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Analyzing the Service Quality Dimensions in Household Waste Management: A Comparison of Public and Private Service Providers in Urban Kerala, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Environmental quality, considered as a public good which is non-rival and non-excludable in consumption and under the absence of price signal government interventions are necessary. But they can also lead to policy failure or market distortion, highlighting the need for techniques to evaluate non-market goods like environmental quality. In this regard, this paper addresses possible options in dealing with the issues of solid waste management under systems of private and public service providers. Thus, the study investigates alternative approaches to solid waste management in Kerala, focusing on the service quality dimensions of public and private service providers in

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waste management. Data for the study are collected from 384 urban households of Kozhikode corporation, Kerala. Mathematical models like discriminant analysis and principal component analysis are used to identify the service quality dimensions like collection charge, attitude of the collector, regularity, efficiency, and feasibility in collection by service providers. The result shows that public service providers are found to be relatively successful in ensuring regularity but failed in ensuring feasibility in the collection. Results from the analysis of service quality offer strong analytical possibilities. The results go in line with the theory that market failure in ensuring environmental quality necessitates government intervention. However, government failure persists in ensuring feasibility in the collection, which paves the way for the intervention of private service provider. This shows that market failure and the government failure have paved the way for a collaborative effort between the private and public service providers in waste management to promote environmental sustainability.

Keywords: Service quality; waste management; market failure; government failure; discriminant analysis; principal component analysis.

JEL Code: Q53, Q58

1. Introduction

Solid waste has become a serious local environmental issue in recent years and one of the impacts of human exploitation of the environment. The rapid growth in population and prosperity has led to a significant rise in municipal solid waste generation, posing serious threats to public health and the environment, affecting every individual globally (Sharma and Jain, 2020, Hoang et.al., 2022). Municipal solid waste mismanagement, driven by population growth and urbanization, exacerbates environmental pollution, contributes to greenhouse gas emissions, and poses significant public health and socioeconomic challenges (Shah et.al., 2021). In developed nations, cities possess the financial means and expertise for the efficient waste management praxis. However, the situation is more challenging in developing nations due to their increasing speed of urbanisation. Municipalities in these regions often lack the necessary financial resources and expertise, leading to a noticeable decline in scientific waste management services. Challenges in solid waste management, including inadequate infrastructure, lack of proper waste disposal facilities, limited recycling initiatives, and public awareness issues contribute to environmental pollution, health hazards, and aesthetic concerns (Asif et al., 2024) Overlooking these deficiencies in public sector service delivery poses serious risks to public health (Ahmed and Ali, 2006). Thus, it is imperative to explore alternative mechanisms for delivering services in the cities of developing countries to maintain their health and liveability. This situation highlights the crucial issue of ensuring quality service provision despite the financial and skill limitations of the authorities.

Solid waste management has emerged as a major global concern, highlighting the need for innovative strategies to improve resource recovery and curb environmental pollution (Khan et al., 2022). Effective management of Municipal Solid Waste has become an urgent and complex challenge, driven by the rapid increase in waste generation and the wide-ranging environmental, social, and economic consequences resulting from improper handling and disposal (Asif et al., 2023). Waste management strategies focused on recycling are essential for achieving sustainability goals, as demonstrated by developed countries with effective waste management systems (Khan et.al., 2022). Despite increased governmental emphasis on municipal solid waste (MSW) management, providing cost-effective and sustainable waste services remains a significant hurdle for municipalities in India. To address technical and financial shortcomings within the current system, there's a growing reliance on private contractors for waste collection, transportation, and disposal. Moreover, the costs involved and the rate of waste generation have virtually forced city authorities to seek new arrangements with the private sector Oteng – Ababio (2010). The involvement of the private sector yielded positive outcomes, as it increased the solid waste collection frequency and improved the quality of the waste management service (Tshekiso, 2020).

