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Research Article

Household Dynamics in Electrical Gadget Usage and Acquisition: A Behavioral Study

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ABSTRACT

The proliferation of electronic devices and their subsequent disposal has positioned electronic waste (e-waste) as a pressing environmental concern. This research seeks to identify the principal sources of e-waste, and quantify its generation, with a particular emphasis on household income, device categories, and replacement patterns. The study hypothesizes the influence of income on the ownership of electronic devices, the significant contribution of large appliances and personal gadgets to e-waste, and the disparity in replacement cycles, particularly for devices such as smart phones and laptops. A mixed-methods methodology is adopted, incorporating household surveys, statistical evaluations, and environmental modeling to estimate e-waste volumes and discern prevailing trends. The anticipated outcomes will provide pivotal insights into the socioeconomic and behavioral determinants of e-waste production, forming the basis for innovative management frameworks and policy recommendations. By addressing quantification challenges and emphasizing targeted strategies for urban and rural areas, this study entente significantly to the global dialogue on sustainable electronic waste management.

Keywords: e-waste, electronic waste management, electronic waste sources, waste quantification, Socio-economic factors, device replacement behavior, environmental sustainability.

1. Introduction

The swift advancement of technology has significantly impacted consumer behavior, particularly in the realm of electrical gadgets. These devices are now indispensable in modern households, catering to a wide array of needs, from basic utilities to advanced functions for entertainment, communication, and productivity. As technological innovations continue to emerge, household adoption, usage, and replacement patterns for electrical gadgets have become increasingly dynamic. Understanding these evolving patterns is essential for a series of stakeholders, including manufacturers, marketers, policymakers, and environmental advocates. Addressing challenges such as e-waste management requires ample grasp of the factors influencing consumer behavior. Elements such as income levels, technological literacy, environmental awareness, and regional contexts play a pivotal role in shaping preferences, and purchasing decisions. This study seeks to explore household trends in the use and acquisition of electrical gadgets, offering insights into consumer preferences, purchasing triggers, and replacement behaviors. By delving into these aspects, the research aims to contribute to a nuanced

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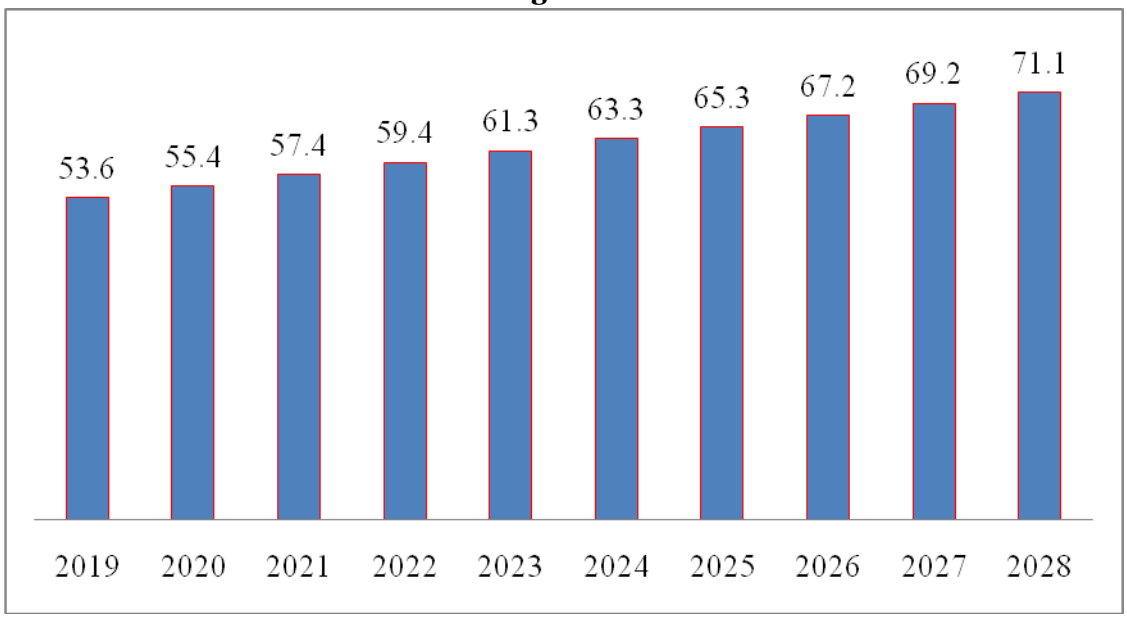
understanding of consumer motivations and their broader implications for technology markets and sustainable consumption practices.

