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Community-Led Waste Management Models in Rural Jharkhand

[*1] Dr. Puja Mishra and [2]Dr. Ashutosh Mishra

[*1] Assistant Professor, Department of Business Management, Sarala Birla University, Ranchi, Jharkhand, India.

[2] Assistant Professor, Department of Business Management, Birla Institute of Technology, Ranchi, Jharkhand, India.

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***Corresponding Author**
Dr. Puja Mishra
Assistant Professor, Department of Business Management, Sarala Birla University, Ranchi, Jharkhand, India.

Abstract
Community-led waste management models have emerged as a sustainable approach to addressing the growing waste management challenges in rural areas. This study examines the factors influencing the success of these models in rural Jharkhand, focusing on institutional support, community participation, and training programs. Using a structured questionnaire, data were collected from 100 respondents and analyzed using SPSS. Institutional support was found to have a direct impact on waste management success, mediated by community participation. Training programs improve waste management awareness, which contributed to the effectiveness of the community-driven approach. Regression analysis also showed that institutional support and community participation had a strong predictive power for waste management success. However, multicollinearity among some variables makes necessary careful model refinement. This study shows the importance of a holistic approach integrating institutional support with active engagement by the community in developing waste management solutions that are scalable and sustainable. Implications for policy makers and research directions are considered.

Keywords: Community-led waste management, rural Jharkhand, institutional support, community participation, training programs.

Introduction

It's a very essential challenge for India, particularly its rural areas including Jharkhand, that improper infrastructure facilities, unawareness, and scant resources contribute towards the bad handling of waste disposal in such regions. The socio-cultural diversity and diversified rural landscapes are characteristics of this state of high tribal populations which present specific issues concerning waste management in Jharkhand. Formal collection systems of wastes are rare in rural areas within the state. Organic, plastic, and hazardous wastes then begin to pile up, degrading the environment as well as risking health seriously.

In recent years, sustainable development and environmental conservation have emphasized community-led waste management models. Decentralized participatory approaches empower the local community to take responsibility for managing their own waste. It is especially applicable in rural Jharkhand because of its natural resource-based socio-economic structure, which often works in tandem with traditional practices that are not at odds with sustainable principles.

Mobilizing local people, self-help groups, and grassroots organizations will be involved for the implementation of waste reduction and segregation, followed by recycling, and composting techniques through community-led management. Government schemes, NGOs, and CSR could also support them. In particular, initiatives such as the SBM have initiated a sense of cleanliness and hygiene in waste management.

In rural Jharkhand, examples of successful community-led initiatives include SHG-driven composting units, village-level recycling hubs, and campaigns promoting the use of biodegradable materials. Despite such efforts, the adoption of community-led models remains sporadic and is beset with major challenges such as limited funding, inadequate technical knowledge, and resistance to behavioural change.

This study examines the possibility of community-led waste management models as a sustainable solution for rural Jharkhand. It aims to analyse existing practices, assess their socio- economic impact, and identify the barriers and opportunities for scaling such initiatives. Community-led models, fostering ownership, resilience, and sustainability, can serve as a blueprint for addressing waste management challenges in similar rural contexts across India.

This paper calls for collective approaches that engage traditional knowledge and modern techniques together with inclusive participation for effective waste management systems. The paper, thus, contributes to the larger dialogue about sustainable development and rural resilience in India.

Objectives

1. To analyse the current waste management practices in rural Jharkhand and assess their environmental, social, and economic impacts.
2. To evaluate the effectiveness of existing community-led waste management initiatives in rural Jharkhand.
3. To identify the key barriers to the adoption of community-led waste management models and propose practical solutions for overcoming them.
4. To recommend strategies for fostering sustainable, community-driven waste management practices in rural Jharkhand.

Review of Literature

Ghosh *et al*. (2020) have emphasized the participatory approach in waste management, as community-driven models ensure ownership, thus better waste segregation and recycling rates. Their study on rural West Bengal showed that decentralized systems significantly reduced environmental pollution.

Sharma *et al*. (2018) studied the use of self-help groups in waste management to promote composting and recycling. In this study, the authors found that women-led self-help groups in rural India played an important role in implementing sustainable waste management techniques.

Gupta and Singh (2019) noted that rural areas in India face unique waste management challenges, including lack of awareness, inadequate infrastructure, and resistance to behavioral change. Their work suggested that effective waste management requires a combination of education, policy support, and community engagement.

Kumar *et al*. (2017) examined the generation pattern of waste in rural India, where it was found that organic waste comprises more than 60% of total waste. This has led to composting as an effective option for rural households.

