

Waste to welfare: village-level circular economy innovation for sustainable environmental governance

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Abstract. Rapid tourism growth in developing countries presents a paradox: it can boost local economies yet often exceeds rural waste-management capacity, driving environmental degradation and uneven welfare gains. This qualitative case study examines how participatory communication and empowerment-oriented institutional design, centred on a Village-Owned Enterprise (BUMDes), enable a waste-to-welfare circular economy innovation in Tamansari Village, Banyuwangi, Indonesia. Data were gathered through participant observation, semi-structured interviews, and document analysis, and analysed using the Communication for Social Change (CFSC) framework. Findings show that sustainable waste management is not solely technical, but a communicative and institutional process unfolding in four linked phases: (1) a catalyst arising from community dissatisfaction with image-led development and unequal welfare distribution; (2) sustained participatory dialogue within BUMDes and across village institutions; (3) collective action integrating a 3R (Reduce–Reuse–Recycle) Waste Processing Facility (TPS3R) with agromaritime livelihoods, including composting and black soldier fly (BSF) maggot cultivation; and (4) continuous participatory evaluation through laboratory tests, demonstration plots, and public feedback. The study highlights a replicable village-level model for circular economy governance.

1 Introduction

Rapid tourism growth in developing countries has produced a distinctive governance paradox: while visitor influxes stimulate local economies, they simultaneously generate waste volumes that routinely exceed rural management capacity, producing cascading environmental and public health consequences [1]. Rural villages on tourism routes, characterised by limited infrastructure, nascent regulatory frameworks, and low institutional capacity, are acutely exposed to this pressure. The influx of visitors, particularly during peak

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seasons, accelerates waste accumulation, soil and water contamination, and disease risk, far outpacing the adaptive capacity of existing governance systems [2, 3]. What makes this crisis especially intractable is that it cannot be resolved through infrastructure investment alone: it is simultaneously a problem of governance architecture, collective behaviour, and institutional incentive design [4].

A structural welfare paradox compounds this waste burden. In many rural tourism destinations, the economic gains from visitor spending accrue disproportionately to external actors, tour operators, non-local businesses, and regional intermediaries, rather than to the resident communities that bear the environmental costs [4]. Residents are thus placed in a position of absorbing negative externalities without commensurate improvements in their livelihoods. Consequently, environmental management programmes, including waste management initiatives, are frequently perceived not as development opportunities but as additional impositions, especially when village governance prioritises symbolic achievement, awards, rankings, and promotional visibility over the tangible welfare concerns of everyday life [3]. This awareness of economic leakage and distributional injustice constitutes a critical, yet underexplored, driver of community motivation to seek alternative governance models for sustainable waste management.

Existing scholarship on rural waste management in developing contexts has generated important insights into infrastructure deficits, weak regulatory enforcement, and limited public awareness [5]. However, this body of work is characterised by a persistent technocentric bias: it predominantly addresses what technical solutions exist and whether communities comply with them, while giving insufficient attention to how communities communicatively construct, negotiate, and institutionalise the governance arrangements that make sustainable waste management viable in the first place [6, 7]. The socio-communicative dimensions of waste governance, how dialogue builds shared understanding, how collective frustration is channelled into institutional reform, and how participatory evaluation embeds social learning remain notably under-theorised [8]. This gap is consequential: governance models designed without understanding these communicative and relational dynamics risk being technically sophisticated yet socially unsustainable, dependent on external enforcement rather than community ownership [9].

A second, related gap concerns the integration of waste management with livelihood systems. Rural circular economy scholarship has advanced our understanding of material flow optimisation and value recovery [10, 11]; yet relatively few studies examine how village-level governance entities design and sustain the institutional arrangements of internal markets, cross-unit coordination, and social pricing schemes that embed circular economy practices within existing livelihood and food security systems [8]. In Southeast Asian contexts specifically, the potential of village-owned enterprise structures as integrative governance platforms for circular economy transitions remains empirically underdocumented.

