

Appraisal of Consumer Electronics and E-waste Generation in Households in Gauteng

Thea Schoeman¹, Isaac T. Rampedi², and Joel Maseki³

Abstract— Nowadays, the advancement of technology through the massive production of consumer electronics has influenced significantly the daily living standards or the lifestyle in the households and has made them essentials for convenience services. Households contribute to the generation of unwanted or not working devices called commonly "e-waste" in the literature. The increased generation of e-waste poses challenges globally and locally in terms of its threats to the environment and public health. In response to this crisis, Gauteng local government has conceived an integrated strategy to tackle the challenges of proliferation of e-waste within its jurisdictions. Since the Gauteng province was identified as the major (55%) generator of e-waste nationwide, it became the focus of the present study, which aims to assess selected consumer electronics segment, the e-waste generated and the disposal practices in households in Gauteng. Results revealed that each household has 4.1 (± 2.3) consumer electronics in use, 0.6 (± 1.1) not working and 1.2 (± 1.8) not needed. Giving the e-waste to someone was the most dominant (40%) disposal practice among the households, while practices such as recycling and others were found to be lower than 40% among the respondents for all the selected consumer electronics. The study showed certain electronic goods which will become waste in the future. The study recommended the implementation of campaigns stimulating awareness and participation of households in the local government strategy to promote pro environmental behaviour for sustainable e-waste management.

Keywords — E-Waste, Consumer Electronics, Households, Disposal Practices.

I. INTRODUCTION

Electronic devices influence the everyday life activities of people in communication, entertainment and information and such devices are commonly called consumer electronics [1]. Globally, in 2023 the amount of consumer electronics such as televisions (TVs), radio and multimedia were estimated to be around 2.3 billion pieces [1]. Such number of items indicates the extent that modern life is led by the sale and utilization of electronic devices. Although electronic devices are useful in supporting daily activities particularly in households, several factors contribute to discarding it. The advancement of

technology, functionality, minimization and consumer decisions are among the key factors contributing to the obsolescence of consumer electronics thus leading to its disposal at the end of use or the end-of-life [2]. Therefore, they become "e-waste" also known as waste electrical and electronic equipment. The management of the growing amount of e-waste is a global concern due to the adverse impacts on human health and the environment when improperly disposed. However, e-waste under a sustainable management system can be a source of job creation and economic growth.

In South Africa, Gauteng province contributes roughly to 55% of the total national volume of the 360 000 tons of e-waste generated yearly [3]. The increasing amount of e-waste in Gauteng province raises an alarming concern due to mismanagement and the lack of proper facilities [3]. In response to the growing e-waste crisis, the Gauteng Department of e-Government developed a strategy that promotes the minimisation of e-waste generation in adopting an e-waste hierarchy labelled as 9Rs meaning 'refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose and recycle' to achieve sustainable development [3]. The strategy aims to implement a holistic approach to encourage the participation of all stakeholders in tackling the e-waste management crisis and to promote sustainable development through a circular economy.

One of the challenges of managing e-waste in South Africa is the uncertainty in the recycling rates and quantity of e-waste generated [4]–[6]. The Global E-waste Statistics Partnership gives e-waste generation for South Africa as 527 000 tons in 2022 with only 4% formal collection rate [7], the State of Waste Report estimated that 360 000 tons of e-waste was generated in 2017 with a recycling rate of 10% [8], the Global E-waste Monitor Report also reported 527 000 tons for 2019 and a recycling and collection rate of 22.9% [9], while [6] only estimated 74 923 tons in 2015 with a recycling rate of 11%. The contribution of households, governmental institutions and businesses were estimated as 20% 45% and 35% respectively [6]. Often e-waste is discarded in landfills or in dumping sites [10], and studies conducted on e-waste in households, public institutions and businesses in South Africa mentioned the stockpiling practices and the low rate of e-waste collection [11]–[13]. E-waste stockpiling is the common practice of storing no longer needed, used or broken devices instead of disposing it [11], [14]. A study conducted nationwide in South Africa reported that 86.4% of e-waste

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generated in 2017 was subject to stockpiling practices [7]. The stockpiling represents therefore a major challenge for collecting and disposal of e-waste. The lack of proper and adequate collection systems and recovery infrastructure provide little support for sustainable e-waste management practices [15].

