Household solid waste management practices and challenges of homemakers in Kerala

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ABSTRACT

Solid waste management has become an intimidating task for authorities who seem to lack the capacity and provision to deal with the intensifying waste issue. The present study assessed the perception on the issues related to the management and disposal of household solid waste of urban and rural households in Ernakulam, Kerala. The study was conducted in Ernakulam district of Kerala among 526 homemakers. A survey method was adopted. In urban areas, people mostly gave their waste-to-waste collectors. Meanwhile, in rural areas, burning was the common method of disposal, especially for kitchen waste, paper, plastic, textiles, and sanitary waste. A high percentage (91.4%) of respondents agreed that scarcity of land is a distinct challenge in household solid waste management. A considerable percentage of respondents, specifically 76.7% of urban and 91.4% of rural participants, were not aware of scientific methods of waste management. This lack of awareness can hinder effective waste management efforts. The majority of urban respondents (71.4%) and all rural respondents (100%) pointed to the lack of waste-related awareness and education as a substantial challenge in household waste disposal. The findings underscore the need for implementing awareness programs that can foster better waste management practices and promote environmental sustainability.

Keywords: Household Solid waste, waste management, disposal, composting, recycling, reuse

INTRODUCTION

Human activities generate waste that can be harmful to the environment, animals, plants, and the ecosystem. However, controlled monitoring can limit environmental damage and conserve valuable resources (Powell, 2001). Effective management of solid waste systems is essential to reduce global environmental and public health risks (Manga. et al, 2007).

Despite better educational systems and a higher literacy rate in Kerala, there is a lack of proper waste management practices among the residents, both young and old (Ifegbesan, 2008). The Environmental Statistics Report of 2002 indicates that Kochi's efficiency in waste collection and management is only

60% of the national average. According to the National inventory on hazardous waste generating industries and hazardous waste management in India published by the Central Pollution Control Board, Ernakulam district has emerged as the new hazardous waste capital of Kerala, producing about 45,560 metric tonnes of hazardous waste annually.

Kerala having high literacy rate in education but nil in hygiene. We used to dumb our waste in the unused or empty plots near to our house or burning them there as an easy method of keeping away the waste. As a dumpster we illegally dumping food to hazardous waste. Hence the study emphasizes the importance of household solid waste, which constitutes 75% of municipal solid waste generated. Managing and planning for household solid waste is crucial due to its significant impact on society. The household is like an individual, plays a vital role in society. Items disposed of in the environment may not decompose over time, causing adverse effects on the human and natural environment in various aspects such as ecological, economic, chemical, physical, mechanical, and physiological. These wastes are recognized as among the most substantial solid waste in the nation. As households operate as units, each family's waste generation and disposal practices are unique, involving specific waste-related behaviors such as production, segregation, and removal. Therefore, managing household solid waste requires a distinct approach and should be addressed separately from municipal solid waste to minimize its impact on ecology and humanity.

Aim: To assess and compare the solid waste management practices among rural and urban homemakers.

Objectives:

To study the general and socio - economic profile of homemakers.

To understand the waste management practices of the homemakers.

To identify the problems, issues and challenges faced by homemakers in the management of household solid waste

METHODOLOGY

The study was conducted in Ernakulam district of Kerala. For the present analysis the investigator selected the Cochin Corporation (Urban), Thripunithura Municipality (semi urban) and Udayamperoor Gramapanchayat (rural) from Ernakulam area. These are chosen based on the current chain of hierarchy of settlements. 526 homemakers were selected for the study. The method used for conducting the study was survey method to collect information among the respondents regarding household solid waste management practices using an interview schedule. The interview schedule was pretested using the test – retest method on ten percentage of the total sample (52 homemakers). The reliability coefficient of the questionnaire was calculated and the face validity of the questionnaire was established with the help of experts. The collected data was analysed using percentage analysis and SPSS

RESULTS AND DISCUSSION

1. General details of the homemakers

The demographic characteristics of the respondents were collected to record the relevant information about the respondent’s personal and family details. In this study homemakers' profile plays a very significant role. The personnel characteristics of respondents based on their participation, forms the backbone of the scientific explanation to the study result.