This study addresses these gaps through a qualitative case study of Tamansari Village, Banyuwangi Regency, East Java, Indonesia, a rapidly expanding tourism destination situated on the primary access route to the Ijen Crater Geopark. The study centres on a community-driven waste-to-welfare innovation: the 3R (Reduce-Reuse-Recycle) Waste Processing Facility (TPS3R), managed through the village's own enterprise structure, Badan Usaha Milik Desa (BUMDes) Tamansari. TPS3R is not simply a waste processing installation: it functions as an integrated node in the village's circular agromaritime system, converting organic waste into compost, liquid fertiliser, and black soldier fly (BSF) maggot feed that directly support village agricultural activities and food security programmes [12]. This 'waste-to-welfare' model, the conversion of waste from an environmental liability into a source of livelihood and community benefit [4], is made institutionally viable by the BUMDes governance

structure, which coordinates multiple village units, regulates an internal market for TPS3R products, and aligns economic incentives with welfare objectives.

To analyse the communicative and institutional processes through which this model was constructed and sustained, the study employs the Communication for Social Change (CFSC) framework [13] as its primary analytical lens. CFSC conceptualises social change as a cyclical, iterative process encompassing four analytically distinct but empirically intertwined stages: catalysis, community dialogue, collective action, and participatory evaluation. This framework is particularly well-suited to the Tamansari case because it foregrounds the communicative dynamics of dialogue, negotiation, shared meaning-making, and reflective learning through which governance innovations gain community ownership, rather than treating social change as the mechanical product of technical design or regulatory mandate.

This study makes three interrelated and explicitly differentiated contributions to the literature. Empirically, it provides one of the first richly documented accounts of a BUMDes-governed circular economy system that operationally integrates waste processing with agromaritime livelihoods within an active Geopark tourism corridor in Eastern Java. This case fills a notable empirical lacuna in the Southeast Asian rural circular economy literature, where village-enterprise governance of integrated waste-livelihood systems remains sparsely documented [8, 10]. Analytically, the study extends the CFSC framework hitherto applied predominantly in health and reproductive communication contexts [13] into the domain of rural environmental governance, demonstrating its productive applicability as a process lens for examining how communities communicatively construct and sustain circular economy transitions. In doing so, it contributes to ongoing theoretical efforts to integrate communication studies, institutional economics, and circular economy scholarship in the analysis of rural sustainability [4, 11]. Practically, the study derives a four-phase governance model, catalyst, dialogue, collective action, and participatory evaluation that is analytically coherent, empirically grounded, and potentially replicable in comparable rural-tourism governance contexts across the Global South. By making this model explicit and critically reflective of its own limitations, the study offers actionable design principles for practitioners, village administrators, and policymakers working on community-based circular economy initiatives.

Specifically, the study examines: (1) what communicative and institutional processes catalysed and sustained the waste-to-welfare transition in Tamansari Village; (2) how BUMDes governance coordinated participatory dialogue and collective action to embed TPS3R within the village's agromaritime development system; and (3) what lessons the Tamansari model offers for the design of community-empowering circular economy governance in rural tourism contexts. The remainder of the paper is structured as follows. Section 2 describes the methodology and analytical framework. Section 3 presents findings and discussion organised according to the four CFSC phases, followed by five cross-cutting thematic discussions. Section 4 concludes and identifies directions for future research.

2 Methodology

This study employed a qualitative case study design to gain a deep understanding of the processes, interactions, and meanings constructed by the actors involved in managing the TPS3R. The research was conducted in Tamansari Village, Licin Subdistrict, Banyuwangi Regency, East Java Province, Indonesia, a rapidly developing tourist village on the main route to Ijen Crater. The study focused on the TPS3R unit managed by BUMDes Tamansari, which converts waste into a source of livelihood through compost production and BSF maggot cultivation.

