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An Assessment of Consumer Perceptions Regarding Electronic Waste Management: A Case Study of Chh. Sambhajinagar City, Maharashtra

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ABSTRACT
Electronic waste (e-waste), generated from discarded electrical and electronic equipment, has emerged as a significant environmental and public health concern due to rapid technological obsolescence and inadequate recycling systems, particularly in rapidly urbanizing regions. This study aimed to assess consumer awareness, perceptions, and disposal practices related to e-waste management in Chhatrapati Sambhajinagar city, Maharashtra, one of the major e-waste–generating urban centres in India. A cross-sectional survey was conducted using a structured questionnaire administered to 620 respondents representing diverse stakeholder groups, including students, households, shopkeepers, industry personnel, and street vendors. Descriptive statistics were used to evaluate awareness levels, while chi-square and correlation analyses examined relationships between awareness, risk perception, and disposal behavior. The results indicated a moderate level of awareness, with a majority of respondents having basic knowledge of e-waste and its potential environmental and health impacts. Statistical analysis revealed a significant association between awareness levels and disposal practices, and a positive correlation between awareness and perceived risks. However, increased awareness did not consistently translate into environmentally sound disposal behavior, primarily due to limited knowledge of formal collection mechanisms and inadequate local infrastructure. The study concludes that awareness alone is insufficient to ensure sustainable e-waste management, emphasizing the need for improved access to formal collection systems, incentive-based participation, and effective regulatory enforcement to enhance e-waste recycling outcomes in urban settings..
Keywords: Electronic waste, Consumer awareness, Disposal practices, E-waste management, Urban sustainability, and Chhatrapati Sambhajinagar

INTRODUCTION:

E-waste refers to all discarded electrical and electronic equipment (EEE) and their components that the owner no longer intends to reuse. It is also known as *Waste Electrical and Electronic Equipment (WEEE)*, *electronic waste*, or *E-scrap*, depending on the region. This category includes a wide range of electronic products, essentially any household or commercial item containing circuits or electrical components powered by electricity or batteries. In **2022, Asia** remained the world's largest producer of e-waste, generating **24.9 million tonnes (Mt),** followed by the **Americas** with **13.1 Mt** and **Europe** with **12 Mt** (Forti et al., 2020).

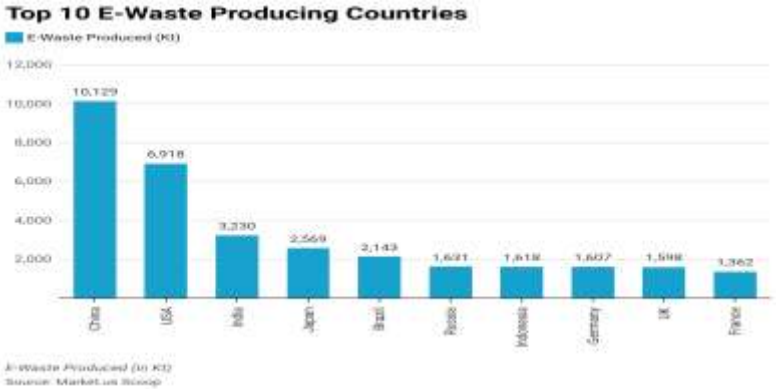

Fig.1. Top 10 E-Waste Producing Countries in the World

(Source: UN Global E-Waste Monitor, 2024.)

India ranks among both the **top five generators** and **top five importers** of e-waste globally (fig1). The country generated approximately **3.5 Mt** of e-waste in **2023,** a significant rise from **2.0 Mt** in **2014** (Central Pollution Control Board, 2023). Projections indicate that by **2030**, India's e-waste generation may exceed **5.5 Mt**, underscoring the urgent need for efficient management strategies (Parajuly et al., 2019).