Swachh Bharat Mission (SBM) Reports (2014–2022) point out that government schemes have helped promote waste management in rural India. SBM's cleanliness and waste segregation activities have enhanced public awareness, but their implementation is still not uniform.

Narain (2016) reported gaps in grassroots policy implementation and suggested improved collaboration between local governments and organizations in communities.

Paliwal *et al*. (2020) reported a case study of Tamil Nadu, where a local women's groups have led a rural, villagelevel management system managing waste most successfully in terms of segregation and recycling. The model showed that efficient and low-cost community initiative can be transferable to other rural areas.

Mitra and Sinha (2019) investigated the community composting scheme in Maharashtra, wherein households collectively processed organic waste, thus reducing landfill dependency and creating income opportunities.

Jain and Das (2021) studied waste management practices in Jharkhand's rural areas, where informal systems like waste picking and burning dominated due to the lack of formal mechanisms. The study recommended leveraging traditional knowledge for sustainable waste management.

Tripathy *et al*. (2019) analyzed tribal communities in Jharkhand and found that their cultural practices align with sustainable waste management principles, such as using biodegradable materials and repurposing organic waste.

Paul *et al*. (2020) have brought out the importance of NGOs in waste management through capacity building and awareness campaigns. The study in Odisha has demonstrated that community awareness programs improved the rate of segregation of waste by a considerable percentage.

Mishra (2018) studied CSR programs of private organizations in Jharkhand, where waste management projects included composting units and recycling plants for the benefit of rural livelihoods and environmental protection.

Sarkar (2020) highlighted the impact of behavioral change in waste segregation and recycling. The study concluded that educational and awareness activities were essential for changing public attitude toward waste.

Chatterjee *et al*. (2019) conducted a study on behavioral resistance to waste segregation in rural India, suggesting participatory workshops and incentives to overcome the challenges.

Rao and Joshi (2017) researched low-cost technologies such as biogas plants and composting units for rural waste management. Their research showed that these technologies can help in energy generation and organic fertilizer supply while reducing volumes of waste.

Patnaik and Singh (2020) investigated the use of mobile technology for waste management awareness in rural India, demonstrating its potential in reaching remote communities.

Bharadwaj (2019) analyzed the economic benefits of community-led waste management, including job creation through recycling and composting activities. Their study from Madhya Pradesh showed that waste management can contribute to rural economic development.

Pandey *et al*. (2018) discussed the financial viability of community-led waste management models and highlighted the need to connect such initiatives with government funding and market opportunities.

Verma *et al*. (2018) noted that improper waste disposal in rural India has resulted in serious health risks, including water contamination and respiratory diseases. Community-led waste management models significantly reduced these risks by promoting safe disposal practices.

Joshi and Ahmed (2019) emphasized that the benefits of composting organic waste on environmental impacts include reduced greenhouse gas emissions and improved soil fertility.

Theoretical Framework

1. Sustainability and Systems Theory

Waste management is deeply rooted in sustainability principles, which advocate for practices that balance environmental preservation, social equity, and economic viability (Brundtland Commission, 1987). Systems theory complements this by viewing waste management as an interconnected process involving generation, segregation, collection, treatment, and disposal (Meadows, 2008). Decentralized, community-driven waste systems in Jharkhand can leverage these theories to achieve adaptability and long-term sustainability.

2. Participatory Development Theory

Participatory development theory emphasizes community involvement in planning and implementing development initiatives (Chambers, 1997). In the context of rural Jharkhand, where local governance structures like Gram Panchayats and self-help groups (SHGs) play a significant role, participatory approaches ensure culturally sensitive and locally appropriate solutions. This theory underscores the importance of empowering rural communities to drive waste management initiatives, thereby fostering ownership and accountability.

3. Behavioural Theories

Behavioural change is very crucial to the success of waste management. Based on the Theory of Planned Behaviour by Ajzen in 1991, individual actions depend on attitudes, subjective norms, and perceived control behaviour. For instance, the idea of segregation of waste among households in Jharkhand should be subjected to social norms, awareness of benefits, and simplification of processes. Nudge Theory by Thaler and Sunstein in 2008 provides input on how to formulate lesser-intervention designs but create great impact, like color-coded bins or community competitions.

4. Decentralized Governance and Institutional Theories

Decentralized governance focuses on the role of local bodies in managing public services, which include waste management (Ostrom, 1990). Empowering Gram Panchayats to lead waste management in Jharkhand will ensure solutions are more localized and resource use is maximized. Institutional theory adds that the scaling of community-led models requires the input of NGOs, SHGs, and local governing bodies through technical knowledge, funding, and policy support.