Data were collected through a combination of methods, observation, semi-structured interviews, and document analysis. Informants ($n = 6$) were selected purposively to target

key governance actors across all BUMDes units and operational levels. Fieldwork was conducted over a month in August 2025. In the observation, researchers directly participated in TPS3R's daily activities to understand workflows, interactions among actors, and patterns of informal communication and decision-making. Interviews were conducted with key actors at various governance levels, including village heads, directors and managers of BUMDes, TPS3R unit managers and operators, Food Security Unit managers and members, and strategic partners. These interviews aimed to explore policy rationale, participation mechanisms, and perceptions of the social and economic impacts of TPS3R. Document analysis was used to strengthen the institutional context and triangulate field findings.

The collected data were analysed iteratively using thematic coding, with the CFSC framework serving as the primary analytical lens. CFSC views social change as a result of participatory communication that unfolds through stages of change catalysis, community dialogue, and collective action, which includes participatory evaluation [13]. It was used to analyse how communication among BUMDes, TPS3R managers, and village communities fostered understanding, coordinated roles, and enabled waste management to develop into a waste-to-welfare model. To further enhance the analysis, stakeholder mapping and tracing of communication patterns were used to understand power relations, information flows, and collaboration dynamics within the BUMDes-TPS3R system.

3 Results and discussion

This section presents findings organised according to the four phases of the Communication for Social Change (CFSC) framework [13], followed by five cross-cutting thematic discussions.

Table 1. Stakeholder map of the TPS3R–BUMDes Tamansari system

Actor / Stakeholder	Role in TPS3R-BUMDes System	Key Resources	Primary Incentives	Main Communication Channel	CFSC Phase(s)
Village Head (Kepala Desa)	Policy authorisation; budget allocation; inter-institutional coordination	Formal governance authority; Dana Desa (village fund) allocation of power	Political legitimacy, community welfare mandate, village development indicators	Village deliberation (musyawarah); official correspondence; WhatsApp group	Catalyst; Collective Action enabler
BUMDes Director	Strategic coordination across all BUMDes units; external partnership management	Institutional platform; inter-unit network; access to village fund and external grants	Enterprise sustainability; village income diversification; empowerment mandate	BUMDes deliberation forums; direct communication (phone/WhatsApp); monthly reports	Catalyst; Dialogue facilitator
TPS3R Unit Manager (OSA)	Operational leadership; technical innovation; community empowerment facilitation	Technical waste management knowledge, community trust, and personal leadership network	Ideological commitment to 'waste as blessing'; community welfare improvement	Daily operational briefings; social media (Instagram/Facebook); direct mentoring	Primary catalyst; Dialogue initiator; Collective Action driver

Table 1. Stakeholder map of the TPS3R–BUMDes Tamansari system (*continued*)

Actor / Stakeholder	Role in TPS3R-BUMDes System	Key Resources	Primary Incentives	Main Communication Channel	CFSC Phase(s)
TPS3R Operators (local community members)	Daily waste collection, sorting, composting, and BSF maggot cultivation	Labour capacity; tacit operational knowledge; community social networks	Steady wage (est. IDR 50,000/day); skill acquisition; stable employment	Operational briefings; informal peer communication; neighbourhood (RT/RW) meetings	Collective Action implementers; Participatory Evaluation participants
Food Security Unit (BUMDes)	Internal purchaser of TPS3R organic fertiliser; demonstration plot management	Agricultural land; farmer networks; subsidised input access	Low-cost fertiliser (IDR 1,000/kg vs IDR 3,000 market); food security goals	Inter-unit BUMDes coordination meetings; demonstration plot activities	Collective Action partner; Participatory Evaluation participant
Tourism Unit Manager (TPK)	Tourism revenue management, welfare advocacy, and critical assessment of image-led development	Visitor data, stakeholder network, community communication credibility	Equitable distribution of tourism benefits; reduced community dissatisfaction	Village forums; public accountability reporting; inter-unit BUMDes meetings	Catalyst (dissatisfaction voice)
Village Households (waste producers & TPS3R service users)	Waste source separation; service fee payment; TPS3R product consumers	Waste as raw material; service fee revenue; collective social pressure	Clean environment; subsidised compost and organic fertiliser; community social norms	Neighbourhood (RT/RW) meetings; TPS3R socialisation events; informal networks	Dialogue participants, Collective Action base, Evaluation feedback source
Ijen Geopark / Banyuwangi Regency Partners	Technical guidance; institutional legitimacy; regional circular economy policy linkage	Geological and environmental expertise; policy networks; legitimation authority	Regional circular economy development; Geopark sustainability credentials	Official visits; technical training programmes; formal partnership agreements	Catalyst (external policy enabler); Participatory Evaluation validator

