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Zero Waste Lifestyle as an Effort to Reduce Waste From Its Source

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ABSTRACT

The issue of waste increasingly threatens life in the biosphere, both on land and in water bodies. The accumulated waste collected each year forms massive piles. Waste that is burned causes air pollution and produces greenhouse gases, contributing to global warming and ozone depletion. Various methods, including recycling, have been implemented, yet only 20% of waste is successfully recycled. Therefore, it is necessary to make efforts to reduce waste at its source by educating people about a zero-waste lifestyle. This research is a qualitative study with data collected from interviews, documentation, participatory observation, and literature review. Additionally, questionnaires were used to obtain the zero-waste index percentage and to complement the data. The research subjects include the community and the KerDUS Community in Kendal Regency, Indonesia. The community actively engages in educating the public about zero waste. The community prepares trainers and mentors to provide environmental awareness materials and training on recycling used goods. The community's slogan "Zero Waste Konco Resikan" inspires members to continually share their knowledge. The divisions involved in waste management include POC Konco Resikan, eco-enzyme, ecobrick, maggot gazebo, florist, Mijel soap, bioactivator, Bungpi lampion, compost, and fabric mats. Trained individuals are expected to practice these methods at home.

Keywords**: **Zero Waste; waste; KerDUS Community

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INTRODUCTION

Population growth impacts the increase in the amount of waste accumulation. As the population increases, consumption and needs also rise. Especially now, society tends to use practical and instant products, which often involve plastic. Initially, plastic was created to replace paper bags made from wood, aiming to reduce wood exploitation and forest ecosystem damage. Plastic was seen as a reusable solution due to its durability, practicality, cost-effectiveness, attractiveness, lightweight, and longevity. However, plastic consumption has increased, especially single-use plastics, triggering an explosion of plastic waste everywhere.

Waste is leftover food or used items no longer needed. According to Indonesian Government Regulation Number 27 of 2020, waste is residual daily human activity or natural processes in solid form. Uncontrolled waste on land and in water bodies is an urgent issue faced by the global community. It is estimated that 13 billion tons of plastic will fill the Earth by 2040, scattered across land and oceans (National Geographic, 2020). Research data from

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Sciencemag 2015 indicates that Indonesia ranks second worldwide in contributing plastic waste to the sea (DLH Kendal news).

Almost every human generates waste, either from body metabolism or daily activities. Annually, the world produces an estimated four billion metric tons of waste, but only 20% is recycled or recovered (Chalmin & Gaillochet, 2009, in Nizar, 2017). The remaining 80% accumulates each year, becoming a global problem. Waste management requires expensive land, funding, technology, and labor. Burning waste causes air pollution, leading to greenhouse effects, global warming, and ozone layer depletion.

The slogan "throw trash in its place" is less suitable for the current situation, as it does not solve the growing waste problem at final disposal sites (TPA). Collected waste is typically dumped at TPAs, which have limited capacity and slow decomposition processes. The constant daily waste production from society means that TPAs accumulate more waste, leading to pollution and disasters. For example, the Leuwigajah TPA tragedy in Cimahi, West Java, on February 21, 2005, killed 150 people due to a 200-meter-long and 60-meter-high waste mountain collapsing after heavy rain and accumulated methane gas from years of waste decomposition exploded (detiknews, February 19, 2020).

Despite various efforts and techniques taught to the public, success is limited, and many revert to old habits. Waste banks and waste donation programs have seen partial success, with some still selling valuable waste to scrap collectors and discarding worthless waste in TPAs. Some waste banks face issues with unsegregated waste, leading to foul smells, maggots, or disease vectors that need cleaning before processing. Additionally, higher waste management costs compared to revenue cause some waste banks to go bankrupt.

A lack of proper waste management leads to increasing waste volume. To prevent this, waste should be managed from its source through educating the public about waste and environmental care. Such knowledge can make society value waste as a raw material for recycling products. According to Sekda Kendal (2019), waste management should be rethought from its source, especially in densely populated urban areas with little empty land, necessitating wise waste handling.