Within India, **Mumbai** is the leading city in e-waste generation, followed by **Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat, and Nagpur (table 1)**. Collectively, these ten cities produce the majority of the nation's e-waste. Additionally, **65 cities contribute over 60%,** and **10 states account for nearly 70%** of India's total e-waste output (Biswas, Parida et al., 2021). The country continues to face challenges in managing this growing waste stream due to **insufficient infrastructure, weak regulatory enforcement, and low public awareness** (Singh et al., 2023). The issue is further aggravated by the **import of e-waste from developed nations**, which intensifies environmental and health burdens (Syed Saif Ali, 2022).

Table 1. Estimated E-Waste Generation by Major Indian States (2024 Data)

Rank	State	Estimated E-Waste Generation (2024, in tonnes)	Main Contributing Cities
1	Maharashtra	820,000	Mumbai, Pune, Nagpur, Nashik
2	Karnataka	510,000	Bengaluru, Mysuru, Mangaluru
3	Tamil Nadu	475,000	Chennai, Coimbatore, Madurai
4	Uttar Pradesh	460,000	Noida, Ghaziabad, Lucknow
5	Gujarat	420,000	Ahmedabad, Surat, Vadodara
6	Delhi NCR	360,000	Delhi, Gurugram, Faridabad
7	West Bengal	290,000	Kolkata, Durgapur, Siliguri
8	Telangana	240,000	Hyderabad, Warangal
9	Haryana	210,000	Gurugram, Faridabad, Panipat
10	Madhya Pradesh	185,000	Indore, Bhopal, Gwalior

Note: India's total estimated e-waste generation (2024): 4.2 million tonnes. (Source: Central Pollution Control Board (CPCB) State-Wise E-Waste Reports, 2020–24; MoEFCC EPR Portal; NITI Aayog Resource Efficiency Data).

Despite increasing global concern, **e-waste recycling rates remain critically low.** In 2022, only **22.3%** of global e-waste was officially collected and processed; the remainder was dumped in landfills, incinerated, or handled by the informal sector, where unsafe practices are common (Lepawsky, 2022). Informal recycling typically involves **open burning** and **acid leaching** to extract valuable materials, releasing toxic chemicals into the environment and exposing workers, often from marginalised communities, to severe health hazards, including respiratory disorders, skin diseases, and even cancer (Parajuly et al., 2019; WHO, 2022; Awasthi et al., 2022).

To address these challenges, India introduced the **E-Waste (Management) Rules, in 2016 which were then replaced by 2022,** which incorporate the principle of **Extended Producer Responsibility (EPR),** making manufacturers accountable for the collection and recycling of discarded electronic products (MoEFCC, 2016). Fig2 presents the key stakeholders in E waste management and also the flow of material. However, the effectiveness of this policy has been constrained by **low public awareness,** limited formal collection systems, and enforcement gaps. Complementary initiatives such as the **Swachh Bharat Abhiyan (Clean India Mission)** were launched to strengthen waste management infrastructure and promote environmental sustainability (MoEFCC, 2023).

Fig 2: E- waste key Stakeholders and material flow

One of the most significant barriers to effective e-waste management is the **lack of consumer awareness.** As primary generators of e-waste, many urban residents lack knowledge and civic responsibility regarding safe disposal practices. Although cities such as **Mumbai, Pune, Nagpur, and Chhatrapati Sambhajinagar** generate high volumes of e-waste, public perception and understanding of its environmental, ecological, and health impacts remain inadequate (Chel et. al., 2025). Consequently, large quantities of e-waste continue to be disposed of improperly, reinforcing the need for **awareness programmes, enforcement mechanisms, and accessible recycling networks.**

2. MATERIALS AND METHODS

Study Design and Area

The present study adopted a cross-sectional, questionnaire-based survey design to assess consumer awareness and perceptions regarding e-waste management among residents of Chhatrapati Sambhajinagar city(fig 3 and 4), Maharashtra, India. The survey was conducted over a period of three months (September–November 2025). The study focused on awareness of e-waste, familiarity with the E-Waste Management Rules, 2022, perceived environmental and health impacts of improper e-waste disposal, and consumers' willingness to pay for formal e-waste processing services.

Fig.3. Location map of the study area showing the state of Maharashtra in India.

Fig 4. Geographical location of Chhatrapati Sambhajinagar within Maharashtra.

