# E-WASTE RECYCLING BEHAVIOUR: A CASE STUDY OF THE CITY OF JOHANNESBURG

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# Aim and objectives

The main aim of this study was to investigate e-waste streams and the e-waste recycling behaviour of households in the City of Johannesburg.

In order to achieve this research aim, the following research objectives were set out:

- Determine household recycling behaviour concerning the ICT e-waste stream.
- Identify challenges and incentives influencing household e-waste recycling behaviour.
- Investigate the relationship between e-waste recycling behaviour and the demographic variables of income level and age.



Figure 1: E-waste in Johannesburg landfill (Waste Plan, 2018)

# Background

- Global and local WEEE management is challenging as electronic items become obsolete and disposed of incorrectly (Labuschagne, 2020; Ádám *et al*., 2021).

- SA has an e-waste collection rate of 11% and only 9.7% is recycled (DEA, 2018).

- Only 12.1% of South Africans knew of drop-off points (Bob, 2015).

- 11% tried to dispose of WEEE correctly (Bob, 2015).

- SA's e-waste industry has a market value of R280 million with only R38 million earned (Mulckhusye *et al*., 2021).

- Personal WEEE growth, impacted by COVID-19 (Ismail & Hanafiah, 2020).

- Incineration of WEEE introduces hazardous elements into the environment that impacts human and environmental health (Ahirwar & Tripathi, 2021; Bob *et al*., 2017; Kumar & Singh, 2019).

- The low volume of e-waste entering the recycling stream (Forti *et al*., 2020).



Figure 2: Informal burning of e-waste in Ghana (Earth Touch News, 2014)

# Study area

- City of Johannesburg, South Africa.
- Economic hub and one of the biggest producers of WEEE as per the SA SoWR (DEA, 2018).
- 55% of collection and processing of WEEE practiced in the CoJ (DEA, 2018).

| | |
|---|---|
| **Region A** | Diepsloot, Kya Sands, Dainfern, Midrand, Lanseria, Fourways |
| **Region B** | Randburg, Rosebank, Emmarentia, Greenside, Melville, Mayfair, Northcliff, Rosebank, Parktown, Parktown North |
| **Region C** | Roodepoort, Constantia Kloof, Northgate, Florida, Bram Fischerville |
| **Region D** | Doornkop, Soweto, Dobsonville, Protea Glen |
| **Region E** | Alexandra, Wynberg, Sandton, Orange Grove, Houghton |
| **Region F** | Inner City, Johannesburg South |
| **Region G** | Orange Farm, Weilers Farm, Ennerdale, Lenasia, Eldorado Park, Protea South |
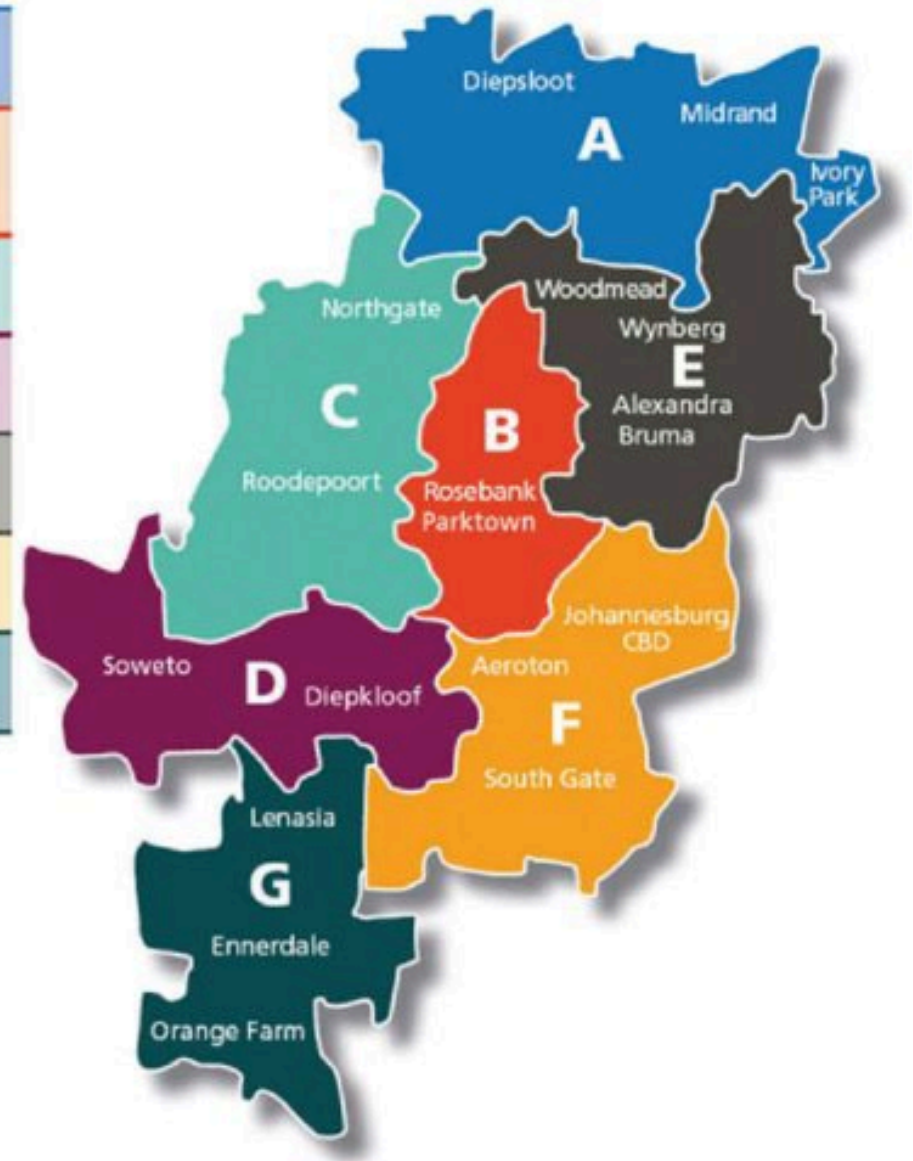
# Data collection methodology

