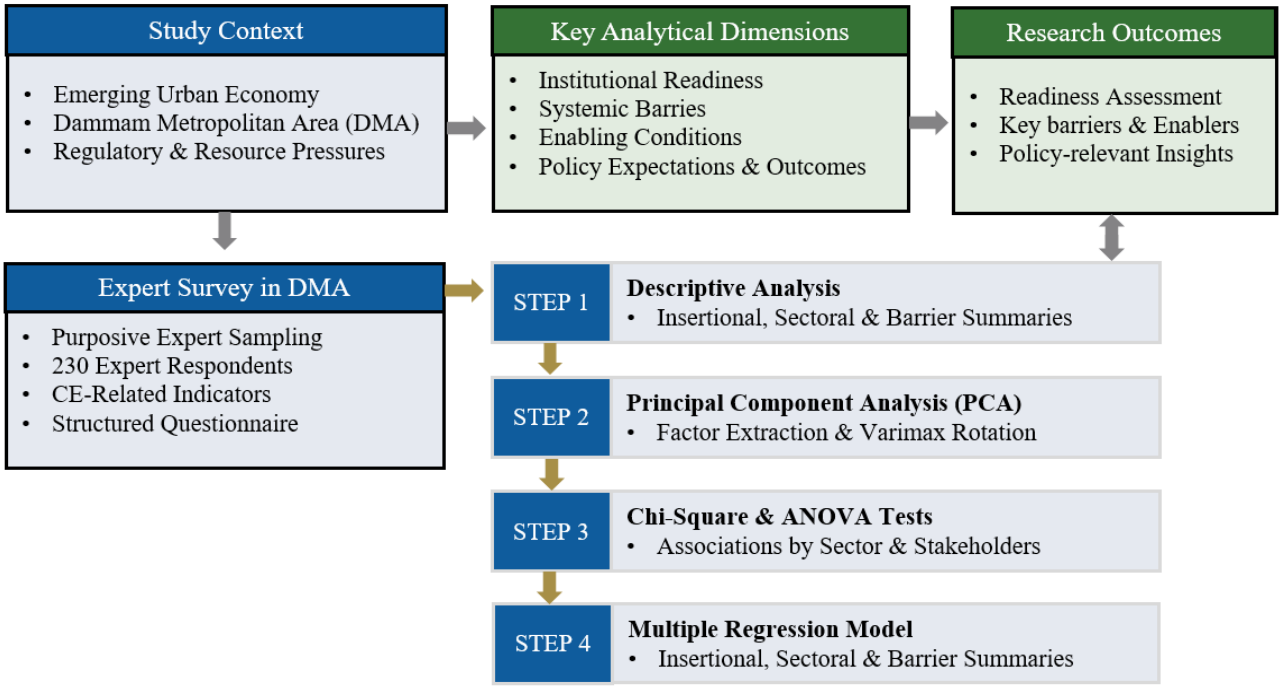

Figure 3. Methodological Framework for Assessing Institutional Readiness for CE Transitions. Source: Developed by the author. (The framework depicts the progression from literature-informed conceptualization through expert sampling and data collection to descriptive, inferential, and multivariate analyses used to assess institutional readiness and its determinants in an emerging urban economy.)

4. Results

This section presents the empirical results of the study, structured to reflect the literature-based conceptual framework in which institutional readiness functions as the central dependent construct shaping circular economy (CE) transitions. The results are organized to progressively examine (i) the characteristics of the expert sample, (ii) levels of institutional readiness and operational capacity, (iii) systemic barriers constraining readiness, (iv) policy measures and expected outcomes, and (v) the multivariate determinants of institutional readiness. Together, these analyses provide an integrated assessment of how governance conditions, operational performance, and stakeholder expectations interact to shape CE transition pathways in an emerging urban economy.

4.1. Demographic Profile of Respondents

The analysis is based on 230 valid survey responses obtained from expert stakeholders engaged in CE-related governance, planning, and implementation. As summarized in Table 1, the sample reflects a diverse and highly experienced group of respondents, providing a robust empirical basis for assessing institutional readiness and systemic barriers.

Sectoral representation spans key public, private, and knowledge-based domains involved in CE governance. The largest share of respondents originated from the oil and gas sector (24.3%), followed by academia and research institutions (21.7%) and construction and real estate (19.1%). Waste management and recycling stakeholders accounted for 14.3%, while municipal governance and public sector institutions represented 12.2%. Non-governmental and non-profit organizations constituted 8.3% of the sample. This distribution reflects the multi-actor governance landscape characteristic of CE transitions in emerging urban economies, where institutional readiness depends on coordination across heterogeneous stakeholders.

Respondents also demonstrated substantial professional experience relevant to CE implementation. More than half (54.8%) reported 5–10 years of experience, while 34.3% had 11–20 years of experience, indicating a strong concentration of mid- to senior-level professionals. Only a small proportion had less than five years of experience (4.3%), while 6.5% reported over 30 years. One-way ANOVA revealed statistically significant differences in experience across sectors ($F = 3.45$, $p = 0.002$), suggesting that exposure to CE-related institutional processes varies by sectoral context.

Professional roles were similarly diverse, with academic researchers (36.1%) and technical experts or engineers (27.0%) forming the largest groups, followed by industry managers and sustainability consultants (each 15.2%). Policymakers and regulators accounted for 6.5% of respondents. A chi-square test indicated a strong association between sector and professional role ($\chi^2 = 89.76$, $p < 0.001$), highlighting the institutional structuring of CE engagement across sectors. Overall, the demographic profile confirms that the dataset draws on informed, sectorally embedded expertise appropriate for analyzing institutional readiness and governance constraints.

Table 1. Demographic profile of respondents (n = 230).

