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To cite this article: F George *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **286** 012023

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Preliminary Study on Waste Electrical and Electronic Equipment (WEEE) Management by Households in the Kota Kinabalu City

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Abstract. The rising amount of e-waste can be attributed to many factors such as the advancement in technology, a variety of electric and electronic equipment (EEE) offered in the market, electric and electronic (EE) product becoming cheaper and exceedingly high demands. E-waste is believed to be mostly generated from domestic items because there is no systematic management of e-waste from households, particularly in many developing countries. The nonsystematic management will have an adverse impact on the environment and human. Therefore, this study attempts to uncover the current state of affairs involving e-waste management by households in Kota Kinabalu, Sabah. The objectives of this study are to identify the composition of electric and electronic equipment owned by households in the selected housing area and to evaluate the behavior of households in managing their e-waste. This study used a survey method using 100 sets of questionnaires which were distributed to respondents in the selected housing area. The results showed that mobile phones are dominating the category of electric and electronic equipment in the study area. In addition, most respondents do not adopt sustainable ewaste management such as recycling which is vital, as many prefer to store them at home or throw them to the rubbish bin. In conclusion, this study has shown that e-waste management scenarios in Kota Kinabalu are not particularly sustainable. The findings of this study can also lead to implication for creating awareness to stakeholders such as the City Hall of Kota Kinabalu and the Department of Environment so that both stakeholders could design a proper e-waste management system as part of an effort to create sustainable e-waste management.

1. Introduction

E-waste is an abbreviation of the electrical and electronic waste which refers to electric and electronic equipment (EEE) that has either reached the end of life or is still functioning but not required or discarded by the user. E-waste is also defined as an electrical and electronic (EE) product which cannot be used, repaired and reused, for example, equipment such as laptops, computers, cell phones, television, and others that have been disposed of by its users when they come to the end of their life [1]. The rising of e-waste is due to many factors such as increasingly advanced technology, an increased amount of EEE offered in the market, EEE is easy to be obtained due to its affordable price and the rapid growth of the consumer. At the same time, the lifespan of EEE has decreased causing EEE to reach the end of their life span quicker than before. Based on the Global E-Waste Monitor Report 2017, e-waste generation in 2016 has increased to 44.7 million metric tons or 6.1 kg per individual compared to, 5.8 kg per individual in 2014 [2]. E-waste generation in 2021 is estimated to increase to 52.2 million metric tons or 6.8 kg per individual. In Malaysia, the DOE estimated that the amount of ewaste would reach 1,119,155 million metric tons by 2020 [3,4].

In general, there are two sources of e-waste generated in Malaysia which are industrial and households wastes [5]. While Kalana [6] claims that e-waste comes from the industry, institutions, households, and smuggling. Hence, it can be concluded that the e-waste is generated from two sources,



namely industrial and non-industrial (households, institutions, shops, and smuggling) sources. The authority responsible for the management of e-waste in Malaysia is the Department of Environment (DOE). This is because e-waste contains hazardous substances listed in the Environmental Quality (Scheduled Waste) Act 2005 of the first table of SW110 Code. The DOE will only authorize licensed parties to perform the collection process up to the disposal of the items [7].

This study focuses on the generation of e-waste from the households. The generation of e-waste from households is increasing due to the lack of mechanisms or guidelines for e-waste disposal. A study by the Good Earth Consultant shows that the current amount of e-waste in Malaysia is still underdeveloped, which estimate the e-waste in 2009 is 700 000 tonnes, and the amount will increase from year to year based on estimation by the DOE [5]. These days, most of the e-waste is disposed of like other domestic waste that eventually will end up in landfills. This non-systematic management will have an adverse impact on the environment and also to humans as most e-waste contained heavy metals such as lead, mercury, cadmium and arsenic [8].

