

UDC 332

COMMUNITY PARTICIPATION IN INFORMATION TECHNOLOGY-BASED WASTE MANAGEMENT

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ABSTRACT

Waste management aims to improve public health and environmental quality and make waste a resource. This has legal consequences that the government is the authorized and responsible party in the field of waste management, although operationally its management can partner with business entities and waste organizations and community groups engaged in the waste sector. The City of Probolinggo has stipulated the Regional Regulation of the City of Probolinggo Number 5 of 2010 concerning Waste Management. Based on the Probolinggo City Regional Environmental Management Performance Information Report (IKPLHD) in 2019 from the population of Probolinggo City in 2019 of 238,012 people, the total waste generation reached 180,889 kg/day, an increase of 2.43% compared to 2018. Public awareness is not yet optimal in managing waste is one of the causes of 39.62% of waste that has not been handled properly. To answer this problem, the author took the initiative to innovate to engineer "Information Technology-Based Community Participation in Waste Management (Case Study of Smart Environment Development in Probolinggo City)" as an important issue in the implementation of regional development. With waste management in accordance with environmental rules, it is hoped that there will be harmonization of ecological, social and economic factors towards the realization of community welfare. Information Technology-Based Community Participation Development is a new step in Waste Management in Probolinggo City. Currently, there is only one embryo application in waste management developed by the Probolinggo City Government through the Environmental Service, namely SIEMAK KASRAKAS which was initiated in 2019. Currently, waste management in the Probolinggo community, especially in terms of reducing waste, has used the 3R (Reduce, Reuse and Recycle) and have an impact on ecological, educative, effective, efficient, economical and social institutions that deal with waste management problems in Probolinggo City.

KEY WORDS

Waste management, Information Technology, Community Participation

Waste management is a systematic, comprehensive, and sustainable activity that includes waste reduction and handling. Waste management is carried out based on the principle of responsibility, the principle of sustainability, the principle of benefit, the principle of justice, the principle of awareness, the principle of togetherness, the principle of safety, the principle of security, and the principle of economic value. Waste management aims to

improve public health and environmental quality and make waste a resource. This has legal consequences that the government is the authorized and responsible party in the field of waste management, although operationally its management can partner with business entities and waste organizations and community groups engaged in the waste sector. In carrying out the development of sustainable waste management, the importance of the participation of every citizen through a sustainable activity. Efforts to reduce waste production through reducing the rate of population growth are less effective. Effective reduction can be done through increasing community participation as the main source of waste (Yuliana and Haswindy, 2017).

One model of sustainable waste management is the use of information technology (Internet) in terms of waste services. Su (2013), stated that the emergence of Internet of Things (IoT) technology provides a new way to improve urban environmental monitoring and management. The Environment Internet of Things (IoT) makes it possible to sense, acquire, process, and transfer environmental information. Waste management problems based on the Probolinggo City Regional Environmental Management Performance Information Report (IKPLHD) in 2021 from the total population of Probolinggo City in 2021 which amounted to 241,202 people, the total waste generation reached 180,889 kg/day, an increase of 2.43% compared to 2020. Not yet optimal awareness community in managing waste is one of the causes of 39.62% of waste that has not been handled properly. The volume of waste increases from time to time and requires optimal handling so as not to have a negative impact. The Probolinggo City TPA with an area of 4 hectares is full and requires the development of new cells which are very expensive and prone to social problems because the location of the TPA is close to settlements. Therefore, the community needs to be involved with the 3R model of waste management (Reduce, Reuse, Recycle).

Smart city development requires top-down and bottom-up collaboration. The implementation of smart cities, especially in the smart environment aspect, greatly contributes to finding solutions to the waste problem by involving all parties to create a clean and sustainable environment. The smart city development in Probolinggo City refers to the Smart City Master Plan which has been stipulated by Probolinggo Mayor Regulation Number 177 of 2018 concerning the 2019-2023 Smart City Master Plan. A clean and comfortable environment for the community supports efforts to create a Smart City or Smart City, which is a city that is interconnected with a Green City, all aspects of life are interconnected and intelligent communities have sustainable ecosystem, environmental and social innovations. The Probolinggo City Government in carrying out its main tasks and functions seeks to realize the implementation of waste management through several models, one of which is sustainable environmental management, especially the development of information technology-based community participation in waste management in the city of Probolinggo.

THEORETICAL FRAMEWORK

Society Participation

The community's overall participation in waste management has thus far been restricted to disposal; it is not yet at the level of management where it can be reused. This situation shows that there is still a lack of public understanding of waste management, the community does not yet view waste as a resource, the community is not aware of the various regulations or guidelines in waste management, and the government tends to treat the community as an object in development rather than involving it in the waste management process (Yuliana et al., 2017). The community should be the focus of development in terms of planning, implementation, and supervision on the part of the government.

