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Status without Routine: Rogers' Innovation Attributes in a Community-Based Waste Separation Programme in Indonesia

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ABSTRACT

Many cities in developing countries rely on households to separate waste at source in order to relieve overloaded landfills, yet uptake remains low. This study examines the Kawasan Bebas Sampah (KBS, Waste-Free Area) programme in Bandung, Indonesia, a public service innovation that certifies neighbourhood units (rukun warga, RW) that manage their own waste. Using Rogers' five innovation attributes, it analyses how implementers and residents perceive the programme, which barriers constrain it, and how they are addressed. We conducted a qualitative single case study in a densely populated sub-district, combining structured interviews with five informants in June 2025, non-participant observation, and monthly monitoring reports of the city environment agency. The number of certified RWs in the sub-district rose from 7 to 20 of 82 during 2024, but household separation compliance stayed between 21.02% and 26.67%, and the monthly waste reduction rate did not improve. Relative advantage was experienced mainly as collective resilience during waste emergencies; complexity was lowered by scheduled collection of organic waste; trialability had been formalised into a probation period of six to twelve months. Barriers included lack of space, entrenched habits, few outreach staff, weak sanctions, and difficulty sustaining status. The findings reveal a gap between collective adoption of status and household routinisation. Local governments should measure community-based innovations with behavioural indicators and align waste collectors' incentives with separation duties. Findings rest on a small number of informants and aggregate sub-district data.

Keywords: Diffusion of Innovations; Source Separation; Co-production; Community-Based Waste Management; Local Government

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INTRODUCTION

Waste management is among the urban services that depend most on citizens' behaviour. The World Bank expects global municipal solid waste to keep growing with urbanisation, while cities in low- and middle-income countries still rely on landfilling and open dumping (Kaza et al., 2018). In these cities, limited finance, weak institutions, and low public participation are persistent obstacles (Guerrero et al., 2013). Separation at source by households has therefore become a central strategy for reducing landfill

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loads, raising recycling rates, and making the treatment of organic waste possible. Yet separation is a behaviour that millions of households must repeat every day, so its success cannot be secured by policy alone (Knickmeyer, 2020; Varotto & Spagnolli, 2017). The issue also lies at the core of Sustainable Development Goals 11 and 12, which call for better municipal waste management and substantial reductions in waste generation (United Nations, 2015).

Indonesia faces the same challenge. The National Waste Management Information System (SIPSN) recorded national waste generation of 33.62 million tonnes in 2024, with food waste as the largest component (39.28%) (Kementerian Lingkungan Hidup dan Kehutanan, 2025). National law divides household waste management into reduction and handling (Law No. 18 of 2008; Government Regulation No. 81 of 2012). The National Policy and Strategy on household waste set targets of 30% reduction and 70% handling by 2025 (Presidential Regulation No. 97 of 2017, Article 5(1)). The reduction target makes households and communities the main actors in waste management, rather than mere recipients of a collection service.

The city studied here illustrates this pressure clearly. Bandung generated 1,496.31 tonnes of waste per day in 2024, the third largest amount in its province, and 60% of it came from households. Its reduction rate rose from 8.67% in 2021 to 21.30% in 2024 but remained below the 30% target (Kementerian Lingkungan Hidup dan Kehutanan, 2025). Since the Leuwigajah landfill collapsed on 21 February 2005, the city has had no landfill of its own and depends on a regional site in a neighbouring regency. A fire at that site in August 2023 forced a waste emergency across the metropolitan area (Winursita & Johan, 2024). In October 2024, the provincial government cut the city's daily truck deliveries from 170 to 140 because the regional landfill was nearing capacity (Pemerintah Provinsi Jawa Barat, 2024). The city then adopted a "not separated, not collected" policy that obliges households to separate waste at home.