Over time, there has been a shift from short-term contracts to longer-term collaborations between the service providers. Olukanni and Nwafor

(2019) review public-private sector collaboration in delivering efficient solid waste management services and show that while the public sector is responsible for SWM, it has often struggled to meet demand, particularly in developing countries and to enhance efficiency and reduce costs, private sector involvement has been pursued. The public sector, constrained by resource and institutional limitations, can address service delivery gaps through partnerships with the private sector, leveraging its dynamism and flexibility for more effective outcomes (Ahmed & Ali, 2006). Ganesh et al. (2024) highlighted the vital role of smart technologies, public–private collaborations, and the adoption of circular economy principles in enhancing the efficiency of municipal solid waste management. Collaborative partnerships benefit investors, the state, and citizens by reducing the costs and potential opposition to new investments, while also giving citizens the opportunity to align these partnerships with local needs (Forsyth, 2005). Olukanni and Nwafor (2019) examines public-private partnerships in solid waste management, highlighting their role in improving efficiency and reducing costs and emphasizes that the success of such partnerships depends on effective government oversight, stakeholder commitment, and strong legislative enforcement to ensure proper waste disposal. Yet, despite the growing popularity of PPPs (Public-Private Partnerships) in MSW services, the lack of established institutional frameworks, governance structures, regulatory measures, and market connections poses considerable challenges to their successful implementation. Hence, given the local institutional dynamics and market conditions, exploring the potential of PPPs in waste management demands meticulous examination.

Opareh and Post (2002) demonstrates that privatisation has brought advantages to consumers through expanded coverage, increased service frequency, and enhanced reliability, however, it comes with several drawbacks, including deteriorating labor conditions, heightened environmental risks and the absence of financial stability. On the other, Ezebilo and Animasaun, (2012) show that the public-private partnership hasn't effectively enhanced household waste management services and factors such as the duration spent visiting waste collection points, income level, and marital status have exhibited negative impacts on people's perceptions. Hence, to ensure effectiveness and sustainability in waste management, it is imperative to assess the service quality of both public and private service providers in waste management. This evaluation of service quality is essential for fostering a robust waste management system that contributes to the overarching objective of environmental sustainability.

Coming to Kerala, a densely populated state of India, the initiation of the Clean Kerala Mission (CKM) in 2004 sought to ensure compliance with waste management regulations outlined in the Municipal Solid Waste (Management and Handling) Rules, 2000. This mission provided technical and financial support to local governments, leading to the establishment of centralized and decentralized waste management systems, especially targeting markets and institutions. Following a comprehensive sectorial study on municipal solid waste management in 2006, Kerala formulated the Zero Waste Kerala Action Plan in 2007. Consequently, the state modified its waste management approach, emphasizing producer responsibility. The launch of the Haritha Keralam Mission in 2016 aimed to revive Kerala's cleanliness standards, collaborating with various missions and launching extensive waste management campaigns. Both state and central governments incentivized municipal waste programs, encouraging community engagement. Acknowledging the importance of private sector involvement, it is perceived as a significant catalyst in augmenting the efficiency of public services related to waste management. While public authorities are generally responsible for solid waste services, public-private participation has emerged as a promising alternative to improve waste management in different parts of the State.

Local administration in Kerala has instituted many waste treatment plants in collaboration with the private service providers for effective waste management. However, a substantial part of the households does not benefit regular waste collection services from the authorities. Besides, inefficient collection and unscientific management pollute water, land and air, and become a threat to human health and environmental quality. People’s protest against waste treatment plants had led to closing down of some plants like Vilappilsala at Trivandrum and Laloor at Thrissur. It demands the need for evaluating service quality dimensions like regularity, collection charge, efficiency in collection, attitude of the collector and feasibility

in collection of waste management mechanism followed by the authorities. Hence, the service quality dimensions of both public and private service providers in waste management are important for empirical scrutiny. The study is designed to examine the service quality dimensions of public and private service providers in waste management in Kerala, the southern state of India.

2. Theoretical Literature

Economists use the theory of externalities or the theory of public goods to model environmental issues as market failures. When environmental quality is evaluated at market value, it causes market failure because it is a public good that is non-rivalry and non-excludable in consumption. Market failure is frequently the cause of environmental degradation, demonstrating the inefficiency of the markets for environmental products and services. Asymmetric information, market flaws, common property resource problems, incomplete markets, and the existence of public goods and public bad all contribute to this failure. It is important to remember that although market failure is a prerequisite, it does not automatically mean that the government should step in. Government engagement ought to outperform the market or improve its functionality. Furthermore, the advantages of the intervention must exceed the expenses related to its conception, execution, and upholding.

The economic theory defines waste as a negative externality. Production and consumption activities generate enormous waste which has a negative impact on the environment and welfare, which is not taken into account by competitive markets. Humans suffer losses from economic activities that degrade the environment now and in the future, including deteriorated health, decreased productivity, depletion of natural resources, and diminished enjoyment of nature.

