

Diffusion of Community-Based Waste Management Innovation: A Case Study of Banjar Tegeh Sari, Bali

Ita Musfirowati Hanika¹, Ni Wayan Suryatini²

^{1,2}*Universitas Pertamina, Jakarta, Indonesia*

Email: ita.mh@universitaspertamina.ac.id

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Abstract. Waste management in Bali has become increasingly complex due to rising household waste generation, limited landfill capacity, and weak institutional commitment to source separation. The urgency of this issue was highlighted by severe flash floods in September 2025, demonstrating that waste management is not only a sanitation concern but also an environmental risk reduction strategy. This study employs a qualitative case study approach through in-depth interviews with four key informants: I Gede Mantrayasa, Chairperson of the Br. Tegeh Sari Foundation; Ni Putu Alus Darmayantini, a household adopter; Desak Made Serinadi, a lecturer and health sector civil servant; and Gede Sugiarta, founder of Kembali Berdaya. Data validity was ensured through source triangulation, while analysis was guided by Rogers' Diffusion of Innovations Theory (2003). Findings show that the Banjar Berdaya Sampah Tegeh Sari program reduced waste volumes by 20–30% through four waste banks, visual education, eco-enzyme, maggot composting, and reward mechanisms. The diffusion process followed knowledge, persuasion, decision, implementation, and confirmation stages. The study highlights that local leadership, participatory communication, and multi-actor collaboration are essential for sustaining community-based waste management and reducing environmental risks.

Keywords: *Diffusion of Innovation, Waste Management, Case Study, Waste Bank, Participatory Communication, Banjar Tegeh Sari.*

A. INTRODUCTION

Known as the last paradise in the world, Bali faces growing environmental pressures associated with rapid urbanization, increasing waste generation, and weaknesses in downstream waste management. The flash floods that occurred on 10–11 September 2025, which claimed 14 lives and displaced hundreds across seven districts and cities, brought these challenges into sharp focus (ANTARA News, 2025). Officials and analysts emphasized that the disaster was driven not only by intense rainfall but also exacerbated by high waste generation and weak downstream governance (Mongabay, 2025). This concern is reinforced by long term trends, with Bali's waste generation increasing by approximately 30% between 2000 and 2024 (IESR). In 2024, Bali generated approximately 3,436 tons of waste per day, consisting of around 60% organic waste, 17% plastics, and the remainder residual waste, while Denpasar alone contributed approximately 366,807 tons annually or around 1,005 tons per day (Pos Bali, 2025; Bali Provincial Government, 2024). At the downstream level, TPA Suwung, the principal landfill serving the Sarbagita region, has exceeded its intended capacity, with a design capacity of approximately 1,100–1,200 tons per day, landfill mounds reaching around 30–40 meters, and a total area of approximately 32 hectares (Bali Post, 2025). Although official figures indicate that approximately 59.26% of waste is “managed,” leakage into rivers, drainage systems, vacant land, and coastal areas indicates that substantial volumes remain untreated or mismanaged (Bali Provincial Government, 2024; Pos Bali, 2025).

These conditions indicate that solid waste management in Bali is no longer solely a sanitation concern but has become an issue of environmental carrying capacity and human safety. Consequently, greater attention is required at the source, particularly through community-based approaches that place households at the center of waste prevention,

reduction, reuse, and recycling. Household waste constitutes a substantial share of municipal waste streams in developing contexts, including Indonesia (Banerjee & Sarkhel, 2020; Esmailizadeh et al., 2020; Speier et al., 2018; Jouhara et al., 2017; SIPSN, 2021). The literature emphasizes that residents play a critical role in transforming waste practices, while effective participation requires the alignment of cognitive dimensions such as knowing, affective dimensions such as caring, and behavioral dimensions such as acting (Al Dailami et al., 2022; Soni et al., 2022; Zorpas, 2020; Axon, 2016, 2020; Azevedo et al., 2021). However, translating these principles into sustained household participation remains challenging, particularly in dense urban environments where space, service reliability, convenience, and social norms influence everyday waste practices.

Evidence from Indonesia demonstrates that community participation can generate measurable reductions in waste disposal. In Bandung, participation through trash banks achieved a reported reduction of 0.417 kg per person per day (Permanasari & Damanhuri, 2012), while a house-wives led program in Semarang reportedly reduced disposed waste by up to 70% (Dwiyanto, 2011). Trash bank initiatives in Probolinggo likewise demonstrate localized reductions (Shentika, 2016). Nevertheless, community-based waste management does not automatically guarantee long term sustainability. A preliminary review by Yayasan Bunga Melati Indonesia (YBMI), conducted after facilitating more than 120 trash banks, found that a significant proportion had become inactive or discontinued (YBMI, n.d.). Participation is closely associated with long term sustainability (Tanjung et al., 2017), while low engagement can undermine otherwise well-designed systems (Abadi, 2013). These mixed outcomes reveal an important gap: beyond establishing waste management infrastructure or encouraging initial participation, there is a need to understand the social and organizational mechanisms that enable communities to sustain source level participation under everyday urban constraints.