One of the city's main instruments for shifting effort from collection to reduction at source is the Kawasan Bebas Sampah (KBS, Waste-Free Area) programme. The programme designates a neighbourhood unit (rukun warga, RW) as an area that manages its own waste by separating it, treating organic waste, and passing inorganic waste to waste banks or collectors. It rests on principles of citizen involvement, self-reliance, efficient reduction, environmental protection, and area integration. A study of one KBS neighbourhood found that the programme reduced the area's waste by 16.43%, well below the 30% target (Djulianti & Ainun, 2018). Studies of the parent programme, Kurangi, Pisahkan, dan Manfaatkan (Kang Pisman, Reduce, Separate, and Use), also show that waste innovation in the city has been constrained by public awareness and by the readiness of implementing organisations (Irmawartini et al., 2023; Setianingsih et al., 2022).

Although the programme has run for about a decade, its spread is limited. According to the city environment agency, by May 2025 more than 400 of the city's roughly 1,600 RWs held KBS status, and in the sub-district studied only 20 of 82 RWs had been certified by the end of 2024. These figures raise a more basic question than how many areas have joined. Does acquiring KBS status reflect a change in household habits, and which attributes of the innovation encourage or hinder that change?

The literature on public sector innovation has examined drivers and barriers at length, but mostly with government organisations as adopters (De Vries et al., 2016). Community-based waste services differ because their success depends on adoption decisions at two levels: the collective decision of an RW to become a KBS and the decision of each household to separate its waste every day. Earlier studies in the city evaluated implementation or effectiveness (Djulianti & Ainun, 2018; Setianingsih et al., 2022) but did not analyse how residents and implementers perceive the characteristics of the innovation. Diffusion theory, however, holds that perceived attributes explain much of the variation in the rate of adoption (Rogers, 2003).

This study addresses that gap by asking three questions: (1) how do implementers and residents perceive the attributes of the KBS innovation; (2) what barriers constrain its implementation; and (3) what measures are taken to overcome them? The article contributes by showing a gap between adoption of status at the RW level and routinisation of habits at the household level, and by connecting Rogers' attributes with the literature on co-production and household separation behaviour.

LITERATURE REVIEW

Public Sector Innovation and the Diffusion of Innovations

Public sector innovation refers to ideas, practices, or services that are new to the adopting organisation or unit. The systematic review by De Vries et al. (2016) found that research in this field is dominated by studies of drivers and barriers at the environmental, organisational, innovation, and individual levels, while outcomes are rarely measured. Indonesian studies understand public service

innovation as a renewal of the ways in which government produces services in response to public problems (Prabowo et al., 2022).

Rogers (2003) defines an innovation as an idea, practice, or object perceived as new by an individual or another unit of adoption. He identifies five attributes that affect the rate of adoption. *Relative advantage* is the degree to which an innovation is perceived as better than the idea it supersedes. *Compatibility* is its consistency with the values, experience, and needs of potential adopters. *Complexity* is the difficulty of understanding and using it. *Trialability* is the degree to which it can be tried on a limited basis. *Observability* is the degree to which its results are visible to others. Rogers also separates the adoption decision from implementation and confirmation, and he recognises discontinuance, in which an innovation is abandoned after it has been adopted.

The difference between adoption and continued use matters even more in service organisations. Greenhalgh et al. (2004) show that adoption in organisations is not a single event but a non-linear process of assimilation, and that an innovation yields results only when it becomes part of routine work. We use this distinction to read the KBS data. Acquisition of KBS status by an RW is treated as a collective adoption decision, whereas daily separation by households is treated as routinisation.

Co-production and Household Separation Behaviour

Community-based waste management is a form of co-production, in which citizens take part in producing public services alongside professional providers (Brandsen & Honingh, 2016; Ostrom, 1996). Separation at home is the citizen contribution that determines whether the government's collection and treatment can work. Osborne et al. (2016) stress that in public services value is created not by providers alone but together with users. It follows that service failure may stem from a service design that makes citizens' contributions difficult.