Externalities are a form of market failure arising in an unconstrained market (Rabl et al., 1998), defined as the external costs and benefits that arise when the social or economic activities of one group of people have an impact on another, and when the first group fails to account fully for their impact (Krewitt et al., 1998). Neoclassical economist, who made an important contribution to environmental theories during 1950, argues the common property nature of natural resources causes economic externalities. The majority of India's natural resources are de facto open access resources, or CPRs, making them vulnerable to deterioration, contamination, and theft. In a nutshell, most of the CPRs and all open access resources in India are subject to what Garret Hardin (1968) called 'the Tragedy of Commons'. In the case of a CPR, an individual can appropriate all the benefits resulting from his increased use of the resource, he bears only a small fraction of the incremental costs associated with increased use, and all the members of the community share the incremental costs (Hardin, 1968) which shows that the common pool problem is one of the reasons for the existence of externality.

From an economic perspective, the general solution to externalities, including those affecting the environment is to internalise the externality, that is, to force the market participants to absorb the external costs or benefit which can be either done through the assignment of property rights or by internalising environmental externalities through policies that change the product price by the amount of the associated external cost or benefit (Callen and Thomas, 2015).

The impact of waste management on the environment has been widely recognized, and since the 1990s, has contributed to a better understanding of the role of the waste sector in ecological, economic, and social frameworks and in the context of sustainable development (Eshet, 2006). All alternative strategies of waste management result in externalities that are generated at the collection, transport, disposal stages, as a result, municipal solid waste generation and its management and associated externalities have been addressed as one of the key targets in environmental policies (Ayalon et al., 1999).

In these situations, government intervention is necessary to address these shortcomings. This intervention may be in the form of direct public investments, policy tools like taxes and subsidies, market-based incentives and regularity measures, and changes to property rights and other institutions governing resource use. Institutional reforms, macroeconomic management, public initiatives, taxation, laws, and private incentives are the typical ways that governments intervene. But due of policy failures, not all government interventions may be socially good. In other words, government interventions may distort a healthy market functioning or failing to create the conditions necessary for a healthy market. Thus, here, the

market and government failure demand the need for an alternative technique like public private participation in waste management that can evaluate environmental quality in general and solid waste management in particular.

3. Data Source and Methodology

The study is based on primary data which are collected from the households of Kozhikode Corporation of Kerala. A total of 384 sample sizes (n) were selected on the basis of stratified random sampling. The entire wards are split into two strata on the basis of mean distance from waste treatment plant which is 8 km. Strata I comprises of the wards that are within the mean distance and Strata II comprises of the wards above the mean distance. Eight wards from Stratum II and seven wards from Stratum I are chosen for the study, and samples were drawn at random from the wards.

The study employed discriminant analysis to identify the most prominent service quality dimensions of service providers and to assess the extent to which households differentiate between the two types of service providers in quality dimensions like regularity in waste collection, collection charge, efficiency in collection, the attitude of the collector, and feasibility in the collection. Regularity in waste collection refers to the consistent and timely collection of waste at scheduled intervals, which is crucial for ensuring the overall service quality of a service provider in waste collection. The collection charge evaluates the cost-effectiveness and affordability of waste collection services, considering the fees charged for the collection of waste from households. The attitude of the service provider assesses the behavior and professionalism of waste collectors, including their interaction with residents, adherence to regulations, and responsiveness to inquiries or complaints. Efficiency in collection involves the use of appropriate equipment like transportation vehicles number of workers etc. to improve the speed and effectiveness of waste collection processes, ensuring that resources are utilized efficiently. Additionally, this dimension considers the proper disposal and recycling of waste collected, aiming to reduce landfill usage and promote sustainable waste management practices. Feasibility in collection examines the practicality and viability of managing non-biodegradable materials. This dimension evaluates the effectiveness of systems and infrastructure for handling inorganic waste, including the availability of appropriate collection methods, transportation logistics, and disposal mechanisms. This includes considering factors such as availability of suitable collection, methods and infrastructure for handling inorganic waste, the feasibility of transportation and disposal, and the potential for recycling or reusing inorganic materials.

