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Circular Economy: Barriers and Strategy to Reduce and Manage Solid Waste in the Rural Area at Jepara District, Indonesia

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ABSTRACT

The term circular economy (CE) refers to a new idea that transforms the old idea of the linear economy, which created the take-make-distribution-disposal-disposal model to take-make-distribution-consume back. When a product reaches its final stage, it will not be discarded; instead, it will be sent back in a form or quality different from the original. The 6R principles: reduce, reuse, recycle, recover, redesign, and remanufacture, are considered during the return process. Several challenges must be overcome for a circular economy to be implemented. However, no one has yet identified and analyzed the difficulties that hinder the implementation of a circular economy in Indonesia, especially in Jepara Regency. This study aims to identify and analyze the difficulties that hinder the implementation of a circular economy in waste management and make plans to overcome them. Five respondents from various stakeholder groups participated in this research, including local government, academics, and non-governmental organizations. The questionnaire was processed using the Interpretive Structural Modeling (ISM) technique to identify the main obstacles. The results show that the critical factor inhibiting the implementation of a circular economy is the price for building a waste collection, storage, processing, and disposal (B8) system and government initiatives to decide on implementation (B2). Furthermore, based on respondents' assessments, the cost of collecting waste (B16) and the practice of disposing of hazardous waste (B1) waste that is not regulated is at the second level. Waste management requires a model that follows the circular economy principle to answer these inhibiting factors. The waste bank model is the most appropriate to apply to ensure the circular economy concept is running.

1. INTRODUCTION

Academics, practitioners, and politicians have paid close attention to the circular economy (CE) concept as a potential remedy for the community, ecological, and financial problems that the existing modest environment presents [1-4]. Socioeconomic and environmental shifts are driving severe challenges to the commercial model of the classical linear economy. In addition, socioeconomic and environmental shifts also impact the unpredictable value of natural resource reserves, increased pressure on waste management, greenhouse gas emissions, and climate change [5, 6]. Contrarily, CE maintains a closed-loop supply chain for its resources. To ensure minimal or no waste formation, it substitutes the old linear economy of take-make-consume-dispose with a circular system that includes decline, preservation, repair, reusing, refurbishing, and recycling [7, 8]. The 3R principle (reduce, reuse, recycle) served as the foundation for the circular economy concept in the beginning, but in more recent years, it has evolved into the 6R principle (reuse, recycle, redesign, remanufacture, reduce, recover) [9]. The adoption of a circular economy has emerged in response to the requirement to contest the shortcomings of the existing linear economic structure. Circular economy systems strive to eliminate waste formation, in contrast to linear production approaches, by retaining additional value from products for as long as possible. According to Bernon et al. [10], this principle works at every level of an economy, including micro (products, enterprises, users), eco-industrial parks, and worldwide (cities, states, and countries), with the main goals of resource conservation and recycling. It seeks sustainable development by fostering social and eco-friendly excellence and financial fortune. Therefore, it creates a crucial option for nations that seek to switch from an extended to an intensive economic growth pattern.

In rising economies, the CE idea and its application to minimize and accomplish waste successfully and capably have grown crucial. The determination of close circle material is actively being promoted by global actors such as the United Nations Environment Programme (UNEP), the Organization for Economic Co-operation and Development (OECD), and the World Wide Fund for Nature (WWF) through several studies and events [11]. Leading economic nations in Asia, China, and Japan, have begun implementing CE programs nationwide. Germany, Denmark, the Netherlands, and the United Kingdom are leading the way in developing CE regulations and pilot programs in Europe [12]. It has been estimated that trash reduction and reuse can help firms in the EU save up to 600 billion euros [5]. Alternatively, CE can create 50,000 employment and €12 billion in investment in the UK [12]. The anticipated potential advantages of CE in the Netherlands are €7.3 billion annually and the creation of 54,000 new employees [13].

CE is the best action to address corporate, social, and ecological needs [14, 15]. The conventional strategy (linear economy), which is still commonly used today, has failed to preserve economic success and environmental well-being. [16, 17]. It results from the take-make-dispose philosophy, which requires businesses to extract natural resources, process them, and dispose of them as waste. CE can potentially eliminate waste through prevention strategies, including reducing, reusing, and recycling [18, 19]. Utilized materials are used in producing the goods, increasing the value of used goods [20].