Table No. 01

General details of the homemakers

Personal details of the homemakers		Frequency (N=526)	Responses in percentage (%)
Age (Years)	21-30	147	27.9
	31-40	185	35.2
	41-50	127	24.1
	51 – 60	48	9.1
	Above 60	19	3.6
Religious affiliation	Hindu	281	53.4
	Muslim	62	11.8
	Christian	183	34.8
Marital status	Married	473	89.9
	Unmarried	53	10.1
Type of family	Nuclear	394	74.9
	Joint	132	25.1
Size of the family	1– 3 members	162	30.8
	4– 6 members	364	69.2

The structure of respondents based on their age group are set between 21years-30 years, 31 years-40 years, 41 years -50 years, 51 years -60 years, above 60 years constituted 27.9%, 35.2%, 24.1, 9.1, 3.6% respectively. Majority of the respondents belonged to the age group of 31-40 yrs with 35.2%. Research conducted by S. Mahima and V.L. Lavanya (2016), in Kerala, a similarity was observed in the predominant age groups of the participants. Majority of the respondents were Hindus with 53.4% representation, followed by 34.8% were Christians and 11.8% were Muslims. In 'Marital Status' the result was the respondents were either married (89.9%) or unmarried (10.1%). Nuclear family refers to the core members of a family, usually parents and children and this type contributes 74.9% in this research result. In India, a joint family is usually a large undivided family where members of more than one generation live together under one roof (grandparents, parents, and children) 25.1% of the homemakers belong to Joint family. In this study, 69.2% of the respondents belong to the family having 4-6 members and 30.8% belongs to 1-3 member family.

2. Socio economic profile of the homemakers

The socio-economic details of the urban and rural homemakers collected includes educational qualification, employment status and type, and total monthly income of the family.

Table No. 02

Socio economic profile of the homemakers

Socio -economic variables		Frequency (N=526)	Responses in Percentage (%)
Educational Qualification	Primary	83	15.8
	Secondary	16	3.0
	HSC	25	4.8
	Graduation	141	26.8

	Post Graduate	209	39.7
	Professional graduation	52	9.9
Employment status	Employed	253	49.1
	Unemployed	273	51.9
Type of employment (n=253)	Government	4	0.8
	Private sector	174	33.1
	Business	33	6.3
	Self-employed	20	3.8
	Daily wage	22	4.2
Total monthly income of the family	Below Rs.10000/-	27	5.1
	Rs.10001– Rs.30000/-	193	36.7
	Rs.30001 – Rs.50000/-	134	25.5
	Rs.50000 – Rs.100000	125	23.8
	More than Rs.100000	47	8.9
Geographical area of the house	Corporation (Urban)	300	57.0
	Municipality (Urban)	121	23.0
	Grama Panchayat (Rural)	105	20.0

Educational Qualification: Based on the data obtained, all the homemakers were literate. The literacy stages constituted of primary education, secondary, higher secondary, graduation, post-graduation, and professional graduation were 15.8%, 3.0%, 4.8%, 26.8%, 39.7%, 9.9% respectively. 39.7% of the respondents were post-graduation holders and they constituted the highest in the participation. A similarity was found in the educational distribution of women between the present study and the NFHS-4 report of Kerala. The report indicates that 28.7% of women completed 12 or more years of schooling, 19% completed 10-11 years, and 34% completed 5-9 years of schooling, with only 4.2% having no formal education.

Employment Status: Most of the respondents were unemployed with 51.9% of participation. Out of the remaining 49.1% of employed homemakers, 4.2% of them were engaged in daily wage activities and 3.8% were self-employed, 33.8% of the homemakers work with private sector and 0.8% were government employees. Only 6.3% were entrepreneurs.

Total monthly income of the family: Numerous studies backed the opinion that household income is directly correlated with the amount of garbage produced daily per person. In this study, 36.7% of the participants constitute the income group of Rs.10001- Rs.30000. 25.5% belonged to the group of Rs.30001- Rs.50000 followed by 23.8% respondents in the Rs.50001- Rs.100000 total monthly income group and just 8.9% fall under the above 1 lakh category.

3. Responsibility regarding household waste disposal

In the survey data mentioned in Table No. 03 provided in the supplementary file, the chi-square test results indicated highly significant differences ($p < 0.001$) in household waste disposal responsibilities between urban and rural areas for both disposal by self and the facility of door-to-door collection systems. In urban areas, 38.7% of households were responsible for disposing of their waste by themselves, whereas all the households in rural areas (100.0%) took responsibility for disposing of their waste by themselves. This was likely due to the fact that in urban areas, a substantial portion of households (66.7%) had access to a door-to-door collection system, while in rural areas, none of the households had access to this facility.