These five dimensions (regularity in waste collection, collection charge, efficiency in collection, attitude of the collector, and feasibility in collection) are evaluated using a 5-point Likert scale, with responses ranging from 1 (very good) to 5 (poor). This scale allows respondents to indicate their perceptions of each dimension towards public and private service providers providing a structured approach to assessing service quality in waste management.

The examination of equality among group means served as the primary step in assessing the significance of an independent variable towards a discriminant function. Wilks' Lambda test is used to determine whether the group mean is equal. The principal component analysis, a dimension reduction approach, is used to break down various dimensions of public and private service quality into two components, Factor 1 and Factor 2. Factor 1 exemplifies service quality dimensions of the public service provider, and Factor 2 exemplifies the private service provider.

4. Results and Discussion

In Kerala, the waste collection service was launched by the Suchitwa Mission in partnership with Kudumbasree [1] on a trial basis. Kudumbasree collects organic waste from households every day except Sunday. This waste is then taken to 32 designated secondary collection points identified by the Corporation, where it is loaded to secondary collection vehicles such as tractors or trucks. Subsequently, the waste is transported to a treatment plant, where biodegradable waste is processed into bio-manure, while non-biodegradable waste and rejects are directed to landfill sites. However, Kudumbasree workers specialize in collecting organic waste and are

[1] *Kudumbasree is the poverty eradication and women empowerment programme implemented by the Kerala State Poverty Eradication Mission of the Government of Kerala, launched on 1998. In Kozhikode Corporation,* Kudumbasree actively involved in the household waste management as a self-employment programme with the support of government.

unwilling to handle inorganic waste. This shows the necessity for additional services to efficiently manage the disposal of inorganic waste in the region. In such situation private service provider like "Niravu" [2] stepping in to fill this gap, collaborating with residents' associations, demonstrates an innovative approach to address this issue. This collaboration not only ensures the proper disposal of inorganic waste but also promotes community involvement in waste management, contributing to a cleaner and more sustainable environment in Kerala. Here, the study aims to investigate individuals' preferences between public and private waste management services, focusing on potential differences in service quality that drive these preferences.

By analyzing the service qualities of of waste management providers and the level of institutional support they receive, researchers and policymakers can identify areas for improvement and develop strategies to enhance waste management practices. As a result, it is critical to analyse the service qualities of providers in waste management in particular and environmental quality in general.

In Kerala, households predominantly rely on a combination of private and public service providers for the disposal of solid waste. A significant proportion of households, 31.5 per cent, opt for public services for the disposal of organic waste. This reliance on public services indicates a level of trust and preference for municipal or government-run waste management systems for biodegradable waste. On the other hand, a similar percentage of households, also 31.5 per cent, rely on private services for the disposal of inorganic waste, particularly plastic waste. This reliance on private services for specific types of waste, such as plastics, suggests a perceived efficiency or effectiveness in handling non-biodegradable waste by private entities. Additionally, 15.4 per cent of households utilize both public and private services, highlighting a nuanced approach where different types of waste are managed by different service providers based on their perceived strengths or specialization. Overall, this data indicates that nearly half of the households (47 per cent) in Kerala rely on either public or private service providers for their waste disposal needs, showcasing a diverse and somewhat fragmented waste management landscape in the region.

The study used discriminant analysis to identify the most prominent service quality dimensions of both public and private services and to examine how far the households are discriminated private and public service providers. Service quality dimensions like regularity in waste collection, collection charge, and efficiency in collection, the attitude of the collector and feasibility in collection (collection of inorganic waste like recyclable and non recyclable wastes) are taken into consideration for the analysis. To trace out the relative significance of the different dimensions of service quality, as a first step, a test of equality of group means was performed. Wilks' Lambda test [3] is used to determine whether group means are equal. The findings from the group mean equality test are given in Table 2.

The Table 2 shows that all dimensions, except for the attitude of the collector, exhibit significance based on Wilk's Lambda test. The overall significance of the model is established through the Wilks Lamda (0.36), which translates to a chi-square value (241.12) with a degree of freedom six is found to be significant ($p = 0.00 < 0.05$). The results suggest that the dimensions included in the model (regularity in collection, waste collection charge, efficiency in collection, feasibility in collection) are important factors in understanding waste management practices and their impact on environmental quality.

