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MORALITY BEFORE KNOWLEDGE

Empowering waste recycling through technology: A case study of the octopus social movement

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ABSTRACT

Background: Garbage is a serious problem that can have a negative impact on the environment and its surroundings, the large amount of waste produced in Bekasi reaches 6 million tons per year, making West Java one of the provinces with the most waste generation in 2022. This has become one of the triggers for the Octopus initiative in engage in social movements in the environmental field. Octopus is present in a new social movement by launching and developing a digital-based recycling waste management application. Based on these problems, this research is aimed at analyzing the Octopus social movement in managing recycled waste in the era of society 5.0. **Methods**: Based on these problems, this research is aimed at analyzing the Octopus social movement in managing recycled waste in the era of society 5.0. The method used is descriptive method with a qualitative approach. **Findings:** The results of the study explained that the new social movement carried out by Octopus was fairly effective, this was shown in the number of Octopus application users reaching nearly 200 thousand users spread across Jakarta, South Tangerang, Bandung, Bali and Makassar including Bekasi. This application also works with more than 1,700 unit waste banks and 14,600 scavengers who have been trained to become conservationists. **Conclusion**: Using applications is an effective alternative to mobilize people to be aware of environmental problems, especially waste issues. **Novelty/Originality of this article:** The novelty in this research is the use of technology used by Octopus in organizing the community

KEYWORDS: octopus; recycled waste; social movement.

1. Introduction

According to Giddens, social movements are efforts to pursue common interests or achieve common goals through collective action outside the scope of established institutions (Mustikawati, 2022). In general, social movements arise due to dissatisfaction with a social issue. Ultimately, people choose to form groups with a single goal and a shared vision and mission (Amalia, 2019). Social movements consist of several areas, including health movements, education movements, and environmental movements. Regarding environmental movements, one of the driving factors is people's indifference to the environment, which is littered with trash, especially plastic waste. Plastic is a material that is easy to produce and durable (Cox, 2010). However, its durability can be a problem for humans because it is not easily decomposed. It can take 200-300 years to decompose.

Wardani et al. (2020) research focuses on raising awareness about waste management by utilizing the 4 R principles: reduce, reuse, recycle, and replant. The research results indicate an increase in awareness regarding waste utilization among community members.

This approach can also reduce environmental pollution through effective waste management practices. Barat-Auleda & Domènech (2022) highlight the use of the Anti-Incineration Platform Cercs (PAIC) as a response to a waste incinerator project in Catalonia, Spain. This community platform aims to influence local policy and increase public participation, particularly on the importance of community involvement in waste management decisions. Research results show that these activities effectively influence local and regional politics. The platform also highlights the need for broader public participation in administration (Setiadi et al., 2020; Sabri, 2019).

The community's paradigm regarding waste is indeed very concerning. Generally, waste is disposed of by throwing it away, burning it, and worse, dumping it into waterways such as sewers and rivers. This will have a worse impact on the environment in the future. The waste produced is seen as something of no value at all and will eventually be discarded. To break this misconception, the community should be educated so that they can change the way they manage waste in the future. This should be done by using community-based waste management principles, namely: Reduce, Reuse, and Recycle (Handana, 2022).
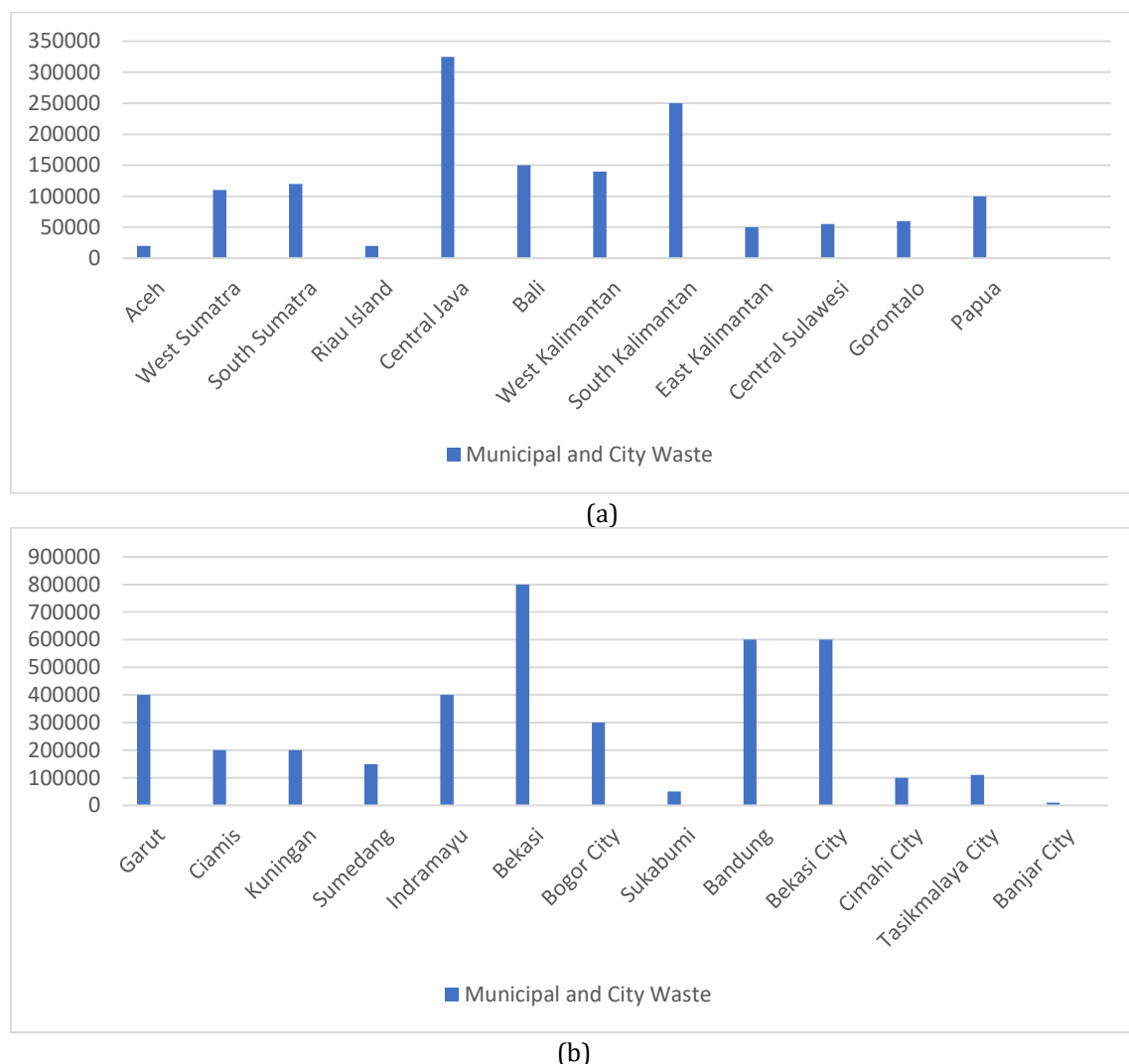