A person engages in community activities outside of work by joining social groups and participating in them (Makhmudi and Muktiali, 2018). A development program requires community involvement since the effectiveness of the program depends on the community's involvement in its administration. Additionally, community engagement entails community involvement in the development planning process, beginning with problem analysis, solution consideration, confidence building, and independent decision-making regarding potential

solutions. In developed nations, community involvement is frequently employed as a successful method of decision-making, public project implementation, and governance (Xie et al., 2017). Karianga (2011) offers the following 10 justifications for the significance of participation:

- Participation can help you produce more at work;
- With the assistance of services, low-cost services may be offered;
- Because it affects their self-esteem, participation has a fundamental value that is very important to participants;
- Participation serves as a stimulus for growth;
- Engagement fosters a sense of accountability;
- Participation ensures that a community need has been addressed;
- By participating, you may be sure that the work will be done correctly;
- The community's knowledge is gathered and used through participation, resulting in a combination of different areas of expertise;
- People who participate are no longer dependent on the knowledge of others;
- Participation increases awareness of the causes of poverty and the measures being made to combat them.

Community Participation in Using Information Technology for Community-Based Waste Management

One method for creating a smart city is to use the internet for garbage management. The internet may now be used for more than just communication; it can also be used to connect objects using sensors to build an automated system known as the Internet of Things (IoT). According to Bello & Zeadally, 2017, implementing IoT is a successful strategy for public services like garbage management. Through their research, Kim et al. (2017) shown that integrating IoT technology into trash management will ultimately lead to cost savings. This is consistent with SWM's mission to implement efficient and integrated waste management while minimizing its damaging effects on the environment.

According to Santoso (2010), an innovative government is one that supports, encourages, and institutionalizes novel ways of handling public interests. In such structure, there are components of society, individuals, and citizens as well as components of the government. The interaction between the two is what really powers the system. In other words, modern innovation stresses creativity or intelligence, but this creativity or intelligence is the nature of the political system, not just the leadership. A government can also be regarded to be creative if it contains 10 innovative government indicators as input and 20 innovative government output indicators, according to the results of theoretical benchmarking from the Global Innovation Index and the Government Innovation Index in South Korea (LAN, 2016). The ten indicators are: a commitment to change, a vision for innovation, rewards for innovators, policies that support innovation, human resource capacity for innovation, concern for human resource capacity for innovation, development of innovation resources, budget support, CSR optimization for supporting innovation, and use of IT (information technology) in work systems.

According to Dwiyanto (2015), public bureaucracy must exhibit high modernism. The advanced development and application of information and communication technology in administrative work processes is one of the traits of modernity. Information and communication technology utilization is a requirement that must be carried out by local governments in waste management activities. Utilizing information and communication technology is one strategy to address the growingly complicated waste issues we face today. Information and communication technology innovations in waste management are thought to be more effective and efficient, as well as having the potential to cut costs and time. It is possible to save and combine all databases and waste management-related information properly. According to Sa'diyah et al., (2020), this innovation will make it simple for garbage owners to collect waste so that managers may appropriately handle it. Additionally, it can

promote a sense of accountability for environmental protection and appropriate waste management.

Information Technology Use in Community-Based Waste Management

If employees in the organization can use the technology correctly, it can be used efficiently. As a result, it is crucial for organization members to comprehend and anticipate the system's utility. By comprehending the variables that can impact the usage of information technology, one can better understand how it is used. Waste owners will find it simpler to collect waste thanks to information technology so that the manager can appropriately treat it. Additionally, it can promote a sense of accountability for environmental protection and appropriate waste management. The way this information technology operates, according to Sa'diyah et al., (2020), is that the waste owner enters his waste information, which is then sent to the admin for information and input. Following that, the rubbish will be analyzed, collected, and the administrator will be paid. To make this program a reality, it will take the participation of many different parties, including local governments, business actors, communities, colleges, and individuals. Information technology can be used to establish a system that integrates waste managers and waste owners in particular, as well as a tool that facilitates waste management, particularly the management of paper and plastic trash.

As a result, a system for waste management that incorporates technology will be created. If this is done correctly, waste owners and garbage collectors will work together to manage waste effectively. The growth of information technology has spawned a new way of life called as "e-life," which denotes a manner of living where different requirements are met electronically from the beginning to the conclusion. There are many terminology that are currently in use that are based on electronics, including e-commerce, e-government, e-education, e-library, e-journal, e-medicine, e-laboratory, and e-biodiversity. The community must meet the requirement of adequate information and communication technologies in order to offer the most benefits.

According to Lee et al. (2014), the infrastructure for information technology is crucial in promoting economic growth. Information technology platforms like personal computers, mobile devices, the internet, databases, and others play a significant role in the company. The three contributions made by information technology platforms, according to Piatkowski (2003), that have an effect on organizational performance are: (1) providing feasibility in business aspects; (2) providing more accurate, reliable, and up-to-date information; and (3) providing solutions to common issues faced by businesses in their daily operations. One can easily follow the evolution.