1.1The Importance of Addressing E-Waste and global perspective

The rapid growth in technology and consumer electronics has led to a significant rise in electronic waste generation worldwide. In 2016, approximately 45 Million tonnes of electronic waste were produced globally, and by 2019, this figure had increased to 53.6 million tonnes, averaging 7.3 kilograms per person. Shockingly only 17.4% of this waste was properly collected and recycled, leaving the majority unmanaged. Current trends indicate that global e-waste will reach 65.3 million tonnes in 2024, and projections suggest it could rise to 75 million tonnes by 2030. Without substantial intervention, the total may double to 120 million tonnes by 2050.

Regionally, Asia is the largest contributor to electronic waste, producing 24.9 million tonnes in 2019, followed by Americas with 13.1 million tonnes, and Europe with 12 million tonnes. Africa and Oceania generated significantly smaller amounts at 2.9 million tonnes and 0.7 million tonnes, respectively. Despite the growing volume, recycling systems remain insufficient, with only a fraction of e-waste being formally processed. This highlights an urgent need for global efforts to improve recycling infrastructure, promote sustainable consumption, and implement policies supporting a circular economy to address the environmental and societal impacts of unmanaged electronic waste.

Figure- 1



Source: Global E –waste monitor 2022

1.2 Top 10 E-Waste Producing Countries (2023 Data)

According to recent data, e-waste generation continues to be a major global issue, with the following countries producing the largest volumes:

China ranks first in e-waste production, generating 10,129 kilotons and achieving a recycling rate of 16%. The USA follows with 6,918 kilotons of e-waste and a recycling rate of 15%. India comes next, producing 3,230 kilotons but with a low recycling rate of just 1%. Japan generates 2,569 kilotons of e-waste, matching China's recycling rate of 16%. Brazil produces 2,143 kilotons with a recycling rate of 15%, while Russia handles 1,631 kilotons but also has a recycling rate of only 1%. Indonesia contributes 1,618 kilotons of e-waste, though its recycling rate is not specified. Germany processes 1,607 kilotons with a commendable recycling rate of 52%. The UK produces 1,598 kilotons and leads with a 57% recycling rate, closely followed by France, which generates 1,362 kilotons and achieves a recycling rate of 56%.

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These figures underscore the major contribution of countries like China, the USA, and India to global e-waste generation. Despite the large volumes of e-waste produced, recycling rates remain low in these regions, with most e-waste either left unprocessed or handled in informal sectors.

1.3 E-Waste Recycling Leaders

Countries such as Estonia, Norway, and Iceland excel in e-waste recycling, setting an example with higher recycling rates. These nations focus on collecting and processing e-waste in a way that reduces environmental damage and recovers valuable materials.

Estonia takes the lead in e-waste recycling, processing 10,129 kilotons with a recycling rate of 16%. Norway follows closely, recycling 6,918 kilotons at a 15% rate. Iceland recycles 3,230 kilotons of e-waste, though its recycling rate is just 1%. Sweden handles 2,569 kilotons, achieving the same 16% recycling rate as Estonia, while Austria recycles 2,143 kilotons at 15%. Switzerland recycles 1,631 kilotons but maintains a low recycling rate of 1%. Finland contributes 1,618 kilotons of recycled e-waste, though its recycling rate is unspecified. Poland reports 1,607 kilotons with a notable 52% recycling rate, Ireland processes 1,598 kilotons with a leading 57% rate, and the UK recycles 1,362 kilotons with a 56% rate.

1.4 E-Waste in India

India ranks third in global e-waste production, with 3,230 kilotons of e-waste generated. This is primarily driven by the demand for computer equipment (70%) and telecommunications devices (12%). However, India's e-waste recycling rate is extremely low, at just 1%. Despite regulations such as the E-Waste (Management) Rules, 2016, which mandate better management of e-waste, much of it remains uncollected or improperly processed. India is projected to experience a 21% increase in e-waste generation annually.

