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Public Service Innovation in Transforming Waste Management into Green Economy-Based Assets through a Quadruple Helix Approach: A Collaborative Study of Waste Bank–Pegadaian

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Abstract: This study examines public service innovation in transforming household waste management into green economy-based assets through The Gade Clean & Gold program, a collaborative initiative involving Bank Sampah Rukmi, PT Pegadaian, local government actors, community participants, and academics within a Quadruple Helix framework in Gunung Anyar, Surabaya. The background problem centers on the limitations of conventional final-disposal-oriented waste governance, the fragile sustainability of community waste banks when economic incentives are weak, and the absence of an integrated coordination platform among public, business, community, and academic actors. This research aims to analyze multi-stakeholder collaboration dynamics, evaluate the quality of waste-to-gold service innovation, and clarify the differentiated contributions of each Quadruple Helix pillar. A qualitative case-study design was applied through in-depth interviews with seven purposively selected informants, field observation, and document analysis. Data were analyzed using the interactive model of Miles, Huberman, and Saldana, while validity was strengthened through source triangulation, technique triangulation, member checking, and saturation-based verification. The findings show that the collaboration has produced measurable outcomes, including 847 active customers and 12.4 tons of managed waste per year, exceeding the annual target by 55%. However, the program still faces capacity imbalance, limited rapid-response communication, digital literacy gaps, and weak formal institutionalization. The study concludes that The Gade Clean & Gold program has generated a promising green-economy service model, yet its sustainability depends on formal regulation, an integrated monitoring dashboard, and a stronger multi-actor coordination mechanism.

Keywords: Public Service Innovation, Waste Bank, Green Economy.

INTRODUCTION

Global waste management currently faces crucial challenges along with the increasing volume of domestic waste caused by population growth, rapid urbanization, and unsustainable consumption patterns (Rahmawati & Fiorentina, 2021). The ecological crisis caused by poorly managed waste accumulation has triggered various negative anthropogenic impacts, including soil and water pollution, greenhouse gas emissions, and a massive decline in public health quality. This condition requires a radical shift in the development paradigm from the conventional linear economic model (take-use-dispose) toward environmentally friendly sustainable development. Based on the Sustainable Development Goals (SDGs), particularly Goal 12 on responsible consumption and production and Goal 13 on climate action, countries worldwide are encouraged to implement green economy policies (Hidayatullah & Fadhliana, 2023). The green economy is defined as an economic system that seeks to improve human well-being and social equity while significantly reducing environmental risks and ecological scarcity. According to Basuki and Liptiay (2024), the global growth rate of urban waste is projected to increase by 70% by 2050 if revolutionary governance measures are not taken. This is reinforced by Masripah et al. (2024), who emphasize the importance of implementing circular economy concepts and integrated environmental governance to align economic growth with the carrying capacity of the environment. At the macro level, the success of this ecological transition depends heavily on the capacity of public administration to formulate adaptive, dynamic, and inclusive regulatory governance and environmental services for all stakeholder groups.

In Indonesia, the commitment to transition toward green economy-based sustainable development is formally embodied in Presidential Regulation Number 97 of 2017 concerning the National Policy and Strategy for the Management of Household Waste and Waste Similar to Household Waste (Jakstranas). This national regulation sets ambitious targets, namely a 30% reduction in waste and 70% comprehensive waste handling by 2025. Although regulations and legal frameworks have been systematically formulated, waste management practices at the regional level still face acute structural barriers. Conventional waste management systems that are centralistic and highly dependent on final processing sites (TPA) using open dumping have proven to trigger socio-ecological crises in various regions. According to Nguyen and Marques (2022), limited landfill capacity and the frequent occurrence of landfill fires due to methane gas accumulation demonstrate the fatal failure of conventional waste governance. This empirical reality requires the decentralization of waste management, emphasizing waste reduction directly from the source through participatory public service innovation. In this context, the Waste Bank program emerges as a community-based social innovation that facilitates independent household waste sorting. Dewi et al. (2024) reveal that the failure of conventional waste handling strengthens the urgency of revitalizing Waste Banks as a primary pillar of upstream environmental services. This is in line with Suryani et al. (2022), who affirm that the existence of Waste Banks can transform domestic waste into high-value recycled industrial materials while shaping environmentally conscious character among grassroots communities.