Research on separation behaviour shows that social and situational factors matter as much as attitudes. The review by Knickmeyer (2020) found that knowledge, convenience and proximity of facilities, social norms, and feedback shape the separation performance of urban households. The meta-analysis by Varotto and Spagnolli (2017) showed that interventions that change the situation, such as providing containers and services, and interventions based on social interaction tend to be more effective than information alone. A study in Surabaya found that household participation in waste reduction remained low and was associated with factors such as education and income (Dhokhikah et al., 2015). In developing countries, the informal sector, including waste pickers, middlemen, and collectors who sell valuable materials, also plays a large part in the recycling chain (Wilson et al., 2006). Taken together, these studies suggest that separation depends on the services and incentives that surround the household, yet they say little about how such services shape citizens' perceptions of an innovation in the terms that diffusion theory uses.

Analytical Framework

The study uses Rogers' five attributes as a deductive framework for analysing perceptions of the KBS innovation. Two lenses complement it. The first is the distinction between adoption and routinisation (Greenhalgh et al., 2004; Rogers, 2003), used to compare the growth in KBS status with behavioural indicators. The second is the co-production and separation behaviour perspective (Brandsen & Honingh, 2016; Knickmeyer, 2020), used to explain why certain attributes encourage or hinder citizens' contributions. Barriers and measures were analysed inductively from the data.

MATERIALS AND METHODS

Research Design and Context

We used a qualitative single case study design. The case is the implementation of the KBS programme in one sub-district (kecamatan) of Bandung, Indonesia. The programme was initiated by a non-governmental organisation with support from the city government in 2015 and was institutionalised as a programme of the city environment agency in 2018, together with the launch of Kang Pisman and the adoption of Bandung City Regulation No. 9 of 2018 on Waste Management.

The sub-district covers 5.27 km² and comprises 8 urban villages (kelurahan), 82 RWs, and 544 neighbourhood associations (rukun tetangga, RT). It had 122,426 residents in 2023, giving a density of about 23,231 people per km². Assuming generation of 0.35 to 0.40 kg per person per day, its potential waste generation is about 42.85 to 48.97 tonnes per day. A total of 45,992 residents were registered in the national social welfare database (DTKS), and the agency informant described most of the area as

dense middle- and lower-middle-class housing. The sub-district was chosen because of its high density, scarce open space, and active expansion of the KBS programme.

Informants and Data Collection

Informants were selected purposively according to their role in and knowledge of the programme. The key informant was an official of the waste reduction section of the city environment and sanitation agency. The main informants were the head of the economic development and environment section of the sub-district and the KBS field facilitator assigned to the sub-district. The supporting informants were one resident of a KBS RW and one resident of a non-KBS RW (Table 1).

Table 1. Informant profile

Code	Informant	Category
D1	Official, waste reduction section, city environment and sanitation agency	Key informant
K1	Head of economic development and environment section, sub-district office	Main informant
P1	KBS field facilitator (agency), assigned to the sub-district since the pilot phase	Main informant
W1	Resident of a KBS RW, separating waste for about one year	Supporting informant
W2	Resident of a non-KBS RW, active in neighbourhood affairs	Supporting informant

Source: compiled by the authors (2025).

Interviews were conducted between 17 and 28 June 2025 using a structured guide based on Rogers' five attributes and adapted for each category of informant. They were held in Indonesian, and the excerpts below were translated by the authors. Non-participant observation covered the work of the organic waste collection teams (petugas pengangkut sampah organik, PPSO) and the condition of the neighbourhoods. Documents included the agency's monitoring and evaluation reports (15 monthly reports from January 2024 to May 2025), the sub-district's records of RWs preparing for KBS status, population data, and relevant regulations.