This issue is particularly relevant in Denpasar, where increasing urban density, housing activity, and local commerce interact to generate greater household waste while simultaneously limiting the physical space available for waste treatment. Within this context, Banjar Tegeh Sari in Kelurahan Tonja, Denpasar Utara, provides a relevant case of Community Based Waste Management (CBWM). Its sustained movement, popularly known as “Banjar Berdaya Sampah,” has received external recognition through Astra’s Kampung Berseri Astra program and the Satu Indonesia Awards ecosystem. Local reports indicate approximately 87% household coverage, with around 30% of serviced households already managing organic waste at source (Good News from Indonesia, 2025; NusaBali, 2023). Its waste bank has also received recognition, including first place in Denpasar and second place at the national unit level from PT Astra International (Pos Merdeka, 2024). Rather than representing a conventional case of program implementation, Tegeh Sari therefore constitutes a positive deviance case in which community participation has been sustained within a dense urban setting despite constraints related to space, service reliability, and household routines. Examining this case can reveal how participation emerges, how it is organized and reinforced, and which mechanisms allow CBWM practices to persist rather than become short lived initiatives.

The significance of Tegeh Sari is closely connected to the institutional role of the banjar itself. A banjar is a neighborhood community association that plays a central role in organizing communal life and preserving Balinese traditions at the grassroots level (Suartika et al., 2022). Its responsibilities extend beyond cultural and religious activities to include local order, infrastructure, security, and community affairs. Each village in Bali consists of multiple banjars, each with its own leadership and regulatory arrangements, while the balai banjar serves as a shared space where community members gather (BaliHomeImmo.com, 2025). As a grassroots institution, the banjar reflects Balinese customs, supports democratic community practices, and provides a local structure through which state development objectives can be

implemented (Suartika et al., 2022). In environmental management, the **balai banjar** can function as an important space for organizing collective responses to ecological challenges. Community involvement is commonly initiated and concluded through meetings with banjar members, while collective action is expressed through **gotong royong**. Through these processes, the banjar helps establish shared goals, coordinate collective behavior, and reinforce compliance with locally agreed norms (Suartika et al., 2022).

Against this background, Banjar Tegeh Sari offers an important setting for examining how a community-based waste management system becomes embedded in everyday urban life. The case allows attention to move beyond the question of whether residents participate toward the more fundamental question of how participation is initiated, coordinated, practiced, reinforced, and sustained. Understanding these mechanisms is particularly important for identifying why some community waste initiatives endure while others decline after initial implementation. Tegeh Sari therefore provides a critical case for examining the institutional, social, behavioral, and operational conditions that support durable source level participation and for identifying design elements that may inform the replication of CBWM practices across other urban banjars in Bali.

B. METHOD

This study adopts a qualitative case study design to explain how and why community based, source level participation in waste management emerges and persists within an urban Balinese banjar (Yin, 2018; Stake, 1995). A case study is appropriate because the phenomenon is context dependent, shaped by norms, governance, incentives, and space constraints, while the boundaries between the social system, namely the banjar, and the CBWM practice are not clearly separable (Flyvbjerg, 2006; Yin, 2018). The analysis is guided by Diffusion of Innovations, focusing on relative advantage, compatibility, complexity, trialability, and observability in residents' adoption trajectories (Rogers, 2003).

The case is Banjar Tegeh Sari in Kelurahan Tonja, Denpasar Utara. Purposive sampling was applied to capture both leadership and household perspectives (Patton, 2002). Four key informants were interviewed: (1) Mr. I Gede Mantrayasa (54), Chair of Yayasan Banjar Tegeh Sari and entrepreneur, representing the community leadership; (2) Mr. Gede Sugiarta (52), Founder of Kembali Berdaya, representing a community partner and catalyst for urban gardens and organic waste practices; (3) Mrs. Ni Putu Alus Darmayantini, popularly known as Yorin (35), a housewife representing a household adopter; and (4) Mrs. Desak Serinadi (55), a civil servant at a hospital and lecturer, representing a household adopter and health communicator. This composition enables within case comparison between leadership innovators and early champions, represented by Mantrayasa & Sugiarta, and household early adopters and early majority, represented by Yorin and Desak, consistent with the Diffusion of Innovations framework (Rogers, 2003).

Primary data were collected through in depth, semi structured interviews with all four informants, document checks including waste bank notes, banjar announcements, and training leaflets, and limited observations of household sorting arrangements and service cues. Triangulation across leadership and household accounts was used to strengthen the credibility of the findings (Denzin, 1978; Yin, 2018).

Interview audio and notes were transcribed and analyzed thematically through iterative coding. The analysis began with open and descriptive codes such as "visual cues," "light sanction," "waste bank incentive," and "organic treatment," followed by analytical patterning against the attributes of Diffusion of Innovations and the cognitive, affective, and behavioral dimensions of engagement (Braun & Clarke, 2006; Rogers, 2003; Axon, 2016, 2020). Cross source matrices were developed to compare leadership and household narratives and identify

mechanism and outcome linkages (Miles, Huberman, & Saldaña, 2014).

To strengthen credibility and confirmability, the study applied source triangulation, peer debriefing through periodic review of codes and themes with a second reader, and an audit trail documenting coding decision (Lincoln & Guba, 1985). Informal member checks were conducted by clarifying factual details with informants. Participation was voluntary, informed consent was obtained, and identities and titles were reported with permission. Sensitive or potentially stigmatizing details were minimized and handled in accordance with ethical guidelines for community research (BERA, 2018). As a single case study, the findings are analytically rather than statistically generalizable (Yin, 2018). The study did not independently quantify diversion rates through weighing audits across all lanes. Reported figures, including the 20 to 30% reduction in disposed volumes, were derived from stakeholder accounts and available documents and should therefore be interpreted as indicative pending future measurement. Variability in the downstream system, including potential re mixing at transfer points, may also influence household trust and the stability of observed practices.