Therefore, this study determined the quantity of consumer electronics available in households, as well as the volume of e-waste (devices no longer needed, used or broken). It also investigated the disposal methods of these devices. The study focused on TVs, radios, stereo systems, game consoles, global position systems (GPSs), videocassette recorder (VCR) and digital video disc (DVD) players, MPEG Audio Layer 3 (MP3) players, calculators, cameras and e-smoking devices. In term of categorisation, these devices are classified as brown goods [16].

Households contribute to the total volume of the e-waste generated from the use of consumer electronics. Households can play a key role in overcoming the low rate of collection of e-waste generation. This study can provide the necessary information that can guide planning and programs involving collection and recycling of e-waste.

II. METHOD

An online questionnaire was designed and pretested during a pilot study to ensure its relevance to address the research question and the key objectives of the study. Google Forms were used as the online platform for the questionnaire and participants residing in Gauteng were invited through social media to participate in the study. This approach of data collection was more effective due to the global and local context of the health challenges raised with the COVID-19 pandemic. A total of 346 respondents participated in the study thus giving a 95% confidence level based on estimated 15.8 million individuals living in Gauteng province in 2022.

Data on 12 selected consumer electronics in households were collected. The appraisal was conducted to determine the number of the selected consumer electronics that were in use or available as e-waste households as well as disposal practices in the households.

Data analysis included the extraction of responses from the questionnaire to an Excel spreadsheet and data processing through descriptive statistics. Throughout the process of collecting, analysing and reporting, the study followed the guideline as provided by university ethical clearance ensuring a voluntary participation and a strict protection of the confidentiality of respondents. Results are given in the following sections.

III. RESULTS AND DISCUSSIONS

The first section presents the results of the number of consumer electronics owned in households – devices in use, no longer needed or used and those no longer working. The second section shows the results of the disposal methods used.

A. Ownership of consumer electronics

Findings on the categorisation of consumer devices are given in **Error! Reference source not found..** The majority of the respondents indicated owning TVs (flat screens, followed by calculators, cameras and DVDs players with 88.2%, 71.5%, 69.1% and 54.7% respectively. The lowest recorded ownership was for cathode-ray TVs (15.9%) and e-smoking devices (13.2%).

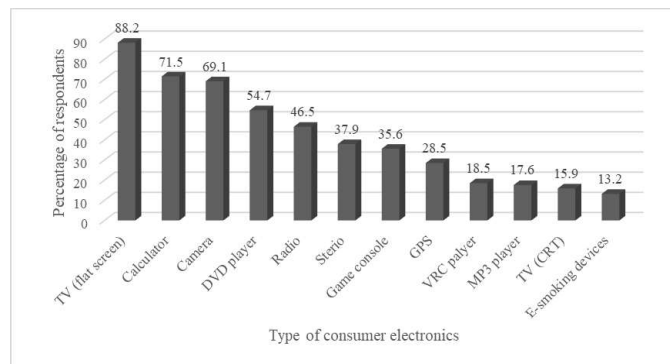


Fig. 1 Type of consumer electronics in households in Gauteng.

The relatively high ownership of TVs shows to what extent these devices are a key component in the audiovisual and multimedia devices that support the lifestyle of modern households. Interestingly, similar findings were given in a previous study on the ownership of TVs in Limpopo province (South Africa) where 86% of the respondents confirmed having TVs [17]. In a similar study in Ota (Nigeria), the majority of 85.6% of respondents confirmed having a television device in their household [18].

Surveys in countries like Austria, Japan, China, UK and Hungary found that each household had at least one television [19]–[23]. In the United States, just below 97% of households had at least one TV in 2023-2024, while more than half or households had three or more TVs [24]. In Australia, 97% of households had a TV, with 34% having two TVs in 2023 [25].

A. Consumer electronics in use in households

Findings on the consumer electronics in use are presented in TABLE . In each household, more than 30% of respondents own at least one of the consumer electronics selected in the study, with three devices that recorded over 60% on top of the list, namely stereos, followed by DVD players and game consoles. A minority (<35%) of respondents mentioned having two devices in use, a proportion of less than 20 % was scored from respondents having more than three devices in use.