Mean value shows that households favour public provider in dimensions such as regularity in waste collection, collection charge, and efficiency in collection which imply that these areas are strengths of the public waste management system. In case of feasibility in the collection, households prefer private service provider as they collect inorganic waste, but the government agencies do not cater to this. It implies that the preference for private providers in feasibility, especially in handling inorganic waste, highlights a potential gap in the services provided by government agencies.

[2] *Niravu started as a community based organization collectively engaged in promoting organic farming and zero waste management in Vengeri, Kozhikode in 2006. Now, it extent its service as a private service provider in the collection of inorganic waste from different parts of the Corporation.*

[3] *Wilks Lamda is a test static used to test whether each dimension of service quality is significantly different in between public and private. The significance of Wilk's Lambda is tested through F-test*

Environmental theorists argue that environmental qualities such as air, water, and natural beauty exemplify public goods, which are not privately owned and thus not easily governed by market principles. Waste collection and its management are carried out mainly for maintaining environmental quality which is considered as a public good. The study suggests an indication of market failure in determining the price of environmental quality, necessitating government intervention. However, government is seemed to be a failure in ensuring dimension like feasibility in waste collection, that is ensure the collection of all types of inorganic waste. This failure has led to the entry of private service providers in collaboration with residents' associations, who collect inorganic waste from households at Rs.70 per sack and transport it out of Kerala. This situation highlights the government's failure to collect inorganic waste, leaving the task to private entities, thereby indicating a failure in the public service provision.

Table 1. Availability of Waste Disposal Service

	Public Service		
Private service	**Available**	**Not available**	**Total**
Available	15.4	16.1	31.5
Not Available	16.1	52.3	68.5
Total	31.5	68.5	100

Source: Estimated from primary data

Table 2. Service Quality Dimensions of Public and Private Service Providers

Public/ Private	Average Mean Score			SD	Wilks' Lambda	F value	Df 2	p Value
	Public	Private	Total					
Regularity in collection	2.92	4.48	3.69	0.73	0.43	323.9	240	0.00
Collection Charge	2.65	2.88	2.76	0.60	0.95	12.37	240	0.00
Efficiency in collection	2.79	3.09	2.95	0.59	0.93	16.84	240	0.00
Attitude of the collector	2.74	2.80	2.77	0.59	0.99	0.69	240	0.40
Feasibility in collection	3.55	3.04	3.29	0.74	0.88	33.31	240	0.00

Source: Estimated from primary data

Table 3. Canonical Discriminant Function Coefficients

Variables	Function
Regularity in collection	0.990
Waste collection charge	0.127
Efficiency in collection	-0.015
The attitude of the collector	-0.319
Feasibility in collection	-0.401

Source: Estimated from primary data

Table 4. Structure Matrix

Variables	Function
Regularity in collection	0.87
Waste collection charge	0.17
Efficiency in collection	0.19
The attitude of the collector	0.04
Feasibility in collection	-0.28

Source: Estimated from primary data

Table 5. Rotated Component Matrix

Dimensions	Factor Loadings	
	Public	Private
Regularity in collection	**0.762**	-0.030
Waste collection charge	**0.785**	0.330
Efficiency in collection	**0.748**	0.502
Attitude of the collector	**0.863**	0.197
Feasibility in collection	0.043	**0.935**

Source: Estimated from primary data

To compare the relative significance between the two groups, the standardised canonical discriminant function coefficients are employed. The findings (Table 3) demonstrates that the variables that have large coefficients have a stronger effect on the variability's explanation. It demonstrates that the garbage collection charge and regularity are the variables with positive coefficients. Among these three, the variable considered to be important for the public agency is regularity in the collection which has larger coefficients. All the other variables, namely, efficiency in collection, the attitude of the collector and feasibility in the collection have negative coefficients, and among these three, feasibility in the collection is more dominant in the private sector.

Table 4 shows the structure matrix of the canonical loading or discriminant loading of the discriminant function. The structural coefficients indicate the relative significance of the discriminating variables based on total correlation, making it possible to identify the crucial variable that separates the two agencies. It reveals a correlation between each variable in the model and the discriminant functions. Overall, these coefficients provide insight into the relative importance of each variable in the analysis, with regularity in collection and feasibility in collection appearing to be the most influential variables for distinguishing between groups.

Structure Matrix indicates that the variable regularity in the waste collection has the maximum loading compared to other variables with positive coefficients and feasibility in the collection has the maximum loading among negative coefficients. Hence, it is clear that regularity in the waste collection is the crucial variable that discriminating the public agency from the private while, feasibility in the waste collection is more dominant for discriminating the private against public.