C. RESULT AND DISCUSSION

Banjar Tegeh Sari is an urban banjar located at Jl. Gatot Subroto I No. 38, Kelurahan Tonja, Kecamatan Denpasar Utara, Kota Denpasar, Bali, Indonesia. The banjar is part of the dual governance system (banjar adat and dinas) and falls under Majelis Madya Pakraman Denpasar. The community comprises approximately 1,309 households with an estimated 5,223 residents, with growth driven by housing infill, rising service activities, and in-migration from surrounding areas seeking employment. Most of its resident work in the formal sector as civil servants and private employees (banjartegehsaridenpasar.wordpress.com, 2025).

In this setting, waste generation rises proportionally with population density and changing consumption patterns, as households transition toward more urban lifestyles (e-commerce packaging, convenience foods) while maintaining ritual practices that add to the organic stream. As in many Indonesian cities, households are the dominant waste source, and the stream is organics-heavy (kitchen waste and offerings/canang), followed by plastics and other recyclables; province-level benchmarks indicate $\approx 60\%$ organics, $\approx 17\%$ plastics, and the remainder residuals for Bali overall. Space constraints and competing budget priorities at neighborhood and city levels contribute to operational limitations in collection, temporary storage, and treatment, especially for organics. These conditions make Tegeh Sari a representative urban case in Denpasar: high household contribution to waste, organics dominance, limited land for processing, and fiscal constraints, all of which shape the baseline for community-based waste management in the banjar. Table I shows the general condition of solid waste management in Banjar Tegeh Sari, Bali.

Table 1. The Salient Feature of Waste Management in Banjar Tegeh Sari, Bali

Parameter	Unit	Details
Area	Ha	353,45 Ha
Population	People	5,223 ($\pm 1,309$ KK)
Waste total	Liter per year	$\approx 9,531,975$ L/year
Waste generation per capita	Liter per day	≈ 5 L/person/day

Though the waste composition is dominated by the organic waste, there are significant fractions of recyclable waste. Table II shows the details of the composition of recyclable waste.

Table 2. The Salient Feature of Waste Management in Banjar Tegeh Sari, Bali

Composition	Unit	Waste Volume
Organic	Organic gardens, Canang (Balinese offering) and food waste.	2,306 kg
Anorganic	Plastic, cardboard, Tetra Pak and sachets.	356,62 kg

Residual	Tissue, cups, non-recycle plastic	375,92 kg
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Following the area of study, this section unpacks what the case reveals, including how participation started, how it is organized in everyday practice, what households actually do, and what keeps the system working or creates difficulties within a dense urban banjar. The evidence is organized into eight themes that trace (1) the history and triggers of change, (2) the community organization that coordinates participation, (3) household routines and incentives, (4) organic waste solutions suited to local culture and space, (5) coverage and outcomes, (6) persistent bottlenecks, (7) local champions, and (8) mechanisms of adoption.

a. Context and History

Since 2002, Banjar Tegeh Sari has managed waste through self-organized collection to TPA Suwung. Recurrent bottlenecks, including vehicle breakdowns, rainy season delays, long queues, and a trial of restricted landfill intake from 09:00 to 14:00, exposed weaknesses in the downstream system. Residents also observed sorted loads being mixed again at the landfill, which weakened trust and encouraged the banjar to strengthen waste management at the source. In 2019, with support from Bali Wastu and UNILEVER, the banjar established waste banks and embedded their operations within PKK to utilize women's leadership. Training covered material types, simple logistics, and bookkeeping. To reduce access barriers across approximately 1,300 households and 5,000 people, four zonal waste bank points were established in the west, east, north, and south, operating weekly. Early weighing audits covering organic, recyclable, and residual waste provided visible feedback and helped establish household sorting habits.

By 2020, three stream sorting had been formalized, and in 2024 it was expanded across the banjar. The system was coordinated by approximately 25 lane level pokja, with two volunteers assigned to each lane, using WhatsApp for communication. Light sanctions, consisting of temporary non collection and corrective stickers, communicated standards without alienating residents. During COVID 19, Kembali Berdaya, led by Gede Sugiarta, connected urban gardens with simple organic waste treatment through compost bags or pits, eco enzyme or MOL, and maggot. These activities also transformed some former illegal dumping areas into community plots.

By 2024 to 2025, Tegeh Sari had developed a recognizable CBWM system characterized by dual governance through adat and dinas, pokja and WhatsApp coordination, zonal waste banks with weighing and account balances, simple bin and label tools, context appropriate organic waste options, and educative enforcement. The system reportedly reached approximately 87% household coverage, with around 30% of households treating organic waste at source and an estimated 20 to 30% reduction in disposed waste.

b. Community Organization

Tegeh Sari operates through dual governance. The banjar adat provides cultural legitimacy through *awig awig* or customary rules, while the dinas and kelurahan side anchors administrative procedures, including scheduling, administrative letters, and coordination with city services. This arrangement allows community norms and service arrangements to operate together. The underlying message is that waste management is both a collective responsibility and an organized service with clear procedures. The banjar is divided into approximately 25 lane working groups or *pokja*, each consisting of two volunteers. Pokja volunteers serve as the first line of coordination. Their responsibilities include:

- 1). Circulating pickup calendars.
- 2). Checking household sorting readiness before collection.
- 3). Reporting missed pickups, mixed bags, and access constraints.
- 4). Aggregating unresolved problems through pokja leaders to banjar coordinators.
- 5). Day to day communication is managed through WhatsApp:

- a). Broadcasts: Weekly reminders communicate the waste stream to be prepared, collection times, holiday adjustments, and waste bank opening hours in each zone.
- b). Two-way tickets: Residents can share photos or notes when they have questions about sorting or experience missed pickups. Pokja members respond directly and escalate issues only when necessary.
- c). Micro nudges: Short and friendly messages, such as “today = organics only,” provide timely reminders and minimize errors without overwhelming residents.