Data Analysis and Trustworthiness

Data were analysed with the interactive model of data condensation, data display, and conclusion drawing and verification (Miles & Huberman, 1994). Transcripts were coded deductively according to Rogers' five attributes and then inductively to identify categories of barriers and measures. Quantitative data from the agency reports were processed descriptively to compare the growth in KBS status with indicators of separation compliance and waste reduction. Trustworthiness was supported by source triangulation (agency official, sub-district official, facilitator, and residents) and method triangulation (interviews, observation, and documents) (Lincoln & Guba, 1985).

Research Ethics

A research permit was obtained from the city's national unity and politics agency (Badan Kesatuan Bangsa dan Politik). Informants took part voluntarily after being told the purpose of the study, and their identities are anonymised in this article.

RESULTS AND DISCUSSION

The results are presented in the order of the research questions, preceded by the indicators that frame them. We first compare the growth of KBS status with behavioural indicators, then describe the five attributes, the barriers, and the measures, and finally interpret the findings against the analytical framework.

Growth in KBS Status and Behavioural Indicators

To obtain KBS status, an RW must complete a series of stages listed on the sub-district form: coordination, outreach, team formation, training, door-to-door education, preparation of facilities, collection of separated organic waste, organic treatment, management of inorganic waste, monitoring,

and evaluation. The RW, together with the urban village and the sub-district, then requests a decree from the agency. The agency informant named the thresholds that must be met: "at least 30% of houses separating and at least 30% waste reduction" (D1). Organic waste in the area is treated with kitchen-waste tubes (lodong sisa dapur, loseda), compost bags (Kang Empos), and maggot cultivation houses, while inorganic waste goes to waste banks or is given to collectors as "waste alms" (sedekah sampah).

The number of KBS RWs in the sub-district almost tripled during 2024, with the largest jump in November (Table 2).

Table 2. Number of KBS RWs in the sub-district, 2024

Month	KBS RWs	Non-KBS RWs	Share of KBS RWs
January	7	75	8.54%
February	7	75	8.54%
March	9	73	10.98%
April	9	73	10.98%
May	9	73	10.98%
June	10	72	12.20%
July	10	72	12.20%
August	13	69	15.85%
September	13	69	15.85%
October	13	69	15.85%
November	19	63	23.17%
December	20	62	24.39%

Source: monitoring and evaluation reports of the city environment and sanitation agency (2025). Total RWs = 82.

Behavioural indicators for the sub-district did not move with the growth in status. Household separation compliance ranged from 21.02% to 26.67% throughout the year, while the waste reduction rate fell from 22.34% in January to 8.13% in December, with an average of 10.52% (Table 3). Because the January and February data did not cover all urban villages, the safer comparison is March to December. In this period the number of KBS RWs rose from 9 to 20, while the reduction rate stayed

between 4.42% and 10.89% and compliance never reached 30%. The number of active waste banks also fell from 12 or 13 at the start of the year to 10.

Table 3. Waste management indicators in the sub-district, 2024

Month	Separation compliance	Recorded waste generation	Reduction rate	Waste banks	Note
January	26.39%	631,669.4	22.34%	12	One urban village missing
February	25.86%	643,850.7	19.04%	13	One urban village missing
March	25.91%	759,273.6	9.46%	10	
April	26.67%	770,124.5	10.89%	8	
May	21.02%	779,492.2	9.85%	10	
June	21.17%	868,253.8	8.84%	10	
July	21.75%	904,653.3	9.79%	10	
August	21.93%	802,580.7	7.55%	10	One urban village incomplete
September	22.16%	875,648.7	4.42%	10	
October	23.70%	901,262.3	7.48%	10	
November	24.60%	872,457.2	8.47%	10	
December	25.78%	898,409.0	8.13%	10	

Source: monitoring and evaluation reports of the city environment and sanitation agency (2025). Waste generation is shown in the units used in the agency reports.

Data on waste composition show the same pattern. Residual waste transported out of the area far exceeded the organic and inorganic waste handled within it each month. In December 2024, for example, 53,744 kg of organic waste were treated while 820,990 kg were recorded as residue. Most waste, in other words, still ended up mixed and was classified as residual.

