



Community Awareness and Willingness to Participate in Electronic Waste Management: A Case Study of the District Banjarsari, Surakarta

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Abstract - Hazardous and toxic waste is the residue of a business or activity containing hazardous and toxic materials which due to their nature and concentration or amount, either directly or indirectly pollute or damage and endanger the health of the environment. This study examines the awareness and willingness of the community in the management of electronic waste in Banjarsari District, Surakarta. The objectives of this study are: (i) Knowing the level of awareness of the people of Banjarsari District regarding electronic waste management; (ii) Knowing the level of willingness of the people of Banjarsari District to participate in electronic waste management; and (iii) Provide recommendations for electronic waste management in Banjarsari District. The research method uses a qualitative descriptive approach that prioritizes descriptive data, observations, and interpretations. The technique of collecting data is through primary data obtained from surveys or questionnaires to the people of Banjarsari District and secondary data derived from related literature. The results showed that the level of awareness and understanding of the electronic waste management of the people of Banjarsari District was quite good. The people of Banjarsari District have a high level of willingness to participate in waste management but are reluctant to incur additional costs due to economic and social problems. Recommendations are applied in the management in Banjarsari District by collecting, picking up electronic waste, and collaborating with third parties such as PT. Arah Environmental Indonesia.

Keywords - Community participation, Electronic waste, Hazardous and toxic waste, Waste management

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1. Introduction

Environmental pollution is the entry or inclusion of living things, substances, energy, and/or other components into the environment by human activities so that they exceed the established environmental quality standards (Law Number 32 of 2009). One of the pollutants is waste. Waste is residual material that is not reused originating from human activities, both from households, industry, and mining (Sunarsih, 2014). Based on the characteristics of the waste can be divided into four, namely: solid waste, liquid waste, gas or particulate waste, and hazardous and toxic waste (Nikalandi *et al.*, 2016). According to Government Regulation No. 74 of 2001 on Processing of Hazardous and Toxic Materials, hazardous and toxic waste is the residue of a business and/or activity containing hazardous and/or toxic materials which due to their nature and/or concentration and/or amount, either directly or indirectly, can pollute and/or damage the environment, and/or can

endanger the environment, health, survival of humans and other living creatures. Even though hazardous and toxic waste only has a small concentration in a substance, it will still be dangerous. Hazardous and toxic waste has a bad impact on health, namely, it can harm humans directly in the form of explosions, fires, and corrosives as well as indirect impacts in the form of acute and chronic toxins (Irawansyah *et al.*, 2019). One example of hazardous and toxic waste is electronic waste.

Electronic waste is electronic goods that are already in the final phase of use and will be replaced by new, more sophisticated, and quality goods (Nahor, 2019). Some electronic waste is found and just piled up in the surrounding environment and the amount of electronic waste is increasing. Examples of electronic waste are rice cookers, electric hair straighteners, thermos, dispensers, televisions, radios, laptops, refrigerators, cell phones, air conditioners, washing machines, and others (Pasha, 2015).

The amount of electronic waste piles globally is 20-50 tons per year which is equivalent to 1-3% of the world's waste (Nindyapuspa, 2018). This can cause electronic waste to become the fastest growing waste in the world and will increase by 3 to 5 percent annually (Schwarzer *et al.*, 2005). Electronic waste contains materials that are toxic and dangerous, therefore electronic waste requires special management to avoid harm to the environment and health. One of them is electronic waste containing carcinogenic substances that can cause cancer (Ayuni *et al.*, 2016). It can also irritate both the eyes and skin. One of the effects caused on the skin is dermatitis or seep into the skin, it can cause respiratory problems. In addition, it can also experience digestive problems, namely nausea, vomiting, and other nervous disorders. Other effects if exposed for too long can cause problems with the heart, kidneys, liver, central nervous system, eyes, and skin. (Hayuning and Sudarmaji, 2015).