2. The Scope of E-Waste Management

According to Global E-Waste Monitor Report 2017, only 44 percent of the 61 countries have e-waste laws in 2014. This percent increased to 66 in 2017. Most countries with no e-waste laws are from Asia including Malaysia [2]. Discussion by Kalana [6] and Tiep et al. [5] pointed out that e-waste legislation in Malaysia is stated in the Environmental Quality (Scheduled Wastes) Act 2005 in the first table under the SW110 code. However, the current legislation only applies to the industry but not to households [5, 6, 7 and 9]. The harmful substances present in e-waste will be more dangerous when landfilled. E-waste at landfills site will cause soil, air and water pollution [10]. Grant et al. [13] stated that the hazardous material would then be exposed to humans in three ways such as respiratory, digestion and direct contact with the hazardous substances present in air, dust, water, food, and land.

A few studies have been conducted on e-waste management by households in Malaysia such as the study by Kalana [6] in Shah Alam, Selangor and Tiep et al. [5] in Melaka. The study in Shah Alam shows, households preferred to store unused or broken electric and electronic equipment instead of using the reuse and recycling methods. The findings indicated that 22 percent of the households sent their ewaste to the recycling centre while 48 percent stored their unused or broken electric and electronic equipment at home. Similar to the study in Melaka, proper e-waste management is not preferred by the household for only 10 percent of the households preferred the reuse and recycling methods. This study also shows that although the electrical and electronic equipment are still functioning well, households often have them replaced. This can be seen in the way the households treated unused TVs and PCs by giving them to friends and traded them in because they still function. Moreover, the second highest disposal method is to store the unused or broken electrical and electronic equipment while proper ewaste management is not the main choice by the households. Both of the studies showed no structured mechanisms to manage e-waste from households compared to e-waste generated by the industries. Contrary to the management of e-waste by households in Japan, they sent e-waste for recycling. Japan is well known for its proactive approach to electronics recycling when Japan implemented the Home Appliance Recycling Law (HARL) in April 2001 [15]. The HARL covers four major types of home appliances such as television, refrigerator, washing machine, and air conditioner. Ten years after Japan implemented the HARL, a review of the system was conducted. The evaluation showed that roughly 2/3 of the e-waste were collected and recycled, 1/3 of them were exported as used goods and as scrap metal [16]. It is clear that the Japanese government is committed to providing guidelines for reusing and recycling, to address the issue of illegal dumping and export of e-waste to countries outside of Japan.

Even India had implemented the e-waste law, but studies by Kwatra et al. [1] showed 74 percent of the population sold their non-working electrical and electronic equipment to Kabadiwala (junk dealers) while electrical and electronic equipment that were still in working condition were either they sold to friends, relatives or exchanged in various offered schemes. 10 percent of the e-waste ended up as

municipal waste, and 16 percent of the household kept the e-waste at home. Even though the 10 percent is a minute quantity, but e-waste are more hazardous compared to municipal solid waste, therefore, the percentages make a significant impact. This situation is similar to the studies conducted by Wang et al. [17]. They argued that even if this country had implemented the e-waste law, but the behavior of household towards e-waste management is an unsustainable method. These studies show that Chinese households sell their unused EEE because the norms among its people consider this kind of waste as tradable properties. Households sell their unused EEE to the peddlers; most literature showed that the peddlers disposed of the e-waste using improper methods that can cause environmental burden. E-waste policies and legislation play a fundamental role because they set standards and controls for e-waste management especially the management of e-waste. Despite legislation being in place, in Malaysia especially in Sabah, there is still a gap in the behavior of households in managing their ewaste. Thus, it is very important to understand how household in Kota Kinabalu manage their e-waste even if there is no guidelines or law to guide them.

3. Study Area

This preliminary study was conducted in Kota Kinabalu City. Kota Kinabalu City divided by four main areas namely Kota Kinabalu, Inanam and Telipok (figure 1). The sample was obtained from two residential areas in Kota Kinabalu namely Taman Kurnia Jaya and Taman Fajar. The 2010 census showed that the number of residents of Kota Kinabalu City is 452 058 [18]. The population of Kota Kinabalu comprised various ethnicities and races namely Bumiputera (70.4 per cent), Chinese (27.4 per cent), India (0.6 per cent) and others (1.6 per cent) and the population of Kota Kinabalu City is showing rapid growth.

