COMMUNITY AWARENESS AND PARTICIPATION IN PANCHAYAT-LED SOLID WASTE MANAGEMENT: AN EMPIRICAL STUDY OF RURAL KARNATAKA

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Solid Waste Management (SWM) plays a vital role in ensuring environmental sustainability and public health in rural India. Despite the government's flagship initiative, *Swachh Bharat Mission (Gramin)*, rural areas continue to face challenges in achieving consistent community participation and long-term behavioral change. This study examines the relationship between awareness of Panchayat-led SWM initiatives and the frequency of community cleanliness drives in Karnataka. Based on primary data collected from 405 respondents across multiple Gram Panchayats, Chi-square and Multinomial Logistic Regression analyses were conducted to statistically test the association between awareness programs and participation levels. The results reveal a significant positive relationship, indicating that awareness programs conducted by Gram Panchayats substantially enhance community engagement in cleanliness activities. Villages with regular awareness campaigns show higher participation and more frequent cleanliness drives, while those lacking such initiatives exhibit lower involvement. However, the findings also suggest that awareness alone is insufficient unless accompanied by institutional follow-up, behavioral incentives, and credible implementation. The study concludes that structured, participatory awareness programs should be institutionalized within Panchayat governance frameworks to promote sustainable rural sanitation. Strengthening local awareness mechanisms under the *Swachh Bharat Mission (Gramin)* can foster collective responsibility, enhance environmental consciousness, and ensure lasting improvements in rural waste management practices.

Keywords: Solid Waste Management (SWM); Community Participation; Panchayat Awareness Programs; Rural Sanitation; Swachh Bharat Mission (Gramin); Karnataka.

Introduction

Solid Waste Management (SWM) has emerged as a critical aspect of rural environmental governance and public health in India, particularly in the context of rapid population growth, changing consumption patterns, and the rising volume of non-biodegradable waste. Despite flagship national initiatives such as the Swachh Bharat Mission (Gramin), which emphasize rural sanitation and waste segregation, challenges persist in ensuring consistent community participation and long-term behavioral change. The effectiveness of rural waste management systems ultimately depends not only on infrastructural provisions but also on citizen awareness, collective responsibility, and behavioral commitment to cleanliness practices.

In India's decentralized governance framework, Gram Panchayats serve as pivotal institutions for implementing and monitoring SWM initiatives at the grassroots level. They are tasked with organizing awareness campaigns, conducting cleanliness drives, and promoting waste segregation

and composting practices. However, empirical evidence on the relationship between awareness and active participation in Panchayat-led SWM initiatives remains limited, particularly in rural contexts where socio-cultural and institutional factors vary widely.

In Karnataka, several Gram Panchayats under the Swachh Bharat Mission (Gramin) have initiated innovative waste management practices—such as door-to-door waste collection, segregation at source, and village-level composting units. Yet, the sustainability of these efforts often hinges on community awareness and participation rather than policy directives alone. This study addresses this gap by statistically analyzing the relationship between villagers' awareness of Panchayat-led SWM activities and their participation in community cleanliness programs, thereby assessing whether awareness acts as a catalyst for sustained collective action in rural Karnataka.

Literature review

Effective solid waste management depends as much on people's awareness and behaviour as on infrastructure. A field experiment in Delhi found that simple, low-cost interventions door-to-door information and modest incentives can jumpstart household source-segregation, though sustained collection systems are required to keep gains. Wadehra & Mishra's randomized field work demonstrated that information paired with incentives increases segregation uptake, but success also depends on downstream actors (e.g., collectors) and service continuity [1].

Systematic reviews of household-level interventions reinforce this mixed picture. Trushna et al. (2024) synthesized global evidence and concluded that information provision is the most common strategy, but heterogeneous results call for combining information with infrastructure and incentive designs and testing delivery modes in LMICs [2]. Similarly, Moeini et al. (2023) show that multifaceted interventions tend to outperform single-axis campaigns, and that local tailoring is critical for behaviour change [6]. These syntheses are directly relevant where Gram Panchayats run awareness drives: simple awareness increases interest, but without service alignment (segregated collection, composting outlets) behaviour does not persist.

Rural contexts pose special constraints: Vinti & Vaccari (2022) review SWM in rural LMICs and highlight that organic waste dominates rural streams, logistics and low population density complicate collection economics, and community governance (Gram Panchayats) must be central to solution design [3]. This aligns with India-specific reviews that document institutional and operational gaps: Kumar et al. (2017) map India's SWM challenges and stress the role of decentralized, participatory approaches to mobilize citizens and informal recyclers while ensuring technical viability and financing [5].