These wastes that are simply dumped into the environment will cause harm to the environment and human health. Considering the risks caused by hazardous and toxic waste, especially electronic waste, management is needed (Bipinang, 2016). In Indonesia, electronic waste just keeps piling up. This is due to a lack of understanding to manage and utilize it. As a result, many owners of electronic waste just let the waste go, there are even owners of electronic services who burn the resulting electronic waste. This can cause pollution and damage the ecosystem (Puspita *et al.*, 2021). Moreover, the rate of population growth is increasing so that electronic waste is also increasing and becomes a big problem for the people of Indonesia. From 2014 to 2016 the rate of electronic waste generation has increased. This can happen due to the high level of public consumption of electronics and the tendency to make the latest models. The electronic waste recycling process is expensive, so many developed countries export to developing countries such as China, India, and Indonesia. The country will recycle to take precious metals (Aji, 2020).

Based on these problems, the author researched in Banjarsari District, Surakarta. The objectives of this study are as follows: (i) Knowing the level of awareness of the people of Banjarsari District regarding electronic waste management; (ii) Knowing the level of willingness of the people of Banjarsari District to participate in electronic waste management; and (iii) Provide recommendations for electronic waste management in Banjarsari District.

2. Materials and methods

The research is located in Banjarsari District, Surakarta City, Central Java. The research was conducted with a qualitative descriptive approach, namely research that prioritizes descriptive data such as observation and interpretation. The type of research carried out is case study research, namely research that is specifically aimed at studying a particular social unit intensively, through in-depth data mining and analysis of the social factors involved (Hardani *et al.*, 2020). Data collection techniques

through primary data and secondary data. Primary data were obtained through observation and surveys/questionnaires related to the knowledge of the people of Banjarsari District on electronic waste management. While secondary data comes from literature such as journals or books that support research. Data analysis was carried out from the facts obtained and then described in words to obtain conclusions so that they were easy to understand.

3. Results and discussion

3.1 Demographics and Socio-Economic Society of Banjarsari District

The results of the questionnaire given to the people of the Banjarsari District include:

3.1.1 Gender

Based on the results of the questionnaire, 40% of male respondents and 60% of female respondents were found.

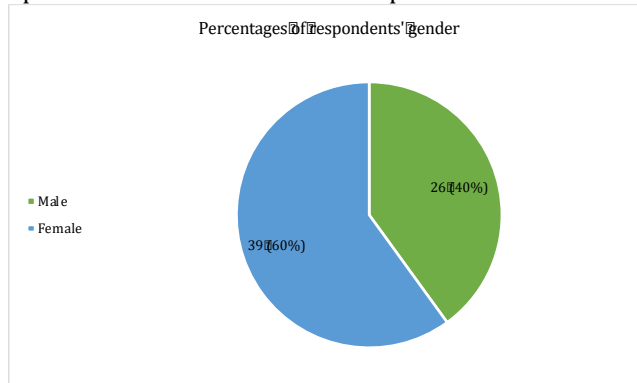


Figure 1. Diagram of Banjarsari District community's gender

3.1.2 Age Group

Based on age, 53.8% of respondents were aged 18-25 years, 41.5% of respondents were over 30 years old and the lowest 4.6% of respondents were between 26-30 years old. Respondents are at least 18 years old. We use this figure because according to Mauliday *et al.* (2018) adulthood usually starts from the age of 18 years to approximately 40 years and is marked by the completion of pubertal growth and the child's genital organs have developed and can reproduce. Adult age shows that there are forms of responsible actions and can carry out certain values, which in this context are related to electronic waste management.