Location	Latitude 19°53' N, Longitude 75°19' E
Land Area (sq km)	179.46 sq. km
Rainfall (mm)	734
Population	11,75,116 (18 Lakhs)
No. of Municipal Zones in ULB	10
No. of wards in the ULB	115
Households in the ULB as per 2011 Census	235,023
Households in the ULB as per Current Scenario	323,645

Table 2:City Profile of Chh. Sambhajinagar City

Target Population

The target population comprised key stakeholder groups actively involved in the generation or handling of electronic waste, including:

- Students
- Households
- Shopkeepers
- Industry personnel
- Street vendors
- Manufacturers, Recyclers and Refurbishers
- SWM (Solid waste management) dept, staff members of CSMC(Chh. Sambhajinagar Municipal Corporation)

These groups were selected to ensure representation of both individual consumers and commercial contributors to e-waste generation within the city.

Sampling Method and Sample Size

A stratified random sampling approach was employed to ensure adequate representation of all identified stakeholder categories. The city was first stratified based on respondent categories, and participants within each stratum were selected randomly.

A total of 620 respondents participated in the survey. The sample size was considered sufficient to provide statistically reliable estimates of awareness levels, given the large and diverse urban population of Chh. Sambhajinagar.

Survey Instrument and Questionnaire Design

Data were collected using a structured questionnaire developed after an extensive review of previous studies on e-waste awareness and management practices. The questionnaire consisted of both closed-ended and Likert-scale questions, grouped under four major themes:

1. General awareness of e-waste and its sources
2. Awareness of E-Waste Management Rules, 2022
3. Perceived environmental and health impacts of improper e-waste disposal
4. Willingness to pay for organized e-waste collection and recycling services

The questionnaire was prepared in simple and clear language to ensure comprehensibility across different educational backgrounds.

Data Collection Procedure

The finalized questionnaire was administered using offline mode to maximize participation and inclusivity. Offline data was gathered through interactions. Participation was voluntary, and respondents were informed about the purpose of the study prior to data collection.

Table 3: Survey details-

Survey Area	Chh. Sambhajinagar
Target population	Students, Households, Shopkeepers, Industry persons, and Street vendors
Total respondents	620
Survey mode	Questionnaire
Duration	September – November 2025

Fig 5: Questionnaire in Progress

Statistical Analysis

Descriptive statistics were used to compute frequencies and percentages. Associations between categorical variables were examined using the chi-square test. Pearson correlation analysis was employed to assess relationships between awareness and perceived environmental risks. Multinomial and binary logistic regression analyses were used to identify predictors influencing disposal preferences and willingness to participate in formal e-waste management programs. Statistical significance was set at $p < 0.05$.

$$\alpha = 0.05$$

- If $p < 0.05 \rightarrow$ statistically significant
- If $p \geq 0.05 \rightarrow$ not significant

3. RESULTS AND DISCUSSION

Among respondents from Chhatrapati Sambhajinagar, 60% reported awareness of electronic waste, 27% had partial awareness, and 13% were completely unaware of the concept. These findings indicate a moderate level of awareness, despite the city being one of Maharashtra's significant contributors to e-waste generation. The presence of partial awareness and non-awareness among nearly 40% of respondents suggests gaps in effective outreach and communication regarding e-waste-related issues.

Comparative analysis with previously published studies reveals notable regional differences. In Pune, Bhat and Patil (2014) reported a significantly higher awareness level (90%). However, this awareness was largely conceptual rather than functional, as it did not translate into environmentally responsible disposal behaviour due to poor knowledge of formal e-waste collection mechanisms and regulatory provisions. Similarly, studies from Bangalore indicate that although public awareness exists due to the city's status as a major IT hub, actual engagement with authorized recyclers remains limited, with a continued reliance on informal recycling networks (Jatindra & Sudhir, 2009).