- Non-probability: Convenience sampling
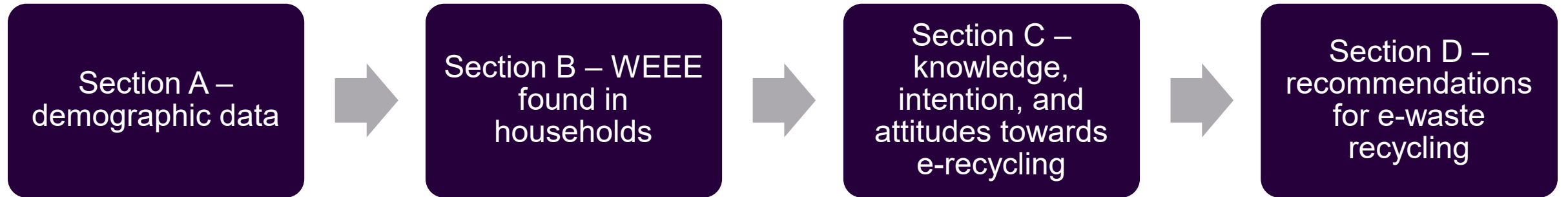- Online survey questionnaire
- Pilot study
- Target population
- Total: 286 participants
- Applicability
- Mixed-method approach

# Data collection methodology: The Questionnaire

Section A – demographic data → Section B – WEEE found in households → Section C – knowledge, intention, and attitudes towards e-recycling → Section D – recommendations for e-waste recycling