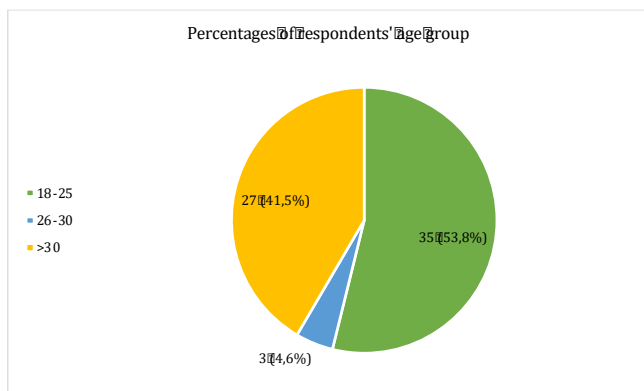


Figure 2. Diagram of Banjarsari District community's age group

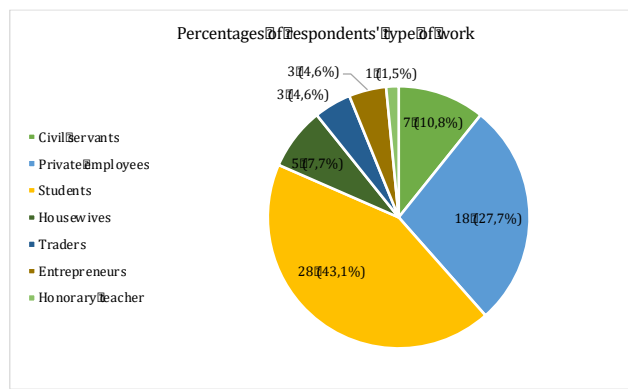


Figure 4. Diagram of Banjarsari District community's type of work

3.1.3 Education Level

Based on education level, 53.8% of respondents are D3/D4/S1/S2/S3 graduates, 41.5% of respondents are SMA/SMK/equivalent graduates and 4.6% of respondents are SMP/equivalent graduates. Education level has a positive effect on family attitudes towards household waste management. The higher level of education, the better attitude towards waste management, and the higher the family income, the higher the attitude towards managing household waste.

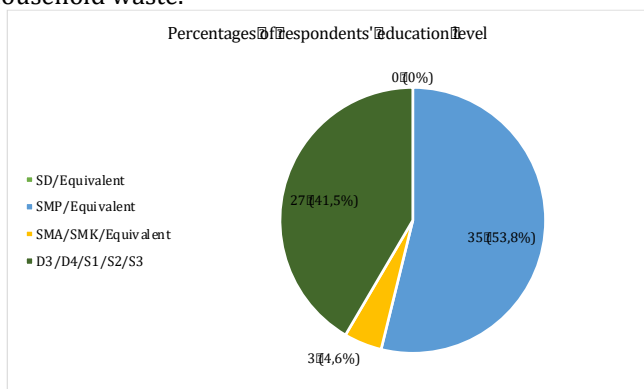


Figure 3. Diagram of Banjarsari District community's education level

3.1.4 Type of Work

Based on the results of the questionnaire, it was found that 43.1% of respondents were students, 27.7% worked as private employees, 10.8% worked as civil servants, 7.6% of respondents were housewives, 4.6% of respondents work as entrepreneurs, 4.6% work as traders, and 1.5% work as honorary teachers. The variety of existing jobs affects the amount of income of the respondents.

3.1.5 Total Income

Based on the results of the questionnaire, it was found that 41.5% earned less than IDR 1,000,000.00; as many as 23.1% earn between IDR 1,000,000.00 - IDR 2,499,000.00; 23.1% earn between IDR 2,500,000.00 - IDR 4,000,000.00; and 12.3% earn more than IDR 4,000,000.00. There is no relationship between family income and knowledge and management of electronic waste. Those with high incomes do not necessarily want to manage electronic waste properly.