The results demonstrated significant differences in the responsibility for waste disposal practices between urban and rural households. This dual approach suggested a blend of self-reliance and institutional support in urban waste management practices. In contrast, rural households overwhelmingly (100.0%) handled waste disposal by themselves, with no access to door-to-door collection services. This complete reliance on self-disposal highlighted a lack of formal waste management infrastructure in rural areas. The absence of door-to-door collection services in rural areas posed challenges in managing household waste, potentially leading to unsustainable practices such as open dumping or burning. The significant chi-square values ($p < 0.001$) confirmed the stark contrast in waste disposal responsibilities between urban and rural areas. Urban households benefited from a combination of self-disposal and formal collection systems, whereas rural households faced the burden of managing waste without institutional support.

Availability of space in the house for managing generated waste

The availability of space in the house for the management of the waste generated for disposal refers to the space that the households have to use for the segregation and storage of various household waste including wet and rotten waste, dry waste, hazardous waste, etc., without contaminating the interior and free from attracting insects, flies, and rodents, and to store solid wastes like textiles, plastics, glass, etc., before final disposal or until the collectors collect the waste from the households. The availability of space around the house for the proper segregation, storage and disposal of wastes for the homemakers was given in table no. 04 provided in the supplementary file.

A larger proportion of rural households (80.0%) reported having enough space around their house for the management of waste before disposal compared to urban households (43.5%). Conversely, a higher percentage of urban households (56.5%) indicated not having enough space in their house compared to rural households (20.0%). The chi-square test results indicated a highly significant difference ($p < 0.001$) in the availability of space for waste disposal between urban and rural households. The lack of space for the management of household waste often led to street dumping and open space waste dumping. Urban households, constrained by limited space, were more likely to rely on waste collectors for disposing of their household solid waste.

In contrast, the availability of adequate space in rural areas reduced the need to depend on waste collectors, as households could manage waste disposal within their premises. However, this also led to significant issues including the burying and burning of household waste among rural households, which posed environmental and health hazards. These findings underscored the need for targeted waste management solutions. Urban areas required interventions to mitigate street dumping and improve waste collection systems. Rural areas, on the other hand, needed strategies to prevent harmful practices like burying and burning of plastic, sanitary and other hazardous waste while managing waste within the available space effectively.

Details regarding waste bins in the home for storage of household waste

The responses of homemakers about the practice of the use of dust bins for the collection, segregation, storage, and disposal of household solid waste are given in table no. 5 provided in the supplementary file. The data presented below provides insights into household waste management practices focusing on various factors such as the number and type of waste bins, the materials from which the bins manufactured, and their placement within homes, highlighting significant differences between rural and urban settings.

In rural areas, 92.9% of households used waste bins, compared to 100% in urban areas ($\chi^2 = 13.806$, $p = 0.000$***). Only 7.1% of rural households did not use waste bins. Rural households used a varied number of bins: 20.7% used one bin, 34.0% used two bins, 11.2% used three bins, 4.0% used four bins, and 30.2% used five or more bins. In urban areas, the distribution was different: 8.6% used two bins, 15.2% used four bins, and 76.2% used five or more bins ($\chi2 = 135.617$, $p = 0.000$***). The higher usage of waste bins in urban areas compared to rural areas indicated better waste management practices in urban settings. The significant p-value (0.000***) underscored this disparity, suggesting that initiatives to increase waste bin usage in rural areas could have been beneficial. The variation in the number of waste bins used between rural and urban households highlighted differing waste management practices. Rural areas tended to use fewer bins, possibly due to limited resources or different waste generation patterns. Urban households, using more bins, suggested a more segmented approach to waste management.

In rural areas, 50.6% of households used closed containers, whereas 49.4% used open containers. Urban households predominantly used closed containers (100%) ($\chi2 = 122.446$, $p = 0.000$***). The predominance of closed containers in urban areas (100%) as opposed to a nearly even split in rural areas emphasized the importance of promoting closed containers in rural areas to improve hygiene and reduce pest issues. The significant p-value (0.000***) indicated a need for targeted education and resources.

Regarding the material type of waste bins, the majority of households used waste baskets, 63.7% in rural and 71.4% in urban areas. Other materials included old buckets (26.1% rural, 20.0% urban), plastic bags (5.2% rural), and cartons (5.0% rural, 8.6% urban) ($\chi2 = 13.600$, $p = 0.004$**). The preference for waste baskets in both areas indicated a general trend toward standardized waste storage. However, the use of old buckets and plastic bags in rural areas pointed to the need for providing better alternatives.