Attributes of the KBS Innovation

Relative Advantage

The agency official and the facilitator saw the main advantage of KBS in the resilience of neighbourhoods when the city system failed. D1 referred to two waste emergencies, the fire at the regional landfill in 2023 and the cut in deliveries in late 2024:

> *"RWs that did not yet have KBS status were overwhelmed during the last waste emergency, because waste could not be taken to the Sarimukti landfill, so the waste from the houses just piled up [...] but RWs that already had KBS status were not affected at all, because they were used to separating their waste." (D1)*

According to D1, a KBS RW can process up to 100 kg of waste per day on average, and some have begun to treat residual waste themselves. D1 also noted that the city's reduction rate was "almost 30%, but not only because of KBS". A second advantage was institutional. P1 explained that the agency now gives priority in equipment and facilities to areas that show effort in managing waste.

> *"So the difference between a KBS RW and a non-KBS RW is that it is easier to get help with cleaning facilities and equipment, and there is also regular guidance and mentoring, consultation, and training." (P1)*

At the household level, the perceived benefits were simpler. W1 said that inorganic waste no longer smelled when its collection was delayed, because the organic part had already been handed over, and that the neighbourhood had become cleaner. K1 added a health benefit, fewer flies during collection gaps of four to five days. P1 framed the programme in moral and religious terms: separating waste eases the work of waste collectors, prevents injuries from sharp objects in mixed waste, and is therefore an act

of worship. By contrast, W2 from a non-KBS RW felt that the programme's benefits had not been communicated because residents "lack information on how to become a KBS".

Compatibility

Implementers adapted the programme to local conditions. D1 found outreach easier in dense middle- and lower-middle-class neighbourhoods, where homemakers spend more time at home and social ties are closer, than in upper-middle-class areas whose residents are busy at work. P1 stressed that areas without land are not forced to treat waste; their minimum duty is to separate it, and organic waste is collected for treatment at a city-scale facility. P1 also drew on existing practices:

> *"There are habits or practices that have been going on for decades, even hundreds of years, in the community, which we do not realise are a form of waste treatment. For example, some people collect leftover rice, simply dry it in the sun, and sell it to buyers who use it as animal feed." (P1)*

Separation nonetheless runs against the old habit of "collect, carry, dump". W1 described the process: "It is actually easy because it is only separating waste. At first I was forced to, but now I am used to it." W1 needed about a month to adjust. K1 noted two clashes of norms that hindered acceptance. Residents who had separated their waste saw collectors mix it again, and residents who paid a waste fee considered separation to be the collectors' job. W2 estimated that separation habits in that neighbourhood were only "fifty-fifty".

Complexity

All informants considered the technical action simple. D1 called the KBS programme "a simple thing", since residents need only three containers, for organic, inorganic, and residual waste, which may even be old buckets. W1 said: "Separating waste is easy as long as we are willing." The real complexity lay in changing a mindset. P1 noted that although Regulation No. 9 of 2018 obliges every resident to manage their waste, the habit of "as long as the waste is away from the house" is hard to change, and change can only be achieved through repeated face-to-face communication.

Implementers reduced complexity by moving part of the burden from households to the service. P1 regarded convenience as decisive:

> *"If we talk about waste treatment in more detail, people get dizzy, because there is too much to understand, and in the end they are reluctant to do it. So we provide conveniences, for example the PPSO team that collects organic waste [...] the consistency of a regular schedule makes residents aware of what the KBS programme is." (P1)*

The sub-district formed one PPSO team for each urban village, which collects organic waste from door to door twice a week, weighs it, and records it. W1 handed over organic waste every Tuesday and Friday, between 1 kg and 5 to 8 kg because W1 also sold food. The weighing also served as social control. In W1's words, "it will be noticed if a resident does not separate their waste".