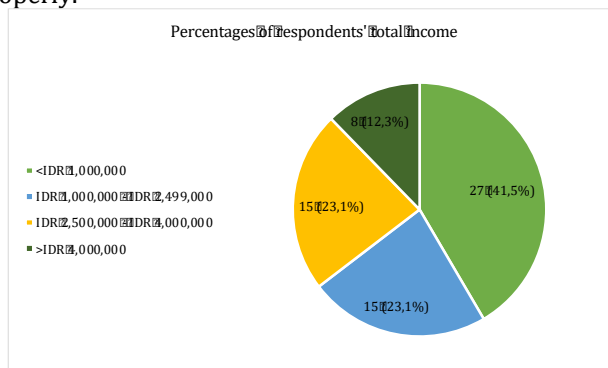


Figure 5. Diagram of Banjarsari District community's total income

3.1.6 Number of Family Members

Based on the results of the questionnaire, it was found that 60% of respondents had a family of 3-4 people, 27.7% had a family of 5-6 people, 10.8% had a family of 1-2 people, and 1.5% of respondents have a family of more than 6 people. The size of the number of family members affects the amount of electronic waste that exists. The amount of electronic waste in a large number of family members tends to be higher than in a few family members. There are only a few respondents with a large number of family members but little stored electronic waste.

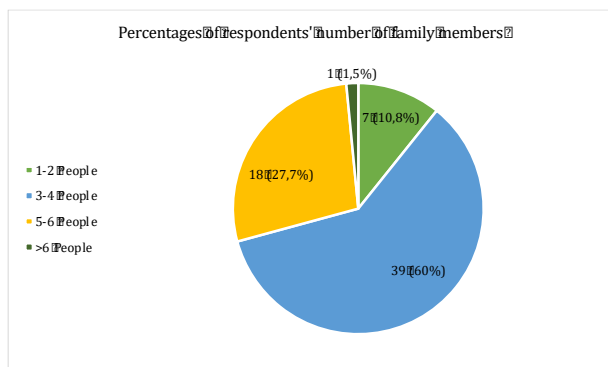


Figure 6. Diagram of Banjarsari District community's number of family members

3.2. Knowledge and Awareness of Electronic Waste in the Banjarsari District

3.2.1 Knowledge of Electronic Waste in the Community

Based on the results obtained, it was found that people who know about electronic waste including hazardous and toxic waste are 47.7% while people who do not know electronic waste including hazardous and toxic waste are 52.3%. This may be the cause of a large amount of electronic waste generation in households, which is presented in Figure 7. The data shows that the most respondents owned electronic waste is battery waste at 56.9% and followed by mobile phone waste at 50.8%. Although it takes up space, in general, people still feel reluctant to dispose of electronic waste.

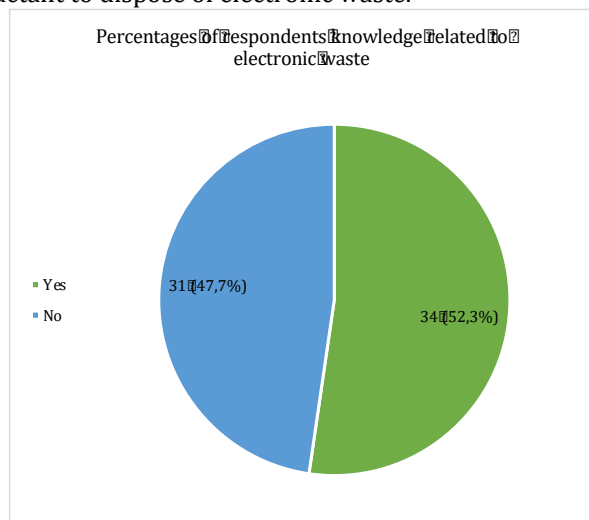


Figure 7. Diagram of community knowledge related to e-waste classified as hazardous and toxic waste