The development of Waste Banks in Indonesia cannot be separated from operational constraints that threaten their sustainability, ranging from low consistency in customer participation and limited local institutional capacity to unstable waste selling prices caused by the monopoly of traditional collectors, which makes economic incentives feel less significant to the community (Riani & Nurhamlin, 2025). This condition is worsened by the financial management of Waste Banks, which is still handled traditionally without synergy with formal financial institutions, thereby limiting service capacity and attractiveness to the wider community (Taufik, 2021). To address this gap, PT Pegadaian launched The Gade Clean & Gold program, which converts customers' waste savings balances into gold investment grams

while introducing formal financial inclusion at the household level. To ensure that this innovation is sustainable and has broad impact, multi-actor involvement is required through the Quadruple Helix approach, which synergizes the Government as regulator, PT Pegadaian as provider of financial access, the Waste Bank as the driver of local participation, and academics as knowledge transfer agents, as visualized in Figure 1 below:

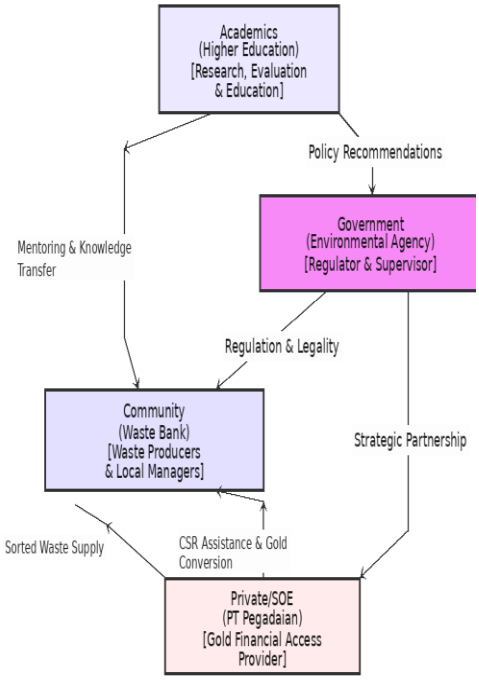


Figure 1. Quadruple Helix Collaboration Model in Waste-to-Gold Service Innovation

Figure 1 illustrates a multifaceted cooperation model that not only focuses on the dimension of waste management but also highlights mutually beneficial working relationships (win-win collaboration). Conceptually, this cross-sector relationship aligns with the shift in contemporary public administration from New Public Management (NPM), which is oriented toward market efficiency, to New Public Governance (NPG), which emphasizes collaboration, public participation, and policy network integration. From the perspective of Collaborative Governance theory, as emphasized by Ulibarri et al. (2023), the success of cross-sector public services depends heavily on face-to-face dialogue, trust building, shared commitment to goals, and the achievement of concrete intermediate outcomes. Although the collaboration between the Waste Bank and PT Pegadaian through The Gade Clean & Gold program offers significant potential to accelerate the green economy, prior studies have generally examined waste banks as community empowerment initiatives, digital waste-bank applications, or corporate social responsibility programs in isolation. The literature has not sufficiently explained how waste-bank operations, formal gold-based financial inclusion, local public-service innovation, and academic facilitation interact as one collaborative governance system. This creates a theoretical gap because the Quadruple Helix framework is often invoked as a descriptive model, but its internal coordination weaknesses, actor asymmetries, and operational implications for public service sustainability remain underexplored in the waste-management context.

This study differs from previous research by treating the waste-to-gold program not merely as a recycling activity or a CSR instrument, but as a public service innovation that converts environmental participation into a long-term household asset. The empirical focus on Bank Sampah Rukmi in Kelurahan Gunung Anyar Tambak, Kecamatan Gunung Anyar, Surabaya, strengthens the novelty of the study because the case links urban neighborhood-

based waste sorting, women's PKK participation, and PT Pegadaian's financial platform within a localized collaborative governance ecosystem. Theoretically, the study contributes to Collaborative Governance scholarship by showing that collaboration quality is determined not only by the presence of multiple actors, but also by the ability to synchronize their decision cycles, data systems, and accountability mechanisms. Practically, the findings provide a governance model for local governments and state-owned enterprises to institutionalize waste-bank innovation through formal regulation, shared monitoring, and inclusive digital assistance for communities with unequal literacy levels.