# Data analysis methodology

Analysis

Descriptive and inferential statistics

Likert-scale: descriptive

Open-ended: thematic analysis

Demographic relationships: chi-square analysis

# Results and discussion

# Demographics

| Characteristics | Class | Percentage |
|---|---|---|
| Gender | Female | 69.4% |
| | Male | 29.9% |
| | Non-binary + | 0.7% |
| Age group | <20 years | 1.9% |
| | 21-30 years | 8.7% |
| | 31-40 years | 14.8% |
| | 41-50 years | 21.3% |
| | 51-60 years | 30.1% |
| | 61+ years | 23.5% |

| Education | | |
|---|---|---|
| Education | Some high school education | 1.8% |
| | Matric certificate | 13.7% |
| | Post-matric diploma/certificate | 23.2% |
| | Bachelor's degree | 20% |
| | Post-graduate degree | 41.4% |
| Income | Lower (<R3500 per month) | 0.7% |
| | Emerging middle (R3500 – R8000 per month) | 3.3% |
| | Realised middle (R8001– R22 000 per month) | 11.4% |
| | Upper middle (R22 001 – R40 000 per month) | 15.8% |
| | Emerging affluent (R40 001- R75 000 per month) | 30.8% |
| | Affluent (>R75 000 per month) | 38.1% |

Table 1: Demographic results

# E-waste recycling knowledge and participation

- Analysed average agreement levels.
- 54.4% of participants know or have heard of recycling projects.
- 57.7% have recycled in the past.
- 42.3% have not recycled.
- Potential increased to 82.2% when asked if they would recycle WEEE going forwards.
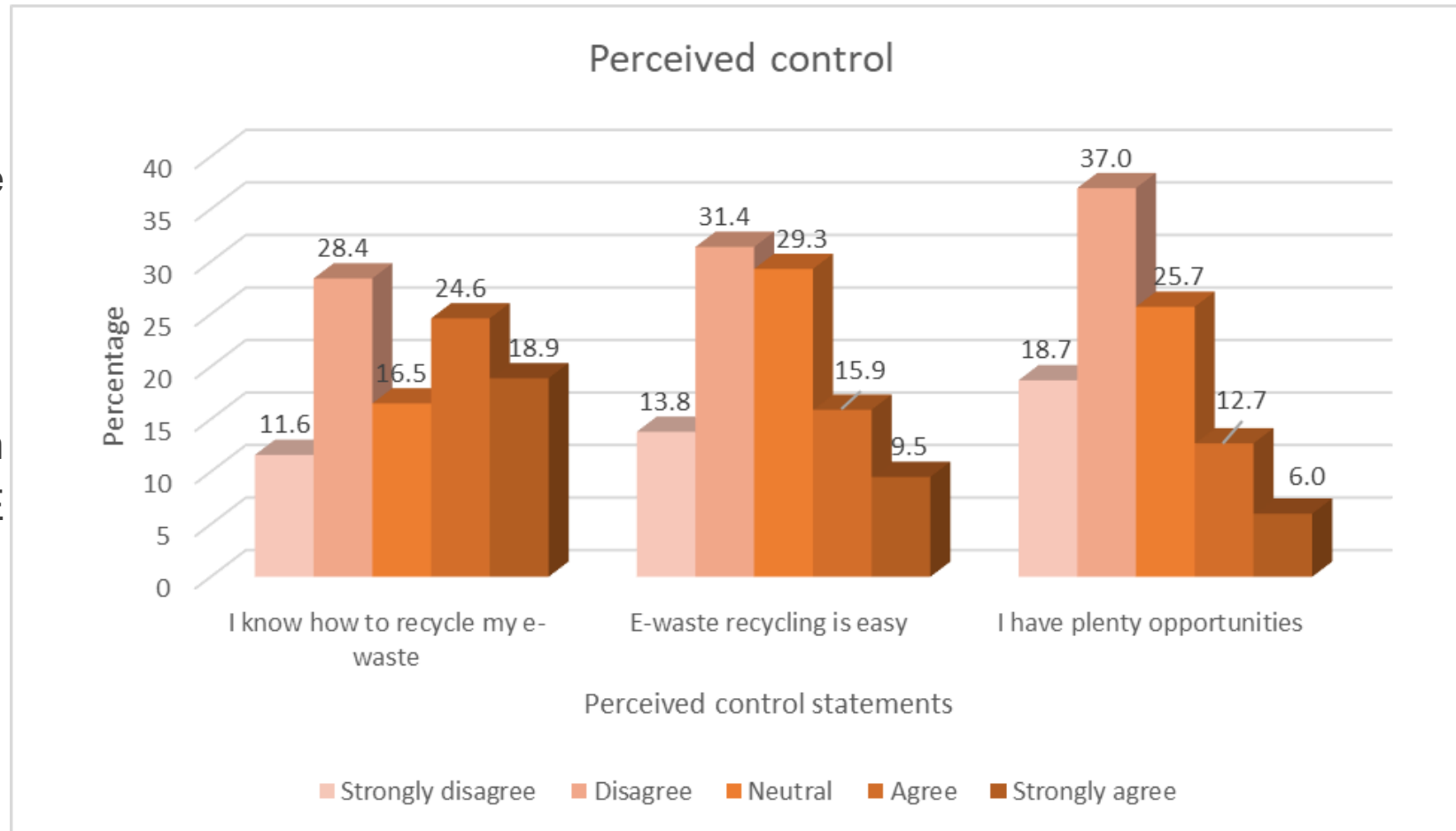