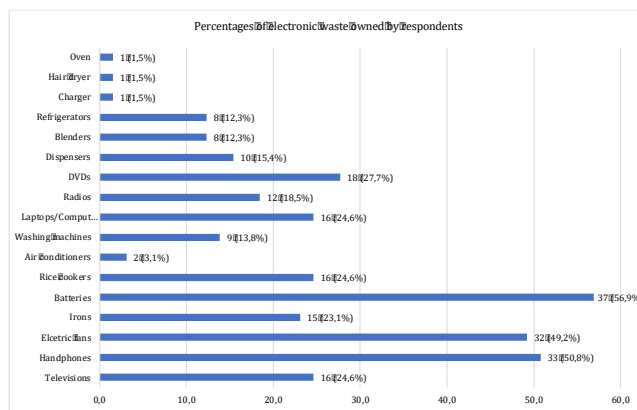


Figure 8. Diagram of electronic waste owned by respondents

3.2.2 Community Awareness of Electronic Waste

Figure 9 shows a diagram of the results of community understanding of electronic waste. Most of the people of Banjarsari District have understood about the special treatment of electronic waste before it is disposed of, the environmental hazards that can occur due to the disposal of electronic waste, hazardous substances in electronic waste, and most have also received education related to electronic waste. However, there are still many people who do not know the health risks that can be caused by electronic waste. Waste, in general, is bad for the environment and requires more attention in its management. This is what the public may already know about electronic waste.

Health hazards that may occur due to the presence of electronic waste include cellular phone waste which can produce environmental pollution, as has happened in developing countries, where large amounts of cellular phone waste are open burning. Heavy metals contained in electronic goods have characteristics that are difficult to decompose so that when these wastes increase, they can cause environmental damage. In addition to harming the environment, electronic waste can also harm human health, such as the presence of arsenic substances, to carcinogenic substances which, when in direct contact with the human body for a relatively long time, can cause dangerous diseases. Electronic waste contains about 1,000 materials, most of which are categorized as hazardous and toxic materials because they are hazardous and toxic elements such as heavy metals (mercury, lead, chromium, cadmium, arsenic, etc.), PVC, and brominated flame-retardants. Another heavy metal content in electronic waste that is commonly found on large flat panel displays or lamps is mercury (Hg) which is known to be toxic to humans and capable of damaging the brain's nervous system, as well as causing birth defects.

Figure 10 shows that there are still many respondents who have not received education about electronic waste, as many as 52.3%. The second highest result is education obtained through social media, which is 36.9%. The rest came from schools as much as 15.4%; public advertising services 7.7%; 3.1% workplace; and from the experience of

friends as much as 1.5%. Based on these results, it can be said that social media can be used as a good strategy in improving public education in electronic waste management. Especially in the digital era, where many platforms can be used to improve public education.

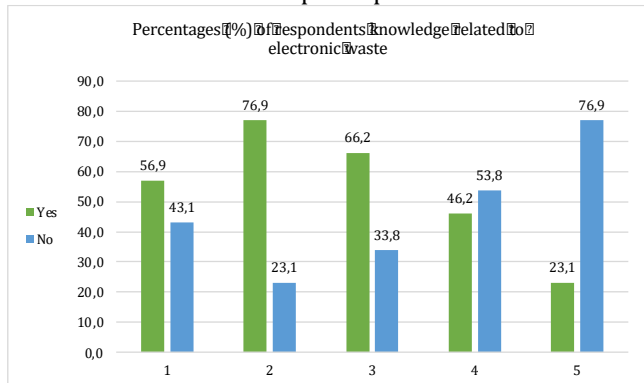


Figure 9. Diagram of community knowledge related to electronic waste treatment, impacts, contents, and management

Description:

1. Do you know that electronic waste requires special treatment before being disposed of?
2. Do you know that electronic waste disposal is harmful to the environment?
3. Do you know that electronic waste contains hazardous substances?
4. Do you know the health risks associated with electronic waste?
5. Have you received any education regarding electronic waste management?