Collaborative Governance is a central concept in contemporary Public Administration, defined by Ansell and Gash (2008) as a governance arrangement in which public agencies directly involve non-state stakeholders in a formal, consensus-oriented collective decision-making process aimed at formulating public policy and creating shared accountability among all parties involved. This framework was expanded by Emerson, Nabatchi, and Balogh (2012), as discussed by Sørensen and Torfing (2021), through Collaborative Governance Regimes (CGR), which incorporate the external system context as a factor that influences collaboration dynamics. Its relevance in the context of government-private-community partnerships in Indonesia has been confirmed by Wirawan and Yandri (2023) and strengthened by Bjärstig et al. (2024), who found that the quality of inter-party dialogue and trust building is the most significant determinant of long-term collaboration success. The Ansell and Gash model itself contains four interdependent cyclical dimensions: starting conditions, institutional design, facilitative leadership, and collaborative process. Weak facilitative leadership has been shown to be a major factor in the failure of Waste Bank programs in various regions because no actor actively bridges differences in interests between local managers and institutional partners.

Public service innovation is a comprehensive transformation that touches the dimensions of values, processes, products, and the ways public services are organized and delivered to society, not merely technological change. Everett Rogers (2003) established its measurement basis through five fundamental attributes that determine the level of innovation adoption: relative advantage, compatibility, complexity, trialability, and observability. This framework was later adapted by LAN RI and the Ministry of Administrative and Bureaucratic Reform by adding the dimensions of sustainability, usefulness, and replicability as evaluation criteria for public sector innovation. A successful innovation is not only marked by the novelty of an idea but is more decisively determined by its ability to survive independently after external intervention (Solong, 2020). In the context of The Gade Clean & Gold program, the relative advantage dimension becomes the main driver of adoption because converting waste into gold provides long-term investment value that exceeds conventional cash savings (Aida Alfita et al., 2024), while its novelty is highly confirmed as the first time waste has been directly linked to a precious metal investment instrument through a national-scale formal financial institution.

The Quadruple Helix model was developed by Carayannis and Campbell (2009) from the Triple Helix model of Leydesdorff and Etzkowitz (1995), as cited in Ryan et al. (2023), by adding the dimension of civil society as an active co-creator of innovation rather than merely a passive beneficiary. Its application in Indonesian public administration has been shown to produce higher-quality innovation outcomes and more contextual environmental management solutions compared with unilateral top-down approaches (Carayannis & Campbell, 2021). In this study, its effectiveness is measured through the contribution of four pillars: the government as regulator, academics as evidence-based evaluators, PT Pegadaian as provider of financial infrastructure, and the community as active participants, as well as the coordination synergy among pillars, which is often hindered by the absence of a structured communication platform (Nguyen & Marques, 2022).

METHODS

This study employed a qualitative approach with an analytical descriptive type and a case study strategy because the collaboration among public institutions, PT Pegadaian, community waste-bank actors, and academics is contextual, multi-layered, and cannot be adequately explained through statistical measurement alone. The research location was Bank Sampah Rukmi in Kelurahan Gunung Anyar Tambak, Kecamatan Gunung Anyar, Surabaya, which was selected because this waste bank is directly associated with socialization and education activities involving PKK Kecamatan Gunung Anyar, PT Pegadaian, and Bank Sampah Rukmi. This location therefore represents a relevant site for examining waste-bank innovation as a public service practice connected to green economy-based asset formation (Prisma Kartini Surabaya, 2025). Informants were selected through purposive sampling based on three criteria: direct involvement in The Gade Clean & Gold program, possession of institutional or operational knowledge about waste-bank management, and ability to explain either policy, business, community, or academic perspectives. The selection process began by mapping the four Quadruple Helix pillars, then identifying key actors within each pillar who were most closely involved in planning, implementation, monitoring, or service use.