(a)

(b)

Fig. 1. National waste generation data in Indonesia

This concern has arisen because Indonesia itself has serious social problems with recycling waste management. The amount of waste in Indonesia is increasing every year, and this can have a negative impact on health and the environment. In fact, the Ministry of Environment and Forestry has recorded that the amount of waste in Indonesia reached 1,373,182.24 million tons in 2022. The amount of waste in West Java, as recorded by the Ministry of Environment and Forestry (KLHK), has increased annually, reaching 668,179.00

million tons in 2022. This makes it one of the provinces with the highest waste production in that year, ranking fourth after East Java, Jakarta, and Central Java (Andreswari, 2022).

Based on Fig. 1b., the city and regency of Bekasi are among the areas with the most concerning waste generation. Every day, the Burangkeng Landfill located in Bantar Gebang, Bekasi Regency, receives 1.8 tons of waste. The Ministry of Environment and Forestry records that waste generation in Bekasi Regency/City reaches 6 million tons per year. The majority of waste generated comes from households. Based on its source, household waste contributes the most to national waste generation, accounting for 63.54%. The next largest source of waste comes from commerce, with a percentage of 4.87%. Markets contribute 13.68% to national waste (Fig. 3)
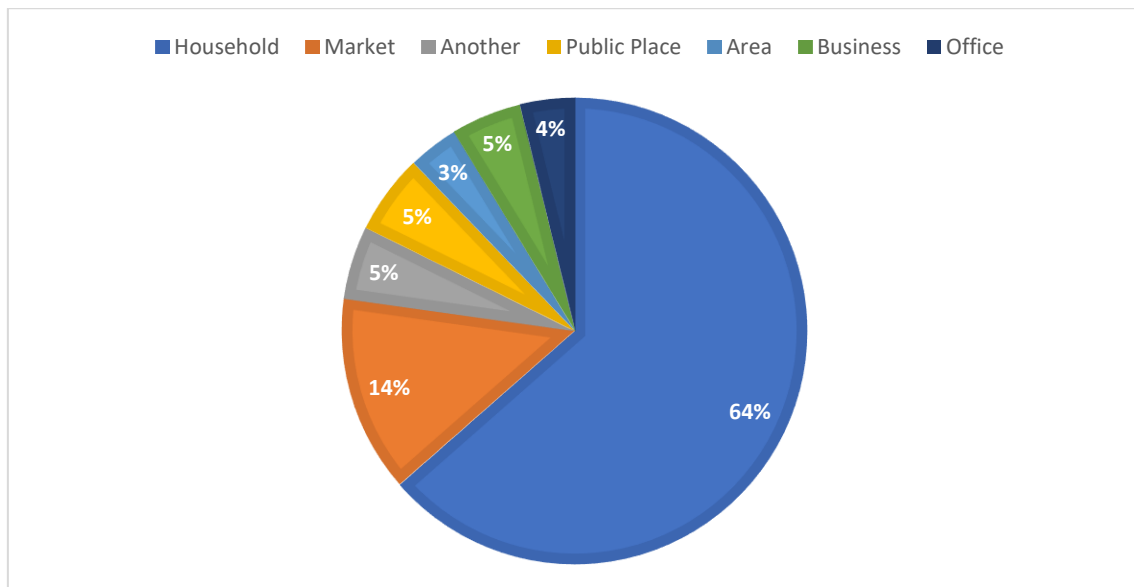