TABLE I

CONSUMER ELECTRONICS IN USE IN HOUSEHOLDS

Type of appliance	Don't own	1 in use	2 in use	3 in use	> 3 in use
TV (CRT)	28.0	48.0	18.0	2.0	4.0
TV (flat panel)	3.7	40.5	29.9	17.3	8.5
Radio	10.4	56.5	22.1	7.1	3.9
Stereo	16.3	69.1	11.4	1.6	1.6
DVD player	20.3	66.7	10.2	1.7	1.1
VCR player	40.7	54.2	5.1	-	-
MP3 player	33.3	40.4	15.8	1.8	8.8
Camera	14.0	48.0	21.8	7.9	8.3
Game console	13.7	64.1	15.4	5.1	1.7
GPS	22.6	47.3	20.4	5.4	4.3
Calculator	5.6	32.6	30.5	16.7	14.6
E-smoking devices	15.9	36.4	31.8	4.5	11.4

B. Consumer electronics not working

For the definition of e-waste in this paper, the consumer electronics that are not working are regarded as e-waste (Fig. 2). For e-smoking devices, 27.9% of households reported to have one or more devices no longer working, followed by VCR players (19.65) and GPSs (19.4%). For all 12 consumer electronic devices, households reported at least one device no longer working. Yet, they still had such devices in their households confirming the stockpiling practices.

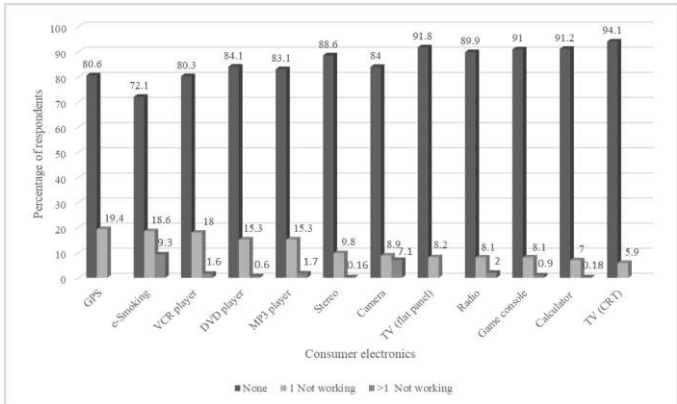


Fig.2 Consumer electronics not working.

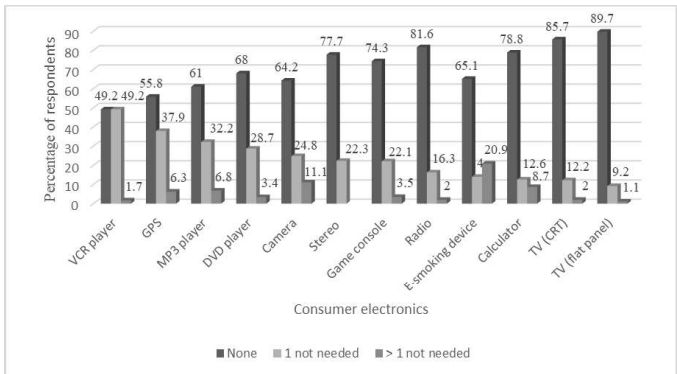


Fig. 3 Consumer electronics not needed.

C. Consumer electronics not needed

Consumer electronics that are not needed in the households can also be regarded as e-waste (**Error! Reference source not found.**). In 50.9% of households there were one or more VCR players no longer needed, followed by GPS devices

(44.2%). TVs recorded the lowest number with 14.2% respondents for CRT TVs and 10.3% for flat screen TVs. The study did not conduct further investigation to determine the reason behind why consumer electronics were not needed. Some of the devices can be considered obsolete and again this provides another evidence of stockpiling of potential e-waste. The study revealed that numbers of consumer electronics have a mean of those in use, not working and not needed 4.1 (± 2.3), 0.6 (± 1.1), 1.2 (± 1.8) respectively in each household. The average of the consumer electronics in Gauteng was similar to the quantities of EEE found in urban, semi urban and rural households in India [26]. Compared to South Africa, where the households contributed to 20% on the e-waste generated nationally [6] India scored 14% of e-waste generated from consumer electronics [27].

D. Disposal practices of consumer electronics

Results on the disposal methods of consumer electronics in households showed that the majority of participants indicated that they would give their unwanted devices to someone. (Table II).