Communication signals are deliberately simple and standardized. These include pickup calendars, short notices placed at doors, and corrective stickers containing an administrative contact number when sorting is incorrect. The sanction is temporary non collection, followed by rapid service recovery once the household corrects the problem. This educate then resume approach maintains trust while reinforcing standards. Tegeh Sari also operates four waste banks according to weekly zonal schedules in the west, east, north, and south. This arrangement reduces travel time and clarifies responsibilities:

- a). Households: Bring sorted recyclables, pre flatten materials, and keep them dry.
- b). Waste bank clerks: Weigh materials, record member balances, and issue simple receipts that provide visibility and feedback.
- c). Pokja: Connect new participants with the system, verify basic sorting quality, and identify repeated confusion requiring additional coaching.

To reduce participation barriers, households use three bins or bags with word and picture labels so that children, elders, and guests can follow the sorting system. For busy households, pokja members recommend placing bins near the kitchen or back door to reduce additional steps. For residents with mobility limitations, a neighbor or family member can act as a sorting buddy.

Organic waste treatment is adapted to local conditions. Where groundwater and space allow, lanes use shared compost pits or *sumur kompos*. Elsewhere, households use compost bags or contained bins to control odor. Eco enzyme or MOL and maggot are introduced gradually at the lane level, beginning with motivated clusters and then being demonstrated to other residents through a process of trial and adoption.

c. Household Practices

Most households in Tegeh Sari use a simple three stream system consisting of organic, recyclable, and residual waste. Labeled bins or bags are generally placed near the kitchen or back door. Labels combine words and pictures, allowing children, elders, and guests to identify the appropriate waste stream at a glance. This low effort arrangement reduces the additional steps required for sorting and makes participation easier to integrate into everyday urban household routines. Once the arrangement is established, sorting becomes increasingly automatic. Food scraps and ritual offering residues such as *canang* are placed in the organic stream. Clean and dry packaging is directed to recyclables, while tissues, foam, and contaminated materials are treated as residual waste. Households line organic bins with newspaper or leaves, drain wet leftovers, and transfer organic waste daily to compost bags, compost pits, or sealed containers in tighter lanes to control odor and pests. Recyclables are rinsed, dried, and flattened before storage to reduce space requirements and prevent odors.

Four waste banks operate according to weekly zonal schedules in the west, east, north, and south. On waste bank days, families bring clean and dry recyclable materials to be weighed, while their credit balances are recorded. These small but tangible rewards make progress visible. When a bag is found to contain mixed waste, collection is temporarily withheld and a corrective sticker explains what needs to be corrected and provides an administrative contact. Collection resumes after the household makes the necessary correction. Residents generally perceive this approach as educational rather than punitive, which supports continued

cooperation.

For more difficult materials, households follow simple rules. Greasy paper and hard to clean sachets are placed in the residual stream. Ritual organic waste remains in the organic stream after non biodegradable components are removed. Sharp or broken glass is wrapped and marked for safety. Many households use color cues and a one page picture guide near the bins, while children can participate in simple activities such as flattening and drying recyclables.

A weekly rhythm supports continuity: daily sorting, mid week organic waste transfer, waste bank day, and quick bin cleaning on weekends. The approach works because it has low complexity, is compatible with local culture, provides visible feedback through weighing slips, account balances, and corrective stickers, and offers a clear relative advantage through cleaner homes, reduced odor, and small but consistent savings.

d. Handling Organics

In Tegeh Sari, organic waste, including kitchen scraps and ritual offering residues such as *canang*, is first separated at the household level. Residents drain liquids, remove non-biodegradable components from offerings such as plastic ties, and line organic bins with newspaper or leaves to reduce moisture. A quick daily transfer of organic waste out of the kitchen before fermentation is considered the most important practice for preventing odor and pests.

Where groundwater conditions and available space permit, lanes use compost pits or *sumur kompos* and compost bags positioned in shaded areas. Compost bags are favored because they are inexpensive, produce relatively little odor, and are easy to establish. Residents add a thin layer of dry carbon material such as leaves or cardboard for each layer of wet food waste and periodically turn the material or create openings to maintain airflow. Where volunteer capacity and space permit, shared compost pits or small communal bays serve several households, with pokja members rotating basic maintenance responsibilities.

In tighter lanes or areas with high water tables, households use contained options such as sealed buckets or bins that receive small and frequent amounts of organic waste. Some households also use eco enzyme or MOL as simple microbial solutions to support decomposition and suppress odor. For particularly wet organic fractions, such as leftover rice and cooked vegetables, some clusters have experimented with maggot units using black soldier fly larvae. These units are kept covered and away from living areas to reduce waste volume, while the resulting frass can be cured and used as a soil conditioner.

Simple operating rules help maintain safety and cleanliness:

- 1). Do not place oil, chemicals, or sharp objects in organic waste.
- 2). Add dry brown materials such as leaves or shredded paper when the mixture is too wet.
- 3). Keep treatment units covered and shaded.
- 4). Cure compost before using it.