Figure 4: Perceived control regarding e-waste recycling

# Perceived economic concern

- Value acknowledgement present.
- E-recycling and implementation is required to advance and realize the economic potential of the WEEE industry.
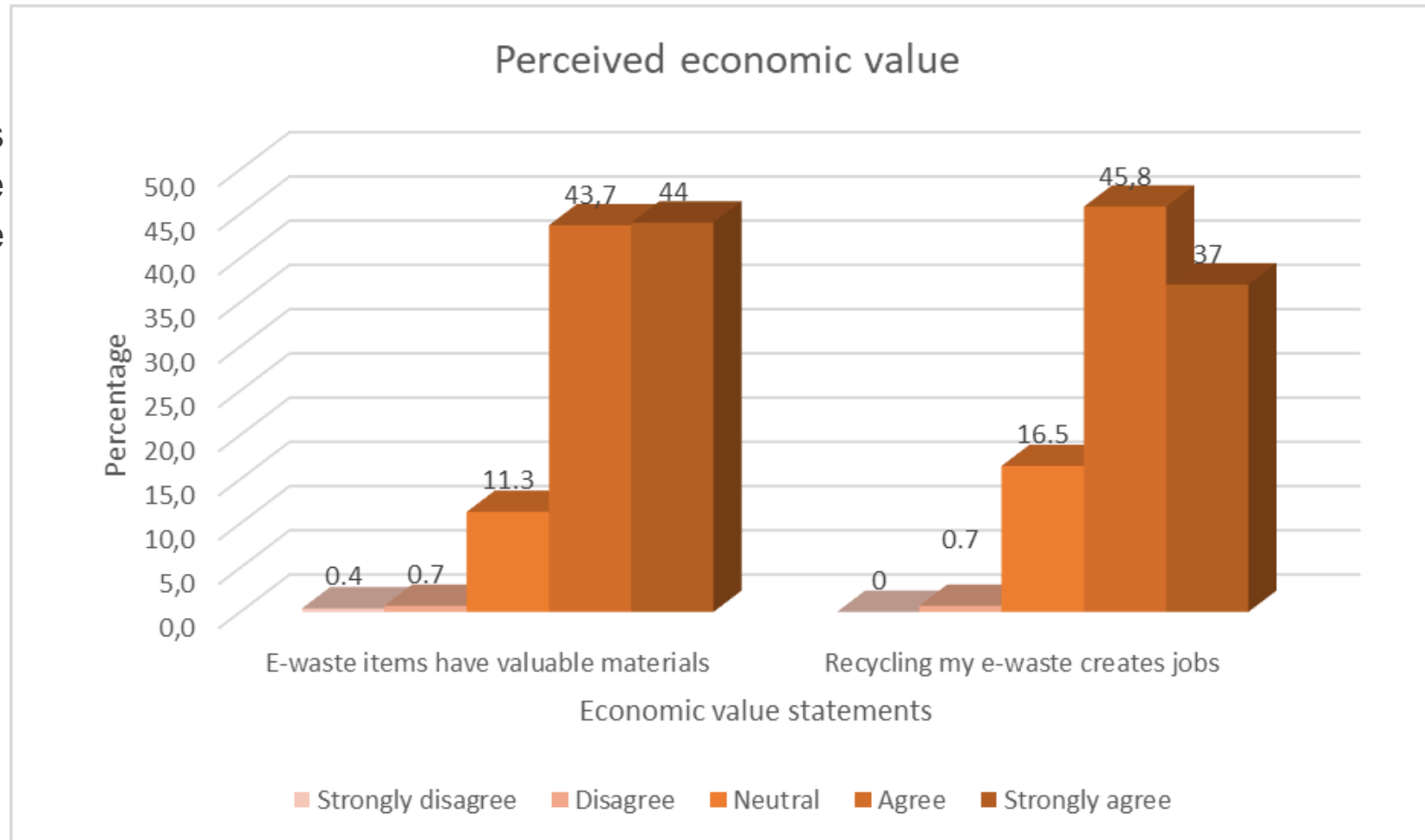