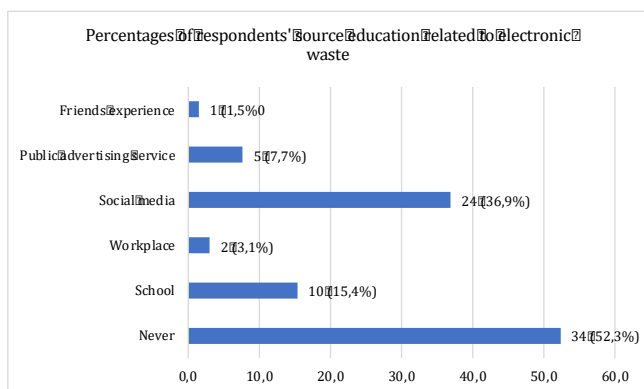


Figure 10. Diagram of community's source education related to electronic waste management

3.3 Banjarsari District Community Willingness to Participate in Electronic Waste Management

The results of the questionnaire on the District community's willingness Banjarsari to participate in electronic waste management are shown in Table 1 with the following three questions given.

Table 1. Community willingness to participate in electronic waste management

Questions	Yes	No
Are you willing to participate in electronic waste management?	52(80%)	13(20%)
Are you willing to pay if there is an electronic waste management program?	22(33.8%)	43(66.2%)
Do you need more socialization or education related to electronic waste management?	52(80%)	13(20%)

Based on the table above, 80% of the people of Banjarsari District are willing to participate in electronic waste management and the rest choose not to. As many as 66.2% of the public choose not to be willing to pay if there is an electronic waste management program and the rest are willing. As many as 80% of the people chose to need more socialization and education related to electronic waste management and the rest did not. It can be concluded that the people of Banjarsari District are willing to participate in electronic waste management and participate in socialization in electronic waste processing, but they are reluctant to incur costs due to economic and social problems in meeting the needs of daily life. Therefore, efforts are needed by the Surakarta city government and a third person to overcome these problems by conducting electronic waste management that is free of charge as has been done in several regions.

In Central Java, there are PT. Arah Environmental Indonesia (ARAH), which is one of the hazardous and toxic waste management companies that has a permit from the government to act as three of the five parties involved in the hazardous and toxic waste management process, namely as a transporter, collector, and processor of hazardous and toxic waste. In 2015, PT ARAH expanded its market to serve the general hazardous and toxic waste and electronic waste generating segment. The transported waste includes used batteries, used car batteries, used lamps, contaminant packaging, and electronic waste generated from health and commercial facilities such as offices and hotels, shopping centers, and industrial sites. This service is called ARAH Ecobox. With the ARAH Ecobox, ARAH services are more comprehensive and integrated under ARAH's goal of becoming a "one-stop-waste management solution". The related agencies also entrust the management of hazardous and toxic waste to ARAH, including the Sleman Environment Service, PT Rentokil Indonesia, PT Calmic Indonesia, PT Angkasa Pura Surakarta, and the Indonesian Institute of Sciences (LIPI) of the Special Region of Yogyakarta.



Figure 11. ARAH Ecobox service

Another example is the management of electronic waste in DKI Jakarta. The DKI Jakarta Government has provided electronic waste management services carried out by the DKI Jakarta Environmental Service by creating an electronic waste collection program, an electronic waste pick-up program, and socialization. In the electronic waste collection program, the waste is collected in every sub-district, then sent to the warehouse of the DKI Jakarta Environmental Service in Pulomas every week. In addition, the collection of electronic waste is also collected at the Adiwiyata Mandiri School before being sent to the sub-district. As for the electronic waste pick-up program, the people of DKI Jakarta can ask the Environment Service officer to come to their house to transport the electronic waste. This service is also free of charge, it is just that the electronic waste transported must have a minimum weight of 5 kilograms and fill out an online registration for electronic waste pick-up via DKI Jakarta Environmental Service website (<https://lingkunganhidup.jakarta.go.id/>).