Table 1. Characteristics of Key Informants and Reasons for Selection

Code	Position/Institution	Role in the Program	Reason for Selection
I-1	Surabaya City Environmental Agency / local government representative	Regulatory support, supervision, and linkage with local waste-management policy	Provides information on policy alignment, institutional support, and regulatory constraints
I-2	Kecamatan Gunung Anyar / local administrative liaison	Coordination with PKK and neighborhood-level community structures	Explains local facilitation, socialization channels, and community mobilization
I-3	PT Pegadaian representative	Gold-conversion platform, financial literacy, and CSR/TJSL implementation	Explains business incentives, service mechanisms, and institutional sustainability
I-4	Bank Sampah Rukmi manager	Daily waste-bank operations, customer recording, and waste collection coordination	Provides operational evidence on capacity, record keeping, and field constraints
I-5	Active waste-bank customer / PKK participant	Service user and household waste sorter	Represents user perception, adoption motivation, and practical service experience
I-6	Neighborhood coordinator / community volunteer	Community scheduling, communication, and informal monitoring	Explains bottom-up participation and peer-to-peer coordination
I-7	Academic / Public Administration researcher	Evaluation, knowledge transfer, and analytical interpretation	Provides theoretical reflection on Collaborative Governance and Quadruple Helix implementation

Data saturation was achieved after the seventh informant because the interviews no longer produced substantially new categories beyond capacity imbalance, financial-inclusion incentives, digital literacy barriers, rapid-response limitations, and the need for institutional regulation. Field notes and interview summaries were compared after each interview so that emerging themes could be confirmed, refined, or challenged in subsequent interviews. Data

collection combined in-depth interviews, non-participant observation of waste-bank service activities, and document analysis of program reports, public information, and institutional materials. Source triangulation was conducted by comparing statements from government, PT Pegadaian, waste-bank managers, customers, and academics, while technique triangulation was conducted by cross-checking interview findings with observation notes and documentary evidence. Member checking was implemented by returning interview summaries and preliminary interpretations to selected informants for confirmation. This procedure was used to reduce misinterpretation, verify institutional terms, and ensure that the interpretation of collaboration dynamics remained consistent with the experiences of actors directly involved in the program.

RESULTS AND DISCUSSION

The analysis of The Gade Clean & Gold program is organized according to the main dimensions of Collaborative Governance proposed by Ansell and Gash, namely starting conditions, institutional design, facilitative leadership, and collaborative process. The discussion then connects these dimensions with public service innovation attributes and the Quadruple Helix roles of government, business, civil society, and academia. This structure is used to prevent the findings from becoming a mere collection of interview quotations and to emphasize the causal relationship between empirical conditions, actor behavior, and governance implications. The starting condition of the collaboration shows a clear capacity imbalance between PT Pegadaian as a formal state-owned financial institution and Bank Sampah Rukmi as a community-based organization. PT Pegadaian controls digital infrastructure, financial procedures, and formal service standards, whereas the waste bank depends heavily on voluntary labor, manual records, and limited collection facilities. This imbalance does not automatically invalidate the collaboration, but it creates a risk of asymmetric agenda setting when weaker actors are not supported through capacity-building and simplified operational guidelines.

The incentive structure explains why the collaboration can continue despite this imbalance. PT Pegadaian gains an expanded customer base, CSR/TJSL legitimacy, and a socially embedded channel for gold-based financial inclusion. Local government actors obtain support for source-based waste reduction without carrying the entire operational cost. Bank Sampah Rukmi receives a stronger value proposition because waste deposits are not only exchanged for short-term cash but also converted into a more durable asset. These reciprocal incentives form a functional basis for collaboration, although they still require formal safeguards to prevent dependence on individual leaders or temporary program enthusiasm.

Institutional design remains the weakest governance dimension. The field findings indicate that participation is already present at the implementation level, but not all actors are equally involved in designing procedures, escalation mechanisms, and evaluation indicators. In Collaborative Governance terms, this shows that inclusiveness must be measured not only by attendance in coordination forums but also by equal influence over rules, service standards, and problem-solving channels. Without a more inclusive design, the program may continue to operate but remain vulnerable to misunderstanding, data inconsistencies, and slow responses to operational disruption. Facilitative leadership has emerged through periodic coordination and financial-literacy activities, yet the leadership function is still episodic rather than continuous. Quarterly meetings are useful for evaluation, but the operational rhythm of waste collection, customer complaints, and digital transaction updates occurs weekly or even daily. This mismatch produces a governance gap: strategic coordination exists, but rapid-response coordination is still underdeveloped. The implication

is that small technical problems, such as delayed collection or balance-record discrepancies, can reduce user trust if they are not resolved quickly.