Variable	Category	Number (%)
Sector	Municipal Governance/Public Sector	28 (12.2%)
	Construction/Real Estate	44 (19.1%)
	Oil and Gas	56 (24.3%)
	Waste Management/Recycling	33 (14.3%)
	Academia/Research	50 (21.7%)
	NGO/Non-Profit	19 (8.3%)
Experience	Less than 5 years	10 (4.3%)
	5–10 years	126 (54.8%)
	11–20 years	79 (34.3%)
	More than 30 years	15 (6.5%)
Role	Policymaker/Regulator	15 (6.5%)
	Industry Manager/Executive	35 (15.2%)
	Technical Expert/Engineer	62 (27.0%)
	Academic Researcher	83 (36.1%)
	Sustainability Consultant	35 (15.2%)

Statistical analysis: one-way ANOVA: significant differences in years of experience across sectors ($F = 3.45$, $p = 0.002$). Chi-square test: strong association between sector and role ($X^2 = 89.76$, $p < 0.001$).

4.2. Institutional Readiness and Enabling Conditions for Circular Economy Transitions

Institutional readiness, conceptualized as the capacity of institutions to translate CE strategies into coordinated and operational action, was assessed through stakeholder perceptions of preparedness and municipal waste management system effectiveness. In the conceptual framework (Figure 1), municipal waste management system effectiveness is positioned as a key enabling condition that supports institutional readiness. While readiness represents the governance capacity to coordinate and enforce CE strategies, enabling conditions reflect the operational systems that allow these strategies to be credibly implemented.

As shown in Table 2, the results indicate that institutional readiness in the Dammam Metropolitan Area remains moderate and uneven, reflecting a persistent gap between policy ambition and implementation capacity. Perceived preparedness for CE adoption yielded a mean score of 2.64 (SD = 0.97), with responses concentrated in the "slightly prepared" (38.3%) and "moderately prepared" (34.3%) categories. Only a limited share of respondents viewed the metropolitan area as mostly (14.8%) or fully prepared (3.0%), while nearly one tenth (9.6%) perceived it as not prepared. These findings suggest that while CE principles are increasingly acknowledged within metropolitan governance, institutional coordination, regulatory alignment, and implementation mechanisms have not yet matured sufficiently to support comprehensive CE transitions. Similar patterns have been documented in emerging urban economies where institutional readiness lags behind strategic intent (Cramer, 2022; Calisto Friant et al., 2023; Alhowaish, 2026).

Assessments of municipal waste management system effectiveness further contextualize readiness perceptions. The mean effectiveness score of 2.95 (SD = 0.84) indicates performance perceived as neutral to moderately weak. Half of respondents rated system effectiveness as neutral, while nearly one quarter considered it ineffective. Only a minority perceived the system as effective or very effective. This distribution suggests that although basic waste services are in place, they are not widely regarded as capable of supporting higher-value CE functions such as material recovery and circular value retention. Consistent with CE governance literature, disposal-oriented waste systems thus limit the operational foundation upon which institutional readiness can be built (Williams, 2019; World Bank, 2023b).

The relationship between institutional readiness and operational capacity is reinforced by a strong and statistically significant association between preparedness and waste system effectiveness ($\chi^2 = 131.28$, $p < 0.001$). Stakeholders who perceived waste systems as underperforming were systematically less likely to view institutions as ready for CE transitions. This finding supports the conceptual argument that institutional readiness extends beyond policy intent to include the effectiveness of core urban service delivery systems, positioning operational capacity as a critical enabler of CE governance.

Table 2. Institutional Readiness and Municipal Waste Management Systems Effectiveness (n = 230).

Variable	Category	Number (%)	Mean (SD)
Preparedness for CE	Not Prepared	22 (9.6%)	2.64 (0.97)
	Slightly Prepared	88 (38.3%)	
	Moderately Prepared	79 (34.3%)	
	Mostly Prepared	34 (14.8%)	
	Fully Prepared	7 (3.0%)	
Waste Management Effectiveness	Very Ineffective	6 (2.6%)	2.95 (0.84)
	Ineffective	57 (24.8%)	
	Neutral	115 (50.0%)	
	Effective	44 (19.1%)	
	Very Effective	8 (3.5%)	

Statistical analysis: a strong and statistically significant association between institutional readiness and waste system performance ($X^2 = 131.28$, $p < 0.001$).

4.3. Systemic Barriers to Circular Economy Transitions

Systemic barriers to circular economy (CE) transitions in the Dammam Metropolitan Area were examined to identify the institutional constraints that condition institutional readiness. As shown in Table 3, governance fragmentation emerged as the most significant barrier (M = 3.34, SD = 0.72), followed by funding constraints (M = 3.23, SD = 0.98) and regulatory gaps (M = 3.13, SD = 0.96). In contrast, technical capacity limitations and public awareness constraints were perceived as comparatively less severe. This ranking indicates that CE challenges are primarily institutional and governance-related rather than technical or behavioral in nature, a pattern that is consistent with findings from other emerging and resource-dependent urban contexts (Schröder et al., 2020; Alnajem et al., 2021; Alhowaish & Alkubur, 2025; Savini 2025).

The prominence of institutional barriers is further reinforced by respondents' identification of the single most critical constraint to CE transitions. Nearly 85% of respondents identified either governance fragmentation (48.5%) or regulatory enforcement gaps (36.4%) as the dominant barrier. This strong concentration highlights the central role of institutional coherence and enforcement capacity in shaping CE readiness and underscores the difficulty of advancing circular initiatives within fragmented governance environments (Cramer, 2022). Importantly, this pattern is not driven solely by a single stakeholder group. Although industry actors constitute a substantial share of the sample, public-sector institutions, academic researchers, and civil society organizations together represent more than two-fifths of respondents and independently identified the same institutional barriers as most critical. The convergence of perceptions across stakeholder groups suggests that the emphasis on governance and regulatory constraints reflects shared institutional conditions rather than sector-specific attribution or responsibility shifting.