In contrast, awareness levels in Saudi Arabia are considerably lower, where over 70% of respondents reported no prior education on e-waste or its environmental consequences, resulting in e-waste being treated as conventional municipal waste (Almulhim, 2022). Overall, while Indian cities demonstrate relatively higher awareness than Saudi Arabia, the results highlight that awareness alone is insufficient without supporting infrastructure and regulatory enforcement. The distribution of awareness levels among Sambhajinagar respondents is illustrated in Figure 1.

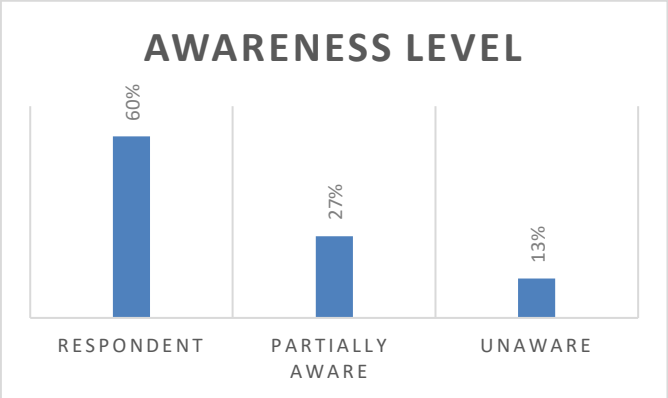

Fig. 6. Awareness level among the consumers.

Table 4. Consumer awareness and e-waste management practices in Chhatrapati Sambhajinagar (n = 620)

Parameter	Category / Response	Frequency (n)	Percentage (%)
Awareness of E-waste	Aware	372	60.0
	Partially aware	167	27.0
	Unaware	81	13.0
Awareness of Environmental & Health Impacts	Agree (Hazardous)	—	65.0
	Not sure	—	23.0
	Disagree	—	12.0
E-waste Disposal Practices	Mixed with municipal waste	310	50.0
	Sold to scrap dealers	124	20.0
	Stored at home	99	16.0
	Donated/exchanged	56	9.0
	Other methods	31	5.0
Waste Collection Infrastructure Awareness	General waste collection is available	—	80.0
	Aware of the e-waste collection facility	—	3.0
Preferred Disposal Method	Drop-off centres (schools/NGOs)	—	40.0
	Exchange/buy-back schemes	—	40.0
	Door-to-door collection	—	10.0
	Not interested	—	10.0

Willingness to Participate in Formal E-waste Management	Willing to participate	Majority	—
	Not willing/undecided	Minority	—

A chi-square test indicated a statistically significant difference in awareness levels among respondents (χ^2, $p < 0.05$), confirming uneven distribution of awareness across stakeholder groups.

$$x^2 = \sum \frac{(Oi - Ei)^2}{Ei}$$

Where:

- O_i= observed frequency
- E_i= expected frequency
- $E_i = \frac{(\text{Row total} \times \text{Column total})}{\text{Grand total}}$

3.2 E-waste Disposal Practices

The disposal practices reported by respondents in Chhatrapati Sambhajinagar reveal a predominance of environmentally unsound behaviour. Nearly 50% of respondents disposed of e-waste along with regular municipal waste, while 20% sold obsolete devices to informal scrap dealers. Additionally, 16% stored unused electronics at home, and only 9% opted for donation or exchange schemes. Comparable trends have been reported in other regions. In Pune, 57% of households mixed e-waste with domestic waste, while 32% exchanged devices during the purchase of new electronics (Bhat & Patil, 2014). In Saudi Arabia, 45% of households stored obsolete electronics, and 32% discarded them with general waste, primarily due to the absence of structured collection systems (Almulhim, 2022).

These findings indicate a consistent disconnect between awareness and action across regions. Disposal behaviour appears to be driven primarily by convenience and accessibility, rather than environmental knowledge. Where formal systems are unavailable or poorly communicated, informal scrap networks dominate disposal choices. A graphical summary of disposal practices is presented in Figure 2.