In rural areas, 82.2% of households kept waste bins in one main room, 9.7% in the kitchen, 2.6% outside the house, 1.2% in a general pit in the compound, 1.9% in other locations, and 2.4% in each

room. In urban areas, the distribution was: 12.4% in each room, 35.2% in one main room, 24.8% in the kitchen, 9.5% outside the house, 7.6% in a general pit in the compound, and 10.5% in other locations ($\chi 2 = 89.378$, $p = 0.000$***). The central placement of waste bins in one main room in rural areas contrasted with a more distributed placement in urban areas. This difference might have affected the ease of waste collection and the overall cleanliness of the household environment. These findings suggested significant differences in waste management practices between rural and urban households. Implementing targeted interventions, such as providing better waste bins, promoting the use of closed containers, and improving the strategic placement of waste bins, could have enhanced waste management practices, especially in rural areas.

Information on waste segregation at household

Table No: 3

Information on waste segregation at household

Particulars	Area of the household located	Waste segregation at household Responses in percentage (%)			χ^2	p-value
		Yes	No	Total		
Using separate bins for dry and wet waste	Urban	273 (64.8)	148 (35.2)	421 (100)	79.192	0.000***
	Rural	105 (100)	-	105 (100)		
Sorting household waste before disposal	Urban	421 (100)	-	421 (100)	31.794	0.000***
	Rural	96 (91.4)	9 (8.6)	105 (100)		

(***) level of significance at 0.001.

In the above table, it appeared that all rural respondents (100%) kept separate containers for dry and wet waste compared to urban respondents (64.8%). This was reflected in the significant chi-square value of 79.192 and a p-value of 0.000, indicating that the difference between the proportions of urban and rural respondents who had separate containers for dry and wet waste was statistically significant. Regarding the segregation of waste before disposal, it appeared that all urban respondents (100%) sorted the household waste before disposal, while the majority of rural respondents (91.4%) did so. The significant chi-square value of 31.794 and a p-value of 0.000 indicated that the difference between the proportions of urban and rural respondents who sorted their household waste before disposal was statistically significant. The study emphasized the crucial role of initiating proper waste segregation practices at the household level (Abas et al., 2020).

4. Household solid waste disposal Practices of the homemakers

Exploring the data from table no. 04 provides a comprehensive overview of the current household solid waste disposal practices among homemakers.

Table No. 04

Household solid waste disposal Practices of the homemakers

Type of waste	Area	Given to Waste / scrap Collectors.	Reuse	Home composting / Recycling-	Burying	Dumping in the empty plots	Dumping in the road side	Burning	χ^2	p value
Organic Kitchen-Waste	Urban	242 (63.9)	36 9.5)	-	101 (26.6)	-	-	-	187.868	0.000***
	Rural	-	51 (48.6)	-	54 (51.4)	-	-	-		
Paper Waste	Urban	220 (52.3)	107 (25.4)	13 (3.1)	-	-	-	81 (19.2)	53.079	0.000***
	Rural	76 (72.4)	1 (1.0)	-	-	-	-	28 (26.7)		
Plastic Waste	Urban	268 (67.3)	49 (12.9)	13 (3.4)	-	-	-	62 (16.4)	71.655	0.000***
	Rural	40 (38.10)	-	-	-	-	-	65 (61.90)		
Textiles, Leather and Rubber	Urban	175 (43.6)	110 (27.4)	34 (8.5)	-	-	16 (4.0%	66 (16.5)	130.965	0.000***
	Rural	16 (15.2)	12 (11.4)	0 (0.0)			-	77 (73.3)		
Sanitary Waste	Urban	2 (0.5)	-	-	245 (61.1)	24 (6.0)	22 (5.5)	108 (26.9)	105.751	0.000***
	Rural	-	-	-	21 (20.0)	16 (15.2)	18 (17.1)	50 (47.6)		
Metal and Glass Waste	Urban	264 (62.7)	60 (14.3)	41 (9.7)		21 (5.0)	35 (8.3)		62.740	0.000***
	Rural	46 (43.8)	44 (41.9)	15 (14.3)		-				
e- waste	Urban	316 (79.2)	-	41 (10.3)		21 5.3)	21 (5.3)	-	38.677	
	Rural	16 (15.2)	-	-	-	89 (84.8)	-	-		
Solid Rubbish	Urban	325 (77.2)	-	-	-	59 (14.0)	21 (5.0)	16 (3.8)	47.831	0.000***
	Rural	-	0	-	-	105	-	-		

			(0.0)			(100)				
Hazardous waste	Urban	270 (71.1)	38 (10.0)	-	34 8.9)	21 5.5)	17 (4.5)	-	41.82144	0.000***
	Rural	-	-	-	14 13.3)	-	16 (15.2)	75 (71.4)		

(***) level of significance at 0.001.