Figure 5: Perceived economic value of e-waste recycling

# Perceived environmental concern

- Acknowledgement of the environmental impact of WEEE.
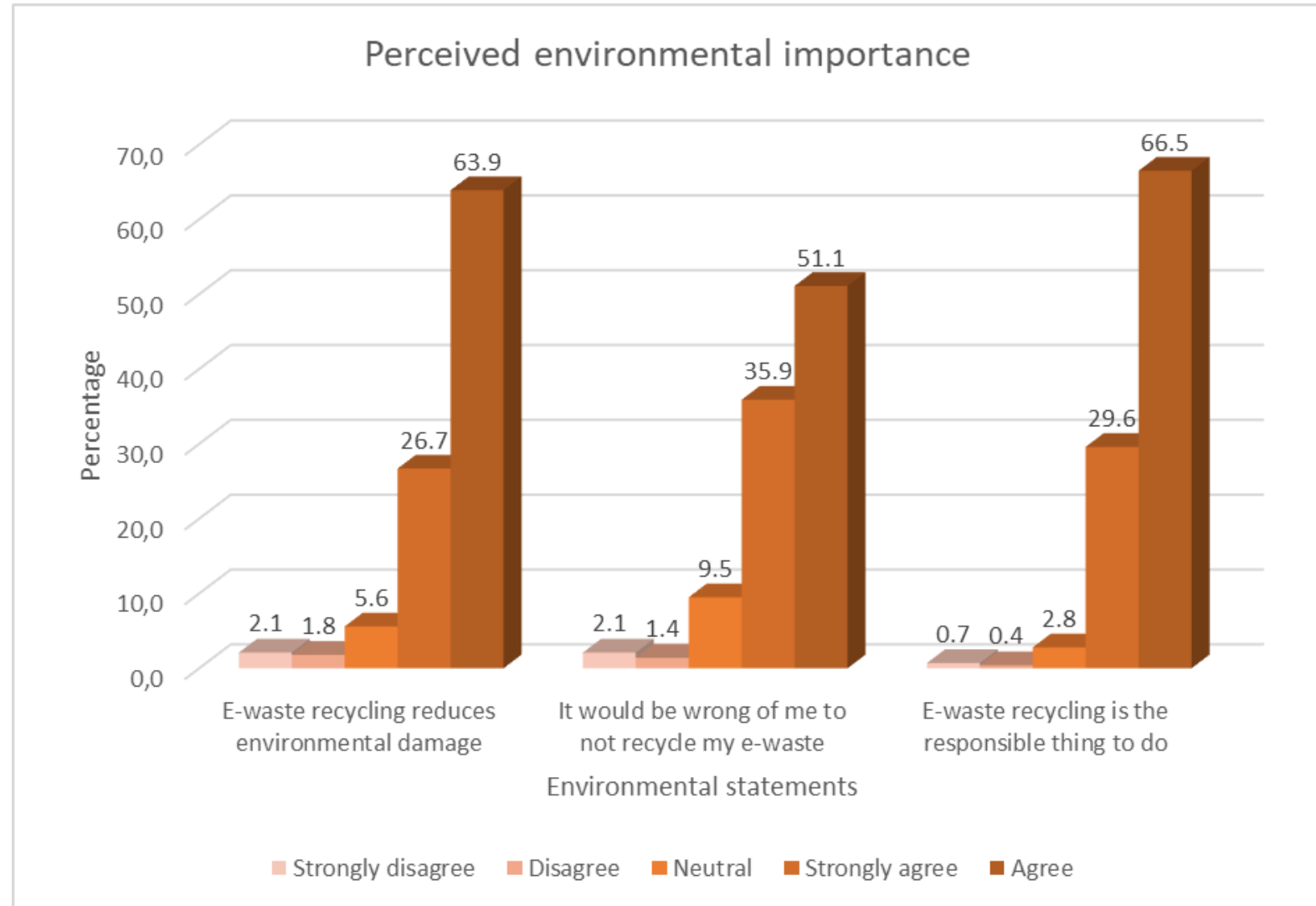- A pro-environmental attitude reflected by CoJ households towards e-recycling.