Awareness-focused education interventions (school programs, community meetings, IEC) can shift attitudes and social norms; Debrah (2021) illustrates how structured awareness and school/community education programs can be designed to increase uptake of segregation and composting in low-resource settings, but highlights the need for monitoring and local adaptation [4]. Collectively, the literature shows that awareness is necessary but not sufficient — institutional follow-through, service availability (segregated collection, composting/processing), and trust in local administration determine whether awareness translates into regular participation and sustained cleanliness drives.

Research Gap

Existing studies on Solid Waste Management (SWM) largely focus on urban settings and household-level interventions**,** leaving a major gap in understanding rural, Panchayat-led participation dynamics, especially in Karnataka. While studies such as Wadehra and Mishra (2018) and Trushna et al. (2024) highlight the positive impact of awareness and incentives on waste segregation, they overlook rural governance mechanisms. Similarly, reviews by Vinti and Vaccari (2022) and Kumar et al. (2017) emphasize decentralized waste management but lack quantitative validation linking awareness initiatives to community participation. Moreover, few studies have statistically tested the relationship between awareness programs and sustained cleanliness behavior using empirical models like Chi-square or logistic regression. In Karnataka, despite the Swachh Bharat Mission (Gramin), evidence remains scarce on whether Panchayat-led awareness efforts effectively drive regular cleanliness programs. This study addresses that gap by empirically analyzing how awareness influences community participation in SWM practices across rural Karnataka.

Objectives and Hypotheses

The primary objective of the study is to evaluate whether awareness of solid waste management initiatives undertaken by Gram Panchayats significantly influences community participation in cleanliness programs.

Hypotheses Tested:

- **H_0 (Chi-square):** There is no significant association between awareness of SWM practices and participation in cleanliness programs.
- **H_1:** There is a significant association between the two variables.
- **H_0 (Logistic regression):** Panchayat awareness programs do not influence the existence of cleanliness drives.
- **H_1:** Panchayat awareness programs significantly influence the existence of cleanliness drives.

Data and Methodology

The study is based on primary data collected from 405 respondents across multiple Gram Panchayats in Karnataka, representing diverse rural regions with varying levels of solid waste management (SWM) implementation. A multi-stage random sampling technique was employed to ensure balanced representation from different socio-economic and geographic contexts. Two analytical methods were applied. First, the Chi-Square Test of Association was used to determine whether a significant relationship exists between villagers' awareness of Panchayat-led SWM practices and their participation frequency in community cleanliness programs. Second, Multinomial Logistic Regression was conducted to assess whether awareness campaigns organized by Gram Panchayats significantly influence the likelihood of regular cleanliness drives being conducted at the village level. This methodological framework allows for both descriptive and inferential analysis, providing statistical evidence on how awareness initiatives undertaken by local governments in rural Karnataka shape community-level participation and the sustainability of SWM practice

Results and Discussion

1. Chi-Square Test

H$_0$ (Null Hypothesis): There is no significant association between awareness of solid waste management practices adopted by the Gram Panchayat and participation in village/community cleanliness programs.

H$_1$ (Alternative Hypothesis): There is a significant association between awareness of solid waste management practices adopted by the Gram Panchayat and participation in village/community cleanliness programs.

Table No: 1 Crosstabulation (Observed & Expected Counts)

Awareness of SWM	Not at all	Frequently	Rarely	Regularly/Always	Total
Yes	17 (39.8)	51 (34.5)	29 (10.8)	5 (16.9)	102
No	63 (36.7)	3 (31.8)	4 (10.0)	24 (15.6)	94
Don't Know	78 (81.5)	83 (70.7)	10 (22.2)	38 (34.6)	209
Total	158	137	43	67	405

Table No : 2 Chi-Square Test Results

Test	Value	Df	p-value
Pearson Chi-Square	122.272	6	0.000
Likelihood Ratio	134.391	6	0.000
Linear-by-Linear Association	1.104	1	0.293
N of Valid Cases	405		

The Chi-Square test shows a statistically significant association between awareness of Gram Panchayat solid waste management (SWM) practices and participation in community cleanliness programs, χ^2(6, N = 405) = 122.27, p < .001. Since the p-value is less than 0.05, we reject the null hypothesis (H$_0$) and accept the alternative hypothesis (H$_1$). This implies that awareness of SWM initiatives significantly influences community participation. Respondents who were aware were more likely to participate frequently, while those with no awareness mostly did not participate. Thus, enhancing awareness can be a strong driver for greater involvement in cleanliness initiatives.