1.5 E-Waste Management Initiatives in India

India's government has implemented several initiatives to curb the rising e-waste problem. The E-Waste (Management) Rules, 2022, which came into effect on April 1st, 2023, emphasize Extended Producer Responsibility (EPR) and aim to boost formal recycling. The rules also address the involvement of the informal sector in the recycling process.

As of June 2023, India's authorized e-waste recycling capacity stands at approximately 1.8 million metric tons annually, with Uttar Pradesh having the highest capacity at 624,219 metric tons per year.

1.6 E-Waste Recycling Capacities across Indian States

This data highlights the regional efforts and disparities in India’s approach to managing e-waste. Uttar Pradesh leads in recycling capacity, while other states like Maharashtra excel in the number of authorized e-waste dismantlers.

Table-1

Rank	State	Recycling Capacity (Metric Tons/Year)
1	Uttar Pradesh	624,219
2	Gujarat	158,605
3	Haryana	157,188
4	Uttarakhand	153,068
5	Telangana	148,115
6	Tamil Nadu	130,636
7	Karnataka	126,015
8	Maharashtra	118,032
9	Rajasthan	82,008
10	Andhra Pradesh	44,003

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2. Research Methodology

This research aimed to explore household attitudes toward e-waste disposal in metropolitan areas, with a particular focus on identifying the challenges that hinder the adoption of formal disposal practices.

The methodology was shaped by a comprehensive review of national and international literature, enabling the detection of research gaps and the formulation of hypotheses that guided the study's unique findings.

2.1Research Questions

- What are the e-waste primary sources in urban areas?
- How do large appliances and personal devices contribute to the overall volume of e-waste?
- Which types of gadgets are replaced most frequently, and why?
- Why is the management of e-waste in metropolitan cities often inadequate?

2.2Objectives:

- To identify the sources of e-waste and quantify the volume of e-waste generated.
- To know the e-waste management practices of households.

2.3 Research Hypotheses:

These objectives and hypothesis address key variables like income, gadget types, and replacement behaviors influencing e-waste generation and quantification.

Hypothesis 1 (H01):
Monthly income does not significantly influence the number of electronic gadgets in households.

Alternative Hypothesis (H11):
Monthly income significantly influences the number of electronic gadgets in households.

Hypothesis 2 (H02):
The frequency of gadget replacement is uniform across all types of electronic devices.

Alternative Hypothesis (H12):
Certain gadgets, such as smart phones and laptops, are replaced more frequently, contributing significantly to e-waste.

2.4 Sample size and sampling technique

The study focused on the population of three metropolitan cities Hyderabad, Vizag, and Vijayawada to assess consumer awareness regarding e-waste.

A structured questionnaire was distributed to a sample of 600 respondents, selected using a blend of random and purposive sampling techniques.

This diverse sample, representing various socio-economic groups, was designed to ensure the findings were reflective of the broader population.

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3. Simple Percentage Analysis of Demographic Variables

Table-2 Demographic and Socio-Economic Profile

Characteristics	Category	Frequency	Percentage
Gender	Male	389	64.8%
	Female	211	35.2%
	Total	**600**	**100.0%**
Age	18-27 years	397	66.2%
	28-37 years	92	15.3%
	38-47 years	99	16.5%
	48-57 years	3	0.5%
	More Than 57 years	9	1.5%
	Total	**600**	**100.0%**
Educational Qualification	SSC	11	1.8%
	Inter	6	1.0%
	Graduate	221	36.8%
	Postgraduate	326	54.3%
	Doctorate	36	6.0%
	Others	0	0.0%
	Total	**600**	**100.0%**
Occupation	Government	36	6.0%
	Business	107	17.8%
	Private	283	47.2%
	Private Professional	10	1.7%
	Other	164	27.3%
	Total	**600**	**100.0%**
Marital Status	Married	231	38.5%
	Unmarried	369	61.5%
	Total	**600**	**100.0%**
Type of Residence	Own House	223	37.2%
	Rent	377	62.8%
	Total	**600**	**100.0%**
Persons in Household	1-2 Persons	35	5.8%
	3-4 Persons	421	70.2%
	5-8 Persons	117	19.5%
	More Than 8 Persons	27	4.5%
	Total	**600**	**100.0%**
Household Income	Rs. 10,000 - 30,000	235	39.2%
	Rs. 30,001 - 50,000	307	51.2%
	Rs. 50,001 - 70,000	38	6.3%
	More Than Rs. 70,000	20	3.3%
	Total	**600**	**100.0%**