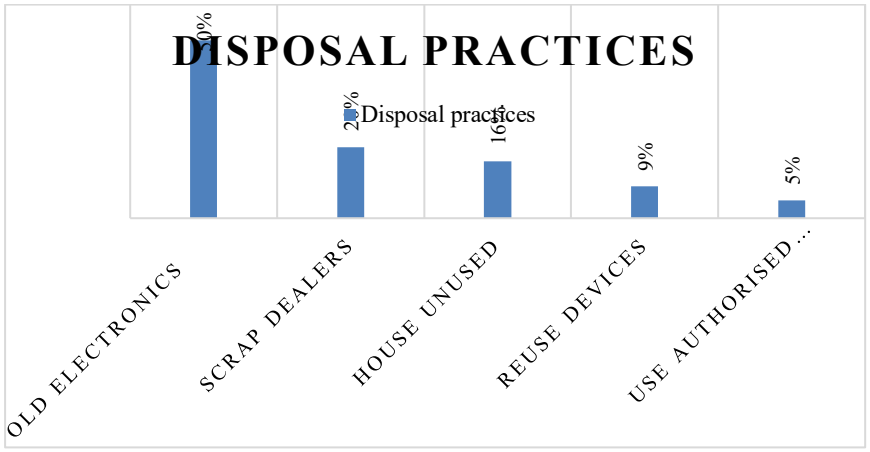

Fig. 7. Disposal practices done among the consumers.

These trends highlight convenience, not awareness, as the dominant influence on disposal behaviour. Informal scrap networks remain preferred where no formal systems are accessible.

3.3 Perceived Environmental and Health Impacts

Perceptions of environmental and health risks associated with improper e-waste disposal varied significantly among respondents. In Sambhajinagar, 65% agreed that e-waste poses environmental hazards, while 23% remained uncertain, and 12% disagreed. This moderate perception level suggests an incomplete understanding of the long-term ecological and health impacts of toxic components such as heavy metals and persistent organic pollutants. In comparison, Pune residents demonstrated higher perception levels, with 80% identifying e-waste as hazardous and 67% explicitly linking it to health risks (Bhat & Patil, 2014). Conversely, respondents in Saudi Arabia showed the weakest perception of risk, although awareness improved following targeted educational interventions (WHO, 2022).

Despite relatively higher hazard recognition in Indian cities, improper disposal practices persist, reinforcing that risk perception alone does not result in behavioural change. The findings further reveal that infrastructure inadequacy, rather than awareness deficit, is the dominant barrier. Although 80% of Sambhajinagar respondents reported access to general waste collection services, only 3% were aware of dedicated e-waste collection facilities. This trend mirrors observations from Pune and Saudi Arabia. The distribution of environmental awareness among respondents is shown in Figure 3.

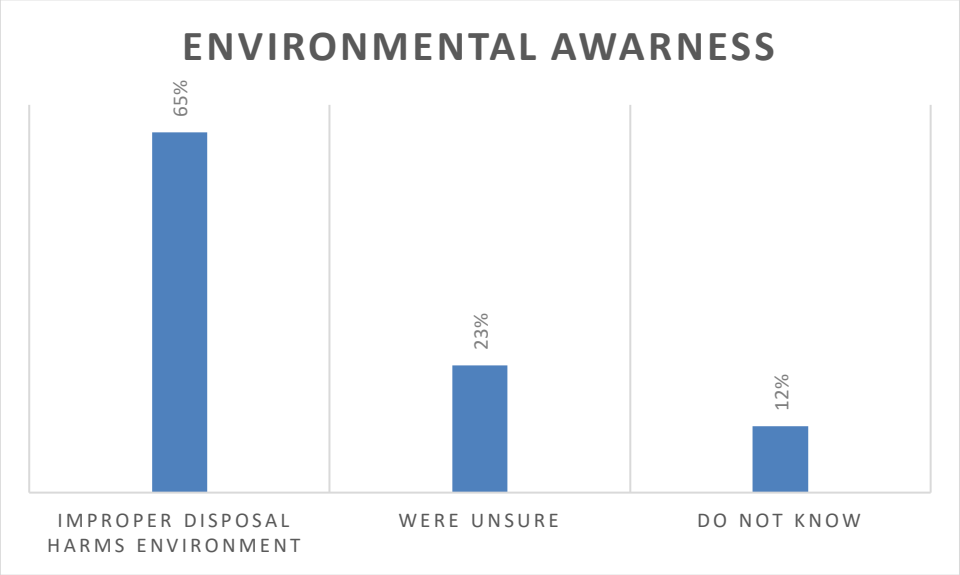

Fig. 8. Environmental Awareness among consumers.