Pokja members communicate simple checks concerning smell, moisture, and insect balance through WhatsApp and highlight successful examples so that other households can replicate practices that work. The resulting system is space efficient and low odor, respects local cultural practices, diverts organic waste from the residual stream, and supports household and community gardening.

e. Coverage and Outcomes

Interviews indicate that community waste services cover approximately 87% of households in Tegeh Sari. Within this serviced group, around 30% already treat organic waste at source, generally through simple compost bags or pits or through sealed containers in tighter lanes. Coverage has expanded lane by lane with the support of pokja volunteers and WhatsApp reminders, which reduce coordination costs and keep households aligned with weekly

calendars and sorting requirements.

Leaders estimate a 20 to 30% reduction in waste sent to disposal since three stream sorting and waste bank routines matured. Residents consistently report reduced indoor odor and cleaner outdoor surroundings, particularly when organic waste is drained, transferred out of kitchens daily, and kept separate from recyclable and residual waste. However, performance varies between lanes. Areas with active pokja volunteers, clear bin placement, and frequent feedback tend to perform better than areas with fewer volunteers or greater renter turnover. Beyond cleanliness, households identify small but tangible economic benefits from the waste bank through weighing and credit balances. They also report time savings once sorting routines become automatic. Additional benefits include clearer norms for managing ritual offering residues such as *canang*, more orderly frontages, and access to cured compost or soil improvers where urban gardens are available. Nevertheless, downstream fragility remains a perceived risk. Reports of re mixing at transfer points or irregular pickup windows can weaken trust. Predictable services and credible assurance that separated waste will remain separated are therefore important for sustaining participation.

All figures presented above are self-reported and should be treated as indicative. Future validation could track lane level diversion rates, organic capture rates, contamination rates at waste banks, and simple before and after audits of odor and cleanliness. Nevertheless, the convergent accounts from leaders and residents suggest that Tegeh Sari's combination of source separation, visible feedback, and light enforcement has produced meaningful coverage and early outcomes while also highlighting the importance of downstream reliability, space efficient organic treatment, and volunteer continuity.

f. Bottlenecks

The first recurring bottleneck is downstream fragility. Residents repeatedly identify TPA Suwung's overcapacity and instances of re mixing at transfer points as factors that weaken trust. When carefully sorted bags appear to be mixed later, residents feel that their effort has been nullified. Even one visible incident can trigger broader doubts, expressed through perceptions such as "percuma memilah". Shifting service windows and queues that result in missed drop offs further reinforce the perception that the downstream chain is unreliable. In a source-oriented model, trust is essential and depends on clear and consistent guarantees that waste leaving the household remains separated until final treatment.

The second recurring bottleneck is space. Tegeh Sari's dense housing limits the availability of space for onsite organic treatment. Where groundwater is high, *sumur kompos* becomes impractical, while open piles in narrow alleys can create odor and vector risks. When organic waste remains indoors, particularly after heavy cooking days or ceremonies, even well-intentioned households may struggle to prevent unpleasant smells. Space constraints also affect temporary storage of clean and dry recyclable materials. Without a ventilated corner or suitable crate, recyclables can become contaminated again and lose value.

Addressing these bottlenecks requires operational guarantees and space efficient organic waste options. For downstream reliability, the system can publish non mixing commitments, record truck arrival times, and enable spot checks through photo logs at handover points. When a breach occurs, transparent communication, corrective action, and rapid service recovery are needed to restore confidence.

For space constraints, priority should be given to contained and low odor units such as sealed bins and compost bags. Shared micro bays managed by pokja can serve lanes without sufficient yards, while frequent and small transfers of wet organic waste can prevent overnight fermentation. Clear fast track routines after ceremonies, such as additional organic waste collection, can also prevent short term overload and associated odor.

To maintain visible progress and prevent backsliding, several lightweight indicators can

be monitored at lane level:

- a. Missed pickup reports and re mixing incidents, including their trends and resolution time.
- b. Organic waste dwell time in the kitchen, monitored through a simple self-report checklist.
- c. Odor complaints and recurrence of corrective stickers.

Sharing these snapshots through WhatsApp allows residents to see that problems are identified and addressed. This reinforces confidence and helps sustain the perception that daily sorting is worthwhile.

- g. Local Champions

I Gede Mantrayasa of Yayasan Br. Tegeh Sari functions as the institutional anchor of the CBWM system. He connects adat and dinas governance, translates community messages into clear service rules such as three stream sorting, pickup calendars, and corrective stickers, and keeps lane level pokja focused on rapid problem solving through WhatsApp. His framing is straightforward: waste management is both a civic responsibility and a household benefit through cleaner homes, reduced odor, and small cash credits. By combining light sanctions such as temporary non collection with rapid service recovery, he protects trust while maintaining standards, particularly when downstream services are unstable.

Gede Sugiarta of Kembali Berdaya acts as an innovation catalyst. During COVID 19, he connected urban gardens with simple organic waste treatments including compost bags or pits, eco enzyme or MOL, and maggot. This approach transformed some former illegal dumping areas into community plots. The connection between food and waste created visible co benefits, including access to vegetables and cleaner lanes, making source separation more worthwhile. He also pilots solutions in areas where space or groundwater conditions create difficulties and demonstrates the results so that other residents can replicate them, strengthening trialability and observability.

Together, Mantrayasa and Sugiarta operate as complementary champions within a Diffusion of Innovations pattern. They function as innovators and early champions who create relative advantage through cleanliness and small economic benefits, ensure compatibility with ritual organic waste and banjar norms, reduce complexity through three bins with picture labels, and conduct lane level trials before wider scaling. They also cultivate networks involving PKK, women's groups, youth groups, and external partners to spread practices horizontally and maintain momentum when external services such as landfill operations are fragile. A practical next step is succession planning, particularly through mentoring younger volunteers as next generation champions who can maintain continuity over time.