METHODS OF RESEARCH

This study employs a qualitative research methodology, whereby a team of researchers in the field of social sciences, including environmental sciences, frequently use and carry out qualitative research as a scientific method. The goal of qualitative research is to increase knowledge by discovering and comprehending the world more thoroughly. Because qualitative research is holistic (holistic), it sees the subject or object of the study as a dynamic thing that is the product of the formation of ideas and interpretations of the occurrences that are being observed (Hermawan, 2019).

Its goal is to develop and design strategies to increase community participation in waste management in order to create a sustainable smart environment. The research is phenomenological in nature and uses waste management information technology engineering that involves human resources and community behavior. This study was done to find out how society is doing right now in terms of waste management, information technology use, and community involvement. Finding out the actual and anticipated conditions of community participation in waste management using information technology is a benefit of this research that goes beyond addressing the objectives (a case study of the development of a smart environment in the city of Probolinggo).

In order to understand the Waste Management issue from the perspectives of socioeconomic, educational, and ecological interests in the City of Probolinggo's development of a smart environment, it is vital to understand:

- The City of Probolinggo's human resources and operational waste management operations;
- Probolinggo City's residents' attitudes toward and support for waste management initiatives;
- The city's handling of waste management issues.

Informants served as the study's data sources. The informant's position enables them to respond to the researcher's questions. Archives are later data, documents, or formal records that may be written materials or other types of recordkeeping. The information used in this study was gathered through interviews with waste managers, community leaders, stakeholders, and members of the waste management community. Participatory Rapid Appraisal is the information gathering technique used in this study to operationally observe the evolution of technology-based waste management (PRA).

RESULTS AND DISCUSSION

Identifying the Needs for Information Technology-Based Community Waste Management Participation

One of the locations with present waste management issues is Probolinggo City. Giving the local community the tools to manage waste through waste banks is one method of waste management. In Probolinggo City, data on trash banks are typically managed manually using just records kept in books and not yet information technology. The need for paper as a data storage medium, the ease with which data can be lost, and the lengthier time required for data administration all pose issues with manual management. Additionally, the absence of an integrated data center makes it challenging for each sub-district to oversee the waste banks placed in the kelurahan units.

A web-based waste bank information system (SIMBASA), which can make it simpler for waste bank officers to manage existing data while customers can perform checking savings more quickly and accurately, is required in light of the emergence of issues in the management of waste banks in Probolinggo City. A web-based information system will also make it simpler for the sub-district to monitor and track the development of the waste bank units within the sub-district, allowing for more seamless management between waste banks.

Information Technology Use for Community-Based Waste Management

According to Government Regulation of the Republic of Indonesia Number 38 of 2017 concerning Regional Innovation, the City Government of Probolinggo has innovated by using information technology to manage waste in a more professional manner. This innovation can be considered a regional innovation because it represents a form of renewal in the way regional government is run. The Probolinggo City Government can implement a waste management innovation integrating online information technology for waste management in the neighborhood, commencing with the urban village or Community Self-Help Groups (KSM). SIEMAK (Waste Management Education Information System), which was started in 2019, is the sole experimental waste management app currently being developed by the Probolinggo City Government under the Environment Agency.

The Smart Environment dimension is being implemented in the establishment of high schools in Probolinggo City with this application. The Smart City Master Plan, which has been mandated by Probolinggo Mayor Regulation Number 177 of 2018 about the 2019–2023 Smart City Master Plan, is what is being developed in Probolinggo City. The community's efforts to build a smart city benefit from a clean and comfortable environment. A smart city is a city connected to a green city, where all facets of life are interrelated and intelligent communities have sustainable ecosystems, environmental innovations, and social innovations. In addition to the use of information technology, community involvement is a crucial component in urban solid waste management. In order to reduce garbage at the

source, separate waste at the household, and reuse waste that can still be used, community cooperation in waste management is crucial.

According to Dewanti et al. (2019), the service model that involves taking and waiting for the deposit of waste segregation results has lost its effectiveness and needs to be followed up with a more professional waste management plan utilizing information technology. According to numerous research studies, both internal and external causes, as well as the community's engagement in waste management, all have an impact. Sukerti et al., (2017) claim that internal elements are linked to personal traits including age, type of employment, resources, education level, awareness of the value of waste management, motivation, income, and level of comprehension. Government involvement, the availability of facilities, socialization, and local norms are among the external elements that have an impact on community participation in garbage management.