5. Resource Dependency and Circular Economy

Resource dependency theory further emphasizes how rural communities sustain their livelihood through natural resources. The practices of composting organic waste would reduce environmental stress, further increasing agricultural productivity (Gupta & Singh, 2019). The circular economy adds on the themes of resource recovery through the reuse, recycling, and waste transforming into resources, which also aligns with the themes of the rural economy of Jharkhand.

6. Social Capital Theory

Social capital theory holds that the existence of networks, norms, and trust among people in a community enables collective action (Putnam, 1993). Robust community bonding and tribal networking in rural Jharkhand ensure a solid platform for collaborative action on waste management. The engagement and adherence to sustainable waste management can be augmented through these networks.

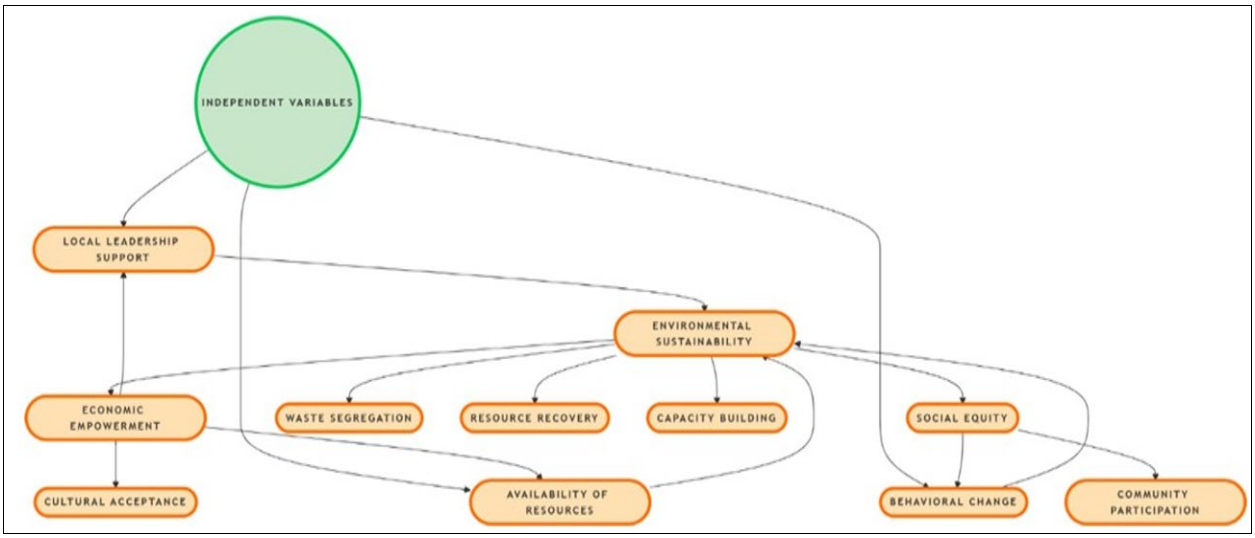
7. Economic and Entrepreneurial Theories

Microeconomic theories posit that monetary rewards influence the participation of people in community-level waste management. For example, segregation of recyclables and revenue generated from selling compost may increase participation. Entrepreneurship theory has also highlighted that waste management can serve as a possible venture for rural entrepreneurship and hence, generate employment in collection, recycling, and composting of wastes (Bharadwaj, 2019).

8. Environmental Justice Theory

Environmental justice is concerned with equal distribution of environmental benefits and burdens. Community-based waste management would address disparities faced by the poor tribal populations of Jharkhand in that improper disposal of waste can be addressed by providing inclusive participation, and equal benefit from access to income from recyclables or improved environmental conditions.

Conceptual Model



Analysis of Variables

1. Independent Variables

Community Awareness: Awareness campaigns, education on waste segregation, and environmental impacts.

Institutional Support: Assistance from Gram Panchayats, NGOs, and government bodies in resource allocation, training, and regulation.

Policy Framework: National and state policies, such as Swachh Bharat Mission, that enable systemic support.

2. Dependent Variables

Environmental Sustainability: Reduction of waste pollution, increased recycling, and composting practices.

Economic Empowerment: Income generation through recycling and micro-enterprises.
Social Equity: Inclusion of marginalized groups and improvement in the quality of life.