Fig. 2. Composition of national waste sources

Given the increasing amount of waste generated, the emergence of social movements contributing to its management is particularly noteworthy. One such initiative is Octopus. This is an environmental movement focused on waste management through recycling, utilizing technology. The approach involves an application designed to facilitate proper waste processing.

Hamish Daud, one of the co-founders of Octopus, stated that the app is a homegrown innovation designed to help sort, collect, and manage household waste. According to his explanation, the app was created to address the issue of post-consumption waste that leads to excessive waste accumulation in households, which could otherwise be wasted if not properly utilized. In the Octopus app, users can send used packaging to be recycled into products with resale value. Octopus also provides a pickup service for post-consumption packaging through its app. Additionally, Octopus offers data useful for the FMCG (Fast-Moving Consumer Goods) industry and provides solutions for the packaging industry.

Octopus also ensures that the quality of the waste received is well maintained and easy to recycle. There are several interesting things about this application, one of which is that users of the application can not only contribute to preserving the environment, but also benefit from the waste they collect. Based on this description, this article provides a more in-depth explanation of the implementation of the Octopus application in waste management.

1.1 Social movement

A social movement is a social activity in the form of a similar movement or action by a group of individuals who are part of an informal organization, large in number. Or individuals who specifically focus on social or political issues by implementing, rejecting, or

campaigning for social change (Islamudin, 2022). In its early stages of development, the social movement was referred to as the Old Social Movement, characterized by: 1) Structural nature, 2) Ideological orientation, 3) Public recognition (Ramlah, 2022). At that time, social movements were defined as "collective enterprises to establish a new order of life" according to Herbert Blumer in (Rizky, 2022).

According to Achwan, there are two types of social movements: old social movements and new social movements (Rizky, 2022). Old social movements focus more on economic concerns, while new social movements focus more on symbolic issues, identity, culture, the environment, and other related issues. New social movements, or New Social Movements (NSMs), are considered "soft" transformations of old social movements that emerged as a result of civil society trends when people were busy discussing public issues on social media but were unable to realize their issues while becoming a public agenda (Rizky, 2022).

The most prominent feature of old social movements is their systematic collective actions within institutions with the aim of radically changing public policy. Other features include social movements with interactive mechanisms among political actors who tend to work in the political sector with the aim of creating changes in the distribution of social justice (Ramlah, 2022). Rajendra Singh in (Wahyudin, 2018) when presenting the development of theoretical studies on social movements attempted to group them into three perspectives, namely: first, the classical perspective on social movements encompasses most studies on collective behavior in crowds, riots, and rebel groups, primarily conducted by Western social psychologists before the 1950s. Second, associated with the main tradition in studies of Old Social Movements. Generally, writings from the neo-classical tradition were published after the 1950s. Third, associated with the era of New Social Movements. This study emerged to study societies in America and Europe in the 1960s and 1970s, when large-scale movements arose around fundamental issues in society, covering several aspects, namely humanist, cultural, and non-materialistic.

Anthony Giddens explains that social movements can be seen as collective efforts to achieve common interests. They can also be understood as efforts to achieve common goals through collective action. In practice, they seek to position themselves as non-governmental movements. Metta Spencer, like Giddens, explains that social movements are collective efforts to bring about change and a new way of life. Spencer outlines the main characteristics of social movements in relation to joint efforts aimed at bringing about change from the current order to a better way of life (Wahyudin, 2022).

1.2 New social movements

New social movements are characterized by various social movement actors dominated by a broad-based civil society, creating a perspective between academics and agents of change (Ramlah, 2022). The transition from this social movement perspective has given rise to more modern theories, such as the theory of political opportunity structure, including complaint theory, framing process, resource mobility structure, and contentious politics. In practice, various movements have emerged worldwide, including the civil rights movement in America, the farmers' movement, the women's movement, and the environmental movement (Ramlah, 2022).

The New Social Movement Theory is relevant because new social movements focus on cultural change and problem solving. In this study, the author uses the New Social Movement Theory because the social movements that are developing today are new social movements. The focus is no longer on changing the state, but on changing society and how these movements are able to solve problems within society. Social movements in waste management have been carried out by the Occupy Movement, which strategically manages waste by building sanitation infrastructure, promoting cleanliness as a form of citizenship, and using waste rhetoric to challenge unfair systems, demonstrating their commitment to a better world while opposing the narrative of chaos imposed by the authorities (Liboiron, 2012). According to Pichardo in Adilah (2022), the characteristics of new social movements have four aspects, including: goals and ideology, tactics, structure, and participation.