Organic Kitchen Waste - In urban areas, the majority of households (63.9%) disposed of organic kitchen waste by giving it to waste or scrap collectors. Additionally, 9.5% of urban households reused organic waste, and a significant portion (26.6%) engaged in home composting or recycling. No urban households reported burying, dumping in empty plots, dumping on the roadside, or burning organic kitchen waste. In contrast, rural households primarily disposed of organic kitchen waste through reuse (48.6%) and home composting or recycling (51.4%), with no reports of other disposal methods. The chi-square test indicated a significant difference between urban and rural disposal practices for organic kitchen waste ($\chi2 = 187.868$, $p < 0.001$).

Paper Waste - Urban households predominantly gave paper waste to waste or scrap collectors (52.3%), with a substantial number also reusing it (25.4%). A smaller percentage engaged in home composting or recycling (3.1%) or burning (19.2%). Rural households showed a high tendency to give paper waste to waste or scrap collectors (72.4%), but very few reused it (1.0%). A considerable portion of rural households reported burning paper waste (26.7%). The chi-square test showed a significant difference between urban and rural paper waste disposal practices ($\chi2 = 53.079$, $p < 0.001$).

Plastic Waste - Urban households primarily gave plastic waste to waste or scrap collectors (67.3%), with smaller percentages reusing (12.9%), home composting or recycling (3.4%), and burning (16.4%). Rural households displayed a lower tendency to give plastic waste to collectors (38.1%) but a higher tendency to burn it (61.9%). The chi-square test revealed significant differences in plastic waste disposal practices between urban and rural areas ($\chi2 = 71.655$, $p < 0.001$).

Textiles, Leather, and Rubber - Urban households disposed of textiles, leather, and rubber primarily by giving them to waste or scrap collectors (43.6%), reusing (27.4%), and burning (16.5%). In rural areas, a significant number of households burned these materials (73.3%), with smaller percentages giving them to collectors (15.2%) or reusing them (11.4%). The chi-square test indicated significant differences between urban and rural disposal methods for textiles, leather, and rubber ($\chi2 = 130.965$, $p < 0.001$).

Sanitary Waste - Urban households mainly buried sanitary waste (61.1%), with smaller percentages dumping in empty plots (6.0%), roadside (5.5%), or burning it (26.9%). Rural households showed a diverse range of disposal practices, including burying (20.0%), dumping in empty plots (15.2%), roadside (17.1%), and burning (47.6%). The chi-square test highlighted significant differences between urban and rural sanitary waste disposal methods ($\chi2 = 105.751$, $p < 0.001$).

Metal and Glass Waste - Urban households disposed of metal and glass waste mainly by giving it to waste or scrap collectors (62.7%), reusing (14.3%), burning (8.3%), and dumping in empty plots (5.0%). In rural areas, households mostly reused these materials (41.9%), gave them to collectors (43.8%), or buried them (14.3%). The chi-square test revealed significant differences in disposal practices between urban and rural areas ($\chi2 = 62.740$, $p < 0.001$).

E-Waste - Urban households predominantly gave e-waste to waste or scrap collectors (79.2%), with some also burning it (10.3%) or dumping in empty plots and roadside (5.3% each). Rural households

primarily burned e-waste (84.8%). The chi-square test indicated significant differences between urban and rural e-waste disposal methods ($\chi2 = 38.677$, $p < 0.001$).

Solid Rubbish - Urban households mostly disposed of solid rubbish by giving it to waste or scrap collectors (77.2%), with smaller percentages dumping in empty plots (14.0%), roadside (5.0%), or burning it (3.8%). Rural households predominantly burned solid rubbish (100%). The chi-square test highlighted significant differences in disposal practices between urban and rural areas ($\chi2 = 47.831$, $p < 0.001$).