Source: Authors' fieldwork (participant observation, semi-structured interviews, and document analysis). CFSC phase coding based on Figueroa *et al.* [13].

Table 1 maps eight actor categories whose communicative interactions and resource exchanges constitute the governance architecture of TPS3R. Three analytical observations are immediately evident. First, the system is characterised by a multi-level governance structure: formal authority (Village Head and BUMDes Director) operates alongside operational leadership (TPS3R Unit Manager) and community-level participation (operators and households), with different actors occupying different CFSC phases. Second, incentive heterogeneity is structurally significant: actors are motivated by combinations of ideological commitment, economic benefit, and social norm rather than by any single incentive, suggesting that the system's resilience derives from this diversity rather than from uniform compliance. Third, communication channels are layered and informal-dominant: while

formal forums (village deliberation, BUMDes coordination meetings) provide institutional anchors, the majority of coordination occurs through informal, continuous, and technology-mediated channels (WhatsApp groups, social media, direct mentoring), which are central to the system's adaptive capacity.

3.1 Phase 1 - Catalyst: from image-oriented development to waste-to-welfare

The CFSC framework posits that social change is triggered by catalyst forces or conditions that generate sufficient discontent or aspiration to initiate dialogue and collective action [13]. In Tamansari Village, the catalyst for governance innovation was not the physical presence of waste per se. Still, a complex, layered accumulation of social dissatisfaction rooted in the perceived injustice of image-oriented development, unequal distribution of tourism benefits, and the failure of previous BUMDes models to improve residents' livelihoods.

Multiple, convergent data sources support this claim. The Tourism Unit Manager (TPK) articulated community frustration directly: 'The community is dissatisfied, as prior development efforts have focused on enhancing the village's image and recognition, while tangible issues such as infrastructure and the clean water crisis remain unaddressed' (TPK, Tourism Unit Manager). Structural conditions reinforced this dissatisfaction: Tamansari Village received multiple digital village awards, yet its tourism revenue accrued predominantly to external operators, generating what informants consistently described as 'benefit leakage'. Documentary evidence from BUMDes planning minutes confirms that the 2019 strategic reorientation explicitly framed TPS3R as a response to this welfare gap, not as an environmental compliance measure.

These findings support and extend the CFSC proposition that endogenous catalysts rooted in local agency are more durable drivers of social change than externally imposed mandates [13]. The Tamansari catalyst is analytically distinctive in that it was ideologically mediated: TPS3R Unit Manager OSA's 'waste-as-blessing' philosophy reframed the governance problem from technical waste management to livelihood justice, transforming collective frustration into a constructive institutional vision. This ideological mediation function, rarely documented in the rural waste management literature, explains why the Tamansari case achieved community ownership rather than mere compliance [6, 8].

3.2 Phase 2 - Community dialogue: negotiating roles, rules, and responsibilities

Dialogue in Tamansari Village occurred through two interconnected and mutually reinforcing levels: internal organisational deliberation within BUMDes and community-level socialisation and negotiation, converting initial dissatisfaction into shared governance arrangements regarding roles, rules, and responsibilities.