First, goals and ideology, the central characteristic of New Social Movements (NSMs) is their differing ideological perspectives. The NSM paradigm focuses more on describing decisions made by movements in the industrial era. Rather than focusing solely on economic distribution (like the working-class movement), the new social movement emphasizes attention to quality of life and lifestyle. Second, tactics, the tactics of the new social movement reflect the orientation of an ideology. Beliefs and characteristics that do not represent modern democracy are consistent with an anti-institutional tactical orientation. GSB prefers to remain outside normal political channels, using disruptive tactics and mobilizing public opinion to gain widespread public influence. Third, structutr, the anti-institutional stance and the New Social Movement have also extended to the way they organize their movement within society. The New Social Movement seeks to replicate within its own structure the type of government representation it desires. The structures they build are generally idealistic and alternative in style. Fourth, participation, the view of participation in the New Social Movement is that it is not defined by class but is characterized by a general concern for social issues developing within society. The basis for participation in the New Social Movement is ideology, not ethnicity, religion, or class-based communities.

The New Social Movement is a theoretical concept about the New Social Movement using groups (organizations) as the unit of analysis. Member involvement is also considered but with certain limitations. Therefore, the author uses this theory because the social movement carried out by Octopus in managing recycled waste toward the Society 5.0 era is considered relevant in using the New Social Movement. In the New Social Movement, there is a sort of life cycle: it is created, grows, achieves success or failure, sometimes dissolves, and stops or ceases to exist (Wahyudin, 2022).

Thalia (2022) identified a new waste management movement using the "FantasticWaste" movement through the Setorplastik.com platform. This movement not only increases public awareness of waste but also develops the Waste Bank in Samarinda City, East Kalimantan. This new social movement maximizes resources in providing rewards and using a price catalog for each type of waste, while non-material resources include social networks and mutually beneficial partnerships. Khan et al. (2022) used the design and development of waste identification and severity ranking mechanisms. They utilized geographic information systems (GIS) and mobile applications for solid waste management.

1.3 Stages of the new social movement

According to Macionis (Wahyudin, 2022), the concept of social movements can be divided into several parts, namely four stages of the social movement process, which consist of: first, emergence, at this stage, social movements are driven by the spread of issues and a perception that things are not going well, resulting in widespread dissatisfaction among the public. Second, the coalescence stage, where the social movement's objectives are clear and it must be able to make the issue accepted and spread throughout society. This stage is marked by action to develop strategies on how their movement can be conveyed to the public. In this stage, there is also action to attract media coverage and public attention, as well as the possibility of alliances with certain groups to form large-scale alliances with common interests to optimize the necessary resources. Third, bureaucratization Stage: At this stage, a social movement becomes established both organizationally and in terms of its implementation system. Fourth, the social movement no longer depends on individual leaders but only refers to a system that is capable of driving the organization, regardless of who the leader is. This stage is marked by the stability of the routine actions they will carry out; and ffth the outcome or Decline Stage, which is the final stage of a social movement. There are five reasons why a social movement experiences decline, several of which are: the social movement has achieved its goals, there are internal conflicts within the organization, it experiences pressure/repression from external parties; and the movement has become institutionalized so that there are no more challenges from the status quo group.

1.4 Recycling waste management

The solution to the waste problem that is commonly used is the 3R method, but now the community is beginning to recognize a more complex method of waste management called 5R according to (Kristianto, 2022), which consists of: reduce, which involves minimizing waste generation by maximizing efforts to minimize activities that produce new waste. The concept of reduce can be implemented by minimizing the use of items with a limited lifespan. This approach helps slow down the daily rate of waste generation. Reuse, which involves using used items again without altering their biological or chemical properties. This allows items to serve various functions over a longer period of time. Recycle (recycling) is an activity to reuse items through additional processes. It can also be done indirectly by separating used items that still have value. The concept of recycling is quite familiar. This can be done by processing organic waste into fertilizer and inorganic waste into various other forms. Replace, is an effort aimed at reducing waste. This is done by replacing items that have the potential to become waste with other items that have a longer lifespan and utility. The goal is to reduce the creation of new waste after the activity is carried out. Activities included in the replace concept include replacing plastic bags with shopping bags so that no new waste is generated from daily activities. Replanting is an activity carried out by utilizing existing plants for cultivation with the aim of saving expenses or generating economic value.