Concerns that industry respondents may understate technical limitations while emphasizing governance obstacles are further mitigated by the internal structure of the results. Technical capacity constraints were not dismissed but consistently ranked as secondary challenges rather than dominant barriers. Moreover, correlation analysis indicates that technical capacity and public awareness exhibit weaker associations with governance fragmentation and regulatory gaps than do funding constraints, suggesting that respondents conceptually distinguish between operational capabilities and systemic institutional conditions. This differentiation implies that the identification of governance-related barriers is not merely a strategic deflection but reflects a broader understanding of how institutional environments shape CE feasibility.

Correlation analysis further demonstrates that systemic barriers are structurally interconnected rather than isolated. Governance fragmentation exhibits moderate positive correlations with regulatory gaps and funding constraints, indicating that fragmented institutional arrangements tend to co-occur with weak regulatory frameworks and constrained financial support. These interdependencies reinforce the interpretation of CE transitions as institutionally embedded processes, where governance failures propagate financial and operational constraints across the system. By contrast, technical capacity limitations and public awareness function more as downstream challenges, whose effects are mediated by the broader institutional context.

Taken together, these findings support a governance-oriented interpretation of CE barriers, emphasizing that institutional readiness is primarily constrained by coordination, regulation, and enforcement rather than by technological capability alone. While the analysis is based on expert perceptions rather than objective performance metrics, this interpretive focus is appropriate for assessing institutional readiness in centralized policy contexts. The results align closely with CE governance scholarship that highlights the need for integrated institutional reform—rather than isolated technical interventions—to enable effective circular economy transitions in emerging urban economies (Calisto Friant et al., 2023; Schröder et al., 2020).

Table 3. Barriers to Circular Economy Transitions (n = 230).

1. Key Systemic Barriers (1 = Not Significant, 5 = Extremely Significant; n = 230)			
Barrier	**Rank**	**Mean**	**SD**
Governance fragmentation	1	3.34	0.72
Funding constraints	2	3.23	0.98
Regulatory gaps	3	3.13	0.96
Technical capacity limitations	4	2.86	0.88
Public awareness limitations	5	2.78	0.78

2. Most Critical Barrier		
Barrier	**Frequency**	**Percentage (%)**
Governance fragmentation	112	48.5
Regulatory enforcement gaps	84	36.4
Funding constraints	17	7.4
Technical capacity limitations	16	6.9
Industry resistance	1	0.4
Public awareness limitations	1	0.4

3. Correlation Metric Among Systemic Barriers					
Association	**Governance Fragmentation**	**Regulatory Gaps**	**Funding Constraints**	**Technical Capacity**	**Public Awareness**
Governance fragmentation	1.00	0.30*	0.25*	0.22	0.26
Regulatory gaps	0.30	1.00	0.29*	0.30	0.25
Funding constraints	0.25	0.29	1.00	0.27	0.29
Technical capacity	0.22	0.30	0.27	1.00	0.29
Public awareness limitations	0.26	0.25	0.29	0.29	1.00

All coefficients are Spearman's rho (ρ) coefficients. Correlations are statistically significant at $p < 0.05$.

Note: The "Key Systemic Barriers" section reflects structured Likert-scale ranking of predefined barrier categories. The "Most Critical Barrier" section reflects a separate item where respondents identified the single most important constraint; additional low-frequency categories emerged from this item and are retained for completeness.

4.4. Policy Measures and Expected Outcomes

Stakeholder perspectives on policy measures and expected outcomes provide important insight into how institutional readiness and systemic barriers translate into future expectations for CE transitions in the Dammam Metropolitan Area. Drawing on expert assessments of priority interventions, the likelihood of achieving national waste targets, and anticipated improvements in recycling performance, the results reveal a pattern of conditional optimism shaped by governance capacity and policy coherence.

The prioritization of policy measures clearly reflects the institutional nature of perceived CE constraints. As shown in Table 4, respondents expressed a strong preference for regulatory and coordination-based interventions over purely market-driven instruments. The most frequently selected measure was mandatory recycling targets (57.6%), followed closely by enhanced inter-agency coordination mechanisms (55.0%) and stricter waste management regulations (50.7%). Financial instruments were also considered important, although ranked lower, while subsidies for recycling infrastructure (33.8%) and tax incentives for circular businesses (28.1%) received comparatively less emphasis. This hierarchy suggests that stakeholders view CE progress as primarily dependent on governance reform, regulatory enforcement, and institutional alignment

rather than on incentives alone, reinforcing earlier findings that identified governance fragmentation and regulatory gaps as dominant systemic barriers.

Perceptions regarding the likelihood of achieving national waste-related targets further reflect this governance-contingent outlook. Perceptions of the likelihood of meeting the Vision 2030 waste diversion and recycling targets concentrated around moderate optimism, followed by notable uncertainty. While 35.7% and 6.1% of respondents considered target achievement likely and very likely, respectively, a substantial share expressed neutrality (37.8%) and skepticism (20.4% unlikely). This distribution indicates cautious confidence tempered by awareness of existing institutional and operational limitations, consistent with earlier evidence of moderate institutional readiness and uneven waste system performance.

Expectations regarding future recycling outcomes provide additional nuance to this picture. When asked to predict potential improvements in municipal recycling rates by 2030, respondents generally anticipated substantial but incremental progress. Nearly half (44.7%) expected recycling rates to increase by 21–40%, while 36.8% anticipated gains of 41–60%. A smaller group (14.9%) expected improvements exceeding 60%, while only 3.5% anticipated minimal progress. These expectations suggest that stakeholders perceive meaningful improvements as achievable, provided that prioritized policy measures, particularly regulatory strengthening, establishing enforceable targets, and inter-agency coordination, are effectively implemented.