This confirms that hazard knowledge alone does not improve disposal behaviour unless supported by accessible options and economic incentives.
Infrastructure inadequacy emerged as a major challenge in all regions. Although 80% of Sambhajinagar respondents confirmed general waste collection availability, only 3% were aware of electronic waste collection services. Pune residents displayed similar ignorance of formal systems despite high awareness levels. Saudi Arabia faced the greatest infrastructural deficit, forcing households to store or discard e-waste informally. These findings reinforce that infrastructure, not awareness, is the primary limiting factor in sustainable e-waste management. Correlation analysis showed a positive relationship between awareness level and perceived environmental risk; however, this did not translate into proportionate improvements in disposal Behaviour.

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 + \sum(y - \bar{y})^2}}$$

Where:

- x= awareness score
- y= environmental risk perception score
- $\bar{x}, \bar{y}$= mean values

3.4 Preferred E-Waste Disposal Practices Among Consumers

Respondents expressed clear preferences regarding potential disposal mechanisms. **Community-based drop-off centres at schools or NGOs were preferred by 40% of respondents,** indicating that **localized and easily accessible collection points** significantly enhance participation. An equal proportion **(40%)** favoured **exchange or buy-back schemes offered by retailers,** emphasizing the effectiveness of **financial incentives** in promoting responsible disposal.
However, **10% of respondents expressed no interest in any disposal option,** reflecting either low awareness or apathy towards e-waste management issues. These findings demonstrate that **incentive-driven and convenience-oriented strategies** are likely to be more successful than awareness campaigns alone. Preferred disposal options are illustrated in **Figure 4.**

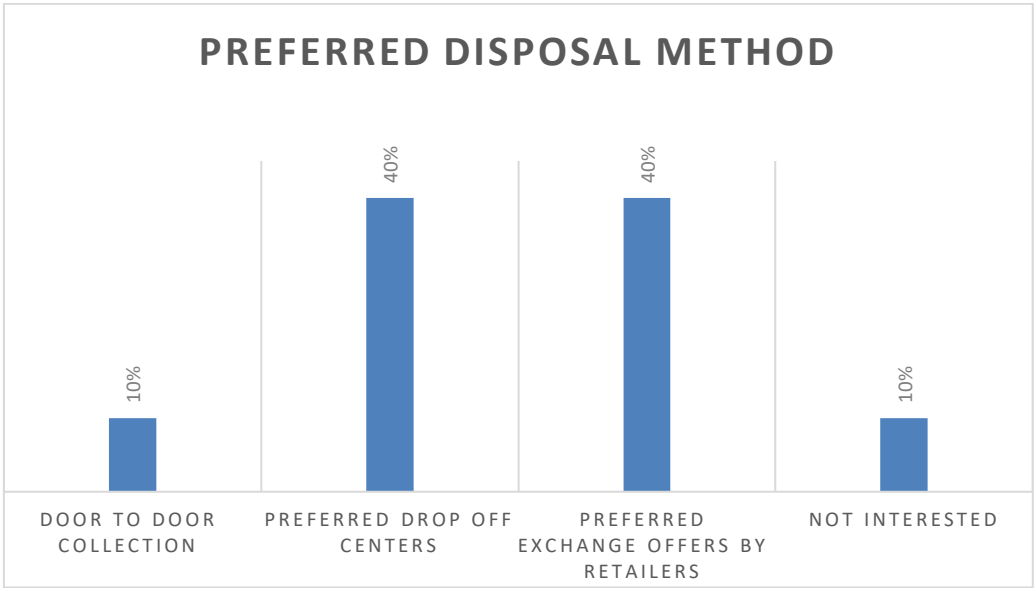

Fig.9. Preferred Disposal Method among consumers.