Hazardous Waste - Urban households gave hazardous waste to waste or scrap collectors (71.1%), with some also reusing (10.0%), dumping in empty plots (8.9%), roadside (5.5%), or burning it (4.5%). In rural areas, the majority of households burned hazardous waste (71.4%), with some also dumping in empty plots (13.3%) or roadside (15.2%). The chi-square test showed significant differences between urban and rural hazardous waste disposal methods ($\chi2 = 41.821$, $p < 0.001$).

The data indicated notable differences in household solid waste disposal practices between urban and rural areas across all waste categories. Urban households were more likely to utilize formal waste collection services, whereas rural households displayed a greater inclination towards burning waste.

5. Problems with present household solid waste disposal

The data given below showed the frequency and percentage of households that had problems and those without issues with household solid waste management.

Table No. 05

Problems with present household solid waste disposal

Locale of the household	Problems with present household solid waste disposal		Total	χ^2	p value
	Responses in percentage (%)				
	Having Problem	Not having Problem			
Urban	207 (49.2)	214 (50.8)	421 (100)	.969	.325
Rural	46 (43.8)	59 (56.2)	105 (100)		
Total	253 (48.1)	273 (51.9)	526 (100)		

P value 0.325 is not significant.

The majority (56.2%) of the rural respondents were of the view that solid waste disposal was not at all a problem in their houses. Just about 50.8% of respondents from the urban area also reported that domestic waste disposal was not a problem for them, while 49.2% reported that domestic waste disposal was a problem. About 43.8% of rural respondents reported that improper solid waste management caused issues. Most of the respondents (51.9%) from both urban and rural areas considered their domestic waste disposal as not a problematic affair, as shown in table no.05. The chi-square test showed that there was no significant difference in the problem with present household solid waste disposal between urban and rural areas ($\chi2=0.969$, $p > 0.05$).

6. Issues faced due to improper waste management by the homemakers

Table No. 06 explored the issues faced due to improper waste management in both urban and rural areas. The data presented the frequency and percentage of households encountering problems and those not facing issues.

Table No. 06

Issues faced by improper waste management by subjects

The extent of seriousness regarding the effect of improper waste management in both urban and rural areas was summarized in the following table.

Issues related to Solid waste management	Area of household	Degree of seriousness Responses in percentage (%) Not at all	Somewhat	Can't Say	Serious	Extremely Serious	Total	χ^2	p value
Flies And Rodents	Urban	115 (27.3)	126 (29.9)	17 (4.0)	105 (24.9)	58 (13.8)	421 (100)	150.765	0.000***
	Rural	-	9 (8.6)	21 (20.0)	16 (15.2)	59 (56.2)	105 (100)		
Unhygienic Surroundings / Waste lying around	Urban	93 (22.1)	169 (40.1)	52 (12.4)	49 (11.6)	58 (13.8)	421 (100)	140.447	0.000***
	Rural	-	46 (43.8)	-	-	59 (56.2)	105 (100)		
Unpleasant Odour	Urban	119 (28.3)	142 (33.7)	48 (11.4)	91 (21.6)	21 (5.0)	421 (100)	194.634	0.000***
	Rural	37 (35.2)	9 (8.6)	-	-	59 (56.2)	105 (100)		
Overflows of Drainage	Urban	183 (43.5)	74 (17.6)	74 (17.6)	69 (16.4)	21 (5.0)	421 (100)	177.471	0.000***
	Rural	37 (35.2)	9 (8.6)	-	-	59 (56.2)	105 (100)		
Blockage of drainage	Urban	154 (36.6)	87 (20.7)	53 (12.6)	61 (14.5)	66 (15.7)	421 (100)	105.458	0.000***
	Rural	37 (35.2)	9 (8.6)	-	-	59 (56.2)	105 (100)		
Health Problems	Urban	129 (30.6)	91 (21.6)	82 (19.5)	98 (23.3)	21 (5.0)	421 (100)	197.532	0.000***