Taken together, the results demonstrate a strong alignment between policy priorities and outcome expectations. Stakeholders recognize that achieving ambitious CE objectives and waste-related targets requires more than financial incentives; it depends on coherent regulatory frameworks, coordinated governance structures, and credible institutional capacity. This alignment reinforces the central role of policy coherence and institutional reform in shaping the trajectory of CE transitions in emerging urban economies, where progress is viewed as feasible but conditional on sustained governance and implementation efforts (Chembessi et al., 2024; Joensuu et al, 2020).

Table 4. Policy Measures and Expected Outcomes (n = 230).

1. Prioritized Policy Measures for Accelerating CE Adoption		
Policy Measure	**Frequency**	**Percentage (%)**
Stricter waste management regulations	117	50.7
Mandatory recycling targets	133	57.6
Enhanced inter-agency coordination	127	55.0
Subsidies for recycling infrastructure	78	33.8
Tax incentives for circular businesses	65	28.1
2. Likelihood of Achieving Vision 2030 Waste Target		
Likelihood Level	**Frequency**	**Percentage (%)**
Unlikely	47	20.4
Neutral	87	37.8
Likely	82	35.7
Very Likely	14	6.1
3. Expected Increase in Municipal Recycling Rate by 2030		
Expected Increase	**Frequency***	**Percentage (%)**
0–20%	8	3.5
21–40%	102	44.7
41–60%	84	36.8
More than 60%	34	14.9

** Two responses contained incomplete entries and were excluded from this item.*

4.5. Regression Results: Determinants of Institutional Readiness

The multivariate analysis explicitly positions institutional readiness as the dependent construct, examining how systemic barriers and operational capacity jointly shape readiness perceptions. The regression model is statistically significant ($F = 10.60$, $p < 0.001$) and explains a modest but meaningful proportion of variance in institutional readiness ($R^2 = 0.159$; Adj. $R^2 = 0.144$; $n = 230$). Importantly, this level of explanatory power is interpreted as consistent with the complexity of governance-driven transitions, where readiness is shaped by multiple interacting institutional, political, and contextual factors rather than a small set of isolated predictors.

Waste management system effectiveness emerges as the only statistically significant predictor of institutional readiness ($B = 0.427$, $p < 0.001$; $\beta = 0.397$), underscoring the central role of operational capacity in translating institutional arrangements into perceived readiness. By contrast, governance fragmentation, regulatory gaps, and funding constraints do not retain significance when tested jointly. The governance fragmentation variable, operationalized as a binary indicator of the most critical perceived barrier, shows a negligible effect, and this result is interpreted with caution given the simplification inherent in binary operationalization.

Rather than diminishing the importance of institutional barriers, these findings suggest that operational performance functions as the practical mechanism through which broader governance conditions are experienced and assessed by stakeholders. In this sense, effective service delivery mediates the relationship between institutional arrangements and readiness perceptions. The modest R^2 therefore reinforces, rather than weakens, the study's core argument: advancing CE transitions in emerging urban economies requires integrated institutional reform that aligns governance structures, regulatory frameworks, and operational systems, rather than reliance on isolated policy instruments.

Table 5. Multiple Regression Results: Determinants of Institutional Readiness

Predictor	B	Std. Error	Std. Beta (β)	t	p	95% CI
Governance fragmentation (binary)	0.043	0.334	0.008	0.129	0.898	[−0.615, 0.701]
Regulatory gaps	0.035	0.065	0.035	0.533	0.595	[−0.094, 0.163]
Funding constraints	−0.024	0.081	−0.019	−0.290	0.772	[−0.184, 0.136]
Waste system effectiveness	0.427	0.066	0.397	6.483	<0.001	[0.298, 0.557]

Model fit: $n = 230$; $R^2 = 0.159$; Adj. $R^2 = 0.144$; $F = 10.60$; $p < 0.001$.

5. Discussion

This study examined how institutional readiness, systemic barriers, and policy expectations interact to shape circular economy (CE) transitions in an emerging urban economy. Rather than treating CE adoption as a primarily technical or predictive process, the findings reinforce governance-oriented CE theory, which conceptualizes circular transitions as institutionally embedded, place-specific, and contingent on coordination capacity, regulatory coherence, and operational performance (Calisto Friant et al., 2023; Cramer, 2022; Williams, 2019). Across the analyses, institutional readiness consistently emerges as the central analytical construct, mediating the relationship between structural constraints and forward-looking policy expectations.

A key contribution of this study lies in clarifying the distinction, and linkage, between circular economy, waste management, and recycling. While CE encompasses a broad systemic transformation involving production, consumption, resource flows, and value retention, waste management and recycling represent only one, albeit critical, operational domain within this paradigm. The findings do not suggest that CE can be reduced to recycling performance alone. Rather, they demonstrate that stakeholder perceptions of CE readiness are strongly shaped by the effectiveness of waste management systems, because these systems represent the most visible and tangible institutional interface through which circular strategies are experienced in urban contexts. This distinction helps avoid conceptual conflation while explaining why waste system performance occupies a prominent role in readiness assessments.

The results on institutional readiness reveal moderate and uneven preparedness for CE transitions, closely aligned with perceptions of municipal waste management effectiveness. From an institutional perspective, this

pattern reinforces the argument that readiness is not equivalent to policy ambition or strategic commitment alone, but reflects the ability of institutions to translate abstract CE principles into coordinated and operational action. In emerging urban economies, where waste management systems remain largely disposal-oriented, limited operational capacity undermines confidence in the feasibility of broader CE strategies. Similar dynamics have been documented in rapidly industrializing cities across the Global South, where infrastructure gaps and service delivery constraints weaken the institutional foundations necessary for systemic circular transitions (Schröder et al., 2020; Chembessi et al., 2024; Alhowaish, 2026).