Multinomial regression analysis identified awareness level and accessibility of collection infrastructure as significant predictors ($p < 0.05$) of preference for formal disposal options.

$$\ln\left(\frac{P(Y=j}{P(Y=k)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

Where:Y= disposal method category

- j= chosen category
- k= reference category
- X_1, X_2= predictors (awareness, infrastructure availability)

3.5 Willingness to Participate in Formal E-waste Management

Encouragingly, respondents across all regions showed a high willingness to participate in formal e-waste management systems, provided adequate awareness and infrastructure are established. In Saudi Arabia, 88.35% of respondents expressed willingness to engage in formal disposal mechanisms following awareness interventions (Almulhim, 2022). Similarly, respondents in Sambhajinagar demonstrated strong interest in NGO- and government-led initiatives, while Pune residents showed support for exchange-based collection systems, despite limited formal access. These findings strongly support the implementation of Extended Producer Responsibility (EPR) frameworks, door-to-door collection programs, and targeted awareness initiatives, as recommended under the E-Waste Management Rules, 2022 (MoEFCC, 2022). Binary logistic regression revealed awareness and perceived environmental risk as significant positive predictors ($p < 0.05$) of willingness to participate in formal e-waste management programs.

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

- Where: p= probability of willingness to participate
- X_1= awareness level
- $\sqrt{X_2}$= perceived environmental risk

Table 5. Consumer Perception Regarding E-waste.

Parameter / Region	**Chh. Sambhajinagar (India)**	**Pune (India)** (Bhat & Patil, 2014)	**Bangalore (India)** (Jatindra & Sudhir, 2009)	**Saudi Arabia** (Almulhim, 2022)	**China** (Li & Li, 2024)
General Awareness of E-waste	60% aware / 27% partial / 13% unaware	90% aware / 10% unaware	High institutional awareness, but public reliance on the informal sector.	29.9% aware / 70.1% unaware	Awareness is increasing due to governance mechanisms
Awareness of E-waste Policy / Rules	Very low	17% aware / 48% unaware / 35% no idea	Regulations exist, but are poorly enforced at the consumer level.	Not reported	Policies present; public involvement emphasized
Common Disposal Method	50% mixed with municipal waste; 20% sold; 16% stored; 9% donated/exchanged	57% mixed with household waste; 32% exchanged when buying new devices	Informal recycling networks dominate despite formal recyclers	45% stored at home; 32% mixed with solid waste	Informal dismantling persists regardless of regulation
Environmental Awareness / Perceived Harm	65% believe e-waste is hazardous	80% consider it hazardous; 67% link it to health risks	Policy recognition but low citizen compliance	Weak perception improved after awareness	Public awareness is improving under participatory governance
Waste Collection Services & Infrastructure	80% general waste collection; only 3% know e-waste services	Good general waste collection; low awareness of e-waste units	Authorized recyclers exist (E-Parisaraa, Ash Recyclers), but are underused	Basic waste systems; no dedicated e-waste collection	Formal channels are present but bypassed by the public

Preferred Disposal Method	40% drop-off centres; 40% exchange offers; 10% door-to-door; 10% not interested	Prefers exchange-based disposal options	Institutional formal recycling is prevalent.	Not specified	Selling to informal scrap collectors is common
Willingness to Participate in Formal E-waste Programs	Strong intent for NGO/government initiatives	Positive but unquantified support for exchange incentives	Institutional participation is active; public indirect	88.35% willing after awareness	Willingness depends on incentive-based governance

(Note: Data for regions other than Chh. Sambhajinagar is derived from published studies cited in the table.)

The findings of the present study are further supported by recent national and international evidence. Trad and Harb (2024) reported that in Lebanon, moderate public awareness of e-waste does not necessarily translate into responsible disposal behavior due to inadequate formal collection systems and weak regulatory enforcement, a pattern closely mirrored in Chhatrapati Sambhajinagar. Similarly, Das and Ghosh (2023), through a research trends analysis, identified a persistent gap between awareness and effective recycling practices across regions, emphasizing that infrastructure availability, policy implementation, and incentive-based mechanisms are critical determinants of sustainable e-waste management. Together, these studies reinforce the conclusion that accessible systems and institutional support must complement awareness to achieve meaningful improvements in e-waste handling.