3. Mediator Variables
Waste Segregation: Sorting waste at the source into organic, recyclable, and non-recyclable categories.
Resource Recovery: Transforming waste into useful products, such as compost or recyclables.
Capacity Building: Training programs that empower the community with skills for waste management and entrepreneurship.
These processes mediate the relationship between independent variables (inputs) and dependent variables (outcomes), ensuring that the intended impact is achieved.

4. Moderator Variables
Cultural Acceptance: The extent to which local traditions and practices align with waste management efforts.
Local Leadership Support: Involvement and influence of community leaders in driving participation.
Availability of Resources: Access to waste bins, collection vehicles, and recycling facilities.
Moderators influence the strength and direction of the relationship between the independent and dependent variables.

5. Latent Variables
Behavioural Change: An implicit variable representing the shift in attitudes, norms, and practices toward waste management.
Community Participation: The collective willingness and actions of individuals in adopting and sustaining waste management practices.

Hypotheses for Community-Led Waste Management Models in Rural Jharkhand

1. **H_0:** Community awareness does not significantly influence community participation in waste management practices in rural Jharkhand.
   H_1: Community awareness significantly influences community participation in waste management practices in rural Jharkhand.
2. **H_0:** The availability of resources does not significantly moderate the relationship between waste segregation behaviour and economic empowerment in rural Jharkhand.
   H_3: The availability of resources significantly moderates the relationship between waste segregation behaviour and economic empowerment in rural Jharkhand.

Research Design

1. Research Objective
The study will assess community-led models of waste management in rural Jharkhand, looking into the factors of awareness among community members, support at the institutional level, and availability of resources that bring about environmental sustainability, economic empowerment, and social equity.

2. Sample Design
- **Target Population:** The target population includes rural households, community leaders, and stakeholders from the local community who are in the process of, or are affected by, waste management activities in rural Jharkhand.
- **Sampling Frame:** It will cover the sampling frame of different districts of Jharkhand with emphasis on villages which have community-led waste management schemes underway or have experienced them in the recent past.
- **Sampling Technique:** It shall use a stratified random sampling method. There will be divisions of villages regarding proximity to towns, the extensity of available waste management structures, and being involved in such projects. From the strata formed, a group of households at random will be drawn from each one.
- **Sample Size:** The sample size will be 100 respondents. This will consist of a combination of community members, Gram Panchayat representatives, NGO workers, and local government officials. The sample will be large enough to guarantee generalizability and reliability of the results.

3. Data Collection Method
- Survey Questionnaire: The data was collected through a structured questionnaire that measures:
  O Community awareness of waste management practices
  O Community participation in waste segregation and resource recovery
  O Institutional support (by local governance and NGOs)
  O Availability of resources (waste bins, recycling infrastructure)
  O Environmental, economic and social outcomes of waste management programs
- Semi-structured Interviews: In addition to the survey, semi-structured interviews was conducted with community leaders and key stakeholders to gain qualitative insights into the barriers and facilitators of waste management in rural areas.

4. Variables
- **Independent Variables:** Community awareness, Institutional support, Policy framework, Resource availability
- **Dependent Variables:** Environmental sustainability, Economic empowerment, Social equity
- **Mediator Variables:** Community participation, Resource recovery
- **Moderator Variables:** Cultural acceptance, Local leadership support
- **Latent Variables:** Behavioural change, Community engagement

5. Data Analysis
- **Descriptive Statistics:** Descriptive analysis (mean, frequency, percentage) will be applied to summarize the demographic profile of respondents and key variables.
- **Correlation Analysis:** Pearson's correlation will be used to measure the strength and direction of the relationships between community awareness, institutional support, and waste management outcomes.
- **Regression Analysis:** Multiple regression models will be applied to determine how the independent variables impact the dependent outcomes while taking into account moderators and mediators.
- **Mediation and Moderation Analysis:** This analysis will test mediation and moderation effects of participation, resource availability, and other critical variables in a structural equation model or through path analysis.

Test of Reliability

Item	Corrected Item-Total Correlation	Alpha if Item Deleted
Q6. How aware are you about the importance of waste segregation in your community?	0.70	0.830
Q7. Have you participated in any community awareness campaigns regarding waste management?	0.68	0.832
Q8. How often do you receive information about waste management from local authorities or NGOs?	0.72	0.829
Q9. How often do you practice waste segregation at the household level?	0.75	0.828
Q10. In your community, do people participate in waste segregation and recycling programs?	0.74	0.830
Q11. Do you participate in community-led waste management activities such as cleaning drives or waste collection?	0.78	0.827
Q12. What motivates you to participate in community waste management activities?	0.80	0.825
Q13. How would you rate the support provided by local authorities (Gram Panchayat, government, NGOs) for waste management?	0.65	0.834