Source: Field Survey 2023

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Interpretation:
The study analyzed the demographic profile of 600 respondents. A majority of participants (64.8%) were male, with 35.2% female. The largest age group was 18-27 years (66.2%), followed by 28-37 years (15.3%) and 38-47 years (16.5%). Most respondents were well-educated, with 54.3% holding postgraduates degrees and 36.8% graduates. In terms of employment, 47.2% worked in private jobs, 27.3% had other occupations, and 17.8% were in business. Regarding marital status, 61.5% were unmarried and 38.5% married. Most households had 3-4 members (70.2%), and monthly incomes were concentrated between Rs. 30,001-50,000 (51.2%). Lastly, 62.8% of respondents lived in rental properties, while 37.2% owned their homes.

3.1Households' Present Usage of Electronic Devices

Electronic Gadgets	No. of Households Using	Percentage (%)
Personal Computer	414	69%
Laptop	450	75%
Mobile Phone	579	96.5%
Tab	264	44%
Television	564	94%
Refrigerator	492	82%
Air Conditioner	342	57%
Washing Machine	360	60%

Table-3 Source: Field Survey 2023)

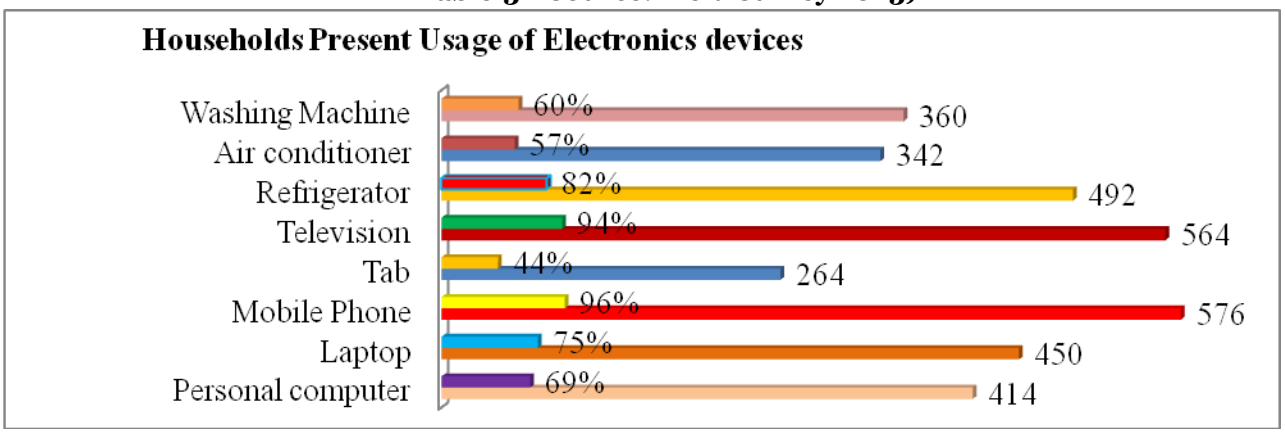

Figure-2

Interpretation: The study aimed to understand the usage of various electronic devices in daily life. Among 600 household respondents, mobile phones had the highest usage at 96.5%, followed by televisions at 94%, and refrigerators at 82%. Laptops were used by 75% of respondents, personal computers by 69%, and washing machines by 60% and air conditioners by 57% and tablets by 44%. This data reflects the widespread adoption of mobile phones and televisions, with other household devices showing significant, though slightly lower, usage rates.

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Hypothesis: 1

Ho_1: Monthly income does not significantly influence the number of electronic gadgets in households.

Table- 4 Chi-Square Test			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	224.993[a]	222	.431
Likelihood Ratio	199.784	222	.855
N of Valid Cases	600		
a. 271 cells (90.3%) have expected count less than 5. The minimum expected count is .03.			