Trialability

Trialability in the KBS programme did not take the form of a low-risk individual trial as Rogers describes it, but of a formalised collective probation. D1 explained that an RW needs "a trial phase of about one year, and at the earliest about six months, to see the consistency of separation and treatment". RWs preparing for status can also visit certified RWs to learn from them. According to P1, these administrative requirements had been introduced only in the previous one or two years, and facilitators deliberately present the stages gradually so that residents are not discouraged. K1 said that an RW may also try on its own without following the procedure, since the method of management is left to residents. For residents, the probation did not feel like a trial: "We actually just do what the head of the RW asks [...] so we did not experiment, it just went ahead" (W1).

KBS status can also be withdrawn. K1 stated: "KBS does not mean that an area is a KBS RW for life. We have a policy that if an area is not sustainable, does not separate and treat its waste, it can no longer be called a KBS area."

Observability

The results of the programme were most visible at the neighbourhood level. D1, K1, and W1 all mentioned smaller piles of waste in KBS RWs, especially during waste emergencies. P1 added that KBS RWs become model RWs that make it easier for other programmes to enter. Successful RWs, especially

those from the pilot phase with an integrated farming concept, have also become destinations for study visits.

Observability, however, also worked in the opposite direction. D1 acknowledged that piles of waste on main roads remained visible, because the city generates about 1,600 tonnes a day, and that some residents concluded that the government was not working:

> *"Many members of the public hold the view that the waste is not managed, that there is no outreach to the RWs, and so on [...] in the end some people who see the piles of waste become apathetic, and some feel encouraged to take part." (D1)*

Table 4 summarises the findings for the five attributes.

Table 4. Summary of perceived attributes of the KBS programme

Attribute	Supporting factors	Constraining factors
Relative advantage	Resilience during waste emergencies; priority for facilities; clean, odour-free surroundings	Benefits collective and institutional, weakly felt by households; information not reaching non-KBS RWs
Compatibility	Adaptation to local character; use of local practices; religious framing	Conflicts with "collect, carry, dump"; belief that the waste fee replaces the duty to separate
Complexity	Simple technical action; scheduled organic collection	Slow change of mindset; home treatment difficult without space
Trialability	Study visits; trying without procedure is allowed	Six- to twelve-month probation and 30% threshold are collective and administrative
Observability	Fewer piles in KBS RWs; model RW status	Piles on main roads breed apathy

Source: compiled from interviews, observation, and documents (2025).

Barriers to Implementation

Six barriers were identified. The first was lack of space and facilities. D1 stated that not all KBS RWs could treat waste themselves, because houses had no room for compost bags or perforated brick bins. Urban villages without a temporary collection point (tempat penampungan sementara, TPS) experienced waste piling up on roadsides (K1), and W2 named the lack of space to store separated waste as the main reason why that RW had not become a KBS. The second barrier was residents' habits and mindset, including reluctance that persists even among those who separate regularly: "when guests come and we eat together, all the waste has to be separated one by one" (W1). The third was the shortage of staff at the sub-district, whose employees cannot focus on one field, so that outreach was not sustained (K1). The fourth was weak sanctions. K1 explained that the "not separated, not collected" policy is enforced by waste collectors rather than by the sub-district:

> *"Sanctions are still very weak, they should be firm, like 'not separated, not collected', but the ones in the field are not from the sub-district but the waste collectors, and since the collectors are paid by residents to take the waste, they will certainly take it." (K1)*

The fifth barrier was the difficulty of sustaining KBS status, especially at the scale of an urban village (P1). The sixth was weak coordination and collaboration in preparing candidate RWs, including collection points that could not hold waste every day because transport to the landfill was limited (W2).