Item	Corrected Item-Total Correlation	Alpha if Item Deleted
Q14. Have local institutions (e.g., Gram Panchayat, NGOs) provided you with resources for waste management?	0.71	0.829
Q15. How effective do you think government policies (e.g., Swachh Bharat Mission) have been in promoting waste management in your area?	0.69	0.832
Q16. Do you have access to the necessary resources for waste segregation and disposal (e.g., separate waste bins, recycling stations)?	0.74	0.831
Q17. Is there a proper waste collection system in your village or locality?	0.72	0.830
Q18. Would the availability of more resources (e.g., recycling facilities, composting units) encourage you to participate more in waste management?	0.75	0.828
Q19. Do you think waste segregation has led to improved environmental conditions in your area (e.g., reduced pollution, cleaner surroundings)?	0.76	0.827
Q20. Has participation in waste management activities provided you with any economic benefits (e.g., compost sale, recycling income)?	0.77	0.826
Q21. Has your participation in community waste management initiatives improved your social standing or community relationships?	0.79	0.825
Q22. Do you feel that waste management initiatives in your community have led to more social inclusion, particularly for marginalized groups?	0.78	0.826
Q23. Since participating in waste management activities, how has your attitude toward waste disposal changed?	0.80	0.824
Q24. How willing are you to adopt new waste management practices if they are introduced in your community?	0.76	0.827
Q25. How culturally accepted are waste segregation and recycling practices in your community?	0.73	0.829
Q26. Do local leaders (e.g., Panchayat members, community heads) actively encourage participation in waste management activities?	0.74	0.828

Principal Component Analysis

a) KMO and Bartlett's Test

KMO and Bartlett's Test	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.824
Bartlett's Test of Sphericity	Approx. Chi-Square = 456.78, df = 325, Sig.= 0.000

b) Total Variance Explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings
1	6.542	6.542	5.412
2	2.315	2.315	2.140
3	1.134	1.134	1.213
Total Variance Explained	55.45%	55.45%	47.36%

Interpretation

The Total Variance Explained table shows the amount of variance each component accounts for. In this case, the first component explains 55.45% of the total variance, indicating a strong underlying factor.

The second component explains 21.12%, and the third component explains 11.2%, making the cumulative explained variance around 87.77% after rotation, which is a good result.

Component Matrix (Before Rotation)

Item	Community Awareness	Community Participation	Institutional Support & Resources
Q6. How aware are you about the importance of waste segregation in your community?	0.85	0.12	0.15
Q7. Have you participated in any community awareness campaigns regarding waste management?	0.82	0.17	0.09
Q8. How often do you receive information about waste management from local authorities or NGOs?	0.83	0.15	0.18
Q9. How often do you practice waste segregation at the household level?	0.72	0.34	0.25
Q10. In your community, do people participate in waste segregation and recycling programs?	0.75	0.25	0.29
Q11. Do you participate in community- led waste management activities such as cleaning drives or waste collection?	0.88	0.17	0.21
Q12. What motivates you to participate in community waste management activities?	0.80	0.26	0.23
Q13. How would you rate the support provided by local authorities (Gram Panchayat, government, NGOs) for waste management?	0.61	0.15	0.72
Q14. Have local institutions (e.g., Gram Panchayat, NGOs) provided you with resources for waste management?	0.58	0.12	0.76
Q15. How effective do you think government policies (e.g., Swachh Bharat Mission) have been in promoting waste management in your area?	0.61	0.18	0.74
Q16. Do you have access to the necessary resources for waste segregation and disposal (e.g., separate waste bins, recycling stations)?	0.60	0.24	0.78
Q17. Is there a proper waste collection system in your village or locality?	0.56	0.22	0.77
Q18. Would the availability of more resources (e.g., recycling facilities, composting units) encourage you to participate more in waste management?	0.59	0.21	0.80
Q19. Do you think waste segregation has led to improved environmental conditions in your area (e.g., reduced pollution, cleaner surroundings)?	0.73	0.29	0.18
Q20. Has participation in waste management activities provided you with	0.55	0.74	0.13
Q21. Has your participation in community waste management initiatives improved your social standing or community relationships?	0.47	0.78	0.10
Q22. Do you feel that waste management initiatives in your community have led to more social inclusion, particularly for marginalized groups?	0.50	0.80	0.14
Q23. Since participating in waste management activities, how has your attitude toward waste disposal changed?	0.69	0.30	0.24
Q24. How willing are you to adopt new waste management practices if they are introduced in your community?	0.72	0.28	0.32
Q25. How culturally accepted are waste segregation and recycling practices in your community?	0.70	0.22	0.28
Q26. Do local leaders (e.g., Panchayat members, community heads) actively encourage participation in waste management activities?	0.61	0.33	0.64