Waste recycling management needs to involve the community, as stated by (Nanda et al., 2024), where community involvement in waste management is necessary to reduce social conflicts. Effective waste management practices can foster healthy, peaceful, and safe communities, highlighting the role of social movements in addressing waste-related issues. Social movements in waste management require civil mobilization to influence solid waste management policies. Additionally, they aim to change food consumption patterns that impact waste generation and disposal (Lutringer & Randeria, 2017). Other studies on waste management and recycling that emphasize community involvement include (Teodósio et al., 2015), (Banerjee & Anand, 2021), (Yoshida, 2020), (Ismail, 2019), (Leonard, 2011), (Has-Yun Hashim et al., 2017), (Perry et al., 2010).

2. Methods

The research method used in this study is a descriptive method with a qualitative approach. This study emphasizes the explanation of data in oral and written form, as well as a deep understanding of phenomena or events from the social setting related to the focus of the research problem. Data collection techniques were carried out through direct observation. In this case, the author acted as a participant, hence the term participant observation (Mekarisce, 2020). In addition to observation, data collection was also carried out through interviews and documentation.

The observation was carried out by observing the management of recycled waste by visiting several nearby Octopoints in Bekasi, such as in East Bekasi (Octopoint Coster), West Bekasi (Octopoint Darling), and South Bekasi (Octopoint Palem Raya). The observation was carried out together with a conservationist named Angger Berliana to find out the waste sorting process there and to deliver the waste that the author had collected from several users. Meanwhile, interviews were conducted with key informants (Expansion Associates) and three other informants, namely two Octopoint managers, one conservationist, and one conventional waste bank manager using a semi-structured interview method.

3. Results and Discussion

The research results focus on Octopus' efforts to communicate social movements in managing recyclable waste. Octopus has formed local scavengers and waste bank managers to work together in managing recyclable household waste. Octopus transforms scavengers

working in cities to join and become conservationists. Similarly, Octopus partners with waste bank managers to become Octopoints. Activities related to recycling waste management on the Octopus app include educating the public about waste segregation both directly and on social media. Furthermore, it involves waste pickers and environmental activists to become Conservationists and waste bank managers to become Octopus partners, namely Octopoints. It also encourages local residents to use the Octopus app as Octopus users.

3.1 Octopus social movement in managing recyclable waste

In the era of society 5.0, local communities are required to solve and adapt to various social challenges and problems by utilizing various innovations born in the era of the Industrial Revolution 4.0, such as the Internet of Things (internet for everything) and Artificial Intelligence (artificial intelligence). As digital technology advances in the Society 5.0 era, Octopus offers a solution for communities and governments to recycle waste with just one click, using the Octopus app. This social movement operates in the field of recycling waste management by leveraging a digital app that is easily accessible to the public. This social movement is part of the New Social Movement.

Based on Martin's New Social Movement theory, there are changes in societal culture and solutions to environmental issues. This is reinforced by the authors' field findings on the Octopus social movement, which is developing by prioritizing the renewal of the recycling waste management system with the integration of digital technology. The New Social Movement no longer focuses on changing the state but on changing society and how the movement can address issues within society itself. And that is what the research team confirmed is present in the social movement initiated by Octopus.

The social movement carried out by Octopus is considered effective in managing recycling waste in the digital era, as Octopus already has nearly 200,000 users spread across Jakarta, Tangerang, Bekasi, Bogor, Bandung, Bali, and Makassar. The Octopus app also collaborates with over 1,700 Waste Banks and 14,600 waste pickers who have been trained as conservationists. Octopus is a platform that makes it easy for users to recycle non-organic waste through its app. So far, Octopus has launched three apps as part of its social movement: Octopus Mitra for Octopoint users, Octopus Collector specifically for conservationists, and Octopus for general users.
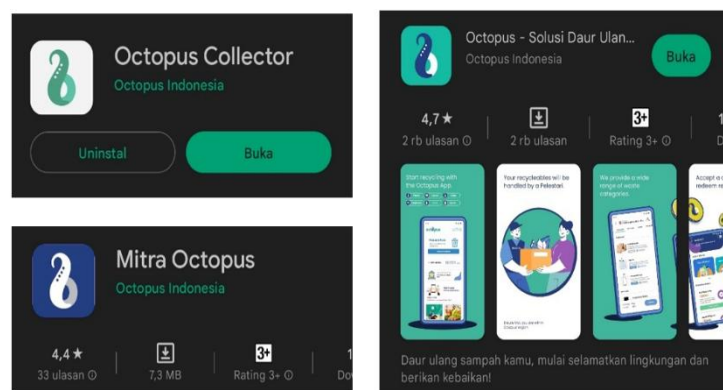

Fig. 3. Octopus app

The Octopus app can be easily downloaded from the Play Store. Users are required to register as users before using the app. After registering as a user, the Octopus app can be used to schedule waste pickup for recycling. As explained by Angger Berliana Despy, an Octopus conservationist, using the Octopus app to schedule waste pickup from each user's home is very convenient. Users no longer need to go through the hassle of expending a lot of effort and costs; simply sorting and cleaning their waste at home is sufficient to contribute to waste recycling management.