Hypothesis result: alternative hypothesis is rejected

Test result indicates Pearson Chi-square value of 224.993 is statistically significant at 5 percent level and thus the Ho is rejected. This suggests there is a significant relationship between monthly income of the sample respondents and availability of EEE gadgets in their households.

3.2Household Purchase Behavior

Table-5

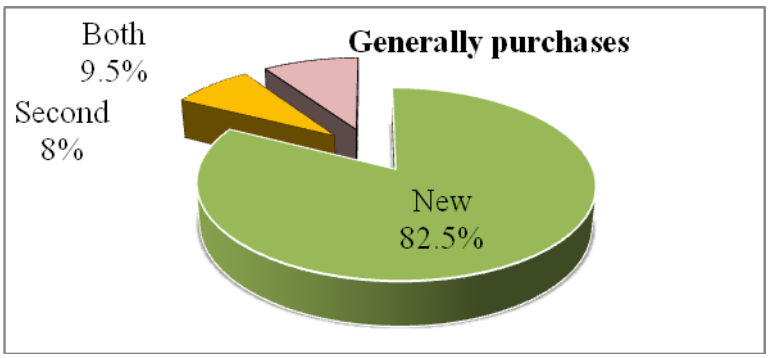
Purchase Type	Frequency	Percentage	Valid Percentage	Cumulative Percentage
New One	495	82.5	82.5	82.5
Second Hand	48	8.0	8.0	90.5
Both	57	9.5	9.5	100.0
Total	**600**	**100.0**	**100.0**	**100.0**

3.3 Household Influence Behavior to Purchase

Table-6

Influence Factor	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Necessity & Convenience	429	71.5	71.5	71.5
New Advanced Features	77	12.8	12.8	84.3
Status Symbol	34	5.7	5.7	90.0
Increase in Income	26	4.3	4.3	94.3
Advertisement	14	2.3	2.3	96.7
Others	20	3.3	3.3	100.0
Total	**600**	**100.0**	**100.0**	**100.0**

(Source: Field Survey 2023)



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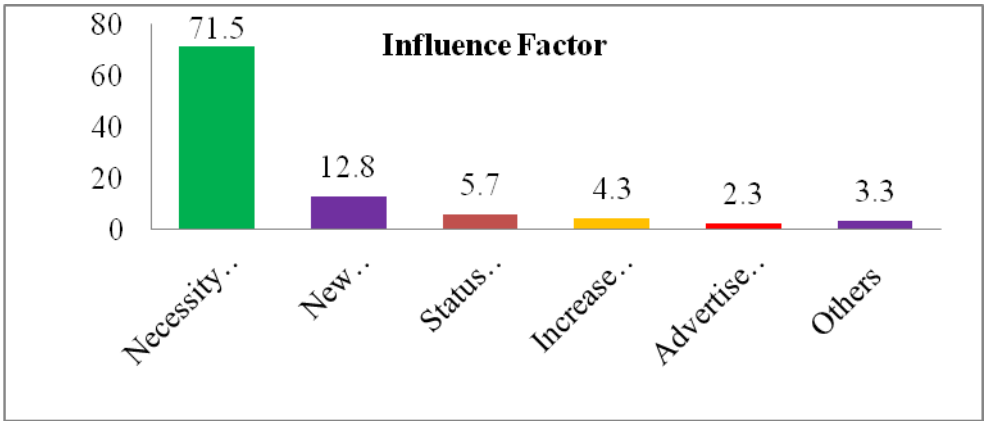

Figure-3

Interpretation: Purchase Behavior: The study reveals that the majority of respondents (82.5%) purchase new electrical and electronic devices. A smaller portion (9.5%) buys both new and second-hand devices, while 8% of respondents prefer second-hand products.

Influence on Purchase Behavior: The results indicate that the primary factor influencing purchases for most respondents (71.5%) is necessity and convenience. Other factors include the appeal of new advanced features (12.8%), purchasing for status symbol purposes (5.7%), income increase (4.3%), advertisement influence (2.3%), and other reasons (3.3%).