Educating the public about the importance of waste management starts with individuals buying only what they need, avoiding waste-generating products, and processing existing waste. Public education also involves waste segregation by type and purpose to facilitate processing, separating organic, inorganic, and hazardous waste (B3). Inorganic waste like plastic, styrofoam, fabric, glass, used pipes, and paper can undergo the 3R (Reduce, Reuse, Recycle) process to reduce its volume. Creative and environmentally conscious individuals view waste as a blessing, making useful products from leftover materials, which can be aesthetic, economical, and eco-friendly. Increased demand for recycled products boosts the need for raw materials, ensuring no more scattered waste as it becomes a source of income.

Waste symbolizes modern inefficiency and misallocated resources, necessitating public understanding of the excessive use of plastic (A. Zaman, 2022). To anticipate waste surges, zero waste education from upstream to downstream is needed, as the zero waste concept offers waste management by eliminating waste, recycling it, and reducing and recovering used items (Nizar et al., 2017).

METHOD

This qualitative study describes the zero waste lifestyle as an environmentally conscious character, reducing waste from its source. Data were collected from participatory observations,

p-ISSN: 2301-9263
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interviews, documentation, literature studies, and questionnaires to determine the recycling percentage using Zaman's (2013) formula:

$$Diversion\ rate = \frac{Weight\ of\ recyclabels}{Weight\ of\ garbage + Weight\ of\ recyclables}\ x\ 100\%$$

Questionnaires were distributed to the KerDUS Community in Kendal Regency, an environmental community educating zero waste. Data were analyzed through data reduction, data presentation, and conclusion drawing to describe the zero waste lifestyle (Sugiyono, 2016).

RESULTS AND DISCUSSION

Zero Waste Concept

Zero waste is a waste management concept for sustainable living (Abdullah, 2016, in Khairunisa & Safitri, 2020). It is not mandatory but an individual awareness to take responsibility for daily consumption leftovers. Zero waste is also an ideal environmental concept in waste management from the community, government, and businesses to minimize waste quantity and impact (Zulfa et al., 2021). Zero-waste culture requires knowledge, experience, encouragement, habituation, and tangible examples. It emphasizes 3R (Reuse, Reduce, Recycle) principles (Handayana et al., 2019). According to Abhishek Kumar et al. (2021), the approach is to inspire the reshaping of the resource supply chain away from an outdated mode so that entire products or by-product materials are reused or recycled.

Zero waste minimizes landfill waste (Ali, 2019). The paradigm of waste management focusing on the end-of-the-pipe approach should shift to viewing waste as a resource with waste-to-energy technology (Setyono & Sinaga, 2021). Zero waste campaigns in communities raise awareness of waste prevention. Waste management programs should focus on human capacity rather than just adding waste collection equipment or landfills (Nizar et al., 2017).

The zero waste concept opposes incinerators, landfills, and waste presence, aiming to create sustainable communities (Nizar et al., 2017). Incinerators and landfills do not solve waste issues, causing smog and odor. Kendal City, Indonesia, faces significant waste challenges, with waste management receiving less attention compared to other issues. Proper waste service quality indicates good governance (Africa, 2010, in Nizar et al., 2017).

Community awareness to reduce waste is low, and waste-to-energy projects face funding and management challenges. No single strategy can solve waste issues (Nizar et al., 2017). Zero waste campaigns in communities can foster waste prevention awareness. Thus, waste management education and zero-waste lifestyle cultivation are necessary, as seen in Kendal's KerDUS recycling community. They educate the public through waste management workshops, open to all.

Zero Waste Management

A zero-waste lifestyle minimizes waste production, making used items or leftovers reusable, recyclable, or processable into new products. This habit reduces waste disposal, preventing environmental threats to human, animal, and plant health (ZWIA, 2004, in Ali, 2019).

Zero waste requires planned environmental management for sustainable practice. Short-term zero-waste programs include 3R implementation, environmental policies, creative industrial design, and guaranteed product marketing. Long-term priorities involve integrating environmental education to foster environmental awareness and character in society.

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Zero waste success depends on prioritizing strategies from education to research on eco-friendly waste reduction. Priorities include sustainable consumption, shopping according to needs, and reducing waste-generating tools. Zero waste involves eco-friendly industrial design (cradle-to-cradle, clean production) minimizing waste by reusing all residual materials as raw materials for new products. Achieving sustainable zero waste needs innovative waste processing technology. Figure 1 illustrates zero waste.