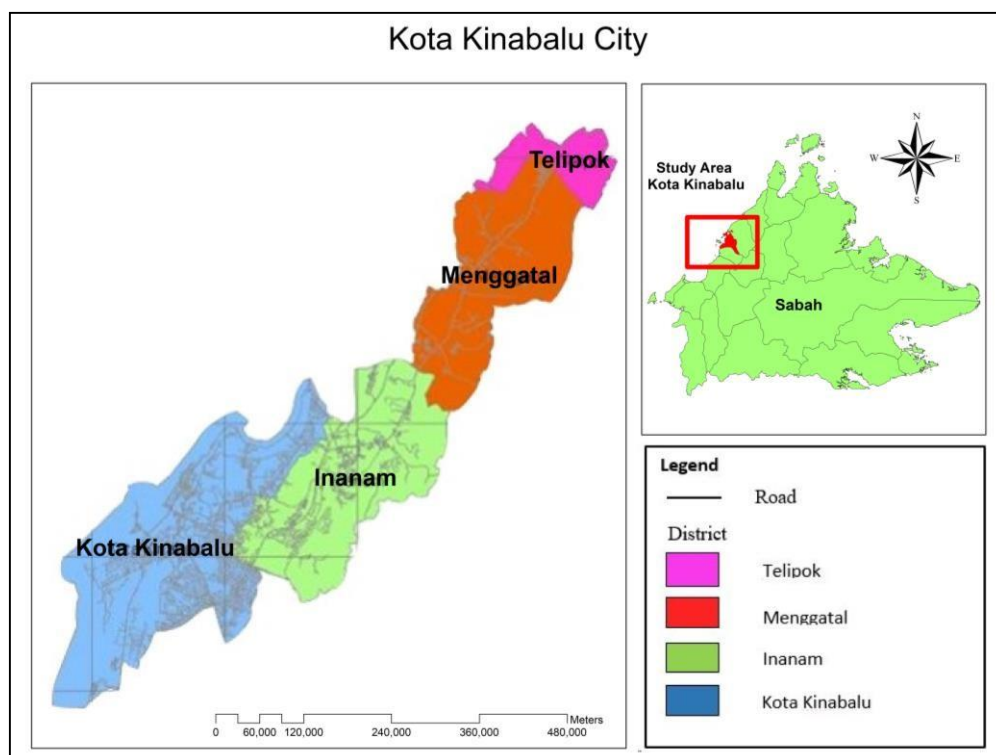


Figure 1. Map of Kota Kinabalu City by four district [19]

4. Research Method

Survey method is used to collect data for the study. The main instrument of this study is a questionnaire form distributed to 100 households. Schumacher & McMilan [20] stated that survey study, the number of suitable samples is about 100 respondents. The respondent of this study is limited to the head of the family either father or mother as they are responsible person in the house. The questionnaire used consists of four parts which comprise of; respondent's demographic profiles, household behaviour regarding e-waste management, knowledge and household awareness about e-waste and household's opinion on waste management of electronic.

5. Results and discussion

The educational background of the respondents indicated that 46 percent of the respondents have *Sijil Pelajaran Malaysia* (SPM) which they form the highest percentage of the studied population while the respondents who have no formal education are the lowest forming just 7 percent of the population. The education stage of UPSR, PMR, SPM and STPM can be in line with K3, K4, O level and A levels in the United Kingdom education system. The majority of the respondents have a monthly income of around RM 501 to RM 1500. However, 30 percent of the respondents have an income below than RM 500. The monthly income shows that the average respondent has a low monthly income. Only 14 percent of the sample has an income of RM 3501 - RM 4500, possibly because Taman Kurnia Jaya and Taman Fajar are low-cost housing. Table 1 shows the demographic background of the respondents.