The prominence of governance fragmentation, regulatory gaps, and funding constraints further underscores the institutional nature of CE challenges. These barriers are not independent obstacles but structurally interrelated conditions that reinforce one another. Fragmented governance arrangements complicate coordination across agencies, dilute accountability, and weaken regulatory enforcement, which in turn limits the effectiveness of financial instruments and discourages private-sector engagement in circular infrastructure. This pattern aligns closely with CE governance literature emphasizing that institutional coherence and enforcement capacity are prerequisites for scaling circular initiatives in resource-dependent and rapidly urbanizing contexts (Cramer, 2020; Calisto Friant et al., 2023). The relatively lower salience of technical capacity and public awareness constraints suggests that, while relevant, these factors operate downstream of institutional integration and governance alignment.

Policy expectations reported by stakeholders reflect a form of conditional optimism shaped by these institutional realities. Respondents anticipate meaningful improvements in recycling performance and moderate progress toward national waste targets, but only if governance-driven reforms, such as mandatory targets, regulatory strengthening, and inter-agency coordination, are effectively implemented. The prioritization of regulatory and coordination measures over market-based incentives indicates that stakeholders perceive CE progress as fundamentally dependent on institutional reform rather than voluntary action or isolated financial tools. This finding is consistent with evidence from other emerging urban economies, where CE strategies advance most effectively when supported by enforceable policy frameworks and coordinated governance structures (Henry et al., 2020; Frendo & Packer, 2026).

The regression analysis provides additional insight into how institutional readiness is interpreted by stakeholders. While the model explains a modest proportion of variance in readiness, this level of explanatory power is appropriate given the complexity of governance-driven transitions. Rather than indicating weak analytical relevance, the modest R^2 reflects the reality that institutional readiness is shaped by multiple interacting political, organizational, and contextual factors that cannot be fully captured by a limited set of survey variables. Importantly, the analysis does not imply strong causal inference. Instead, it demonstrates that operational capacity, specifically waste management system effectiveness, functions as a practical manifestation of institutional readiness. When core service systems perform effectively, stakeholders interpret institutions as more capable of implementing CE policies, even in the presence of broader governance challenges.

From a theoretical perspective, these findings contribute to CE governance scholarship by empirically illustrating how institutional readiness operates as a mediating condition between systemic barriers and policy expectations at the metropolitan scale. The results support calls to move beyond linear or technocratic models of CE implementation and toward governance-based, place-sensitive frameworks that account for institutional capacity, regulatory coherence, and service delivery performance (Williams, 2019; Calisto Friant et al., 2023). For emerging urban economies, the evidence suggests that ambitious CE targets and policy commitments must be accompanied by sustained investments in institutional integration and operational capacity. Without such alignment, CE strategies risk remaining aspirational, reinforcing the gap between policy discourse and implementation outcomes.

6. Conclusion, Policy Implications, Limitations, and Future Research

This study investigated how institutional readiness and systemic barriers shape circular economy (CE) transitions in an emerging urban economy, using the Dammam Metropolitan Area as an empirical case. Drawing on expert-based survey evidence and a sequential quantitative analytical approach, the findings confirm that CE transitions are not primarily technical or market-led processes, but governance-driven

transformations rooted in institutional capacity, regulatory coherence, and operational performance. Across the analyses, institutional readiness emerges as a central condition mediating the relationship between structural constraints and future policy expectations, highlighting the persistent gap between CE policy ambition and implementation capacity in rapidly industrializing urban contexts.

A core theoretical contribution of this study lies in empirically demonstrating how institutional readiness is materially grounded in operational capacity. While governance fragmentation, regulatory gaps, and funding constraints are widely recognized as critical barriers to CE implementation, their influence is experienced by stakeholders largely through the performance of core urban service systems. Municipal waste management effectiveness emerged as the most robust determinant of perceived institutional readiness, suggesting that operational systems function as a practical manifestation of institutional capability. From a governance perspective, this finding reinforces recent CE scholarship arguing that institutional readiness cannot be assessed independently of service delivery performance, as infrastructure effectiveness translates abstract governance capacity into credible implementation potential (Calisto Friant et al., 2023; Cramer, 2022; Williams, 2019).

Importantly, the results clarify the relationship between CE and recycling, avoiding conceptual conflation. While recycling and waste management represent only one component of the broader CE paradigm, they constitute a critical operational entry point for urban CE transitions. Stakeholder reliance on waste system performance as an indicator of readiness reflects the visibility and tangibility of this sector in everyday governance practice. This does not imply that CE can be reduced to recycling outcomes, but rather that effective waste management provides an institutional and infrastructural foundation upon which more systemic circular strategies, such as industrial symbiosis, circular construction, and resource-efficient urban systems, can be developed.

The policy implications of these findings are substantial. First, CE strategies in emerging urban economies should prioritize strengthening municipal waste management systems as foundational infrastructure for circular transitions. Investments in material recovery capacity, data integration, and recycling infrastructure can enhance institutional credibility and reinforce stakeholder confidence in CE policy implementation. Second, the prominence of governance fragmentation and regulatory gaps underscores the need for integrated, cross-sectoral governance frameworks. Aligning municipal authorities, sectoral agencies, and private actors through clear mandates, enforceable targets, and inter-agency coordination mechanisms is likely to yield greater impact than isolated financial incentives or voluntary initiatives. Third, while market-based instruments such as subsidies and tax incentives remain important, their effectiveness depends on being embedded within coherent regulatory and institutional frameworks that provide long-term policy certainty and implementation consistency.