Figure 1. Zero Waste Management
Source**:** (A. U. Zaman & Lehmann, 2013)

Developing the idea of waste management systems into zero waste systems requires the integration of several parameters, including geography, waste prevention through design, behavioral changes, and waste reduction through reuse and redesign. According to Zaman (2013), the seven main domains of zero waste indicators are geo-administrative, socio-cultural, management, environmental, economic, organizational, governance, and policy.

The involvement of all parties is necessary to implement the zero waste concept, including private sectors, government, and educational institutions in campaigning for the zero waste concept (Nizar et al., 2017). These seven indicators are interconnected to achieve zero waste. Besides these indicators, the sustainability of the program is also an equally important factor for the success of zero waste. The domain diagram of zero waste is shown in Figure 2.

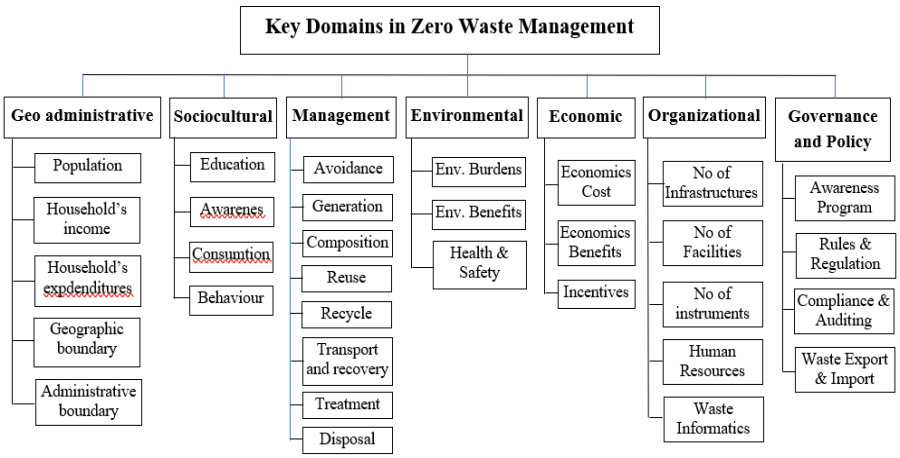

Figure 2. Domain Scheme in the Zero Waste Management System

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Source: (A. U. Zaman & Lehmann, 2013)

The Zero Waste concept implemented by the KerDUS Community in Kendal Regency is still a self-initiative that collaborates with schools, pesantren (Islamic boarding schools), the Health Department, the Environmental Department, and PKK women's groups. The zero waste education conducted is still local within Kendal Regency and has slightly extended to the eastern part of Batang Regency. The management of the KerDUS community is still in the form of share ownership that is not solely profit-oriented. One of its flagship products is the ecobrick, a product capable of accommodating dozens to hundreds of used plastics in a plastic bottle to be made into structures such as chairs or stools, tables, walls, fences, gates, or similar items. The ecobricks produced by the KerDUS Community adhere to a minimum weight standard of 0.33 times the bottle volume, which has been tested for strength and recognized internationally. The management and calculation of ecobricks are registered with the Global Ecobrick Alliance (GEA). GEA records the number and weight of ecobricks collected, thus showing how much plastic has been saved. An example of ecobricks crafted by the KerDUS community is shown in Figure 3.

Figure 3: Example of Ecobrick from the KerDUS Community
Source: Author

Development of Zero Waste

Zero waste is the cheapest and most effective waste management concept, but it requires diligence, habituation, and responsibility in its implementation. The first city to implement the zero waste concept was Canberra, which issued the Zero Waste Act in 1996 (Nizar, 2017). The Act implied that "the government will not produce waste starting from 2010." The zero waste program includes the "Resource Recovery Park," a place that helps industries create products from separated materials and market reusable goods.

Adelaide has implemented the zero waste concept since 2004 with the Zero Waste SA Act to improve waste management systems and to foster zero waste in South Australia (ZWSA, 2011 in Zaman, 2013). Adelaide banned the use of plastic shopping bags that could generate waste and promoted composting and recycling. As a result, Adelaide continues to build composting facilities, achieving a target of 82% composting and reducing waste sent to landfills.