Figure 6: Perceived environmental importance of e-waste recycling

# Challenges limiting current e-waste recycling

- Answered through Likert-scale and open-ended questions to identify keywords.
- Lack of education and awareness.
- Inaccessibility.
- Convenient drop-off points and support required.
- Data security concerns.
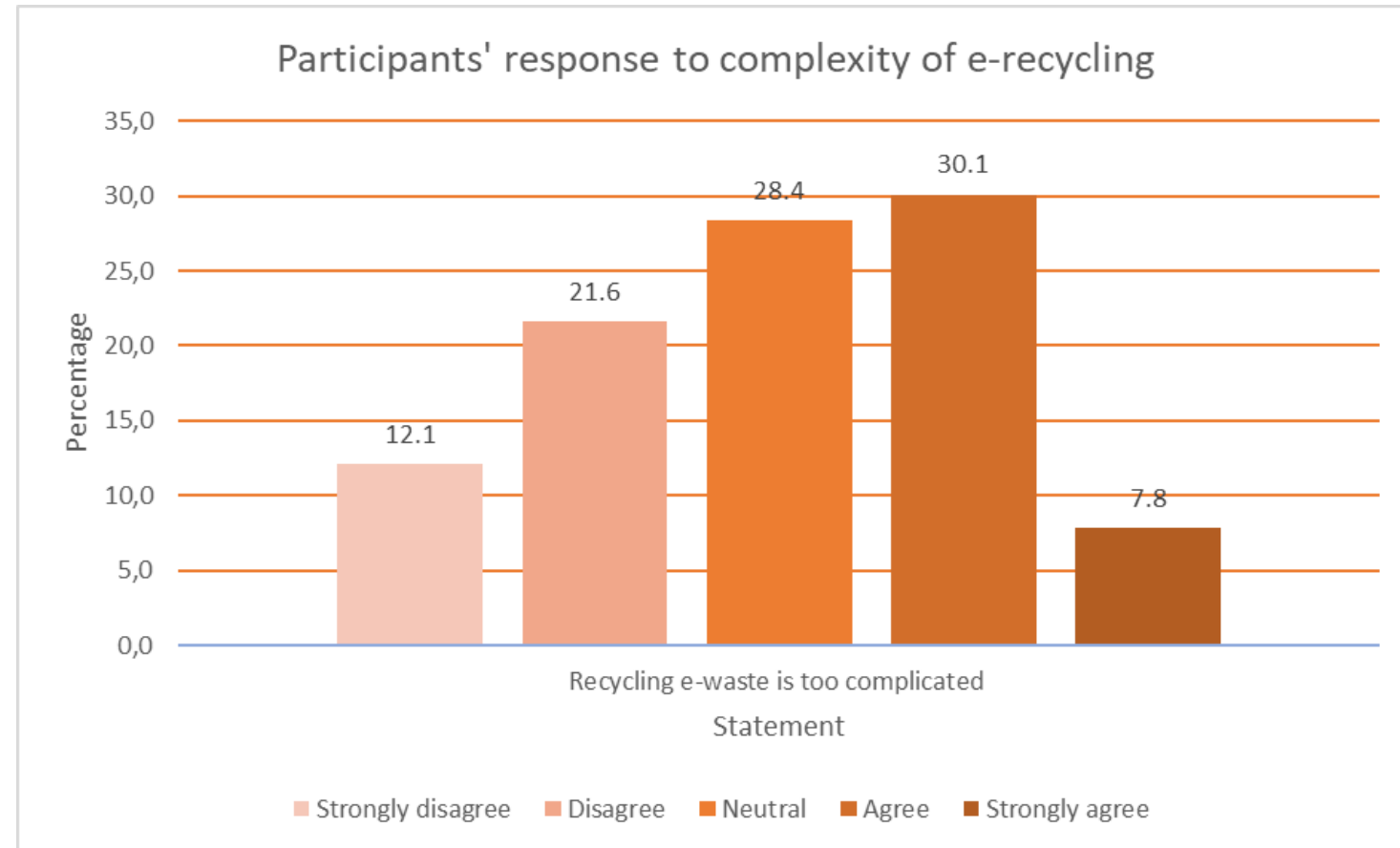- Complexity of recycling WEEE (different streams).
- Time.