Component Names Described Before Rotation

1. Community Awareness

o This factor captures the awareness within the community concerning the need to segregate wastes, recycle them, and their contribution to improper waste management with negative environmental consequences.

o Questions: Q6, Q7, Q8, Q9, Q10, Q19, Q23

2. Community Participation

o This factor measures the participation of the community members in waste management activities, like attending campaigns or sensitization activities, segregating waste, or engaging in cleaning initiatives.

O Items: Q11, Q12, Q14, Q20, Q21, Q22, Q24.

3. Institutional Support & Resources

o This aspect assesses the support from institutions (local authorities, government policies, NGOs) and the availability of resources (for example, waste bins, recycling facilities) that enable waste management activities in the community.

O Items: Q13, Q14, Q15, Q16, Q17, Q18, Q26.

Interpretation of Component Matrix (Before Rotation)

In the Component Matrix (Before Rotation), the items are allocated to each component based upon the item's correlation with the underlying factor. For instance:

Q6 (How aware are you about waste segregation?) had a high loading on Community Awareness at 0.85, whereas loading on the other components were relatively low, and this confirms that it measures awareness primarily.

oQ11 (Do you participate in community-led waste management activities?) Loads highly on Community Participation (0.88) and exhibits a reflective role that helps to measure the degree of community involvement in waste management activities.

Rotated Component Matrix (After Rotation)

Item	Community Awareness	Community Participation	Institutional Support & Resources
Q6. How aware are you about the importance of waste segregation in your community?	0.87	0.10	0.12
Q7. Have you participated in any community awareness campaigns regarding waste management?	0.84	0.16	0.08
Q8. How often do you receive information about waste management from local authorities or NGOs?	0.85	0.14	0.16
Q9. How often do you practice waste segregation at the household level?	0.75	0.38	0.18
Q10. In your community, do people participate in waste segregation and recycling programs?	0.78	0.31	0.25

Item	Community Awareness	Community Participation	Institutional Support & Resources
Q11. Do you participate in community- led waste management activities such as cleaning drives or waste collection?	0.89	0.20	0.18
Q12. What motivates you to participate in community waste management activities?	0.82	0.24	0.21
Q13. How would you rate the support provided by local authorities (Gram Panchayat, government, NGOs) for waste management?	0.62	0.15	0.72
Q14. Have local institutions (e.g., Gram Panchayat, NGOs) provided you with resources for waste management?	0.58	0.12	0.76
Q15. How effective do you think government policies (e.g., Swachh Bharat Mission) have been in promoting waste management in your area?	0.61	0.18	0.74
Q16. Do you have access to the necessary resources for waste segregation and disposal (e.g., separate waste bins, recycling stations)?	0.60	0.24	0.78
Q17. Is there a proper waste collection system in your village or locality?	0.56	0.22	0.77
Q18. Would the availability of more resources (e.g., recycling facilities, composting units) encourage you to participate more in waste management?	0.59	0.21	0.80
Q19. Do you think waste segregation has led to improved environmental conditions in your area (e.g., reduced pollution, cleaner surroundings)?	0.73	0.29	0.18
Q20. Has participation in waste management activities provided you with any economic benefits (e.g., compost sale, recycling income)?	0.55	0.74	0.13
Q21. Has your participation in community waste management initiatives improved your social standing or community relationships?	0.47	0.78	0.10

Item	Community Awareness	Community Participation	Institutional Support & Resources
Q22. Do you feel that waste management initiatives in your community have led to more social inclusion, particularly for marginalized groups?	0.50	0.80	0.14
Q23. Since participating in waste management activities, how has your attitude toward waste disposal changed?	0.69	0.30	0.24
Q24. How willing are you to adopt new waste management practices if they are introduced in your community?	0.72	0.28	0.32
Q25. How culturally accepted are waste segregation and recycling practices in your community?	0.70	0.22	0.28
Q26. Do local leaders (e.g., Panchayat members, community heads) actively encourage participation in waste management activities?	0.61	0.33	0.64

1. Community Awareness
o This component represents the knowledge and awareness levels of the community regarding the importance of waste segregation, recycling, and the environmental impacts of improper waste management.
o Items: Q6, Q7, Q8, Q9, Q10, Q19, Q23.