Table 1. Demographic

Table 1: Demographic		
Background variables	Respondents (%)	Total (%)
Sex		
Man	51	100
Women	49	
Level of Education		
Malaysia (UK education system)		
UPSR (KS3)	9	100
PMR (KS4)	8	
SPM (O Level)	46	
STPM / DIPLOMA (A Level)	21	
Degree and above	9	
No formal education	7	
Monthly Income		
Below 500	30	100
RM 501 – RM 1500	41.8	
RM 1501 – RM 2500	14	
RM 3501 – RM 4500		

Figure 2 shows that mobile phones are owned by the majority of the respondents. Balde et al. [2] explained that mobile phones are among the most widely used equipment, and most individual would own more than one set of mobile phones. 99 percent of the respondents state that they owned television and refrigerator and while 93 percent of the respondents own washing machines. The study indicates that computer (desktop) is the least owned by the respondents (31 percent) as most of them prefer to use a laptop possibly because laptops are more convenient.

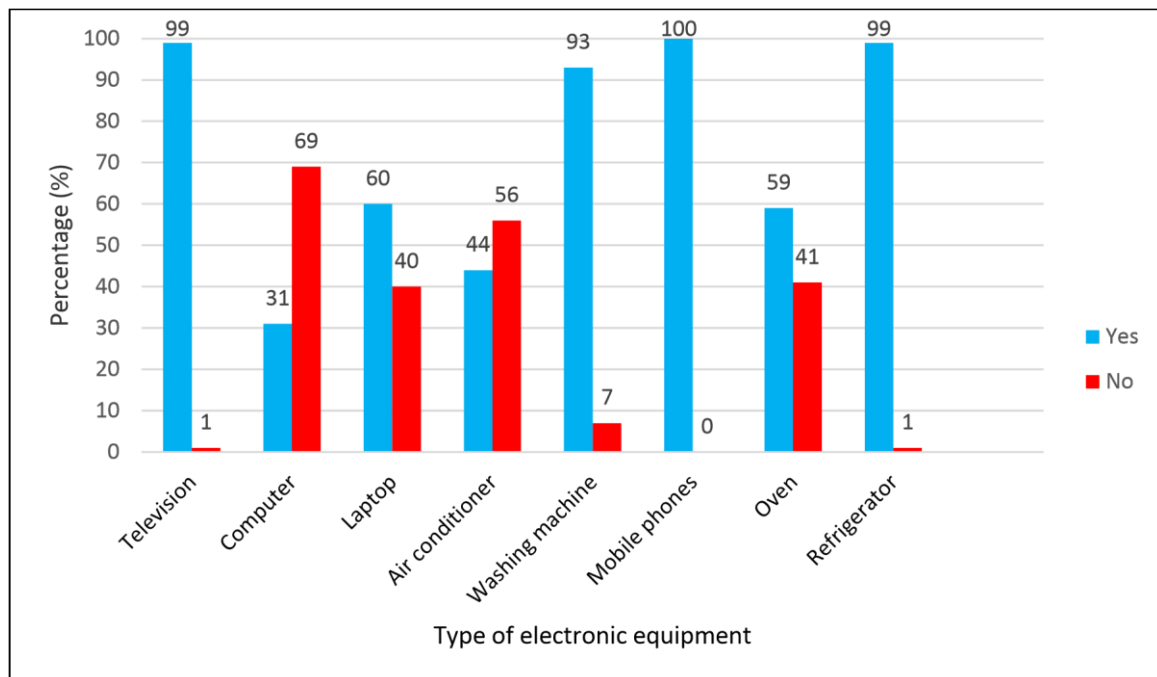


Figure 2. The composition of Electrical and Electronic Equipment owned by the respondents