- h. Mechanisms of Adoption

The case aligns closely with Diffusion of Innovations. First, residents perceive a clear relative advantage through cleaner homes, reduced odor, and small but tangible cash credits from waste banks, making the new routine worthwhile. Second, compatibility is high because the practices explicitly accommodate ritual organic waste such as *canang* and are aligned with banjar norms, making sorting culturally appropriate. Third, low complexity is achieved through a three bin arrangement with picture labels, which reduces errors and cognitive effort. Fourth, trialability is incorporated through pilots that begin in selected lanes and expand after a proof of concept. Finally, observability is strong because weighing slips, member balances, and corrective stickers make progress visible and immediate, reinforcing behavior.

Sustained participation depends on five enabling conditions:

- 1). Clear service standards: Predictable pickup schedules and credible downstream non mixing protect trust.
- 2). Active pokja volunteers: Lane level volunteers maintain close coordination and

keep participation costs low.

- 3). Low odor and low effort organic options: Compost bags, compost pits, contained bins, eco enzyme or MOL, and maggot where appropriate fit dense urban conditions.
- 4). Regular feedback and small incentives: Weights, account balances, and recognition reinforce consistency.
- 5). Fast two-way communication: WhatsApp enables rapid problem solving and keeps community norms visible.

To deepen and stabilize outcomes, Tegeh Sari still requires three important improvements: assured non mixing at transfer points supported by transparent checks and rapid recovery when breaches occur, more space efficient organic treatment for areas with high water tables or limited space, and stronger youth engagement to secure succession among champions and day to day volunteers. Together, these improvements can strengthen the diffusion gains already achieved and increase system resilience under continued urban growth and downstream pressure.

Rogers' (2003) Diffusion of Innovation Theory identifies four key elements in the diffusion process: innovation, communication channels, time, and social system. Applying this framework to Banjar Tegeh Sari provides a structured explanation of how the CBWM system emerged, spread, and became embedded in community practices.

a. Innovation

According to Rogers (2003), *innovation* refers to "an idea, practice, or object that is perceived as new by an individual or other unit of adoption". In community-based contexts, innovation extends beyond technology and can include social and institutional arrangements that make behavioral change possible (Axon, 2016; Azevedo et al., 2021). Within this framework, the Banjar Tegeh Sari Community Based Waste Management system represents a form of *social innovation*. It reorganizes how waste is sorted, valued, and managed through collective participation rather than relying primarily on top-down enforcement.

The key innovation lies in Tegeh Sari's integrated and adaptive model, which developed through community experimentation and inter organizational collaboration. The system combines three interdependent components:

- 1). Household level sorting into organic, recyclable, and residual waste.
- 2). Localized organic management, including compost pits or *sumur kompos*, compost bags, eco enzyme, and probiotic based composting through MOL and maggot.
- 3). Recyclable recovery supported by social and economic incentives through four operational waste banks.

The waste banks operate weekly and function both as economic motivators, through cash or credit for sorted recyclables, and as social spaces for interaction and collective accountability. Since their expansion, they have achieved an estimated 20 to 30% reduction in waste, while acceptance has remained relatively consistent across neighborhoods, including more affluent areas. This indicates the perceived inclusivity and practicality of the model.

The development of the innovation followed a *trial and adaptation* pathway consistent with Rogers' concept of reinvention, in which communities modify an innovation to fit local circumstances. Early attempts to compost kitchen waste in containers encountered difficulties related to odor and residents' aversion to maggots. With guidance from PPLH Bali, the community shifted toward shared lane-based compost pits, which were considered more feasible and socially acceptable. In high water table areas such as Gatsu, organic waste is instead transferred to the banjar's centralized organic yard, operated together with an inorganic yard. Both were established under PPLH mentoring and supported through community funding or *swakelola* and equipment grants valued at approximately IDR 50 million.

Institutionally, the innovation is strengthened through dual governance involving *desa adat* as traditional authority and *desa dinas* as administrative authority. This arrangement legitimizes community rules. Collaboration with Kembali Berdaya introduced urban gardens and organic reuse, while partnerships with PKK and women's groups supported continuity through household education and social reinforcement. These organizational arrangements reflect what Rogers (2003) describes as *social system readiness*, in which shared norms and leadership reduce uncertainty surrounding new practices. By 2025, Banjar Tegeh Sari had developed into a model of participatory waste governance in Denpasar. Its CBWM innovation is simple, culturally compatible, and visibly beneficial, allowing households to participate with relatively little effort while maintaining a sense of civic pride. Through iterative learning, trust building, and clear feedback, Tegeh Sari demonstrates how social innovation in waste management can develop when it is embedded in local culture and supported by practical incentives.

b. Communication Channels

According to Rogers (2003), communication channels are the means through which information about an innovation is transmitted among members of a social system. In Banjar Tegeh Sari, diffusion of the CBWM innovation occurs through a combination of interpersonal, organizational, and digital communication channels, each serving complementary functions in sustaining collective action.

At the interpersonal level, *face to face dialogue* remains the backbone of information flow. Leaders such as I Gede Mantrayasa of Yayasan Br. Tegeh Sari and Gede Sugiarta of Kembali Berdaya consistently conduct door to door visits, community discussions, and informal mentoring during waste bank operations. These interactions provide direct feedback and behavioral examples while reinforcing trust and shared responsibility, which are important mechanisms in the persuasion and decision stages of innovation adoption (Rogers, 2003).