Stockholm is a country with high environmental quality standards. Stockholm is very prominent in regulations and policies in waste management systems, with one of the most important policies being the ban on putting combustible waste and organic waste in landfills (Avfall Sverige, 2008, in Zaman, 2013). The zero waste project "Vision Stockholm 2030" aims for sustainable development in the future as a fossil fuel-free city by 2050 (Stockholm City, 2009, in Nizar, 2017).

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The flow of materials with circular and linear systems (Song et al., 2015, in Ali, 2019). The developments and zero-waste activities of cities around the world are shown in Table 1.

Table 1: Achievements and Events Related to Zero Waste

Year	Country	Milestone/Event
1970s	United States	The term "Zero Waste" introduced by Paul Palmer
1986	United States	National Coalition Against Mass Burn Incineration formed in Seattle
1988	United States	Presentation of Pay-As-You-Throw (PAYT)
1989	United States	California Integrated/Waste Management Act passed to achieve 25% waste diversion target by 1995 and 50% by 2000
1990	Sweden	Thomas Lindhqvist presents Extended Producer Responsibility
1995	Australia	Canberra passes No Waste by 2010 Act
1997	New Zealand	The Zero Waste New Zealand Trust founded
1997	United States	California Resource Recovery Association (CRRA) holds zero waste conference
1998	United States	Zero Waste adopted as key waste management principle in North Carolina, Seattle, Washington DC
1999	United States	CRRA holds zero waste conference
2000	United States	San Francisco Global Alliance for Incinerator Alternatives
2001	United States	GrassRoots Recycling Network publishes Citizen Agenda for Zero Waste
2002	New Zealand	Publication of the book "Cradle to Cradle"
2002	United States	Zero Waste International Alliance (ZWIA) formed and first Zero Waste Summit held in New Zealand
2004	United States	ZWIA defines zero waste
2004	Australia	Zero Waste founded in South Australia
2008	United States	Sierra Club adopts zero waste producer responsibility policy
2012	United States	Documentary film "Trashed" premieres at Cannes Film Festival, The Zero Waste Business Council founded in the United States

Source: (Ali & Kumar, 2019)

Conventional waste management still follows a collect-transport-dispose system with a linear circular system, resulting in landfills becoming unsightly places filled with piles of waste. Waste in these landfills is considered useless and harmful to the environment. Even long-buried waste produces methane gas, which can eventually explode and cause disasters. Managing waste in landfills also requires large areas far from residential areas, as it can produce odors, leachate, disease vectors, and pollution. Therefore, environmentally friendly and cost-effective waste management is needed, which can be achieved with the zero waste concept.

The zero waste concept operates cyclically, involving the government's role as policy makers, instilling environmental care in the community, environmental management that supports sustainable development, the green economy, and the involvement of the private sector and government in processing and marketing waste-processed products. With the cyclical concept, waste from previous materials can be used as raw material for recycled products, and

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this cycle continues until the products/materials are used again. Figure 4 explains the cyclical waste diagram.

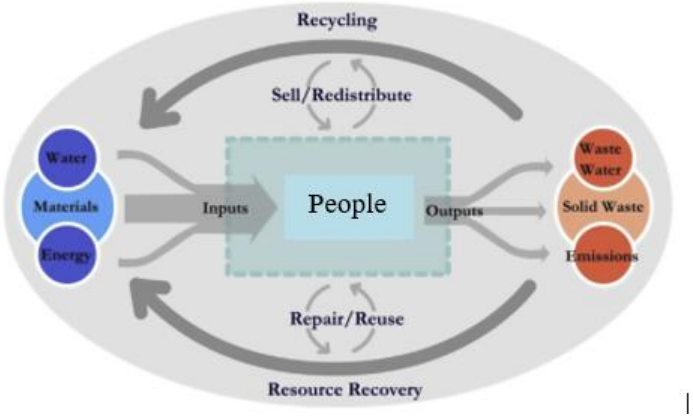

Figure 4. Material flow in a zero waste system
Source: Girardet, 1992, 1999 in Zaman, 2013

The zero waste concept does not always follow a cycle because the materials of certain products have varying quality and lifespan, leading them to eventually become waste. Zero waste applies a mixed flow diagram combining both cyclical and linear diagrams. This is explained in

Figure 5. Material Flow Rate Through Circular (zero waste) and Linear Systems
Source: (Song et al., 2015 in Ali & Kumar, 2019).