Measures to Overcome the Barriers

The measures taken reflect a shift from requiring residents to treat waste themselves towards providing services that make separation easier. For areas without space, the agency collects separated organic waste and processes it at a city-scale facility into compost or animal feed (D1). The agency places one KBS facilitator and one maggot house supervisor in each sub-district, and the sub-district has formed PPSO teams in each urban village (K1). Facilitators have studied communication and psychological approaches to tailor their messages to different groups of residents, including informal discussions with waste collectors "over coffee" (P1). Among residents, W1 sustained the habit by recalling its direct benefits and appreciated the regular reminders of the RW head. W2 said that the RW was ready to

become a KBS if the government came to the field, provided education, and helped with facilities such as collection carts.

Adoption of Status without Routinisation of Habits

The most important finding is the misalignment between the growth in KBS status and the behavioural indicators. Between March and December 2024, the number of KBS RWs more than doubled, yet separation compliance in the sub-district stayed below 30% and the reduction rate did not rise. This finding must be read with care. The sub-district indicators cover both KBS and non-KBS RWs, the data are self-reported by urban villages, and some months are incomplete. Still, if the spread of status had been accompanied by meaningful behavioural change in the certified RWs, an increase from 9 to 20 RWs, about a quarter of the area, should have begun to appear in the aggregate indicators.

In Rogers' (2003) terms, KBS status is the outcome of a collective adoption decision made by neighbourhood leaders, while daily separation belongs to the stages of implementation and confirmation that must take place in every household. Greenhalgh et al. (2004) show that innovations in service organisations are often adopted formally without being assimilated into routine. The KBS case shows a similar pattern at the community level: the indicator that the government monitors, the number of KBS RWs, measures adoption decisions rather than routinisation. K1's statement that status can be withdrawn when an area stops separating, and P1's view that the greatest challenge is keeping areas sustainable, indicate that implementers are aware of the risk of discontinuance, but this awareness is not reflected in performance indicators. The finding is consistent with the critique by De Vries et al. (2016) that public sector innovation research and practice rarely measure outcomes.

Collective Relative Advantage

The strongest advantages of KBS, resilience during emergencies and priority for facilities, accrue to neighbourhoods and to government rather than directly to households. For a household, the costs of separation are private and recurrent, in time, space, and containers, while the benefits are collective and felt mainly when the city system breaks down. This structure resembles the collective action problem in co-production, in which citizens' contributions produce a public good and individual incentives to contribute are weak (Ostrom, 1996). The individual benefit that W1 described, waste that does not smell when collection is late, depended on the organic collection service. This suggests that relative advantage for households is not an inherent property of the innovation but a result of service design.

The religious framing used by the facilitator can be read as an attempt to bridge this gap by offering a non-material benefit, merit for easing the work of others. The strategy is consistent with evidence that social and moral norms influence household separation (Knickmeyer, 2020). Moral framing, however, works best when it is backed by situational convenience; without it, the framing risks becoming an appeal that is not acted upon.

Complexity and Compatibility as Outcomes of Service Design

The data show that the complexity of KBS lies not in the act of separating but in what happens after waste has been separated. When residents had to treat waste themselves with kitchen-waste tubes, compost bags, or brick bins, the programme became complicated and incompatible with houses that lack space. When the government collected organic waste on a schedule, residents' duty shrank to simple separation. This finding agrees with the meta-analysis by Varotto and Spagnolli (2017) that interventions which change the situation are more effective than information, and with Knickmeyer's (2020) emphasis on the convenience of services. Complexity and compatibility in co-produced innovations are thus not fixed; they can be changed by the division of labour between citizens and providers (Osborne et al., 2016).

Two practices in the service chain also undermined compatibility. Residents who saw their separated waste mixed again by collectors lost their reason to separate, and residents who paid a waste fee regarded separation as part of a service already paid for. Both point to an incompatibility between an upstream innovation and a downstream system still designed for mixed waste.