Participants' response to complexity of e-recycling

Strongly disagree: 12.1
Disagree: 21.6
Neutral: 28.4
Agree: 30.1
Strongly agree: 7.8

Recycling e-waste is too complicated

Statement

# Suggestions to increase the recycling of e-waste

- Accessibility
- Organization
- Incentives
  - Financial
  - Environmental
  - Community
- Positive reinforcement such as rebates and discounts.
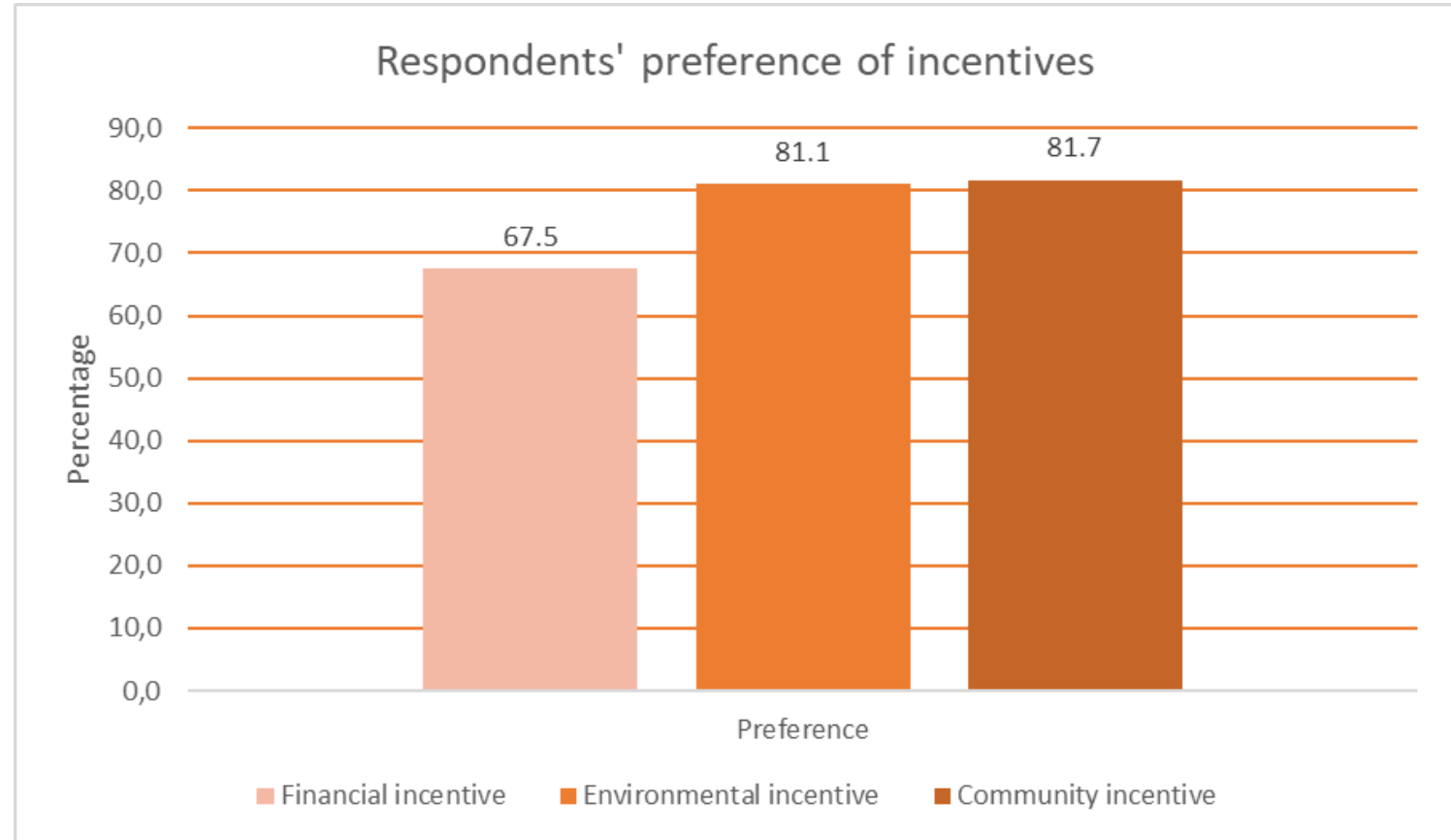- Negative reinforcement such as stricter legislation.