The collaborative process has generated trust-building and shared understanding among actors, particularly through face-to-face meetings, community socialization, and repeated service use. However, trust is still more relational than institutional. Participants trust specific managers, field officers, or community coordinators, but the program has not yet been fully protected by binding local rules and a shared monitoring system. This finding supports Ulibarri et al. (2023), who argue that environmental collaboration becomes durable only when dialogue and trust are converted into stable procedures and measurable intermediate outcomes. The most visible intermediate outcomes are the growth of active customers and the volume of managed waste. The reported achievement of 847 active customers and 12.4 tons of managed waste per year, exceeding the target by 55%, indicates that the program has moved beyond symbolic CSR and has produced tangible environmental and economic outputs. Nevertheless, these figures should be interpreted as an early sign of effectiveness rather than definitive proof of sustainability, because long-term performance still depends on institutionalization, digital inclusion, and routine inter-actor accountability.

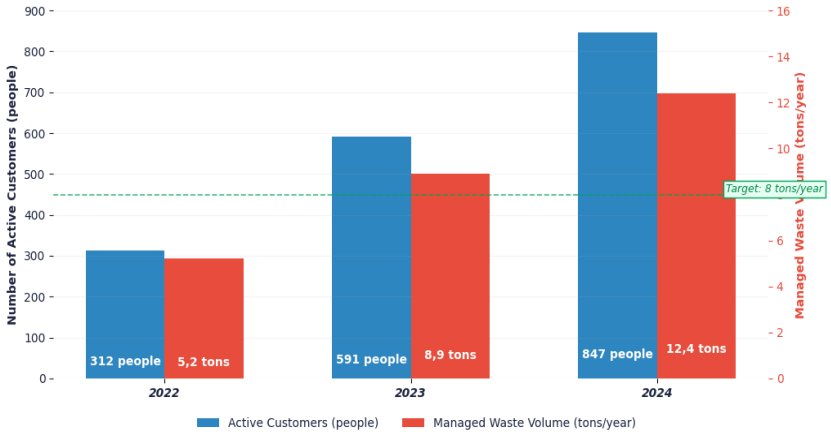


Figure 2. Development of The Gade Clean & Gold Program Achievements, 2022–2024

Figure 2 indicates that the program's achievements are not incidental but follow a cumulative adoption pattern. Growth in the number of customers suggests increasing public acceptance of waste-to-gold conversion, while the rising volume of managed waste shows that the innovation has begun to change household disposal behavior. From Rogers's innovation perspective, the program's relative advantage lies in its ability to transform waste from a low-value recyclable commodity into a visible long-term savings instrument. Its compatibility is also strong because gold is widely understood by Indonesian households as a secure and familiar form of saving. The innovation's main limitation lies in complexity. Customers who are familiar with digital applications can monitor balances more easily, but digitally vulnerable users depend on waste-bank managers to interpret transaction records and explain gold-balance conversion. This condition shows that technological innovation in public service is not automatically inclusive. The service becomes genuinely public only when the digital system is accompanied by assisted access, simple manuals, and community-based help desks.

Sustainability is also constrained by the absence of formal local institutionalization. At present, the program relies strongly on the commitment of PT Pegadaian officers, waste-bank managers, PKK networks, and local facilitators. Such commitment is valuable, but it is insufficient as a long-term governance guarantee. A Mayor Regulation or formal cooperation framework is needed to define actor responsibilities, minimum service standards, data-sharing procedures, and the role of the local government in monitoring and scaling the

program. Within the Quadruple Helix framework, each actor contributes a distinct resource. Government provides legitimacy, local coordination, and alignment with waste-reduction policy. PT Pegadaian provides the financial platform, gold-conversion mechanism, and financial-literacy support. The community, represented by Bank Sampah Rukmi, PKK members, and neighborhood coordinators, provides daily participation, waste sorting, and informal communication networks. Academia contributes evaluation, knowledge transfer, and evidence-based recommendations for improving collaboration design.

The findings differ from earlier waste-bank studies that mainly emphasize community empowerment or application development. In this case, the central innovation is not only the existence of a waste bank, but the integration of waste sorting with formal asset formation through gold savings. Compared with studies on digital waste banks, this case shows that technology must be embedded in social facilitation. Compared with studies on CSR-based waste programs, this case demonstrates that CSR becomes more sustainable when it is connected to public service governance and local community co-production. The main implication is that the program should not be expanded merely by increasing the number of customers. Scaling must be accompanied by governance upgrading. The most urgent improvements are a rapid-response protocol for operational problems, a simplified digital-assistance mechanism, a shared dashboard for tracking waste volume and gold-balance conversion, and a formal multi-actor forum that meets more frequently than quarterly when operational risks emerge.