This study has several limitations that also point toward important directions for future research. First, the analysis relies on expert perceptions, which are appropriate for assessing institutional readiness and governance dynamics in centralized and policy-driven contexts, but may not fully capture objective system performance or technical capacity. In particular, as discussed in the results section, perceptions of systemic barriers may be shaped in part by respondents' sectoral positioning. For example, industry actors may emphasize governance and regulatory constraints relative to technical limitations, while public-sector respondents may prioritize coordination or enforcement challenges. Accordingly, the ranking of barriers should be interpreted as reflecting institutional signals about perceived constraints within the governance system rather than as definitive assessments of actual technical capability. Future research could strengthen empirical robustness by triangulating perception-based data with administrative records, waste flow statistics, infrastructure performance indicators, or longitudinal monitoring data. In addition, the cross-sectional design limits the ability to examine institutional change and causal dynamics over time. Finally, the binary operationalization of governance fragmentation in the regression analysis, while analytically useful for isolating its association with institutional readiness, may underrepresent the multidimensional nature of institutional coordination challenges, suggesting the value of more granular and longitudinal governance indicators in future studies.

Building on these findings, future research should adopt longitudinal and comparative designs to examine how institutional readiness evolves as CE policies mature and infrastructure investments are implemented. Comparative analyses across metropolitan regions in the Gulf and other emerging urban economies would help identify transferable governance models and context-specific constraints. Further inquiry is also needed into the role of digital governance tools, public–private partnerships, and behavioral interventions in strengthening the link between institutional capacity and circular outcomes. By moving beyond policy discourse to examine

the institutional and operational conditions of implementation, future research can support more actionable, place-sensitive pathways for advancing circular economy transitions.

By empirically positioning institutional readiness as a central mediating condition between policy ambition and implementation, this study contributes to circular economy theory by bridging governance-oriented and infrastructure-based perspectives. The findings reinforce emerging views of CE transitions as place-based, institutionally embedded processes shaped by the interaction of governance capacity, systemic barriers, and operational credibility, offering a theoretically grounded explanation of how readiness mediates between ambition and action in emerging urban economies.

Acknowledgments The authors greatly acknowledge the support of Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Data Availability The data are available from the authors upon request.

Funding This research received no external funding.

Declarations

Competing Interests The authors declare no competing interests.

Institutional Review Board Statement The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University (protocol code IRB-2026-06-0028) Approval Date: 11/1/2026.

Informed Consent Statement Informed consent was obtained from all subjects involved in the study.

References

Alhowaish, A. K. (2015). Eighty years of urban growth and socioeconomic trends in Dammam Metropolitan Area, Saudi Arabia. *Habitat International, 50*, 90–98. https://doi.org/10.1016/j.habitatint.2015.08.019

Alhowaish, A. K. (2025). Toward the adaptation of green bonds in the Saudi municipal system: Challenges and opportunities. *Sustainability, 17*, 5698. https://doi.org/10.3390/su17135698

Alhowaish, A. K., & Alkubur, F. S. (2025). Unlocking the potential of the circular economy at municipal levels: A study of expert perceptions in the Dammam Metropolitan Area. *Sustainability, 17*(10), 4323. https://doi.org/10.3390/su17104323

Alhowaish, A. K. (2026). Governing the blue economy in arid coastal regions: opportunities, constraints, and stakeholder perspectives from the Eastern Province coast of Saudi Arabia. *Front. Mar. Sci.* 13:1735326. https://www.frontiersin.org/articles/10.3389/fmars.2026.1735326

.Alnajem, M., Elheddad, M., & Alfar, A. J. (2021). Circular economy in the Gulf Cooperation Council: A systematic literature review. *Journal of Cleaner Production*, *311*, 127612. https://doi.org/10.1016/j.jclepro.2021.127612

Arfaoui, N., Bourdin, S., Torre, A., Vernier, M. F., & Vo, L. C. (2024). Geographical and organised proximities influencing circular economy practices: The closer partners, the better? *Regional Studies, 58*(12), 2485– 2500.

Bakıcı, T., Almirall, E., & Wareham, J. (2021). IoT-driven smart waste management systems: A case study of Barcelona's urban innovation. *Sustainable Cities and Society, 73*, 103128. https://doi.org/10.1016/j.scs.2021.103128

Bianchi, M., & Cordella, M. (2023). Does circular economy mitigate the extraction of natural resources? Empirical evidence based on analysis of 28 European economies over the past decade. *Ecological Economics*, *203*, 107607. https://doi.org/10.1016/j.ecolecon.2022.107607

Bocken, N. M. P., Ritala, P., & Huotari, P. (2017). The circular economy: Exploring the introduction of the concept among S&P 500 firms. *Journal of Industrial Ecology*, *21*(3), 487–490.

Bourdin, S., & Torre, A. (2025). Economic geography's contribution to understanding the circular economy. *Journal of Economic Geography, 25*, 293–308.

Calisto Friant, M., Reid, K., Boesler, P., Vermeulen, W. J. V., & Salomone, R. (2023). Sustainable circular cities? Analysing urban circular economy policies in Amsterdam, Glasgow, and Copenhagen. *Local Environment*, *28*, 1331–1369.

Chembessi, C., Bourdin, S., & Torre, A. (2024). Towards a territorialisation of the circular economy: The proximity of stakeholders and resources matters. *Cambridge Journal of Regions, Economy and Society, 17*(3), 605–622.

Circle Economy. (2023). *Circularity Gap Report 2023*. Retrieved December, 20, 2025, from https://www.circularity-gap.world

Cramer, J. (2020). Implementing the circular economy in the Amsterdam Metropolitan Area: The interplay between market actors mediated by transition brokers. *Business Strategy and the Environment*, *29*(6), 2857–2870. https://doi.org/10.1002/bse.2548

Cramer, J. (2022). Effective governance of circular economies: An international comparison. *Journal of Cleaner Production*, *343*, 130874. https://doi.org/10.1016/j.jclepro.2022.130874

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Davies, A. R., Evenhuis, E., Willams, J., Avoyan, E., & Tyler, P. (2024). Critical geographies of the circular economy. *Cambridge Journal of Regions, Economy and Society, 17*(3), 431–442.

De Jesus, A., & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco-innovation road to the CE. *Ecological Economics, 145*, 75–89.

de Morais, L. H. L., Pinto, D. C., & Cruz-Jesus, F. (2021). Circular economy engagement: Altruism, status, and cultural orientation as drivers for sustainable consumption. *Sustainable Production and Consumption, 27*, 523–533.