Respondents' preference of incentives

Financial incentive: 67.5
Environmental incentive: 81.1
Community incentive: 81.7

Figure 8: Respondents' preference of incentives

# The relationship between income level and e-waste recycling behaviour

- Null hypothesis: 'E-waste recycling behaviour does not depend on the income level of consumers.'
- Null hypothesis upheld.
- Results showed income was not a significant demographic variable.
- This contrasted some studies that identified a positive correlation (Jafari *et al.*, 2017).

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 4.404ᵃ | 3 | 0,221 |
| Likelihood Ratio | 4,387 | 3 | 0,223 |
| Linear-by-Linear Association | 4,327 | 1 | 0,038 |
| N of Valid Cases | 273 | | |

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.85.

**Symmetric Measures**

| | | Value | Approximate Significance |
|---|---|---|---|
| Nominal by Nominal | Phi | 0,127 | 0,221 |
| | Cramer's V | 0,127 | 0,221 |
| N of Valid Cases | | 273 | |

Table 2: Chi-square analysis output for cross-tabulation between household income and previous e-waste recycling practices

# The relationship between age and e-waste recycling behaviour

- Null hypothesis: 'E-waste recycling behaviour does not depend on the age of consumers.'
- Null hypothesis rejected.
- Age was a significant variable but contrasted international studies (Kumar, 2019; Mahmod *et al.,* 2021).
- Results aligned with another local study on recycling (Schoeman & Rampedi, 2021).

**Chi-Square Tests**

|  | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 19.040[a] | 5 | 0,002 |
| Likelihood Ratio | 19,247 | 5 | 0,002 |
| Linear-by-Linear Association | 6,676 | 1 | 0,010 |
| N of Valid Cases | 281 | | |

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.89.

**Symmetric Measures**

|  |  | Value | Approximate Significance |
|---|---|---|---|
| Nominal by Nominal | Phi | 0,260 | 0,002 |
| | Cramer's V | 0,260 | 0,002 |
| N of Valid Cases | | 281 | |

Table 3: Chi-square analysis output for cross-tabulation between age and previous e-waste recycling practices

# Conclusion

- Electronic consumption and the WEEE community are further pressured by the 4IR and the IoT.

- The study aimed to investigate e-waste recycling behaviour in the CoJ.

- Main challenges: lack of knowledge, lack of time, accessibility issues, and outdated e-waste recycling information.

- Respondents had an overall pro-environmental attitude towards e-recycling.

- Respondents acknowledged the economic value of the WEEE industry and its' potential.

- Despite increasing levels of e-waste in SA, e-recycling is lagging behind and changes need to be made to engage CoJ residents in more active recycling behaviour.

# Acknowledgements

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