"With waste collection from each household, users can relax completely, as we no longer need to go through the hassle. We just need to check the waste around us or our personal waste at home, see what we have collected, and then simply open the app. We enter the app, input the types of waste we want to order, and the next day, Pelestari will collect it. It's very easy, and even better, we don't need to pay any collection fees—just use our own smartphones." (ABD)*.*

This is as explained by Absoro Sarwoko, the Manager of Octopoint and the Waste Bank in West Bekasi. AS explained that Pelestari is responsible for collecting users' waste. Once Pelestari has completed the collection, they will transport the waste to the nearest Octopoint. AS explained that Octopoint also records data through the Octopus app, which serves as an archive for future reference when Octopus needs it. The Octopoint manager will contact the Octopus central office to arrange for waste pickup at the Octopoint. Here is an overview of how Pelestari collects waste and delivers it to the Octopoint.

Fig. 4. Pelestari collecting user waste

3.2 Octopus recycling waste management

In waste management, Octopus coordinates with the Bekasi City Environment Agency (DLH) and the Patriot Main Waste Bank (BSIP), which is the coordinator of the Waste Bank Unit (BSU) located in the Bekasi area. Furthermore, the BSU works together as a partner of Octopus, known as Octopoint. Octopus collaborates with the DLH to identify BSU in the Bekasi area that can be designated as Octopoints. This is done to ensure that Octopus's reach to the community is effective through the nearest BSU. As of the time of this study, there are four BSU that have become partners: Bekasi Timur (Octopoint Coster), Bekasi Barat (Octopoint Darling), Bekasi Selatan (Octopoint Palem Raya Indah), and Bekasi Barat. Technically, once a BSU becomes an Octopoint, waste collectors can send the waste previously collected from Octopus users to the Central Warehouse, which is then sent to a local recycling plant. The waste management process is as follows (Fig. 5).

Based on Figure 5, the waste management process through the Octopus app is as follows: first, users of the Octopus app sort and clean the waste. After that, the waste is recorded according to its quality and quantity. Then, the user uses the Octopus app to schedule a pickup, and the Waste Collector comes the next day to collect the waste. Second, the Waste Collector picks up and weighs the waste at the user's location, while also checking the quality, segregation, and quantity of the waste. Pelestari will scan the barcode so that the user can earn points. Additionally, Pelestari will provide education to the user regarding waste sorting to improve future recycling waste collection. Third, octopoint conducts a final inspection of the waste brought by Pelestari. This is done to ensure that the waste to be recycled meets the specified criteria. Fourth, affter being sorted and deemed suitable, the waste is stored in the Octopus warehouse before undergoing the final waste processing to be recycled and turned into useful products.
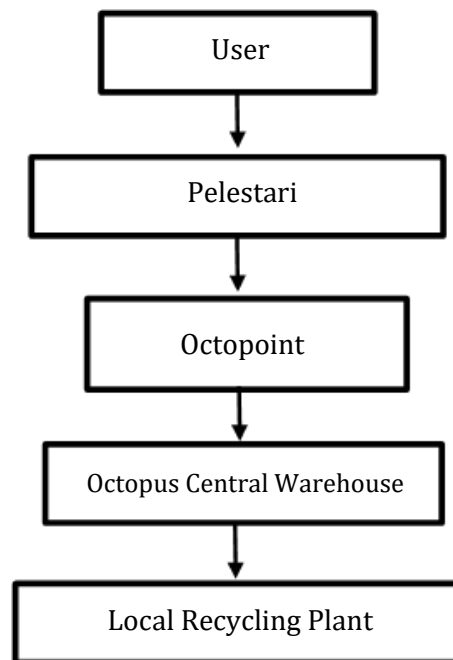
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Fig. 5. Octopus recycling waste management process

3.3 Stages of the octopus social movement in managing recyclable waste

According to Macions' theory (Wahyudin, 2022), the concept of social movements is divided into several parts, namely four stages of the social movement process, which consist of several stages, including: Emergence Stage, Coalescence Stage, Bureaucratization Stage, and Decline Stage. Octopus began its social movement as an agent of environmental change by focusing on environmental issues that apply a technology-based recycling waste management system. First emergence, octopus emerged and became a start-up industry when a young man born on December 8, 1992, in Maros, South Sulawesi, had a dream to simplify the waste collection chain. Musawwir Muhtar is one of the finalists of the Recoupling Awards who successfully received the Young Global Changers Recoupling Awards 2022. He received this prestigious award that captured global attention at the Global Solutions Conference held in Berlin, the capital city of Germany, on March 28-29, 2022.

Recoupling, or linking economic activities with social welfare and environmental concerns, is a concept that is currently being widely discussed. Musawwir Muhtar represents Octopus Indonesia. Through this app, Musawwir and his team aim to simplify the waste collection chain from users to ultimately enable recycling by waste recycling industries. Musawwir hopes that household users can earn extra income from recycling their waste. Additionally, waste pickers can also receive more decent income than before. In 2019, Musawwir and four of his colleagues met in Makassar and designated the capital city of South Sulawesi Province as a pilot project.