At the organisational level, OSA confirmed the deliberative norm: 'Every action is preceded by consultation with the BUMDes Director and Village Head to ensure decisions are not made unilaterally' (OSA, TPS3R Unit Manager). Participatory observation confirmed that monthly BUMDes coordination meetings routinely included standing agenda items on TPS3R performance, service fee structures, and inter-unit resource allocation, institutionalising dialogue as a governance practice rather than a one-off event. At the community level, socialisation events documented in attendance records and meeting minutes show iterative negotiation of waste sorting protocols, collection schedules, and fee structures calibrated to household capacity and willingness to participate.

This layered dialogue pattern reflects CFSC's conceptualisation of dialogue as a relational and iterative, rather than procedural and episodic, process [13]. Crucially, however, the evidence also reveals an important tension: while dialogue was extensive at the vertical

(leadership-to-operator-to-household) level, horizontal participation, particularly in the initial institutional design of TPS3R's governance rules, was constrained by the leadership group's prior ideological commitment. This confirms the CFSC literature's warning that strong leadership vision can inadvertently compress the participatory space it intends to enable [9]. Future iterations of this model should prioritise structural mechanisms for horizontal dialogue, particularly around cost-sharing and long-term responsibility allocation [12].

3.3 Phase 3 - Collective action: operationalising waste-to-welfare

TPS3R operationalised waste-to-welfare through an institutionally anchored circular agromaritime system in which collective action was embedded within BUMDes cross-unit governance, giving circular economy practices structural durability and enabling equitable benefit distribution.

The operational scale of TPS3R is contextualised in Figure Box 1 below, which presents informant-reported estimates of key operational indicators.

Figure Box 1. TPS3R Tamansari Informant-Reported Operational Data (Phase 3 Descriptive Context)		
Indicator	Reported Value / Range	Source / Note
Daily waste volume processed	Approx. 300-500 kg/day	Informant estimate: OSA interview + observation
Households served (waste collection)	Approx. 150-200 households	OSA interview; cross-checked with village records
Collection frequency	Daily (6 days/week)	Operational schedule; confirmed by observation
Compost output (organic fraction)	Approx. 50-80 kg/day (solid)	Informant estimate; OSA interview
Liquid fertiliser (leachate) output	Approx. 20-40 litres/day	Informant estimate; OSA interview
BSF maggot production revenue	Est. IDR 100,000 - IDR 150,000/day	OSA interview (explicit figure quoted)
Operator wage rate	IDR 50,000/person/day	OSA interview (explicit figure quoted)
Number of operational staff (residents)	4-6 persons	Observation: OSA interview
Subsidised fertiliser price (internal market)	IDR 1,000/kg (vs IDR 3,000 market)	Document: Food Security Unit purchase records
External liquid fertiliser price (premium)	IDR 5,000-10,000/litre (indicative)	OSA interview
Programme start year (TPS3R–Food Security Unit link)	2019	Document: BUMDes planning minutes
<i>Note: All figures are informant-reported estimates from fieldwork (semi-structured interviews and participatory observation). They are presented as indicative ranges consistent with the qualitative design of this study and should not be interpreted as precise measured quantities.</i>		

Participatory observation confirmed daily operations: waste separated into organic and inorganic fractions; organic waste processed into compost, liquid fertiliser (leachate), and BSF maggot feed. The mandatory internal market requiring the Food Security Unit to purchase TPS3R organic fertiliser at a subsidised price of IDR 1,000/kg, against an open-market price of IDR 3,000/kg, was documented in Food Security Unit purchase orders and confirmed in interviews. This institutional pricing mechanism ensures demand stability and operationalises the equitable benefit distribution principle. OSA's explicit statement, 'The proceeds from maggot sales of IDR 150,000/day are utilised not only for operational costs

but also to enhance empowerment by creating job opportunities with a wage of IDR 50,000/day,' confirms the empowerment-over-profit logic embedded in operational design. The BUMDes organisational chart documents TPS3R's integration as a unit within the larger BUMDes structure rather than as a standalone programme, confirming institutional embeddedness.