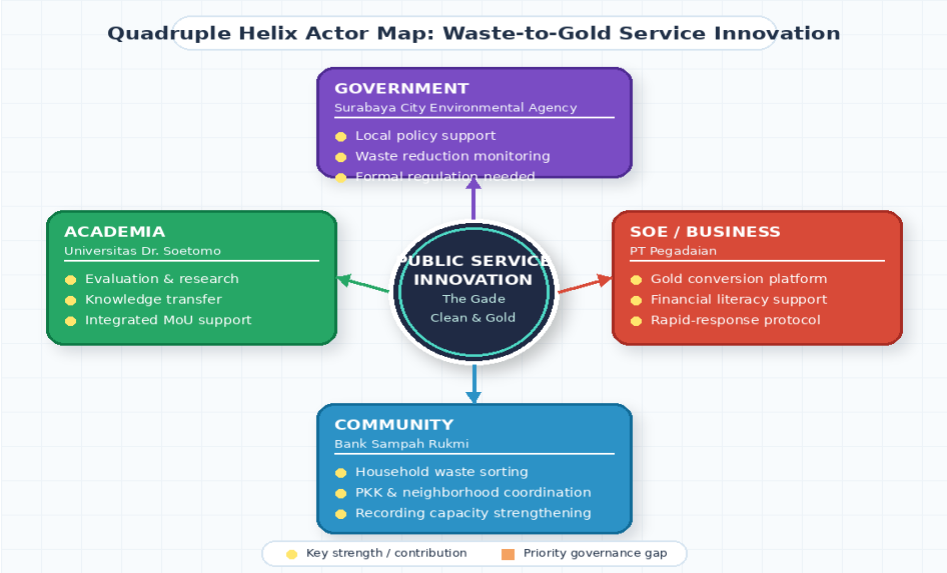


Figure 3. Map of Actor Contribution Strengths and Barriers in the Quadruple Helix Ecosystem

Figure 3 summarizes the differentiated strengths and barriers of each actor in the Quadruple Helix ecosystem. The figure confirms that the problem is not the absence of actors, but the lack of an integrated coordination mechanism that can align their different working rhythms. Government actors follow policy and reporting cycles, PT Pegadaian follows business and CSR performance cycles, the waste bank follows weekly operational cycles, and academics follow research and mentoring cycles. Therefore, the most important governance recommendation is the creation of a shared platform that translates these different cycles into coordinated decisions, measurable indicators, and timely corrective action.

CONCLUSION

This study concludes that The Gade Clean & Gold program at Bank Sampah Rukmi, Gunung Anyar, Surabaya, has demonstrated the practical value of Collaborative Governance

in transforming household waste management into green economy-based assets. The main findings show that the collaboration has produced measurable environmental and economic outcomes, including 847 active customers, 12.4 tons of managed waste per year, and an achievement level exceeding the annual target by 55%. These outcomes indicate that waste-bank innovation can move beyond environmental awareness campaigns when it is linked to formal financial inclusion and tangible household asset accumulation. The theoretical contribution of this study lies in clarifying that Quadruple Helix collaboration is not determined solely by the presence of government, business, community, and academic actors, but by the degree to which their resources, decision cycles, and accountability mechanisms are integrated. The study extends Collaborative Governance theory by showing that starting-condition imbalance, weak institutional design, episodic facilitative leadership, and incomplete collaborative processes can coexist with strong intermediate outcomes, yet still threaten long-term sustainability if they are not institutionalized.

Practically, the study recommends the formulation of a Mayor Regulation or equivalent local policy instrument, the establishment of a tripartite cooperation framework among local government, PT Pegadaian, and academia, the creation of a shared monitoring dashboard, and the development of inclusive digital-assistance services for customers with limited digital literacy. These recommendations are intended to convert the program from a promising local innovation into a replicable and accountable public service model. The study is limited by its single-case design, its focus on a localized collaboration ecosystem, and its reliance on qualitative informant accounts supported by available program documents. Future research should compare several waste-to-gold programs across different urban and rural settings, measure long-term changes in household income and waste-reduction behavior, and test whether integrated dashboards and formal regulations significantly improve the sustainability of Quadruple Helix-based waste management innovation.

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