The steps of the zero waste action plan include: a) Pre-evaluation consisting of pre-data collection, data analysis, and pre-assessment of Waste Management System (WMS); b) Implementation strategy includes education and awareness of waste, transformative knowledge of waste, responsible shopping practices, collaborative consumption, cradle-to-cradle product design, extended producer responsibility, expanding product lifespan, creating a recycling market, improved collection systems, decentralized recycling centers, improving source reduction, empowering social technology, environmentally friendly technology, interim

p-ISSN: 2301-9263
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landfill, restrictions on mass incineration, economic incentives, standardized waste data, and zero waste research; c) Post-evaluation includes post-data collection, post-assessment, and performance evaluation. Figure 6 explains the action plan in depth.

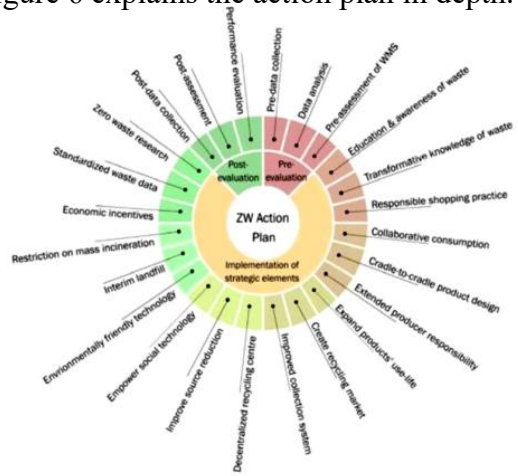

Figure 6. Zero Waste Action Plan
(Source: Ali & Kumar, 2019)

The community must properly plan the implementation of Zero Waste to ensure its application and acceptance. Therefore, before implementation, an analysis of the field situation, community characteristics, and waste data in the community should be conducted. This data is analyzed to select and determine an action plan that can be implemented using various strategies. The results of the implementation are evaluated for feedback and improvements towards a better zero-waste system.

Zero Waste Lifestyle

Waste, which is the residue of human activities, can either be a disaster or a blessing, depending on how we handle and process it. Excessive consumption leads to global issues such as climate change, loss of biodiversity, increased air, water, and soil pollution, deforestation, and depletion of resources and materials. Therefore, strategies are needed to minimize waste and to eliminate waste from processes and product residues for sustainable living (Zero Waste SA Strategy, 2020, in Nizar, 2017).

The management strategy starts from the source, which is community awareness. If people are responsible and wise about the waste they generate, waste production will decrease or even be eliminated. The success of waste management begins with a wise and environmentally conscious community. Other supporting aspects include the involvement of the private sector, government, environmental community groups, and the education sector in campaigning for the zero waste movement. Through such campaigns, awareness of not creating or avoiding waste will arise. Thus, the focus of waste management is not on increasing waste collection equipment or creating sanitary landfills, but rather on human awareness (Nizar, 2019).

The KerDUS community educates and provides examples of a zero-waste lifestyle that can be applied in daily life, such as bringing baskets or bags for shopping. These baskets are made from woven coffee wrappers, while the shopping bags are made from unused clothing or t-shirts repurposed into shopping bags. When traveling, going to school, or going to the office, people can bring food in reusable containers and drinks in tumblers to refill. Reduce the use of

p-ISSN: 2301-9263
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tissue by using handkerchiefs, napkins, or cloths. Clean and collect food wrappers, snack packages, or parcels to create crafts such as bags, mats, brooches, flowers, or ecobricks.

Mothers cooking in the kitchen also sort their waste; vegetable scraps and fresh fruit peels can be collected to make ecoenzyme, while food leftovers and other organic waste can be put into compost drums to make liquid organic fertilizer and compost. The finished liquid organic fertilizer and compost can be used to fertilize vegetables or plants around the house or garden. Vegetables can be cooked and eaten, with the leftovers made into fertilizer again.