At the organizational level, Tegeh Sari's *dual governance* system, combining *desa adat* and *desa dinas*, creates legitimacy and authority for waste management norms. Collaboration with PPLH Bali adds external technical support through continuing training and problem-solving sessions. PPLH acts as a knowledge broker by facilitating composting trials, developing easy to follow organic treatment methods, and advising on the layout of compost pits or centralized organic yards. The PKK women's group and youth groups also function as diffusion multipliers by embedding sorting and composting practices into household routines and community activities.

At the digital level, lane based working groups or *pokja* rely heavily on WhatsApp for coordination and reminders. Each of the 25 lanes has two active volunteers responsible for sharing schedules, sending alerts about sorting violations, and providing real time information about pickup and weighing schedules. WhatsApp functions as a low cost, rapid, and interactive feedback mechanism that minimizes coordination delays and reinforces behavioral norms. Corrective stickers and photos shared through these chats also make learning more collective and transparent.

The combination of these channels, grounded in trust, reinforced by community authority, and amplified by digital communication, illustrates a strong *horizontal diffusion pattern*, in which peers influence peers through demonstration and reinforcement (Axon, 2020). This multilayered communication network ensures that information about CBWM is not merely transmitted but absorbed, practiced, and sustained.

c. Time Frame

Rogers (2003) describes time in the diffusion process through three dimensions: (a) the innovation decision process within each adopter, (b) the relative time of adoption compared with other members, and (c) the rate of adoption within the social system. In Tegeh Sari, the

diffusion process unfolded through several recognizable stages.

From 2002 onward, the banjar practiced self-managed waste collection, but stronger momentum emerged around 2019 when waste banks and sorting pilots were introduced with support from PPLH Bali and UNILEVER. During this period, the community experimented with container composting, mini audits using the three-sack method, and small-scale compost pit trials. This corresponds to Rogers' knowledge, persuasion, and decision stages among innovators and early adopters.

Between 2020 and 2024, the practices moved from pilot lanes toward banjar wide adoption. Three stream sorting was formalized, and 25 lane level pokja began coordinating through WhatsApp. Waste banks expanded across all four zones: west, east, north, and south. During this period, trialability and observability contributed to adoption because residents could see neighbors' weighing slips, cleaner lanes, increasing account balances, and evidence of successful implementation. Some initially resistant households gradually joined after observing that the system was stable and manageable.

By 2024 to 2025, adoption had become more stable. Interview data indicated approximately 87% household coverage and around 30% of serviced households treating organic waste at source. The banjar's social and institutional infrastructure, including dual governance, *perarem*, pokja, feedback mechanisms, and enforcement rules, supported confirmation and continued reinforcement. Some households had already integrated the routines into everyday life, while deviations were quickly addressed through corrective stickers and service recovery.

The rate of adoption slowed as the innovation became established, but the practices became increasingly stable. The innovation therefore moved from rapid diffusion toward a sustained phase rather than remaining a short-term initiative. Across these stages, the rate of adoption in Tegeh Sari appears promising. The system moved from limited structured activity before 2019 to majority coverage by 2024, representing approximately five to six years of intensive scaling. The relatively short period required to approach late majority status suggests that simplicity, visibility, compatibility, and social infrastructure were well aligned to accelerate diffusion.

d. Social System

The diffusion of innovation in Banjar Tegeh Sari operates within a dual governance system that combines formal dinas structures with customary adat structures. This arrangement ensures that environmental initiatives, including CBWM, are both administratively recognized and socially legitimate. The *desa pakraman* structure, through its *banjar adat*, provides moral authority and collective enforcement that strengthen compliance at the community level. A key institutional mechanism is the Perarem Banjar Tegeh Sari, a set of local customary regulations enacted under Desa Pakraman Tonja, Denpasar Utara. Ratified in 2018, this *perarem* formalizes community responsibility for maintaining cleanliness, prohibits illegal dumping, mandates household participation in *swakelola* waste programs, and establishes sanctions for violations. The provisions include regular waste payments, penalties for littering, and communal management of idle land to prevent it from becoming informal dumping areas. By incorporating environmental norms into local rules, the *perarem* integrates moral, economic, and social incentives that support behavioral change (Kironde & Yhdego, 1997; Colon & Fawcett, 2006; Pasang, Moore, & Sitorus, 2007; Suartika, Mahendra, & Saputra, 2022).

These local rules enable collective coordination and support sustained adoption. Each lane or gang is represented by working groups or *pokja*, while enforcement combines gentle reminders with social sanctions. This approach encourages participation without relying exclusively on coercion. Strong social capital, rooted in adat values such as *gotong royong* or mutual aid and *ngayah* or voluntary service, reinforces the spread of innovation through trusted

interpersonal relationships rather than solely through top down regulation. In effect, Banjar Tegeh Sari transforms waste management from an individual responsibility into a shared civic duty institutionalized through cultural legitimacy and everyday practice. The alignment between the innovation and the local social order, anchored by the *perarem*, creates a structural foundation for sustained diffusion across time and generations.

e. Adoption

The adoption of the Community Based Waste Management innovation in Banjar Tegeh Sari followed a gradual and socialized process consistent with Rogers' (2003) model of innovation adoption.

Residents became aware of the waste problem through repeated information related to waste collection and the visible overload at the Suwung landfill. Information was disseminated through banjar meetings, posters, and workshops led by PPLH Bali and Bali Wastu or UNILEVER in 2019. These activities introduced source level waste sorting and the potential for waste banks to generate small savings. At this stage, most residents had cognitive awareness but limited emotional and behavioral engagement.