Makassar produces a significant amount of waste daily, totaling 1,200 tons, with 40% of it being plastic waste, most of which originates from household waste. There, Musawwir and his four colleagues conducted in-depth and intensive interviews with waste pickers in the area, as well as with waste collectors. Based on the interviews conducted by Musawwir and his team in the field, information was obtained about the supply chain between waste pickers and the recycling industry. This process is quite lengthy. In terms of income, it is also quite low because waste pickers must sell their recyclable waste to small collectors, then to medium-sized collectors, and finally to large collectors before they can sell it to the recycling industry. There are several lengthy processes, so the scavengers have no choice but to sell their recycled waste at a small profit.

Not to mention that the scavengers' safety is exposed to dangerous things because they work directly at the landfill. They also sort waste with makeshift equipment. Since then,

Musawwir has implemented the concept that if they simplify the recycling waste management process by eliminating the existing supply chain factors, it will be appealing. Musawwir explained that he has involved and embraced the waste pickers and collectors to maximize profits from the simpler process.

Second, coalescence, early January 2020, Musawwir and his team conducted a pilot project in Makassar, inviting the community to test their product. Octopus explored various approaches, such as a redemption system. The results of Musawwir and his team's efforts received a positive response from the community, leading to the development of the Octopus app. Users who recycle can call Pelestari to collect their waste and receive points that can be converted into cash or shopping vouchers. This system creates a mutually beneficial economic cycle between users, Pelestari, and Octopoint managers.

Third, Bureaucratization, the Octopus app already has over 100,000 users across four provinces, including South Sulawesi, Bali, West Java, and Jakarta. The cities include Makassar, Bandung, Bekasi, Bogor, Denpasar, Tabanan, and Jakarta. Since daily active users have not yet reached 50% of those who downloaded the app, Octopus needs to educate users to raise awareness about recycling issues. Fourh, decline, the beginning of Octopus' launch, they faced some challenges in communicating with the scavengers. This community is vulnerable and not sufficiently educated to use the technology-based Octopus app. However, over time, Octopus implemented a mentoring system while also hiring young people to assist them. Although waste pickers belong to the lower-middle class, they can adapt to technology. What they are truly seeking is how to gain benefits and work more decently. That is the simplicity of their situation.

3.4 Characteristics of the octopus social movement in managing recyclable waste

The social movement initiated by Octopus in managing recycled waste has evolved into a new social movement. Its focus is on environmental issues, aiming to bring about social change within the community to manage waste in a more valuable way. Octopus has established the characteristics of a new social movement in the environmental field, including its objectives, tactics, structure, and participation. Octopus actively launches and develops an application to support the circular economy and assist local recyclable waste producers in tracking and collecting used consumer products that can be recycled through a digital system. At least that is what UZ, as the Expansion Associate Division of Octopus and a key informant in this study, explained:

"Octopus actively collaborates with communities, particularly environmental enthusiasts and zero-waste advocates, to continue creating a waste-free Indonesia. One of the social movements conducted annually is a cleanup event, such as the beach cleanup in Bali with 'Bye-Bye Plastic' and the city cleanup in its active areas, which is always held on National Waste Awareness Day." (UZ)

UZ explained that Octopus actively synergizes with several environmental activist communities, especially environmentalists who are active in their fields and zero waste activists, to continue creating a waste-free Indonesia. One of the social movements that is carried out every year is a clean-up event, such as in Bali with a beach clean-up together with Bye-Bye Plastic and in its active area, a city clean-up that is always held on National Waste Awareness Day. Octopus' social movement also assists waste producers, particularly waste banks, to keep moving forward amid the digital era. As stated by SH, the manager of Octopoint and Waste Bank in Kota Baru Village, Bekasi:

"Octopus presents activities from Octopoint, whose principles are similar to the manual system of waste banks in general. For example, when the community comes to manage their waste, the waste collectors manually input and weigh the waste using a notebook. However, the difference with Octopus is that it is digital-based." (SH)

Satwoko further explained that Octopus presents its activities by introducing the Octopoint system as a partner of Octopus to conventional waste banks. It also invites them to join in running the business together. The Octopoint system is similar to that of conventional waste banks. Both collect waste, but the difference lies in data recording: conventional waste banks do it manually, while Octopus is computer-based.

The core of the Octopus social movement is to actively manage recyclable waste. Currently, society is required to address various social challenges and issues by leveraging technological innovations. In the era of the 4th Industrial Revolution, we are familiar with technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and digital robots. All of these are utilized to enhance the quality of life for humans living alongside digital technology. As stated by ABD as an Octopus Preserver.