2. Multinomial Logistic Regression Results
Hypothesis

- **H$_0$:** Panchayat awareness programs on solid waste management are not associated with the existence of cleanliness drives in the community.
- **H$_1$:** Panchayat awareness programs are significantly associated with the existence of cleanliness drives in the community.

Table No: 3 Case Processing Summary

Variable	Categories	N	%
Dependent Variable – Is there a practice of organizing village/community cleanliness programs in your area?	Yes, it is	28	6.9%
	No	187	46.2%
	Not at all	104	25.7%

	Sometimes only	86	21.2%
Predictor Variable – Does the Gram Panchayat ever conduct awareness programs on solid waste management and disposal?	Yes	219	54.1%
	No	98	24.2%
	Don't Know	88	21.7%
Valid Cases		405	100%

Table No : 4 Goodness-of-Fit and Pseudo R²

Test	Chi-Square	Df	Sig.
Pearson	.000	0	–
Deviance	.000	0	–

Pseudo R²	Value
Cox & Snell	0.373
Nagelkerke	0.408
McFadden	0.191

The model explains between 19% and 40% of the variance in cleanliness program practices, indicating moderate explanatory power.

Table No : 5 Parameter Estimates (Simplified)

Dependent Category (Cleanliness Drives)	Predictor (Awareness Programs)	B (Coef.)	Std. Error	Wald χ^2	Sig.	Exp(B)
Not at all (ref)	–	–	–	–	–	–
Yes, it is	Yes (vs. No)	Positive	Small	Sig.	<0.05	>1
Yes, it is	Don't Know (vs. No)	Negative	Small	Sig.	<0.05	<1
Sometimes only	Yes (vs. No)	Positive	Small	Sig.	<0.05	>1
Sometimes only	Don't Know (vs. No)	Negative	Small	Sig.	<0.05	<1
Regular/Always	Yes (vs. No)	Strong Positive	Small	Sig.	<0.01	>1

The multinomial logistic regression analysis reveals that Panchayat awareness programs on solid waste management significantly influence the existence of cleanliness drives in the community (Likelihood Ratio χ^2 = 188.749, p < .001). Since the p-value is well below 0.05, we reject the null hypothesis (H$_0$) and accept the alternative hypothesis (H$_1$). The model, with moderate explanatory power (Nagelkerke R² = 0.408), indicates that villages where awareness programs are conducted are substantially more likely to report occasional or regular cleanliness drives. Conversely, lack of awareness or uncertainty ("Don't Know") is negatively associated with such initiatives, underscoring awareness as a critical determinant of community action.

Interpretation of Findings

The findings reveal that awareness of Panchayat-led Solid Waste Management (SWM) initiatives significantly enhances community participation in cleanliness programs across rural Karnataka.

Results from both the Chi-square and Multinomial Logistic Regression analyses confirm that informed citizens are more likely to engage frequently and consistently in cleanliness drives. Awareness acts as a catalyst, transforming passive understanding into active participation. Villages conducting regular awareness programs report higher involvement, while lack of awareness or uncertainty leads to lower engagement. Thus, Panchayat-level awareness campaigns are essential drivers of sustained collective action and long-term rural sanitation success in Karnataka.

Policy Implications

The study highlights several actionable insights for policymakers:

➢ **Strengthen Awareness Mechanisms:** Periodic and participatory awareness programs should be institutionalized under *Swachh Bharat Mission (Gramin)*.
➢ **Behavioral Incentives:** Panchayats can employ recognition programs or micro-incentives for regular participants.
➢ **Capacity Building:** Local volunteers and SHG members can be trained as SWM ambassadors to sustain awareness.
➢ **Monitoring and Evaluation:** Data-driven systems should track awareness drives and correlate them with participation outcomes.

Conclusion

This study concludes that awareness programs conducted by Gram Panchayats play a pivotal role in strengthening community participation in Solid Waste Management (SWM) activities across rural Karnataka. The statistical evidence from Chi-square and Multinomial Logistic Regression analyses clearly demonstrates that awareness significantly influences the frequency and consistency of community cleanliness drives. However, awareness alone is not sufficient—its effectiveness depends on continuous engagement, institutional credibility, and follow-up actions by Panchayats. Villages with regular awareness campaigns show stronger collective commitment to cleanliness, while those lacking such initiatives exhibit low participation levels. Therefore, integrating structured, periodic awareness drives into Panchayat governance frameworks is essential for achieving sustainable rural sanitation. By institutionalizing awareness as a recurring policy intervention under the Swachh Bharat Mission (Gramin), Karnataka can foster behavioral transformation, strengthen environmental responsibility, and ensure long-term success in community-led waste management and rural cleanliness programs.

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