Figure 12. Electronic waste collecting program by DKI Jakarta Environmental Service

3.4 Electronic Waste Processing Methods in the Banjarsari District Community

Time is growing, of course, causing the need for electronics to increase and there are various types as well. However, this is inversely proportional to the preparedness and anticipation of the community regarding the electronic waste that continues to be generated. Unfortunately,

electronic waste is not ordinary waste because it contains toxic and dangerous contents so that this waste is categorized as hazardous and toxic waste (Wahyono, 2013). Therefore, electronic waste needs to be managed properly, which is environmentally sustainable before being disposed of because it can endanger the lives of living things around it.

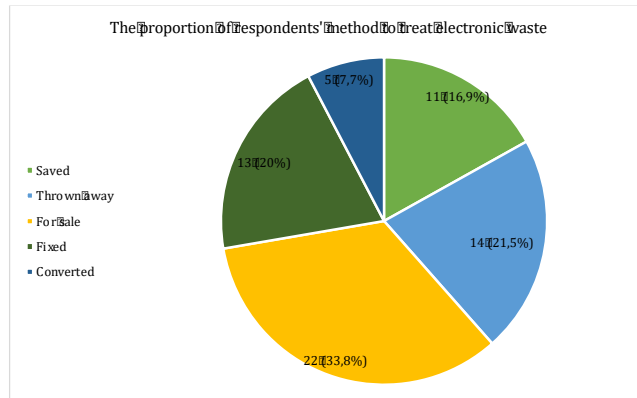


Figure 13. Diagram of electronic waste treatment methods by Banjarsari community

Based on the results of a questionnaire regarding the management of electronic waste in Banjarsari District, many of the 65 respondents chose to sell their unused electronic goods, which was 33.8%. Then 21.5% chose discarded, 20% chose repaired, 16.9% chose to keep, and 7.7% chose to be converted. Many people choose to sell their electronic waste because people's thinking about meeting the needs of life is higher by selling used goods to get money even though they get a low price (Salim, 2018). Furthermore, some people choose to dispose of their electronic waste because they think that instead of storing waste and filling their homes, it is better to dispose of it without thinking that electronic waste can be processed or converted so that it becomes useful in everyday life (Gustia et al., 2019). In the results of the questionnaire, on average, people who choose to dispose of electronic waste are people who still think that processing electronic waste is a complicated thing (Sekarningrum et al., 2020). 20% of people choose to repair electronic waste because some people still think that buying new electronic goods is more expensive than repairing damaged electronic goods. Problems like this have been studied by Widyarsana (2010) in a final project conducted by Rahmadani (2019) that very high components of electronic products cause the components to live longer or longer after the item is repaired. As many as 16.9% of people choose to store their electronic waste because there is a sense of reluctance to dispose of the waste. For example, if a broken fan is sold to a collector, it will only get a lower price than the price when buying a new fan. The rest of, people choose to convert the electronic waste because they think that the waste can still be used even though it is not following the original designation. For example, a used refrigerator that is not used is converted into a bookshelf.

In addition to the options for processing electronic waste items above, some respondents answered that they did not know or did not understand how to properly process electronic waste. This shows that public knowledge in Banjarsari District regarding electronic waste management is still lacking. Therefore, efforts are needed to overcome electronic waste, one of which is by learning from other countries that have implemented electronic waste management systems. For example, an unused keyboard was turned into a snake statue by a Korean artist named Choi Jung Hyun. However, some said that socialization or education is needed about the dangers of electronic waste and how to manage the electronic waste if it is left abandoned and mixed with ordinary waste.

3.5 Recommendations for Electronic Waste Management in Banjarsari District

The consumer's consumptive attitude towards the use of electronic goods has also led to an increase in the number of electronic goods desired and usually a short usage time. This has the potential to cause more and more electronic waste. Electronic waste is categorized as hazardous and toxic waste which contains hazardous and toxic materials with properties such as flammable, corrosive, and reactive. If this is allowed to enter the environment, it will disrupt the lives of living things, including human health (Rahim et al., 2018).