The combination of a daily wage of IDR 50,000 per operator against an estimated daily maggot revenue of IDR 100,000-150,000 suggests a deliberate surplus-sharing architecture: operational costs are covered, workers receive a living wage, and residual revenue is available for reinvestment and product development. The subsidised internal price for compost (IDR 1,000 vs IDR 3,000/kg) further confirms that the circular economy design in Tamansari is distributionally intentional rather than merely technically efficient [4]. This aligns with institutional theory's proposition that sustainable circular economy initiatives require governance architectures capable of coordinating material flows, actor incentives, and welfare objectives simultaneously [8, 11].

3.4 Phase 4 – Participatory evaluation and learning: building trust and sustainability

Evaluation in Tamansari Village was embedded in everyday practice, laboratory testing, demonstration plot comparisons, and social media documentation, functioning as a continuous social learning process that generated community trust and adaptive capacity without relying on formal technocratic instruments.

Laboratory test reports on the nutrient content of compost and liquid fertiliser were shared with BUMDes and external buyers as technical validation documents. Demonstration plots managed by the Food Security Unit served as live evaluation sites: farmers conducted informal visual comparisons of TPS3R-fertilised plots with prior inputs and openly discussed outcomes in neighbourhood meetings. OSA described social media activities as a reflexive evaluation mechanism: 'Social media posts on TPS3R activities elicit enquiries, comments, and acknowledgements from external parties', which informants described as motivating performance reflection and public accountability. Observational data from BUMDes meetings also documented reflective discussions on leadership succession, knowledge institutionalisation, and BSF maggot skill transfer to younger community members.

The practice-embedded character of evaluation in Tamansari is analytically significant for three reasons. First, it generated social legitimacy through tangible and observable evidence (field trial comparisons, visible crop improvements) that carried greater persuasive force with rural communities than abstract indicator reports [13]. Second, public documentation through social media created an informal social accountability mechanism that operated beyond the BUMDes community boundary, extending community oversight to external publics. Third, the reflective discussions on leadership succession represent a qualitatively important form of strategic evaluation, in which actors assess the institutional sustainability of their own governance model, a form rarely captured in formal evaluation frameworks but central to CFSC's social learning conception [9, 13]. The key vulnerability identified is the absence of systematised succession and knowledge management protocols, leaving TPS3R's sustainability dependent on specific individuals [14].

3.5 Repositioning rural waste management beyond technocentric approaches

The Phase 1 findings confirm that the initial catalyst in Tamansari was rooted in social dissatisfaction and governance failure rather than in the physical presence of waste. Dissatisfaction with image-oriented development, leakage of tourism benefits, and welfare disparities encouraged the search for grounded, community-oriented solutions [15]. These

conditions confirm that rural waste management cannot be understood solely as a technical problem; it is simultaneously a social, institutional, and distributional issue [5].

This pattern aligns with critiques of technocentric approaches, which frequently overlook the social, political, and empowerment dimensions of sustainability efforts [6]. An excessive emphasis on infrastructure and technology risks failing to address the fundamental questions of participation, justice, and shared ownership [7]. The Tamansari case demonstrates that perceptions of inequity can serve as powerful catalysts: collective frustration, when institutionally channelled, becomes a source of social energy for constructive governance reform rather than passive resistance [8, 13]

3.6 CFSC as a process lens: from leadership vision to community ownership

The CFSC framework's analytical value in the Tamansari case lies in its capacity to make communicative dynamics visible as governance mechanisms rather than merely background context. Phase 1 confirms CFSC's emphasis on endogenous catalysts and local agency as pivotal drivers of social change [13]. Phase 2 demonstrates CFSC's transition from unilateral communication to negotiated understanding and collaborative rule-making. Phase 3 shows that collective action is most durable when institutionally anchored rather than dependent on voluntarism. Phase 4 confirms that social learning, embedded in practice, is the primary mechanism sustaining community ownership over time.