Study Recommendations: Actions Required

1. Government Response: Policies and the Need for Stronger Enforcement

India has introduced several important policies to manage its growing e-waste crisis. The E-Waste Management Rules (2016, amended 2022) and the Extended Producer Responsibility (EPR) framework require companies to take back and recycle the products they sell. New rules for battery waste, a network of more than 450 authorised recyclers, public awareness drives, and a digital monitoring portal show that the government is trying to build a safer system. India has strong e-waste laws, and with better enforcement and transparency, it can effectively protect communities and create a safer, cleaner environment.

2. Infrastructure & Technology

India cannot rely on scattered recycling centres or outdated manual processes if it hopes to manage millions of tonnes of e-waste effectively.

• Set Up District-Level E-Waste Collection Hubs

Today, most citizens do not know where to deposit old electronics. Establishing accessible, well-publicised collection centres in every district can dramatically increase safe waste inflow into formal recycling channels.

• Deploy AI-Based Sorting & Automated Material Recovery Technologies

Manual dismantling is slow, unsafe, and inefficient. AI-guided systems can identify components, separate valuable metals, reduce human exposure to toxins, and improve recovery yields for gold, copper, cobalt, and rare earth elements. Integrating such technology would put India closer to international recycling standards.

• Formalise the Informal Sector Through Training & Certification

Nearly 80% of India's e-waste passes through informal workers, many of whom operate in hazardous environments without protective gear. By training them, providing PPE, and integrating them as micro-entrepreneurs or certified dismantlers, India can improve safety, increase recycling efficiency, preserve livelihoods, and redirect waste away from unsafe backyard operations.

3. Citizen Behaviour

Even the strongest policies will fail without public participation. Changing consumer habits is critical to preventing e-waste from ending up in household garbage or roadside dumps.

• Offer Incentives for Returning Old Electronics

Cashbacks, vouchers, or exchange bonuses can motivate consumers to part with unused devices stored in drawers and cupboards. Studies show that over 200 million unused phones lie idle in Indian homes, representing vast recoverable resources.

• Launch Digital Campaigns on Proper Disposal

Awareness remains a major challenge. Clear messaging through social media, government apps, electric retailers, and local bodies can explain: where to dispose of e-waste, why it is dangerous to throw it in household trash, and show citizens can participate in recycling drives.

• Integrate E-Waste Education into Schools & Community Programs

Teaching young people about responsible consumption, repair, and recycling can cultivate lifelong habits. Community workshops, school curricula, science fairs, and citizen volunteer networks can all play crucial roles in building a culture of responsible disposal.

4. CONCLUSION

The survey and its analysis reveal that, although general consumer awareness about electronic waste is relatively mediocre. In Chhatrapati Sambhajinagar, 60% of respondents were aware of electronic waste, 27% had partial awareness, and 13% were completely unaware. there is still a lack of understanding regarding proper disposal practices, available collection centres, and relevant regulations. This gap in complete understanding leads many households to mix e-waste with regular solid

waste rather than dispose of it in an environmentally responsible manner. Consumer awareness is crucial across the entire e-waste supply chain, as it fosters habits of repair, reuse, and recycling that support effective electronic waste management while protecting health, the environment, and sustainable development. This can be achieved by educating consumers about the harm caused by improper disposal and the benefits of reuse and recovery. Consumers must begin to view electronic products not merely as luxury goods but also as sources of valuable materials and potential environmental and health hazards. All stakeholders share this responsibility, and the Cradle-to-Grave concept should guide these efforts. While the government has fulfilled its role by implementing regulations, it is now essential for consumers to take responsibility for managing e-waste appropriately.

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Conflicts of Interest: The authors declare that there are no known financial or personal conflicts of interest that could have influenced the work reported in this paper. The research was conducted independently, and the funding agency had no role in the study design, data collection, analysis, interpretation of results, or preparation of the manuscript

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