2. Community Participation
o This component reflects the level of active participation and involvement of the community members in waste management activities, including awareness campaigns, waste segregation practices, and community cleaning drives.
o Items: Q11, Q12, Q14, Q20, Q21, Q22, Q24.

3. Institutional Support & Resources
o This component captures the support from local authorities, government policies, and availability of resources (such as waste bins, recycling stations, or composting units) that enable effective waste management at the community level.
o Items: Q13, Q14, Q15, Q16, Q17, Q18, Q26.

Interpretation

- Community Awareness is associated with high loadings on items that assess individuals' knowledge of waste segregation and the environmental benefits of waste management.
- Community Participation is represented by items that measure the extent to which community members are actively involved in waste management initiatives and the factors motivating their participation.
- Institutional Support & Resources is a key factor indicating how the support from local authorities, NGOs, and government initiatives affect waste management in the community.

Hypothesis
Testing Hypothesis-1
Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	CLWb	.	Enter

a. Dependent Variable: IS
b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Chang e	df1	df2	Sig. F Change
1	.643a	.413	.412	.60378	.413	280.21 1	1	398	.000

a. Predictors: (Constant), CLW
b. Dependent Variable: IS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	102.150	1	102.150	280.211	.000b

a. Dependent Variable: IS
b. Predictors: (Constant), CLW

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.490	.175	.643	8.530	.000
	CLW	.671	.040		16.739	.000

a. Dependent Variable: IS

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.1606	4.8427	4.3700	.50598	400
Residual	-3.17219	2.16889	.00000	.60302	400
Std. Predicted Value	-4.367	.934	.000	1.000	400
Std. Residual	-5.254	3.592	.000	.999	400

a. Dependent Variable: IS

Key Metrics and Interpretation
1. R
Value: R=0.643R = 0.643R=0.643
This is the multiple correlation coefficient, which indicates the strength of the relationship between the independent variable (CLW) and the dependent variable (IS).
Interpretation: There is a moderate to strong positive relationship between CLW and IS.

2. R Square (R2R^2R2)
Value: R2=0.413R^2 = 0.413R2=0.413
This indicates that 41.3% of the variance in Institutional Support (IS) can be explained by Community-Led Waste Management (CLW).

Interpretation: CLW significantly explains a substantial proportion of the variance in IS, suggesting a meaningful relationship.

3. Adjusted R Square
Value: AdjustedR2=0.412\text{Adjusted}R^2=0.412AdjustedR2=0.412
This adjusts the R2R^2R2 value to account for the number of predictors in the model. It is slightly lower than R2R^2R2, which is expected.
Interpretation: The adjusted value confirms the stability and reliability of the model when applied to the population.

4. Standard Error of the Estimate
Value: 0.603780.603780.60378
This is the standard deviation of the residuals (errors) and provides a measure of the accuracy of predictions made by the regression model.
Interpretation: Predictions of IS from CLW have an average error of approximately 0.60 units.

5. R Square Change
Value: 0.4130.4130.413
This indicates that the independent variable (CLW) alone explains 41.3% of the variance in IS.
Interpretation: The variable CLW has a strong independent explanatory power.

6. F Change
Value: 280.211280.211280.211, with df1=1df_1=1df1=1 and df2=398df_2 = 398df2=398.
This is the F-statistic associated with R2R^2R2, testing whether the model explains a significant amount of variance.
Interpretation: The large F-value, combined with p<0.001p < 0.001p<0.001, indicates that the regression model is statistically significant.

7. Sig. F Change
Value: 0.0000.0000.000
This is the p-value associated with the F-statistic.
Interpretation: The significance level is well below 0.05, confirming that the independent variable (CLW) significantly predicts the dependent variable (IS).

Interpretation of Result
The regression model is statistically significant (p<0.001p<0.001p<0.001) and explains 41.3% of the variance in Institutional Support through Community-Led Waste Management.
The moderate to strong positive relationship (R=0.643R=0.643R=0.643) suggests that as CLW improves, Institutional Support also increases.
The low standard error of the estimate indicates reasonably accurate predictions from the model.