Processing kitchen waste into liquid organic fertilizer requires compost drums arranged as needed so leachate and residue can be directly separated for easy harvesting. The KerDUS Kendal community innovated by creating a tool to decompose waste into liquid organic fertilizer and compost using compost drums or stacked buckets. Each household can use these drums due to their safety and capacity to store a substantial amount of waste. It is estimated that these drums can hold kitchen waste for up to a year until the waste residue is full. The residue is then buried or covered with plastic to be turned into compost for about three months. Liquid organic fertilizer is usually harvested weekly, depending on the type and quantity of organic waste added. The amount of black liquid flowing from the compost drum hose serves as an indicator that the leachate or liquid organic fertilizer is full. Figure 7 illustrates the composter.

Figure 7. KerDUS Community Composter Model
Source: Author

The composter is equipped with partitions to separate solid waste and leachate (liquid organic fertilizer). The leachate is discharged through a clear hose installed at the bottom of the compost drum, allowing it to flow directly into a collection bucket. The compost drum is equipped with small holes for air entry and hoses on the right and left sides as exits for maggots/BSF flies (decomposing flies rich in protein for animal feed).

The leachate used for liquid organic fertilizer must be aerated for about two days to eliminate gas and offensive odors. This liquid fertilizer is environmentally friendly, made from natural materials with the addition of a bioactivator created from the fermentation of pineapples, banana stems, coconut water, brown sugar, and rice washing water for 4 weeks.

The KerDUS community, in educating the public about zero waste, is divided into divisions consisting of the ecobrick division, the bungpi division, the gazebo florist division, the POC Konco Resikan division, the maggot division, the bioactivator division, the PVC pipe lantern division, the mijel soap division, and the cloth mat division. Each division has trainers/mentors who are experts in their respective fields. The division breakdown is shown in Figure 8.

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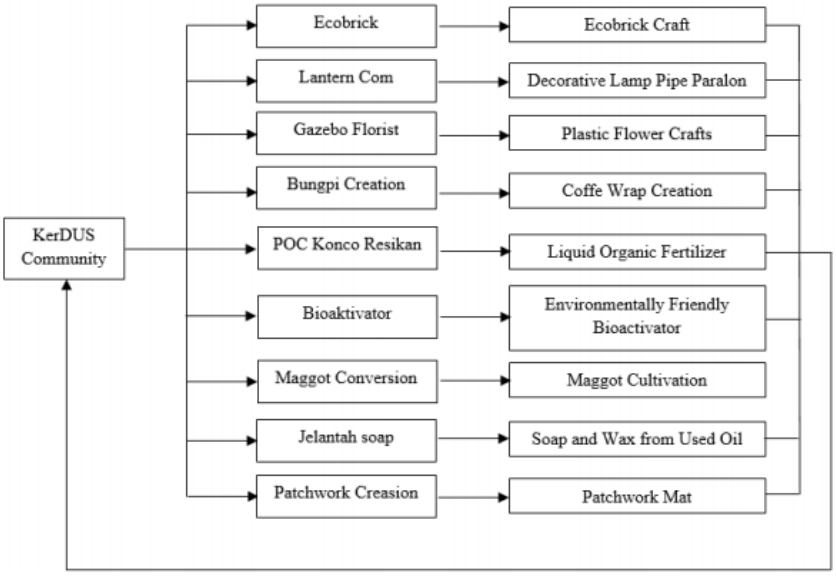

Figure 8. KerDUS Community Divisions

The products and zero waste concepts of the KerDUS Community are shown in Figure 9. The KerDUS Community has the vision "Zero Waste Konco Resikan" as a cheer to boost the enthusiasm of the community and training participants.