In the analysis of service quality, the study initially examined five dimensions. Using principal component analysis through the varimax rotation, [4] the dimensions were consolidated into two factors. This is based on the apriori information that we have gained from the discriminant analysis and these two factors elicidated 72.5 per cent of the total variability. Furthermore, the study employed rotated component matrix to estimate the correlation between each of the variables and the estimated components.

Table 5 provides the factor loadings for each of the five components that were extracted and rotated using the Varimax Rotation method. Each factor's dominant loadings are displayed in bold letters. It shows the rotated component matrix which is the rotated loadings of each dimension on to factor 1 and factor 2. Factor 1 denoting preference towards public service providers has significant loadings of four dimensions namely regularity in collection, waste collection charge, efficiency in collection and attitude of the collector. Factor 2 denoting preference towards private service providers has significant loadings of dimension namely feasibility in the collection.

From factor analysis it can be inferred that regularity in collection, waste collection charge, efficiency in collection and attitude of the collector forms the major factor that contributes to the preference of the people towards public service providers while dimension like feasibility in collection contribute to the preference of the people towards private service providers. This suggests indirect validation of the theoretical construct.

The results of service quality dimensions of both public and private service providers show that households strongly prefer public service provider in regularity in the collection since Kudumbasree volunteers and Corporation sanitary workers collect solid waste from household every day except Sunday. Public service providers are highly successful in this dimension but failed in ensuring feasibility in the collection. Government failure has paved the way for private service providers to enter the market and ensure feasibility in the collection. They collect all types of plastic (recyclable and non-recyclable) waste from households but fail in keeping regularity.

Comparative analysis revealed that the public sector demonstrated commendable performance in certain aspects, while the private sector exhibited competitive advantages in specific areas. Notably, the private sector demonstrated more feasible in collection, whereas the public sector exhibited regularity. The study suggests that formal private sector involvement in waste collection, while contributing positively to service feasibility, should be augmented by reinforcing

[4] *Varimax rotation is used to simplify the expression of a particular subspace in terms of a few major items each*

informational capabilities within the public sector concerning contracted services and performance evaluation criteria throughout the contracting process.

Solid waste management services are non-excludable, showing that when provided to a particular community, they contribute to the general public welfare rather than exclusively benefiting the residents who directly receive the service. Additionally, these services are non-rivalry, permitting any person to enjoy the benefits without reducing the benefits for others. The responsibility for urban solid waste management typically lies with local or metropolitan authorities, although this does not imply that these entities are solely responsible for service delivery, as the private sector often plays a pivotal role in contributing staff, equipment, and funding (World Bank, 1994).

5. Conclusion

The discussion on service quality dimensions of public and private service providers in waste management in Kerala show that public service provider ensure regularity in collection by collecting day to day organic waste from households, but failure in collecting inorganic waste. On the other private service provider collect all types of inorganic waste from households thereby ensure feasibility in collection, but failure in ensuring regularity. Not much significant difference can be seen in the other three dimensions that are collection charge, efficiency, attitude and total performance of public and private service.

In conclusion, the examination of solid waste management reveals a dual challenge marked by market failure, due to negative externalities, and government failure in ensuring feasibility in waste collection efforts. Government interventions, incorporating sanitary and Kudumbasree workers, though well-intentioned, encountered feasibility challenges. Recognizing the limitations, the private sector stepped in to address these issues, demonstrating a capacity for feasibility in collection. This study posits that the confluence of market and government failures necessitates an innovative solution, namely, collaborative approach of public and private participation which harmonizes the strengths of both sectors. Public services ensure regular waste collection, upholding a sense of order, while private entities contribute their efficiency, particularly in addressing feasibility concerns. This synthesis not only rectifies the shortcomings of market and government interventions but also emerges as a practical and sustainable solution for ensuring environmental quality and fostering long-term sustainable development. Therefore, the findings of this research advocate for the adoption of private public participation as a promising strategy to address the complexities of solid waste management, presenting a harmonious blend of market forces and governmental oversight for a more effective and sustainable future. The privatisation of solid waste collection activities has often been flagged as a suitable intervention to overcome some of the challenges of solid waste management experienced by Kerala.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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