Deutz, P., Jonas, A. E. G., Newsholme, A., Pusz, M., Rogers, H., Affolderbach, J., Baumgartner, R., & Ramos, T. B. (2024). The role of place in the development of a circular economy: A critical analysis of potential for social redistribution in Hull, UK. *Cambridge Journal of Regions Economy and Society*, *17*, 551–564.

Ellen MacArthur Foundation. (2015). *Towards a circular economy: Business rationale for an accelerated transition.* Retrieved January 5, 2026, from https://www.ellenmacarthurfoundation.org

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *Aswan University Journal of Environmental Studies*, *5*, 1–4.

European Commission. (2020). *Circular Economy Action Plan*. Retrieved January 4, 2026, from https://ec.europa.eu

Frendo, C., & Packer, P. A. (2026). The adoption of circular business models in small island states: Challenges and opportunities. *Journal of Circular Economy, 4*(1), 44–52. https://doi.org/10.55845/joce-2026-4188

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy – A new sustainability paradigm? *Journal of Cleaner Production, 143*, 757–768.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, *114*, 11–32. https://doi.org/10.1016/j.jclepro.2015.09.007

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Hart, J., Adams, K. T., Giesekam, J., & Tingley, D. D., & Pomponi, F. (2019). Barriers and drivers in a circular economy: The case of the built environment. *Procedia CIRP*, *80*, 619–624.

Henry, M., Bauwens, T., Kirchherr, J., & Hekkert, M. (2020). A typology of circular start-ups: Analysis of 128 circular business models. *Journal of Cleaner Production*, *245*, 118528. https://doi.org/10.1016/j.jclepro.2019.118528

Joensuu, T., Edelman, H., & Saari, A. (2020). Circular economy practices in the built environment. *Journal of Cleaner Production*, *276*, 124215.

Joshi, R., & Ahmed, S. (2022). Institutional fragmentation and waste management inefficiencies: A case study of New Delhi's circular economy challenges. *Journal of Environmental Policy & Planning, 24*, 345–362. https://doi.org/10.1080/1523908X.2022.2055672

King Abdullah Petroleum Studies and Research Center. (2022). *Financing circular economies in the Gulf: Challenges in mobilizing private capital.* Retrieved January 2, 2026, from https://www.kapsarc.org

Kirchherr, J., Reike, D., & Hekkert, M. (2018). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, *127*, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics*, *143*, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production*, *115*, 36–51.

Moreau, V., Sahakian, M., van Griethuysen, P., & Vuille, F. (2017). Coming full circle: Why social and institutional dimensions matter for the circular economy. *Journal of Industrial Ecology, 21*(3), 497–506.

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: An interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics*, *140*, 369–380.

Niang, A., Bourdin, S., & Torre, A. (2024). The geography of circular economy: Job creation, territorial embeddedness and local public policies. *Journal of Environmental Planning and Management*, *67*, 2939–2954.

Pansera, M., Barca, S., Martinez Alvarez, B., Leonardi, E., D'Alisa, G., Meira, T., & Guillibert, P. (2024). Toward a just circular economy: Conceptualizing environmental labor and gender justice in circularity studies. *Sustainability: Science, Practice and Policy*, *20*(1), 2338592.

Savini, F. (2025). The circular economy is over: The scalar politics of circular production. *Urban Studies*, 1–13. https://doi.org/10.1177/00420980251383341

Schröder, P., Almeida, S., Bengtsson, M., & Singh, R. (2020). Just transitions in circular economies: A global South perspective. *Ecological Economics*, *176*, 106729. https://doi.org/10.1016/j.ecolecon.2020.106729

Suárez-Eiroa, B., Fernández, E., Méndez-Martínez, G., & Soto-Oñate, D. (2019). Operational principles of circular economy for sustainable development: Linking theory and practice. *Journal of Cleaner Production*, *214*, 952–961.

Sugiura, T., Nakamura, K., & Fujii, H. (2021). Overcoming cultural resistance to food waste recycling: Gamification and behavioral interventions in Tokyo. *Resources, Conservation and Recycling, 168*, 105432. https://doi.org/10.1016/j.resconrec.2021.105432

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Pearson.

Torre A., & Bourdin, S. (2026). The territorial circular ecosystem: Foundations for a systemic and place-based approach to circular economy. *Journal of Circular Economy, 4*(1), 27–43. https://doi.org/10.55845/joce-2026-4181

UN-Habitat. (2023). *Circular economy transitions in the Global South: Workforce challenges and informal sector exclusion.* Retrieved December 22, 2025, from https://unhabitat.org

United Nations Environment Programme (UNEP). (2022). *Informal waste pickers and circular economy transition: A case study of Nairobi's recycling sector.* Retrieved December 25, 2025, from https://www.unep.org.

van Stijn, A., Smith, J. K., & Doe, R. L. (2021). Digital material passports for circular construction. *Journal of Cleaner Production, 292*, 126000.

Williams, J. (2019). Circular cities: Strategies for governing urban resource efficiency. *Urban Studies*, *56*, 2746–2762. https://doi.org/10.1177/0042098018810549

World Bank. (2023a). *Water scarcity and circular solutions in the GCC.* Retrieved December 22, 2025, from https://www.worldbank.org/en/news/opinion/2024/03/26/from-scarcity-to-sustainability-the-gcc-s-journey-towards-water-security

World Bank. (2023b). *Green bonds for sustainable cities.* Retrieved December 22, 2025, from https://thedocs.worldbank.org/en/doc/667f95939700497452d00a1544ba2d01-0340022024/original/World-Bank-IBRD-FY23-IMPACT-REPORT.pdf

Appendices

Appendix A. Construct Operationalization Table

This appendix details the theoretical grounding and operationalization of the key analytical constructs used in the study. All constructs were deductively derived from established circular economy governance literature and operationalized through structured survey items measured primarily on 5-point Likert scales unless otherwise indicated.