Sanctions Enforced by Those Whom Residents Pay

The "not separated, not collected" policy makes neighbourhood waste collectors the enforcers of the rule. These collectors, however, are paid by residents through fees and earn extra income from selling valuable inorganic waste, so they have an incentive to keep collecting mixed waste. The situation reflects the dilemma of street-level bureaucracy, in which formal rules are carried out by front-line workers who face pressure from those they serve and enjoy wide discretion (Lipsky, 2010). In developing countries, such collectors are also part of the informal sector that sustains the recycling chain (Wilson et al., 2006).

Enforcement of separation therefore cannot rest on sanctions alone; it requires a rearrangement of collectors' incentives, for example through formal recognition and payment based on separated waste.

Formalised Trialability

Rogers (2003) sees trialability as an opportunity for potential adopters to try an innovation at low risk. In the KBS programme, this attribute had become a collective probation of six to twelve months with performance thresholds and administrative procedures. The change makes sense from the government's point of view, because KBS status opens access to facilities. For RWs with low capacity, however, the procedure adds a burden, and facilitators themselves had to soften it so that residents would not be discouraged. For households, meanwhile, probation did not feel like a trial, because the decision was taken by RW leaders. Trialability in community-based innovations thus needs to be designed at two levels: a low-risk trial for households, such as a few weeks of organic collection without formal obligations, and a probation for RWs.

Theoretical and Practical Implications

Theoretically, the article shows that Rogers' attributes in co-produced service innovations need to be read at two levels of adopter, collective and household, which may perceive the attributes differently. The attributes are also not fixed properties of the innovation; they are shaped by the design of supporting services such as collection schedules, collectors' incentives, and status procedures. The article further underlines the importance of distinguishing adoption from routinisation in evaluating public sector innovation.

Four practical implications follow. Local governments should measure the success of KBS with behavioural and sustainability indicators, such as the share of separating households per RW, the reduction rate per RW, and the retention of status, rather than only the number of certified RWs. Scheduled organic collection should be prioritised for dense areas without space, because it lowers complexity while creating an individual benefit. Collectors' incentives should be aligned with the duty to separate, so that sanctions are not undermined in the field. More outreach staff at the sub-district and direct visits to non-KBS RWs are needed to reach areas that have not yet received information.

CONCLUSION

This study found that implementation of the KBS programme in the sub-district studied was not yet optimal. The number of KBS RWs rose from 7 to 20 of 82 during 2024, but household separation compliance remained below 30% and the waste reduction rate did not improve. The programme's relative advantage was felt mainly collectively; its compatibility and complexity depended heavily on the organic collection service; its trialability had been formalised into an administrative probation; and its observability worked in both directions. The main barriers were lack of space and facilities, old habits, few outreach staff, weak sanctions, difficulty in sustaining status, and weak collaboration. The measures taken included city-scale collection and treatment of organic waste, field facilitators, PPSO teams, and communication tailored to residents.

The main contribution of the article is to show a gap between the adoption of status at the community level and the routinisation of habits at the household level in co-produced service innovations. Where success is counted in certified areas, this gap remains invisible.

SUGGESTION FOR FUTURE RESEARCH

The study has several limitations, each of which suggests further work. The number of informants was small, with only two residents, so the variety of household experience was not fully captured. Future studies should interview a larger and more varied group of residents in both certified and non-certified RWs, including households that stopped separating after their RW obtained status.

The quantitative data were sub-district aggregates self-reported by urban villages, with some months incomplete, so the performance of KBS RWs could not be separated from that of non-KBS RWs. Comparing separation and reduction indicators at the RW level would test directly whether certification is followed by behavioural change. Tracing RWs that lost their KBS status would also shed light on discontinuance. Waste collectors and PPSO teams were not interviewed, although their incentives emerged as central; including them would clarify how enforcement works in practice.

CO-AUTHOR CONTRIBUTION

The authors declare no conflict of interest in this article. The third author worked as an enumerator for the city environment and sanitation agency in 2025, which the authors disclose for transparency. All

authors contributed to the conception and design of the study, the analysis and interpretation of the data, and the writing and revision of the manuscript, and all authors approved the final version.

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