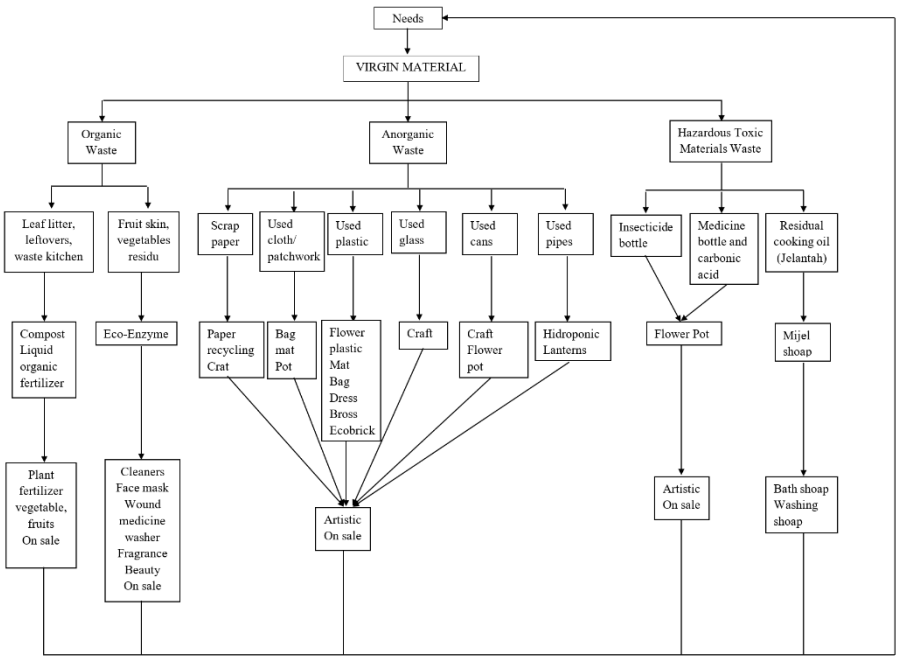

Figure 9. KerDUS Community Zero Waste Concept
(Source: Author)

In addition to educating the community, the KerDUS community also practices a zero waste lifestyle in their daily lives. Research shows that the community members generate an

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average of 1.5 kg of waste per day, with an average waste processing rate of 1.1 kg. According to Zaman's (2013) formula:

$$Diversion\ rate = \frac{Weight\ of\ recyclabels}{Weight\ of\ garbage + Weight\ of\ recyclables}\ x\ 100\%$$

an average of 73.33% of KerDUS Community members practice a zero waste lifestyle by processing both organic and inorganic waste.

Challenges in Implementing Zero Waste

The zero-waste lifestyle aims to reduce the generation of waste to prevent it from increasing and endangering human life. In Kendal Regency, the zero-waste lifestyle is not yet mandatory and is only practiced by a small environmentally conscious community, such as the KerDUS Community in Kendal Regency. Despite being in the minority, the KerDUS Community continues to educate the public on implementing zero waste. Mentoring and training are conducted voluntarily by trained mentors and trainers.

These activities do not always run smoothly or successfully. Only a small number of participants apply the guidance and training they receive. Reasons for such failures include laziness, complexity, lack of government restrictions or sanctions, and the local government's lack of enthusiasm for waste management. Another significant challenge is the difficulty in marketing waste-processed products such as liquid organic fertilizer, compost, eco-enzyme, and other plastic and inorganic waste crafts. Consequently, individuals frequently utilize or gift recycled or waste-processed products to their neighbors and friends. The community is not yet accustomed to using organic products and still undervalues recycled products, despite their superior benefits compared to factory-made chemical products. However, recycled products are environmentally friendly and essential for sustainable living.

Marketing management of zero-waste products requires collaboration between the community, government, and private sector, especially in product marketing. This guarantees that the broader community enjoys zero-waste products instead of accumulating and wasting them. This can motivate others to adopt waste processing habits.

CONCLUSION

Conclusion

Zero Waste is an environmental program aimed at reducing and even preventing waste generation. Waste, when managed, can become valuable creations rather than disasters. The flow of waste shifts from a linear circular system to a circular material system, where waste becomes raw material for products. This is the goal of the KerDUS Community in Kendal Regency, Indonesia, as an environmental awareness community promoting zero waste education. The KerDUS Community has various waste recycling divisions, including POC Konco Resikan, bioactivator, eco-enzyme, maggot, bungpi, gazebo florist, lampion, mijel soap, and cloth mats. The goal of the KerDUS Community is not to profit from recycling sales but to prioritize zero-waste education for the community. The zero waste index of the KerDUS Community currently reaches 73% based on average questionnaires distributed. This is hindered by work commitments and the lack of local government policies on zero-waste culture.

Suggestion

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Suggestions for future research include focusing on the analysis of the effectiveness of zero waste strategies at the community or city scale, as well as the barriers to their implementation.

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