Table-7 One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
City	600	2.00	.817	.033
Influence to Purchase	600	1.63	1.247	.051

Table- 8 One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
City	59.950	599	.000	2.000	1.93	2.07
Influence to Purchase	32.048	599	.000	1.632	1.53	1.73

The One-Sample T-Test results show that respondents have a significant positive perception of both the "City" and it's "Influence to Purchase." The "City" variable has a mean of 2.00 ($t = 59.950$, $p < 0.001$), indicating a favorable view, with a 95% confidence interval of 1.93 to 2.07. Similarly, the "Influence to Purchase" variable has a mean of 1.63 ($t = 32.048$, $p < 0.001$), suggesting a meaningful impact on purchasing behavior, with a confidence interval of 1.53 to 1.73. These findings highlight the strong positive association between the city and purchasing decisions among respondents.

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Hypothesis: 2

$H2_0$: The frequency of gadget replacement is uniform across all types of electronic devices.

3.5 Number of Electrical and Electronic Gadgets Not In Use or Stored

Table- 9 Number of Electrical and Electronic Gadgets Not In Use or Stored						
	Zero	One	Two	More Than Two	Not applicable	Total
Personal computers	331	153	9	9	98	600
	55.2	25.5	1.5	1.5	16.3	100.0
Laptop	246	188	36	18	112	600
	41.0	31.3	6.0	3.0	18.7	100.0
Mobile phone	134	125	170	117	54	600
	22.3	20.8	28.3	19.5	9.0	100.0
Tab	380	81	9	5	125	600
	63.3	13.5	1.5	.8	20.8	100.0
Television	259	242	27	9	63	600
	43.2	40.3	4.5	1.5	10.5	100.0

(Source: Field Survey)

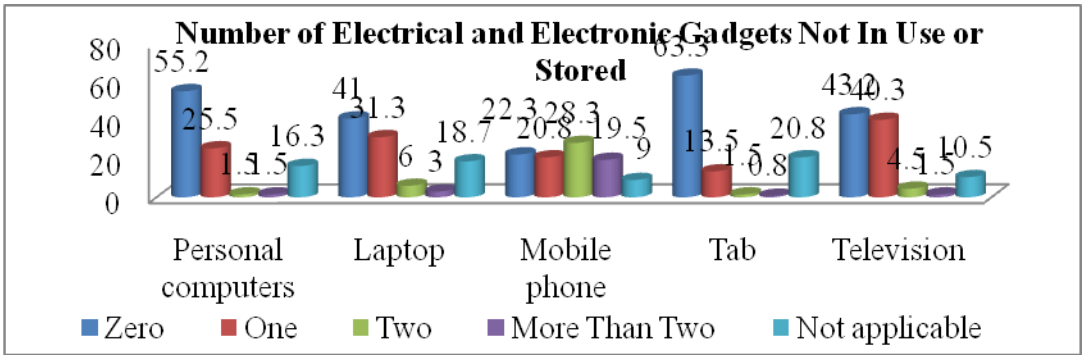

Figure-5

Interpretation: The table shows the frequency of unused or stored electronic gadgets. Among the respondents, 25.5% stored one personal computer, 31.3% stored one laptop, 20.8% stored one mobile phone, and 40.3% stored one television. Fewer respondents stored more than one of each item, with 1.5% storing more than two personal computers, 6% storing more than two laptops, and 4.5% storing two televisions.

3.6 Condition of the gadgets/equipments while discarding (disposing)

Valid	Table- 10 Condition of the gadgets while discarding (disposing)					
	Broken	Working condition	Beyond repair	others	Not applicable	Total
Personal computers	72	63	106	18	341	600
	12.0	10.5	17.7	3.0	56.8	100.0
Laptop	53	36	142	27	342	600
	8.8	6.0	23.7	4.5	57.0	100.0
Mobile phone	154	108	212	36	90	600
	25.7	18.0	35.3	6.0	15.0	100.0
Tab	63	54	79	36	368	600

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	10.5	9.0	13.2	6.0	61.3	100.0
Television	81	90	134	45	250	600
	13.5	15.0	22.3	7.5	41.7	100.0