	Rural	16 (15.2)	30 (28.6)	-	-	59 (56.2)	105 (100)		
Polluted Water Supply	Urban	130 (30.9)	148 (35.2)	53 (12.6)	40 (9.5)	50 (11.9)	421 (100)	129.927	0.000***
	Rural	37 (35.2)	9 (8.6)	-	-	59 (56.2)	105 (100)		
Stray animals – Dogs/ birds Problems	Urban	148 (35.2)	111 (26.4)	3 (0.7)	141 (33.5)	18 (4.3)	421 (100)	120.704	0.000***
	Rural	-	30 (28.6)	16 (15.2)	59 (56.2)	-	105 (100)		
Environmental Pollution	Urban	60 (14.3)	167 (39.7)	27 (6.4)	126 (29.9)	41 (9.7)	421 (100)	122.40	.000***
	Rural	-	30 (28.6)	-	16 (15.2)	59 (56.2)	105 (100)		

Percentage exceeds due to multiple responses (***) level of significance at 0.001

The degree of seriousness of the urban respondents towards the effect of improper waste disposal generally seemed to be fairly low. Although 39.7% of urban respondents reported that environmental pollution was somewhat serious, 28% of rural respondents shared the same opinion. At the same time, 14.3% of urban people responded not at all serious about environmental pollution. No rural respondents supported the urban indication of triviality. However, 29.9% of urban people responded that environmental pollution was serious, and 9.7% indicated it was extremely serious. In the table no.06, it is indicated that the majority (56.2%) of the rural respondents reacted that there was extremely serious environmental pollution.

The level of serious causes of improper waste disposal was high among rural respondents compared to the urban area. In the urban area, 18 (4.3%), 141 (33.5%), 3 (0.7%), 111 (26.4%), 148 (35.2%) respondents reported having extremely serious, serious, can't say, somewhat, not at all stray animals/dogs/birds problem, respectively, due to improper solid waste disposal. But when compared to rural areas, the number of respondents who had extremely serious, serious, can't say, somewhat, not at all stray animals/dogs/birds problem stood at None (0.0%), 59 (56.2%), 16 (15.2%), none (0.0%), respectively.

The study reveals that there is a spatial disparity that existed between urban and rural communities with respect to the degree of serious impacts on improper waste disposal. While the household solid waste situation in the district was bad, the rural communities had a majority of the serious issues like flies and rodents, stray dogs, bad odor, drainage overflows, pollution, etc. Meanwhile, the study found that the issue of solid waste disposal was increasingly becoming a problem in the rural areas of Ernakulam district. The above table shows a significant difference in the degree of seriousness on the effect of solid waste disposal based on location (urban or rural), $p < 0.001$. The chi-square test showed that there was a significant difference in *affects of flies and rodents* between urban and rural areas ($\chi 2=150.765^*$, $p < 0.05$).

The study reveals that there is a spatial disparity that existed between urban and rural communities with respect to the degree of serious impacts on improper waste disposal. While the household solid waste situation in the district is bad, the rural communities have majority of the serious issues like flies and rodents, stray dogs, bad odor, drainage overflows, pollution etc. Meanwhile, the study found that the issue of solid waste disposal is increasingly becoming a problem in the rural areas of Ernakulam district.

7. Challenges in managing household solid waste

As illustrated in the table no.07, very few homemakers among the urban (15.7%) and rural (8.6%) areas responded that lack of collection facilities was not a major challenge for managing household wastes. The majority of urban (84.3%) and rural (91.4%) respondents considered insufficient collection facility a big challenge for waste management. The majority of the urban and rural respondents considered source segregation, storage, and dumping of e-waste as big challenges in waste management. Lack of awareness was considered a challenge by every respondent (100%) in the rural area. At the same time, 77.9% of urban respondents had the same reasoning. As indicated in the table, 91.4% of the total respondents strongly agreed that the scarcity of land was a distinct situation in household solid waste management. But 56.1% of the urban respondents did not see the lack of land or space as a challenge.

Table No. 7
Challenges in managing household waste

Particular	Locale of the household	Responses regarding challenges in managing household waste in (%)			χ^2	p value
		No	Yes	Total		
Lack of facilities for collection	Urban	66 (15.7)	355 (84.3)	421 (100)	3.845	0.050*
	Rural	9 (8.6)	96 (91.4)	105 (100)		
Segregation at source	Urban	66 (15.7)	355 (84.3)	421 (100)	3.845	0.050*
	Rural	9 (8.6)	96 (91.4)	105 (100)		
Scarcity of land	Urban	236 (56.1)	185 (43.9)	421 (100)	87.862	
	Rural	9 (8.6)	96 (91.4)	105 (100)		
Dumping of e-waste	Urban	154 (36.6)	267 (63.4)	421 (100)	2.429	0.119
	Rural	30 (28.6)	75 (71.4)	105 (100)		
Lack of awareness	Urban	93 (22.1)	328 (77.9)	421 (100)	46.158	0.000***
	Rural	-	105 (100)	105 (100)		