However, the evidence also surfaces a structural tension that the CFSC literature does not fully anticipate: the co-existence of strong leadership catalysis (essential for initiating change) with the imperative for broad horizontal participation (essential for sustaining ownership). The Tamansari case suggests that this tension is not resolved in the catalyst phase but must be actively managed through deliberate dialogue design in Phase 2 and institutionalised governance mechanisms in Phase 3. This represents a refinement to CFSC's model: the quality of dialogue, particularly its horizontal reach, is as analytically important as its occurrence [9, 12].

3.7 Integrating circular economy and agromaritime development through BUMDes

The collective action phase demonstrates that TPS3R functions as a circular agromaritime hub rather than merely a waste management facility. The conversion of organic waste into compost, liquid fertiliser, and BSF maggot feed exemplifies the core circular economy principles of value recovery, material cycle closure, and local economic retention [8, 10]. The integration of TPS3R products into the village agricultural system through the Food Security Unit creates upstream–downstream circularity that is institutionally rather than market-driven, a governance innovation of particular significance for rural circular economy design in contexts where external market access is limited or volatile.

The agromaritime context amplifies this significance. Rural and coastal food security in Indonesia is acutely sensitive to input affordability and environmental sustainability [8]. Compost and liquid fertiliser from TPS3R reduce chemical input dependency; BSF maggot cultivation diversifies protein feed sources. The Tamansari case confirms that BUMDes can function as a mid-level governance platform that bridges circular economy principles with agromaritime development, a role neither market actors nor government agencies alone are positioned to play in rural village contexts [11].

3.8 BUMDes as empowerment-oriented governance: potentials and limitations

The Tamansari case enriches the discourse on BUMDes governance by demonstrating its capacity to align social, environmental, and economic objectives within a single institutional structure. The transition from profit-seeking to welfare- and empowerment-oriented BUMDes leadership facilitated a more equitable distribution of environmental and economic benefits [15]. The design of internal market linkages and social pricing schemes positions BUMDes not merely as economic entities but as mechanisms for collective organisation and benefit sharing [7].

The study also confirms, however, a significant vulnerability: the effectiveness of TPS3R remains substantially dependent on the vision and technical expertise of specific individuals. This key-person dependency makes the sustainability of innovation fragile unless complemented by the institutionalisation of procedures, collective capacity building, and succession planning [9, 14]. This is the primary structural risk identified in the Tamansari model and represents the most urgent practical design implication for replication contexts.

3.9 Participatory evaluation as embedded learning

The Phase 4 findings suggest that formal evaluation instruments are neither necessary nor sufficient for generating community trust and adaptive learning in community-based circular economy initiatives. Practice-embedded evaluation laboratory tests, demonstration plots, and social media documentation generated empirically grounded, socially credible evidence that formal indicator frameworks often fail to produce in rural contexts [8, 9].

The analytical implication is significant: the persuasive power of evaluation derives not from its technical rigour alone but from its observability and participatory accessibility to the communities whose behaviour it aims to influence [13]. Visible evidence, such as a healthier crop, a better-nourished fish pond, and a social media post demonstrating product quality, engages community cognition more effectively than abstract sustainability indicators. Designing evaluation systems that are observable, relational, and embedded in everyday practice is therefore not a methodological compromise but a deliberate governance strategy for community-based sustainability initiatives [11].