"The waste collection service provided to each user's home using the app is extremely convenient. We don't have to go through the hassle; we can simply stay at home and check what types of waste we have around us or manage personally, what we collect, and as users, all we need to do is open the app. They will enter the types of waste they want to order, and the next day, their waste will be collected by Pelestari. In my opinion, this is already very easy, and even better, we don't need to pay any collection fees—just use our own smartphones. So, this digitalization is already very much in line with the Society 5.0 era because it makes it easier for the community to actively participate in environmental conservation." (ABD)*.*

ABD stated that the waste pickup service conducted from each user's home using the Octopus app is very practical. This is highly beneficial for users, as they no longer need to expend significant effort, time, or mental energy managing their waste. They can simply stay at home, relax, and wait for the waste collectors to come and collect their waste. Users do not need to pay any fees; they only need to activate the Octopus app and operate it, and the issue of accumulated household waste at home can be properly addressed. Additionally, the community can indirectly contribute to cleaning the environment.

3.5 Implications of adopting waste management innovation

Based on the research results, it was found that waste recycling management using the Octopus app has involved good cooperation with the local government's Environmental Agency. Especially in their efforts to optimize Waste Bank units in their area. The social movement initiated by Octopus is an activity aimed at building relationships with local provincial governments, communities, and Waste Bank communities. Octopus has collaborated with waste stakeholders, including over 1,700 Waste Banks and 14,600 waste pickers who have been trained as Waste Keepers.

The social movement carried out by Octopus involves collaboration with the government, communities, and the public to actively participate in achieving proper waste recycling management. This movement includes conducting outreach and promotion to encourage public interest and awareness of the importance of preserving the environmental ecosystem. This environmental social movement aims to encourage the public to manage their waste independently at home using the Octopus app. The pickup technology through the app makes it easier for the community to participate in recycling waste management.

The Octopus app is active daily without any time restrictions. Pelestari continues to collaborate in serving users by assisting in sorting and picking up their waste. Octopoint managers also help with sorting and providing temporary storage for users' waste. When users' waste reaches the storage capacity at Octopoint, the Octopoint management will immediately contact the Octopus central office to collect the waste. After the Octopus central office arrives to collect the waste at Octopoint, it will be stored at the Octopus central warehouse for distribution to local waste management plants.

Octopus has created a waste recycling management concept utilizing digital technology in line with the developments of the Society 5.0 era. This is a systematic and large-scale effort to reduce the amount of improperly managed waste at final disposal sites (FDS). Octopus has initiated a social movement by encouraging the community to collaborate in sorting their waste at home, utilizing a smartphone app with a one-click solution, and transforming waste into valuable processed goods. Users earn points from the waste they exchange, and these points can be redeemed for food and beverage vouchers, phone credit, data packages, and electricity tokens. Based on observations and interviews conducted by the research team, it was found that the social movement initiated by Octopus is functioning effectively and has been positively received by the government, community, and public media. This is evidenced by the numerous positive news articles highlighting Octopus as a practical recycling solution for the community.

Not only that, the local government is also working together with Octopus to tackle waste issues at the final disposal site and household waste issues using the Octopus app. Octopus' achievements in managing recycled waste have been demonstrated by the fact that it has collected 9.1 million plastic pieces. This is particularly aimed at preventing the accumulation of plastic waste in water bodies. The ecosystem can also monitor and reduce the carbon footprint of consumer goods, with 80% of this achieved by Octopus, thanks to collaboration with over 200,000 people who have used the Octopus app. Although it appears to be running smoothly, there are still challenges in engaging the community regarding waste management. This is because some members of the community lack knowledge about waste sorting. Additionally, many people are unfamiliar with digital technology and claim that it is very difficult to operate the app.

4. Conclusions

Based on research results in recycling waste management, Octopus has made a significant contribution in encouraging the community to care about collecting recyclable waste. Through this movement, the community is encouraged to work together to reduce environmental problems. The use of technology in the Octopus application has made it easier for the community to find collectors who can transport their waste to be sent to the Waste Bank Unit. As a result of collaboration and cooperation, there are now over 1,700 waste banks and 14,600 waste pickers who have been trained as Waste Keepers, as well as over 200,000 people using the Octopus app. This demonstrates that the new social movement initiated by Octopus is highly effective. This is because communication plays a crucial role in helping the government and community work together to reduce environmental issues.

Octopus employs Communication, Information, and Education as techniques for socialization and smooth collaboration with the Government, Community, Conservationists, and Waste Banks. Octopus collaborates with the City Government through the Environmental Agency and the Patriot Central Waste Bank to provide information and education to Waste Bank Units in order to become Octopus partners as Octopoints. The local government also encourages the community to use Octopus as a means of managing recyclable waste through a digital system, so that the Indonesian community can get accustomed to recycling their waste. Octopus has collected 9.1 million pieces of plastic, aiming to prevent the accumulation of plastic waste in water bodies. This ecosystem can also monitor and reduce the carbon footprint of consumer goods, with Octopus having achieved 80% of this goal.

Author Contribution

The authors was involved in formulating the research idea, designing the study, collecting and analyzing the data, and preparing the manuscript. All authors took part in writing, revising, and giving final approval for the manuscript to be published.

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