- Internal Factors:

In addition to many potential advantages, information technology (IT) development can also result in issues. Particularly on the Internet, the spread of uncontrollable information has made it easier to access unhelpful and immoral material (Rusydi, 2017). As a result, user ethics preparation is also necessary. The best defense against attacks from useless knowledge is ethics that are instilled in the user's soul. In order to anticipate a growth in the amount of urban garbage, which keeps rising owing to an increase in population, the pattern of waste management by incorporating the community as an actor who can actively contribute to reducing the volume of waste is the proper choice. According to Nugraha et al. (2018), the community or individual can begin playing an active role in waste management by engaging in positive behaviors including collecting, storing, sorting, and recycling waste to lessen its volume and dispersion.

- External Factors:

The Regional Government will have much easier time controlling garbage in the future if the public is informed of how to manage their waste from the beginning. The rapid pace of technological advancement necessitates innovation across all industries, including government bureaucracy (Yuliana et al., 2017). This situation shows that there is still a lack of public awareness of waste management, that waste is not yet seen as a resource, that the community has not been informed of the various rules or guidelines in waste management, and that the government prefers to treat the community as an object in development rather than involving it in the waste management process. Information and communication technologies are also able to make it easier for the government and its bureaucracy to make informed judgments. By employing information and communication technology and involving the community, it is possible to overcome the lack of information that has been a barrier to making wise judgments.

The outcomes of a meeting between the Office of Communication and Information (KOMINFO), the Department of Environment (DLH), and the Probolinggo City waste managers as government partners provided information about the garbage problem that needed to be addressed from the ground up. Building a landfill, waste bank, 3R facility, or waste power plant alone does not complete the task of waste management. By acquiring the chosen waste, the breakthrough using the online trash was accomplished. Trash in communities, including organic and inorganic waste, must be sorted.

Identification of the need for the development of information technology-based community participation in waste management

The use of information technology in waste management operations is crucial to improving ICT human resource capabilities. Starting with skills and knowledge, planning, operation, maintenance, and supervision, as well as improving ICT capabilities, the end result will be output that is extremely beneficial for people as individuals as well as for all areas of life, including waste management. This calls for government action, in this case from the City Government of Probolinggo through the Office of Communication and Information working in tandem with the Office of the Environment to create a mobile application that

combines informational features, educational content, and waste management services in an effort to reduce waste issues in Probolinggo.

With this application, it is intended to integrate, synchronize, and synergistically disseminate programs, activities, and information on waste management to the community via an Android-based application in Probolinggo City. In light of the aforementioned issues, a supporting tool such as an application is required to support the management of waste in Probolinggo City and to be able to rapidly, effectively, and efficiently disseminate information relevant to waste management. SIEMAK (Management Information and Education System) KASRAKAS is the name of the application that will be made available; it is an online network of android-based apps that integrates information, education, and waste management services in Probolinggo City and is open to the general public. The SIEMAK Application Procurement activity's goal is to equip Probolinggo City with a waste management supporting tool based on information technology. While the goals of the intended activities are to:

- Inform DLH about solid waste management programs and activities;
- Offer users educational material in the form of games and quizzes related to solid waste education;
- Provide the most recent information on waste management;
- Provide Probolinggo Municipal Solid Waste Data;
- Manage cash registers; and
- Tag areas (TPS and garbage banks);

The SIEMAK KASRAKAS program is described as being web-based; any updated content will be shown in the banner portion, and we may view detailed content by selecting & clicking on the banner image; The News, Infographics, Video & Management menu will appear in the program once the banner has been displayed if we scroll down; We click or select a news headline to view the news, after which the news details emerge; Choose the infographic's title, then click the infographic's desired image to get a detailed version. For the graphical info detail page display, please use the following; Click on the desired video title to view the most recent waste-related video information; Go to the management menu and choose the content title to examine the Probolinggo City DLH work program. The following is for showing article details on the management menu: A Game & Report menu can be found in the footer section. Select the Report option, fill out the list of fields that is supplied, then click Send Message to submit a report about fallen trees or other items.

CONCLUSION

Researchers found that waste management in accordance with environmental principles is expected to harmonize ecological, social, and economic factors in order to realize community welfare. This finding is based on research on information technology-based community participation engineering innovations in waste management as a smart environment development in Probolinggo City. Environmental and economic benefits have resulted from increased public understanding of appropriate conduct and support for trash management initiatives in Probolinggo City. The content of SIEMAK KASRAKAS, an application system that connects waste managers and producers of household waste, must be updated in order to meet user needs. The use of information technology faces challenges during implementation that could become barriers in information technology-based waste management. These challenges include the need for quite high costs for the development and upkeep of technology systems, human resources for upkeep and operation of the internet, and slow internet connections that result in slow data transmission and discourage businesses from using the internet for waste management. Based on the findings of this study, it is hoped that in terms of management, commitment will be required between the City Government of Probolinggo, in this case the Department of the Environment (DLH), and the community to carry out waste management tasks in order to create clean, healthy, and comfortable environmental conditions in accordance with environmental regulations.

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