TABLE II
CONSUMER ELECTRONICS DISPOSAL METHODS

Type of appliance	Second-hand shop	Informal waste collector	Dispose with household waste	Recycling company	Put on street	Give to someone	Sell to someone	Donate	Other
TV (CRT)	18.9%	9.4%	1.9%	32.1%		45.3%	17.0%	28.3%	5.7%
TV (flat screen)	25.0%	9.8%	2.7%	28.4%	2.7%	53.0%	26.0%	29.7%	2.7%
Radio	13.9%	13.9	6.6%	25.8%	1.3%	55.6%	16.6%	32.5%	2.0%
Stereo	22.2%	12.7%	4.0%	33.3%		54.0%	24.6%	31.0%	2.4%
DVD player	17.2%	12.2%	5.0%	31.1%	2.2%	55.0%	20.6%	32.8%	1.1%
VCR player	8.5%	13.6%	5.1%	39.0%		49.2%	10.2%	30.5%	
MP3 player	18.6%	18.6%	8.5%	32.2%	5.1%	54.2%	20.3%	28.8%	3.4%
Camera	19.8%	9.3%	5.3%	26.4%	0.9%	52.9%	26.0%	30.0%	3.1%
Game console	24.8%	4.3%	6.8%	20.5%		56.4%	32.5%	26.5%	4.3%
GPS	15.6%	11.5%	10.4%	26.0%	1.0%	55.2%	19.8%	24.0%	1.0%
Calculator	9.5%	12.1%	17.7%	21.2%		54.5%	10.8%	32.0%	2.2%
E-smoking device	14.0%	4.7%	37.2%	30.2%		27.9%	11.6%	9.3%	4.7%

Consumer electronics that 50% or more of respondents gave or will give away to someone were flat screen TVs, radios, stereos, DVD players, MP3 players, cameras, game consoles, GPS devices and calculators. Only VCR players (49.2%) and e-smoking devices (27.9%) recorded values below 50%. Other two disposal options favored by respondents were donating them or using a recycling company with a proportion lesser than 40% for each type of devices.

The practice of sharing e-waste was previously reported in a study conducted in Brazilian households where audio- and video devices were given to other users or charity organisations [28]. Cameras and LCD televisions were previously identified among the main discarded items in the households in India [26]. Similarly, a study conducted in Spain showed that 32.9% of the respondents were using recycling points to discard of electronic toys [29]. The disposal method of sending e-waste to recycling companies was also found in a study conducted in Jordan [30].

Rates lower than 30% were observed for five disposal methods, namely selling to a second-hand shop or to someone, giving it to an informal waste collector, discarding it with household waste or putting it out on the street. The practice of selling no longer needed or used devices is well documented in studies conducted in Ghana and Nepal [32]–[33].

IV. CONCLUSION

This study determined the ownership of consumer electronics and the volume of e-waste available in households in Gauteng. The results found a high penetration rate of consumer electronics with 88.2% of households showing ownership of one or more flat screen TVs. Even obsolete consumer electronics such as DVDs MP3 and VCR players were still available in households. The average number of consumer electronics categorised between those 'in use', 'not

working' and 'not needed' was 4.1 (± 2.3), 0.6 (± 1.1), 1.2 (± 1.8) respectively. The most preferred method of disposal of consumer electronics was to give it to someone, followed by donating it and selling it.

Therefore, a considerable volume of e-waste or potential e-waste is being stockpiled in households in Gauteng. With regard to the implementation of the Gauteng e-waste strategy, the study recommends an e-waste campaign to increase the awareness of households on what is e-waste and how to dispose of such items in a sustainable manner.

There are limitations in the study conducted and recommendations for further research are necessary. Firstly, the study is limited in geographical area and doing similar studies in other areas in South Africa can significantly contribute to the understanding of e-waste stockpiling and recycling participation. Secondly, more specific information is needed to determine who the 'someone' is most respondents are willing to give their e-waste to. With the evidence that stockpiling is taking place, further research must investigate what would be needed for households to make better use of these devices to be integrated in becoming part of the circular economy in South Africa.

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DATA AVAILABILITY STATEMENT

The data presented in this study are available from Thea Schoeman (theas@uj.ac.za).

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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