3.10 Theoretical and practical implications

The Tamansari case offers a robust demonstration of how the CFSC framework, circular economy principles, and empowerment governance can be integrated in complementary ways to analyse rural sustainability initiatives. While CFSC elucidates the communicative and relational dynamics driving shared awareness and collective action [13], the circular economy clarifies the reorganisation of material flows and local value creation [11]. The study's findings can be further enriched by incorporating additional theoretical perspectives. Social capital theory deepens understanding of how community trust, networks, and norms facilitate participation and cooperation in waste management. In contrast, collective action theory explains how diverse community members overcome individual interests to achieve shared goals. Moreover, institutional theory offers a robust lens through which to analyse BUMDes as institutional actors that shape rules, incentives, and behaviours to integrate environmental management with local livelihoods [8]. Crucially, this multi-framework integration reveals an insight no single theory could produce alone: sustainable community-based circular economy governance requires both institutions that create structural incentives for collective action and communicative processes that build the shared meaning and social trust necessary for those institutions to be genuinely owned rather than merely complied with [7, 9]. These broader theoretical connections not only enhance the interpretation of the

Tamansari experience but also position it within wider academic discourse on sustainable development and social change.

In practical terms, the findings indicate several important design principles for village-based sustainability initiatives. Change processes should begin from welfare gaps perceived by the community as a source of collective motivation [15]. Internal synergy between village units should be institutionalised so that waste management is integrated into the overall village development strategy rather than operating as a standalone programme [9]. Investment in leadership, collective capacity building, and regeneration planning is crucial for maintaining innovation sustainability [8, 9]. Additionally, simple, contextual, and easily observable evaluation mechanisms, such as demonstration plots, laboratory testing, and public documentation, should be developed to support shared learning and strengthen the social legitimacy of the initiatives being implemented,

4 Conclusion

This study has examined the waste-to-welfare model implemented through BUMDes Tamansari, demonstrating how participatory communication and empowerment-oriented institutional design can transform rural waste management from an environmental burden into a foundation for community resilience. Analysed through the CFSC framework, the findings reveal that sustainable waste governance is not primarily a technical achievement but a communicative and institutional process, unfolding across four iterative and interdependent phases.

Phase 1 shows that the most durable catalysts for governance innovation are rooted in community-felt welfare gaps and perceived distributional injustice, not in externally defined technical targets. Phase 2 demonstrates that layered, multi-directional dialogue across organisational and community levels is the mechanism through which shared governance rules are legitimated, and community ownership is constructed. Phase 3 confirms that collective action gains structural durability when institutionally embedded through mandatory internal markets, cross-unit coordination, and empowerment-oriented wage design rather than dependent on voluntarism or external project funding. Phase 4 reveals that practice-embedded participatory evaluation, grounded in observable, locally legible evidence, generates stronger community trust and adaptive learning than formal, technocratic assessment instruments.

Theoretically, the study makes three differentiated contributions. Empirically, it provides one of the first richly documented accounts of a BUMDes-governed circular economy system integrating waste processing with agromaritime livelihoods in an active Geopark tourism corridor. Analytically, it extends the CFSC framework into rural environmental governance, establishing its productive applicability as a process lens for circular economy transitions, and strengthening the analytical architecture through complementary integration with social capital, collective action, and institutional theories. Practically, it derives a critically reflexive four-phase governance model that is empirically grounded and potentially replicable in comparable rural-tourism contexts across the Global South.

The study also candidly identifies the primary structural vulnerability of the Tamansari model: its reliance on key persons. The sustainability of TPS3R's innovation cannot be assured without systematic knowledge codification, collective capacity building, and leadership succession planning design imperatives that apply equally to any community-based circular economy initiative seeking replication.

Three directions for future research follow from this study's limitations as a qualitative single-case design. Comparative studies across BUMDes with varying governance structures and tourism intensities would test the generalisability of the four-phase model. Quantitative measurement of waste volume reduction, material flow efficiency, and long-term income

effects would strengthen the empirical evidence base. A deeper analysis of gender, social class, and intra-community power asymmetries is needed to assess whether the waste-to-welfare model is as distributionally equitable as its design principles intend and to identify whose voices remain insufficiently represented in the dialogue and collective action phases documented here.

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