In a study conducted by Nahor (2019), examples of developed countries that already have their regulations for managing electronic waste are the United States, Australia, and Japan. The United States processes electronic waste in the Environmental Protecting Agency (EPA) with the number EPA-HQRCRA-2004-0012 namely Hazardous Waste Management System, Modification of the Hazardous Waste Program, Cathode Ray Tubes, and Final Rule. Australia treats electronic waste using the Product Stewardship (Television and Computer) Regulations in 2011. This regulation regulates the handling of computers and televisions but does not apply to computers manufactured in Australia. Japan regulates electronic waste management policies using two regulations, namely the Law for the Promotion of Effective Utilization of Resources (LPEUR) in 1998 which focuses on measures to increase recycling and minimize electronic waste. While the second regulation is the Law for the Recycling of Specified Kinds of Home Appliances (LRHA) in 2000 which imposes certain obligations related to the recycling of electronic waste that applies to manufacturers and consumers. In developed countries, electronic waste management has implemented regulations that prioritize environmental, social, and economic aspects.

Indonesia regulates hazardous and toxic waste management in Presidential Decree Number 61 of 1993, Decree of the Minister of Industry and Trade of the Republic of Indonesia Number 520/MPP/Kep/8/2003, Regulation of the Minister of Trade Number 756/MPP/Kep/11/2002, Law number 32 of 2009,

Government Regulation Number 74 of 2001, and Government Regulation Number 18 and 85 of 1999. However, in terms of electronic waste management, there are still no specific regulations. There are still many electronic waste recycling systems in Indonesia that are not environmentally friendly and are still conventional so that they can pollute the environment and also endanger human health. The Indonesian government should make regulations on the management of electronic waste specifically with due regard to environmental, social, and economic aspects. Electronic waste management can use the Extended Producer Responsibility (EPR) system. But, behind it all, the electronic waste management system can work if it has the support and participation of the community so that it requires socialization about the importance of managing electronic waste and education to increase public knowledge about the dangers of electronic waste if left alone, let alone mixed with non-hazardous and toxic waste.

The innovation to solve the problem of community participation and awareness in Banjarsari District on the importance of electronic waste management but does not incur costs is that the Surakarta City Environmental Service can follow the example of the DKI Jakarta Environmental Service to carry out programs for collecting electronic waste, picking up electronic waste, and socializing about those programs. In addition, the Surakarta City Environmental Service can also cooperate with PT. Arah Environmental Indonesia in the ARAH Ecobox service to manage electronic waste. For socialization and education efforts can be done through social media. This effort needs to be done considering the results of the questionnaire, which showed 36.9% of respondents received education on electronic waste management from social media. It is expected that socialization and education will be more effective, such as research conducted by Kapriani and Lubis (2014) that social media is effective in changing followers' behavior towards mangrove conservation. Even so, if the Surakarta City Environmental Service want to make efforts to manage electronic waste such as in DKI Jakarta, it is still necessary to directly disseminate and educate the public

4. Conclusion

Based on the results and discussion, it can be concluded that:

- (i) The people of Banjarsari District have a fairly good level of awareness of electronic waste management. This can be seen from a good level of understanding regarding special treatment before disposal, the environmental hazards caused, and the hazardous substances contained. However, there are still many people who do not know the health risks posed. A good level of awareness is supported by education related to electronic waste that some people have received.
- (ii) The people of Banjarsari District have a high level of willingness to participate in electronic waste

management and participate in socialization in electronic waste processing, which is 80%. However, they are reluctant to incur additional costs due to economic and social problems.

- (iii) Recommendations that can be applied in the management of electronic waste in Banjarsari District include conducting electronic waste collection programs, picking up electronic waste, and collaborating with third parties such as PT. Arah Environmental Indonesia in the ARAH Ecobox service. In addition, socialization and education are needed either directly or using social media related to electronic waste management.

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