Each electronic device has its different lifespan. Figure 3 shows the lifespan of electronic appliances by households. For television, washing machine, oven and refrigerator majority are expected to have a lifespan more than 7 years. However, oven and computer have a lifespan of 5 to 6 years. While laptop, air conditioner, and mobile phones are expected to be replaced within 3 to 4 years. The lifespan of electronic equipment determines the fate of e-waste after being purchased. Tiep et al. [5] state that the lifetime of electronic equipment is declining. Widmer et al. [22] has also pointed out that the lifespan of electronic equipment will decline for instant in 1997 the CPU's average life expectancy is between four to six years while in 2005 the average lifespan is reduced to two years.

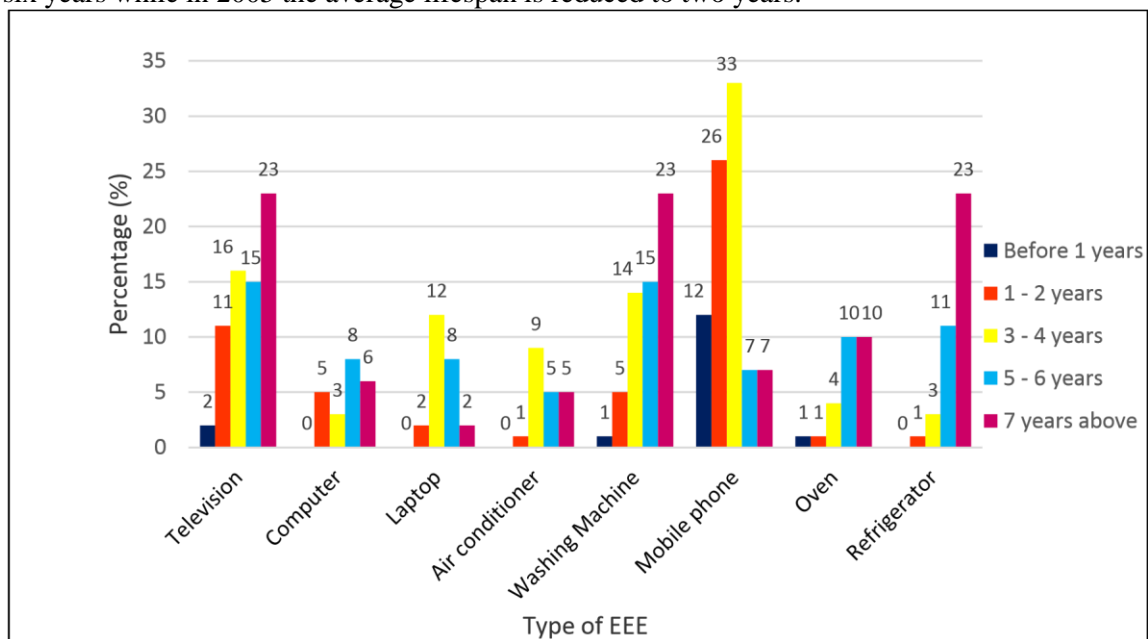


Figure 3. Replacement of Electrical and Electronic Equipment by the respondents

Figure 4 shows the reasons for replacement of the household equipment and the findings show that each electronic device is discarded due to different reasons; being replaced due to malfunction during use or end of life of electronic equipment are two most likely reasons given by the respondents. This study also revealed that even though most of the electrical and electronic equipment is still in good condition, the respondents admit that they prefer to buy new electronic equipment as most of the product are more advanced in features and design. In Figure 4, being outdated is mentioned as one of the reasons for the replacement of mobile phones. This result is supported by Oomman [21] who assert that the dominant reason for replacing mobile phones is due to the introduction of new models in the market with advanced features with lower price. The expensive cost of repairing electronic equipment is also the reason why the respondents switch to new equipment. This is because it is easier and inexpensive to buy new equipment than to repair. Table 2 shows an average price to repair different types of electronic equipment:

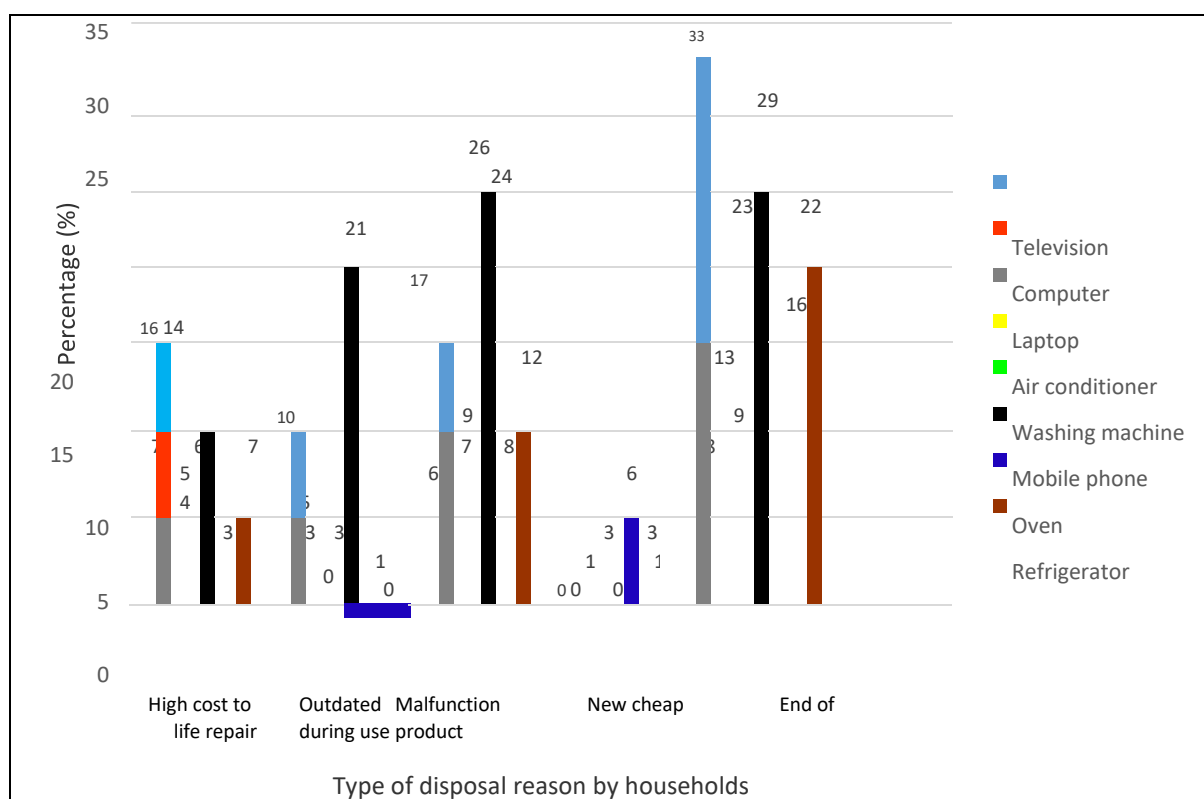


Figure 4. The reasons for the disposal of EEE by the households

Table 2. The average price for the repair of electronic equipment

Electronic Equipment	Price (RM)
Television	352
Computer	325
Laptop	289
Air conditioner	450
Washing machine	277
Mobile phone	185
Oven	250
Refrigerator	386

Figure 5 shows that the majority of the respondents prefer to store or dispose of electronic items directly to the trash bin. However, selling used electronic goods is less practised by the respondents although it can extend the lifespan of a product. The practice of bringing used electronics to the recycling centre is also less practised by the respondents. Wang et al. [23] explained that there are some reasons why households do not practice recycling. Among them include the fact that the households are not ready to engage in recycling, fewer recycling facilities, and complicated policies. It is acknowledged that Malaysia is currently facing the problems of the lack of recycling facilities and inadequate policy. This becomes a barrier to the recycling activities among its residents.