Percentage exceeds due to multiple responses (*) level of significance at 0.001

Out of the 421 urban respondents, 63.4% considered dumping of e-waste along with household waste was an ample challenge, whereas in rural areas, 71.4% among 105 respondents reckoned e-waste dumping as an important challenge in managing household wastes. Most of the urban respondents (328, 71.4%) and every rural respondent (105, 100%) indicated that lack of waste-related awareness and education was a real challenge in household waste disposal. However, 93 (22.1%) respondents in the urban area reported that the lack of awareness was not at all a challenge to them.

In the survey, it was found that 63.4% of the 421 urban respondents identified the dumping of e-waste with household trash as a significant challenge, while 71.4% of the 105 rural respondents considered it a crucial issue in managing household waste. The majority of urban respondents (71.4%) and all rural respondents (100%) pointed to the lack of waste-related awareness and education as a substantial challenge in household waste disposal. However, 22.1% of urban respondents reported that the lack of awareness was not a challenge for them. The chi-square test indicated no significant difference in the lack of facilities for collection and segregation at the source between urban and rural areas ($\chi2=3.845$, $p > 0.05$). Conversely, significant differences were observed in the dumping of e-waste ($\chi2=2.429$, $p < 0.05$) and lack of awareness ($\chi2=46.158$, $p < 0.05$) between urban and rural areas. These findings underscore the need for targeted awareness campaigns and interventions to address specific challenges in both urban and rural areas.

8. Level of Satisfaction with the current household solid waste management practices

The study assessed the satisfaction levels with present household solid waste management practices in both urban and rural areas. The data presented the frequency and percentage of households satisfied and those not satisfied with the current practices.

Table No. 8

Level of Satisfaction with the current household solid waste management practices

Locale of the household	Satisfaction with waste management Responses in percentage (%)		Total	χ^2	p value
	Satisfied	Not Satisfied			
Urban (N=421)	195 (46.3)	226 (53.6)	421 (100)		
Rural (N=105)	65 (61.9)	40 (38.1)	105 (100)	8.553	0.014**
Total	260 (49.4)	265 (50.4)	526 (100)		

(**) level of significance at 0.05

The survey data indicates the level of satisfaction with current household solid waste management practices among urban and rural households, as detailed in Table No.08. In urban areas, 46.3% of respondents reported being satisfied with their household solid waste management practices, while 53.6% were not satisfied. This majority dissatisfaction could be attributed to irregular waste collection services and the higher dependence on municipal waste management systems. Conversely, 61.9% of rural respondents expressed satisfaction with their current waste management practices, and only 38.1% were not satisfied. The higher satisfaction levels in rural areas might be due to more space available for waste disposal, allowing households to manage their waste more effectively on their own. When combining both urban and rural responses, 49.4% of the total respondents were satisfied

with the current household solid waste management practices, and 50.4% were not satisfied. This nearly equal split indicated a diverse range of satisfaction levels across different locales. The chi-square test ($\chi^2 = 8.553$, $p = 0.014$) demonstrated a statistically significant difference in satisfaction levels between urban and rural households. This significance highlighted the impact of the household locale on satisfaction with solid waste management practices.

Conclusion

The study highlights significant spatial disparities between urban and rural areas in the Ernakulam district regarding the impact of improper waste disposal. The absence of external waste collection and treatment facilities exacerbates the issue, making solid waste disposal increasingly problematic in these areas. The findings emphasize the urgent need for targeted interventions and awareness campaigns specifically designed for rural households to enhance their knowledge and participation in solid waste management. Implementing educational programs in both urban and rural regions is essential to fostering better waste disposal practices and promoting environmental sustainability. Unscientific waste disposal remains a significant challenge, especially in developing areas. These practices contribute to environmental degradation, public health risks, and inefficiencies within waste management systems. Although strategies such as infrastructure improvements, awareness campaigns, and policy enforcement have been proposed, further research is needed to identify more effective, context-specific solutions that are culturally appropriate and sustainable in the long term.

Conflict of interests

The authors declare that no competing interests exist.

Author's contributions

Both the authors contributed equally to the theoretical development, analysis, interpretation and writing of the manuscript. Exclusive contribution of individual Author should be written.

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