Table A1. Operationalization of Analytical Constructs

Construct	Conceptual Definition	Survey Indicators (Measurement Items)	Scale Type	Key Theoretical Sources
Institutional Readiness (Dependent Construct)	The extent to which metropolitan institutions possess the governance capacity, coordination mechanisms, regulatory alignment, and operational systems necessary to translate CE strategies into effective implementation.	- Perceived preparedness for CE adoption in the metropolitan area - Overall effectiveness of municipal waste management systems in supporting CE objectives	5-point Likert scale (1 = Not prepared / Very ineffective; 5 = Fully prepared / Very effective)	Cramer (2022); Calisto Friant et al. (2023); Williams (2019); de Morais et al. (2021)
Governance Fragmentation	The dispersion of authority and decision-making across multiple institutions with overlapping mandates and weak coordination mechanisms.	- Degree to which fragmented institutional responsibilities hinder CE implementation - Identification of governance fragmentation as the most critical institutional barrier (binary variable in regression)	5-point Likert scale (barrier significance) Binary indicator (1 = selected as most critical barrier)	Cramer (2020, 2022); Hart et al. (2019); Deutz et al. (2024)
Regulatory Gaps	Weaknesses or inconsistencies in regulatory frameworks and enforcement mechanisms affecting CE adoption.	- Perceived adequacy of regulatory frameworks for CE - Strength of enforcement capacity	5-point Likert scale	Calisto Friant et al. (2023); Schröder et al. (2020); Davies et al. (2024)
Funding Constraints	Limitations in financial instruments and capital availability for CE infrastructure and implementation.	- Extent to which lack of funding constrains CE projects - Availability of financial incentives or support mechanisms	5-point Likert scale	World Bank (2023a); Alnajem et al. (2021); Cramer (2022)
Technical Capacity Limitations	Constraints related to technological readiness, skills, and infrastructure necessary for CE implementation.	- Adequacy of technical expertise in CE-related sectors - Availability of advanced recycling and recovery technologies	5-point Likert scale	Bakıcı et al. (2021); van Stijn et al. (2021); Schröder et al. (2020)
Public Awareness Limitations	Insufficient stakeholder awareness, participation, or behavioral engagement in CE practices.	- Public awareness of CE principles - Citizen participation in recycling and waste separation	5-point Likert scale	Joensuu et al. (2020); UNEP (2022); Sugiura et al. (2021)
Sectoral Prioritization	Variation in perceived relevance of CE strategies across economic sectors.	- Ranking of priority sectors for CE intervention (waste, construction, energy, etc.)	Ranking scale	Williams (2019); Bourdin & Torre (2025)
Policy Expectations	Stakeholder perceptions regarding feasibility of achieving CE-related policy targets.	- Likelihood of achieving national waste diversion targets - Expected increase in recycling rates by 2030	Ordinal categorical responses	European Commission (2020); Chembessi et al. (2024)

All constructs were measured using a structured questionnaire developed deductively from the literature-based conceptual framework. Items were refined through expert pre-testing prior to deployment. Internal consistency reliability was assessed using Cronbach's alpha, with all multi-item constructs exceeding the acceptable threshold of 0.70 (Hair et al., 2019). Construct validity was examined through principal component analysis (PCA) with Varimax rotation, and sampling adequacy was confirmed using KMO and Bartlett's tests.

Appendix B. Principal Component Analysis and Reliability Diagnostics

This appendix reports construct validity and internal consistency diagnostics for the analytical dimensions used in the study. Principal Component Analysis (PCA) with Varimax rotation was employed to identify latent institutional dimensions underlying systemic barriers and enabling conditions. Reliability was assessed using Cronbach's alpha.

Table B1. Sampling Adequacy and Factorability

Diagnostic Test	Value	Threshold	Interpretation
Kaiser–Meyer–Olkin (KMO) Measure	0.842	> 0.60	Sampling adequacy confirmed
Bartlett's Test of Sphericity	$\chi^2 = 612.37$, $p < 0.001$	$p < 0.05$	Correlation matrix suitable for factor analysis

The KMO value indicates meritorious sampling adequacy (Hair et al., 2019). Bartlett's test confirms sufficient inter-item correlations to proceed with PCA.

Table B2. Rotated Component Matrix (Varimax Rotation) (Loadings ≥ 0.50 are shown. Cross-loadings < 0.40 are suppressed for clarity.)

Survey Item	Institutional Barriers	Enabling Conditions	Social/Behavioral Conditions
Governance fragmentation	0.781	—	—
Regulatory gaps	0.744	—	—
Funding constraints	0.703	—	—
Technical capacity limitations	0.612	0.422	—
Waste management effectiveness	—	0.814	—
Recycling infrastructure adequacy	—	0.776	—
Public awareness limitations	—	—	0.738
Stakeholder participation	—	—	0.705

Total variance explained: 62.4%

- Component 1 (Institutional Barriers): 28.7%
- Component 2 (Enabling Conditions): 21.3%
- Component 3 (Social/Behavioral Conditions): 12.4%

The factor structure supports the multidimensional conceptualization of CE governance, distinguishing structural institutional constraints from operational enabling conditions and social engagement factors.

Table B3. Reliability Analysis (Cronbach's Alpha)

Construct	Number of Items	Cronbach's Alpha	Interpretation
Institutional Barriers	3	0.81	Good reliability
Enabling Conditions	2	0.78	Acceptable reliability
Social/Behavioral Conditions	2	0.74	Acceptable reliability
Overall Scale	7	0.84	Strong internal consistency

All alpha values exceed the recommended 0.70 threshold (Hair et al., 2019; Nunnally, 1978), indicating satisfactory internal consistency.