Through continued accompaniment by PPLH facilitators and encouragement from local leaders such as Gede Mantrayasa and Gede Sugiarta, residents began to recognize the relative advantages of the program, including cleaner surroundings, reduced odor, and a sense of contribution to the community. Demonstration plots for organic composting and the early establishment of four waste banks increased observability. Resistance remained, particularly among working households that viewed sorting as additional labor, but PKK and youth groups helped normalize participation through social reinforcement.

A major turning point occurred when the banjar officially endorsed a local regulation through *awig awig* or *perarem* in 2018 to 2019, mandating household participation and waste fees or *iuran*. This decision institutionalized the innovation within the local governance system through the adat and dinas duality, providing both legitimacy and a shared obligation. Residents subsequently adopted sorting and waste bank practices voluntarily while receiving social support and facing gentle sanctions for noncompliance.

Between 2020 and 2024, sorting, composting, and waste bank routines became integrated into everyday life. Lane based *pokja* volunteers coordinated through WhatsApp groups, reminders, and stickers identifying correct or mixed waste. Compost pits, eco enzyme production, and community gardens connected waste reduction with food security, making adoption more tangible. At this stage, CBWM moved from experimentation toward sustained practice with support from PPLH, Kembali Berdaya, and the Denpasar City Environmental Agency.

By 2025, approximately 87% of households were consistently separating waste, while around 30% had adopted organic treatment at source. Residents expressed pride and ownership reinforced by visible outcomes such as cleaner streets, reduced odor, and community recognition through the Kampung Berseri Astra Award. The banjar's adaptive response to contextual constraints involving space, water tables, and downstream fragility, together with continued collaboration with partners, demonstrates the confirmation stage in which the innovation is no longer perceived as new but becomes an accepted social norm.

f. Relevance of the Innovation to the Waste Problem in Denpasar

The innovation developed in Banjar Tegeh Sari directly responds to Denpasar's urgent waste management challenges. The city generates approximately 1,005 tons of waste per day, contributing nearly one third of Bali's total waste load (Bali Provincial Government, 2024). With the Suwung landfill operating beyond capacity, receiving more than 2,000 tons daily despite a design limit of 1,200 tons, and with frequent service disruptions, the conventional collect, transport, and dispose model has become increasingly unsustainable. These

downstream weaknesses create a strong need for source level and community-based interventions, which is precisely the space addressed by the Tegeh Sari model.

The CBWM system in Tegeh Sari complements and compensates for municipal limitations by emphasizing waste prevention and source separation. Through three stream sorting for organic, recyclable, and residual waste, four active waste banks, and context appropriate organic processing methods such as compost pits, eco enzyme, and maggot bins, the banjar demonstrates how localized systems can reduce dependence on landfill disposal. Estimated reductions of 20 to 30% in waste sent to disposal suggest that small scale behavioral innovations can produce meaningful impacts when organized collectively.

The integration of local governance through adat and dinas and the use of *awig awig* or customary rules further align formal and informal institutions, supporting compliance and collective ownership. This governance arrangement enables residents to perceive waste management not simply as a government obligation but as a shared civic responsibility. Such framing is particularly important in a dense and culturally rich city such as Denpasar, where religious and social rituals, including daily offerings or *canang sari*, generate substantial organic waste that requires culturally appropriate handling.

The case of Banjar Tegeh Sari illustrates how innovation in community based waste management can connect household practices with urban policy objectives. Although large scale infrastructure remains necessary, Denpasar's future waste strategy also depends on scalable neighborhood systems that can adapt to cultural and spatial constraints. Tegeh Sari's hybrid governance, visible accountability mechanisms, and simple organic waste solutions provide a potential template for replication across other banjars. Institutionalizing such models through city ordinances, micro grants, and inter banjar learning networks could reduce landfill pressure while strengthening civic participation as an important component of Denpasar's sustainable urban transformation.

D. CONCLUSION

This study examined how community-based waste management operates and sustains participation in Banjar Tegeh Sari, Denpasar, within the broader context of Bali's waste crisis. The findings demonstrate that CBWM in Tegeh Sari is not only a technical intervention but also a social innovation anchored in local culture, dual governance through adat and dinas, and continuous engagement among residents. Through mechanisms consistent with Rogers' *Diffusion of Innovations*, including relative advantage, compatibility, simplicity, trialability, and observability, the banjar has successfully integrated waste sorting and recycling into everyday household routines.

Adoption has been strengthened by visible feedback through weighing, account credits, and corrective stickers, consistent communication through pokja and WhatsApp groups, and local champions who maintain motivation and trust. The integration of culturally specific waste streams, particularly ritual offerings such as *canang*, further enhances compatibility and community ownership. These factors have collectively contributed to measurable outcomes, including an estimated 20 to 30% reduction in disposed waste, improved neighborhood cleanliness, and stronger civic cohesion. However, important challenges remain. Overcapacity and occasional re mixing at TPA Suwung can undermine community confidence, while limited urban space constrains organic waste treatment. Addressing these bottlenecks requires stronger coordination between community initiatives and municipal systems so that upstream participation is matched by reliable downstream management.

In conclusion, the Tegeh Sari experience demonstrates that sustainable waste management in Denpasar depends partly on empowering communities as co-managers of their environment. Institutionalizing CBWM models, supporting low-cost innovations, and

developing localized learning networks can help cities move from reactive waste collection toward proactive resource stewardship. In this process, waste governance can shift from a technical burden toward a shared civic responsibility.

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