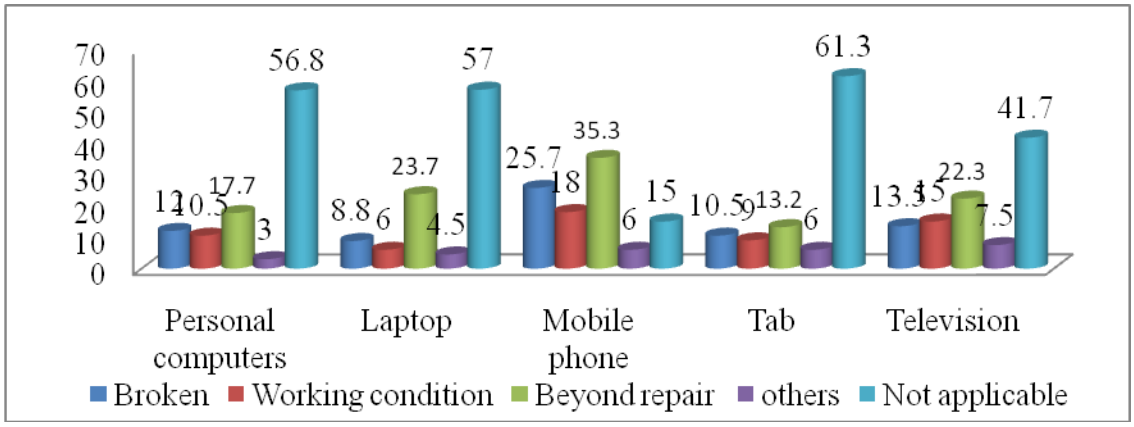

Figure-6

Table- 11 One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Personal computers	600	3.82	1.489	.061
Laptop	600	3.95	1.357	.055
Mobile phone	600	2.67	1.326	.054
Tab	600	3.99	1.433	.058
Television	600	3.49	1.482	.061

Table-12 One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Personal computers	62.872	599	.000	3.822	3.70	3.94
Laptop	71.259	599	.000	3.948	3.84	4.06
Mobile phone	49.258	599	.000	2.667	2.56	2.77
Tab	68.150	599	.000	3.987	3.87	4.10
Television	57.649	599	.000	3.488	3.37	3.61

Interpretation: The table shows the condition of gadgets when discarded by respondents. For personal computers, 12% disposed of broken ones, 10.5% while working, and 17.6% beyond repair. For laptops, 8.8% were discarded broken, 6% while working, and 23.7% beyond repair. For mobile phones, 25.7% were discarded broken, 18.5% while working, and 35.3% beyond repair. For tabs, 10.5% were discarded broken, 9% while working, and 13.2% beyond repair. Many respondents (56.8% to 61.3%) did not dispose of these gadgets.

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4. Major findings

Mobile phones and televisions are essential for communication and entertainment, as shown by their high usage rates. Laptops, personal computers, and refrigerators are crucial for work, leisure, and food storage. The widespread use of air conditioners and washing machines highlights the increasing reliance on appliances for comfort and convenience. Tablets serve as secondary devices for tasks like media consumption and light browsing. Overall, the data reflects the growing presence of electronic devices in daily life, driven by evolving lifestyle preferences and technological progress.

Overall, the results show a preference for new equipment driven by technological advancements and practical needs, with some respondent's also taking status and income generation into account when making purchases.

The data shows that while most respondents store only one unit of each device, a considerable number keep multiple units, which may reflect redundancy or the presence of backup devices in households. Analyzing these storage patterns offers valuable insights into consumer behavior and preferences related to gadget usage and ownership.
The data also indicates different rates of replacement or purchase of EE gadgets over the past five years. Notably, the majority did not replace or purchase any gadgets during this period, with the exceptions of mobile phones and televisions. This suggests varying consumer behaviors and priorities when it comes to gadget replacement.
Findings highlight the strong positive association between the city and purchasing decisions among respondents.

Overall, the data underscores the importance of considering the condition of gadgets/equipment when it comes to disposal, with a significant percentage being discarded due to irreparable damage. This highlights the need for proper recycling and waste management practices to minimize environmental impact.

5. Conclusion: The rise in the use of electronic devices has resulted in higher production and sales, making these products more accessible due to improved distribution channels. However, it is crucial to raise awareness about the environmental effects of these products to encourage responsible usage and disposal. Improper disposal can lead to the build-up of e-waste, which harms the environment. Governments must implement effective policies and create systems to manage e-waste and support recycling. Educating the public about the environmental dangers of e-waste can promote responsible disposal, helping build a more sustainable community and reduce environmental harm.

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