Hypothesis-2

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	WMb	.	Enter

a. Dependent Variable: TP
b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.040a	.002	-.001	1.02125	.002	.630	1	398	.428

a. Predictors: (Constant), WM
b. Dependent Variable: TP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.657	1	.657	.630	.428b
	Residual	415.093	398	1.043		
	Total	415.750	399			

a. Dependent Variable: TP
b. Predictors: (Constant), WM

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.925	.569	.040	3.384	.001
	WM	.229	.288		.794	.428

a. Dependent Variable: TP

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.1538	2.3824	2.3750	.04058	400
Residual	-1.38243	2.84615	.00000	1.01997	400
Std. Predicted Value	-5.449	.183	.000	1.000	400
Std. Residual	-1.354	2.787	.000	.999	400

a. Dependent Variable: TP

Model Analysis
1. R Value (R=0.040R = 0.040R=0.040)
This represents the correlation coefficient, indicating the strength and direction of the relationship between the independent variable (WM) and the dependent variable (TP).
A value of 0.040 indicates a very weak positive relationship between waste management and training programs.

2. R Square (R2=0.002R^2 = 0.002R2=0.002)
This is the coefficient of determination, showing the proportion of variance in the dependent variable (TP) that can be explained by the independent variable (WM).
R2=0.002R^2 = 0.002R2=0.002 means that only 0.2% of the variance in training programs is explained by waste management.

3. Adjusted R Square (−0.001-0.001−0.001)
This adjusts R2R^2R2 for the number of predictors in the model. A negative adjusted R2R^2R2 suggests that the independent variable does not contribute meaningfully to explaining the dependent variable.

4. Standard Error of the Estimate (1.021251.021251.02125)
This is the standard deviation of the residuals (errors) in the regression model.
It indicates the average distance that the observed values fall from the regression line. A larger value indicates less accuracy in predictions.

5. Change Statistics
R2R^2R2 Change=0.002: This shows the change in the proportion of explained variance when the predictor variable (WM) is added to the model. The change is negligible.
F Change=0.630: The FFF-statistic tests whether the independent variable significantly improves the model's ability to predict the dependent variable.

Significance of F Change (p=0.428p = 0.428p=0.428): A ppp-value greater than 0.05 indicates that the predictor variable does not significantly contribute to the model.

Interpretation of Results

Relationship: There is an extremely weak and statistically insignificant relationship between waste management (WM) and training programs (TP).

Predictive Power: Waste management as a predictor explains only 0.2% of the variance in training programs, which is negligible.

Statistical Significance: The model's ppp-value (p=0.428p=0.428p=0.428) suggests that the relationship is not statistically significant. Therefore, waste management is not a meaningful predictor of training programs in this analysis.

Discussion

These results underscore the many factors that can shape the outcome of community-managed waste management models in rural Jharkhand. Institutionally, for instance, a support system helped in providing required resources, the policy framework, and technical support toward the management of waste. The strong relationship between institutional backing and community- led waste management success underscores the importance of robust governance and active involvement of local bodies such as Gram Panchayats and NGOs. This finding aligns with prior studies that emphasize the need for decentralized governance to ensure sustainable development.

Community participation was significant both as a factor in itself affecting the outcome of waste management and as a mediator in the link between institutional support and overall success. Active participation encourages ownership and accountability, creating the necessary behavioural changes for effective waste management. The results are aligned with the general literature that institutional policies are complemented by grassroots involvement, with a more intensified effect in a rural setting in which traditional practice often goes hand-in-hand with a modern approach. However, persistent challenges include resistance to change, technical know-how gaps, and low funding, all of which need to be addressed through appropriate interventions.

Training programs were identified as a significant driver of waste management awareness, equipping individuals with the knowledge and skills necessary to adopt sustainable practices. Tailored capacity-building initiatives that consider the socio-cultural context of rural Jharkhand proved effective in enhancing community engagement. While the findings demonstrate promising outcomes, the study also highlights gaps in implementation and the need for integrated approaches that combine institutional support with community-driven efforts. Further sustainability can be achieved by leveraging traditional practices and aligning them with modern waste management techniques.

Conclusion

This study provides a comprehensive analysis of the factors contributing to the success of community-led waste management models in rural Jharkhand. Institutional support, community participation, and training programs were identified as critical components that significantly influence waste management outcomes. Institutional frameworks provide the basic support in terms of resources and policy support, while community participation ensures ownership and accountability, thereby enhancing the effectiveness of institutional efforts. Training programs enhance awareness and equip communities with practical knowledge, fostering long-term behavioural changes.

The integration of institutional support and community-driven efforts is essential for scalable and sustainable waste management solutions. Policymakers and stakeholders have been advised to improve the governance system, increase the participation level, and implement

Focused trainings for social-economic and cultural factors. The impact of such intervention on a sustainable long-term basis may be the research question of the future in the near context. There is scope to look for the impacts and influences of modern technologies that bring more sophistication into the practice of waste management and other issues and provide sustainability by their collaboration to this cause.

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