Placing electronic waste into the domestic waste bin is an unsustainable practice and can negatively affect the environment and human health. Keeping e-waste at home is likely to be profitable in the future, but most of it will end up in the domestic waste bin. The literature has also shown that most households keep their unused or broken EEE for years before reselling or discarding the equipment [5,6].

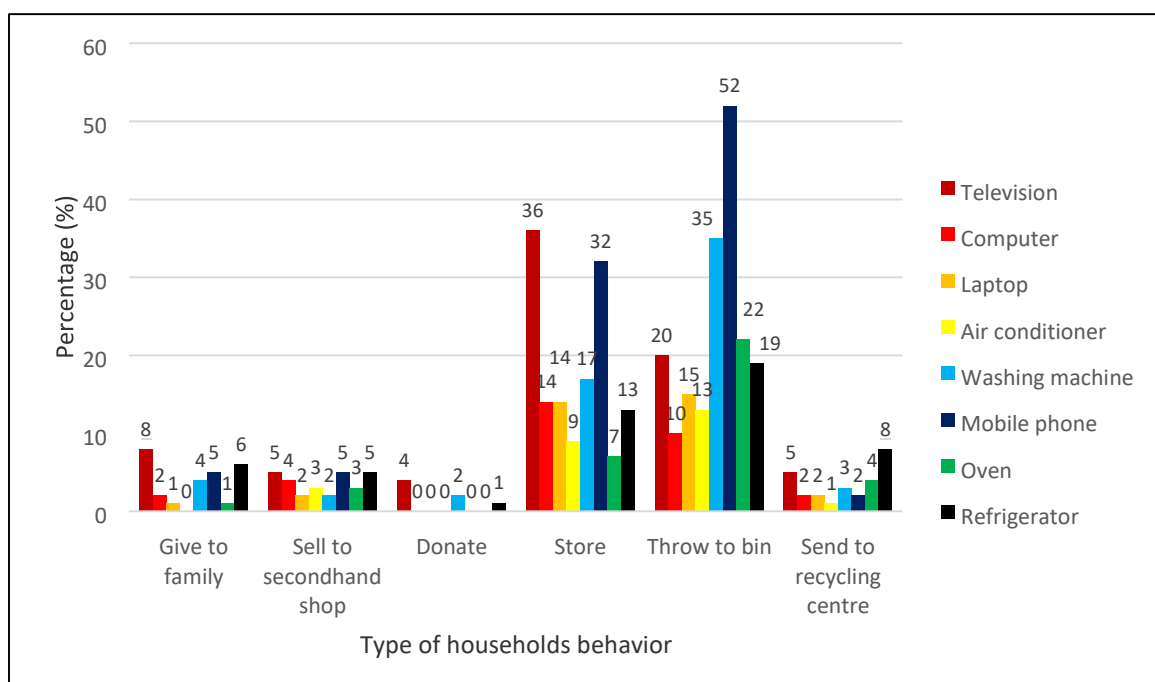


Figure 5. Households behavior toward e-waste management

6. Conclusion

The study able to gather information on the e-waste practices of households from the City Hall of Kota Kinabalu. Overall, the findings show that almost every electronic equipment is owned by the households. However, some electronic devices are expected to have a short lifespan of between 3 to 4 years. The storage and disposal of damaged electronic appliances along with other domestic waste are widely practised by the respondents.

The lack of laws or guidelines in managing e-waste in the residential areas is a major issue identified by the study. This situation will not motivate the households to recycle their electrical or electronic waste. Therefore, the government should form relevant regulations so that more electric and electronic waste can be recycled by the community. This study shows the necessity of laws or regulations as the amount of electrical and electronic products in the market is very significant. In addition, residents must also be exposed to proper disposal of electric and electronic waste. This can be established by providing awareness of the importance of disposing of e-waste systematically.

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