Since they can reduce emissions and rely more on natural raw materials, cost-saving and supply-strengthening strategies positively affect environmental safety. Given this, the CE is a well-known method to forecast environmental problems and a shortage of natural resources brought on by traditional models [21, 22].

Cradle to Cradle is an economic strategy emphasizing circularity in product design to ensure that each product can still perform its original function at the end of its useful life. It was in this situation that the concept of CE first emerged. This is how CE differs from the recycling economy, where products made through recycling may not always be of similar value as the original, and some parts may still end up as waste [23]. The linear economy only uses natural resources to produce goods and disposes of them as waste.

The zero waste project and the concepts contained therein have recently been implemented in Jepara District, Central Java Province, Indonesia, and have carried out projects related to zero waste management. By what is mandated by the Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management. Other laws and regulations which form the legal basis for the issuance of Jakstrada include Law no. 32 of 2009 concerning Environmental Protection and Management, PP of the Republic of Indonesia No. 81 of 2012 concerning Management of Household Waste and Household-like Waste as well as Regulation of the State Minister for the Environment of the Republic of Indonesia No. 13 of 2012 concerning Guidelines for the Implementation of reduce, reuse, recycle Through Waste Banks. The Jepara Regency Government followed up by issuing Regional Regulation Number 3 of 2009 concerning Waste Management in Jepara Regency and Regional Regulation Number 20 of 2012 concerning Implementation of Order, Cleanliness and Beauty in Jepara Regency. Furthermore, in 2016 the Jepara Regency government also issued Regional Regulation No. 8 concerning Garbage/Cleaning Service Retribution in Jepara Regency.

In 2017 the government issued Presidential Regulation Number 97 of 2017 concerning National Policy and Strategy for the Management of Household and Household-like Waste. The Jepara Regency Government also followed up by issuing Regent Regulation Number 46 of 2018 concerning Jepara Regency policies and Strategies in Household Waste Management and household-like waste. Through Jakstrada, Jepara Regency targets 30% waste reduction and 70% waste handling by 2025. In a general sense, what is meant by waste reduction is the implementation of waste management carried out at the source by the community, and what is meant by handling waste management activities carried out by the government.

With the existence of Jakstrada, it is hoped that it can overcome the waste problem in the Jepara Regency area. Efforts to reduce and handle household waste and household-like waste in Jepara Regency are described in the Jakstrada document. The Government has implemented several programs, including developing the Jepapah (Segregated Garbage Pickup) application, Siangsa (Jepara Garbage Transport Information System) and the Mandiri Garbage Village. Jepapah, Siangsa and the Mandiri Garbage Village are innovations in technology-based and community-based waste management, pickup and sorting programs that have been running since 2017. Jepapah is for waste management in urban areas, while the Mandiri Garbage Village and Siangsa are for waste handling in rural areas and many other programs - programs implemented to reduce and handle the household and household-like waste.

The Jepapah, Siangsa, and Mandiri Garbage Village programs have the substance that waste reduction is carried out starting from the source. The source of waste is seen from the origin of the source, namely urban and rural areas. Reduction from this source does not merely reduce the amount of waste production but separates waste. When the reduction from the source is underway, later management at the collection stage will only be waste grouping, and final processing at the TPA will only process a small amount of waste that cannot be sorted.

Indonesia’s zero waste initiative is developing as a result of the country’s determination to meet international environmental standards and achieve circular economy goals. However, current constraints make adopting zero waste management a challenge. Successful management of waste depends on identifying and accurately understanding these possible bottlenecks. No research examines the significant obstacles to organizing and implementing circular economy-based waste management in Indonesia.

One method that can be applied to determine the key factors inhibiting circular economy implementation in Indonesia is Interpretive Structural Modeling (ISM). Forrester used structural analysis to link concepts in the 1960s when creating models of industrial dynamics [24]. In the Interpretive Structural Modeling (ISM) group learning technique, participants assess a variable’s validity and its relationships to other factors [25]. The ISM technique enables addressing the system’s complexity and resolves it into a simple, understandable form by working out the hierarchical organization of system variables, according to Qureshi et al. [26]. The group determines which variables are related and how through brainstorming sessions, but the group does not weigh the variables. The process known as Interpretive Structural Modeling (ISM) is used to determine the connections between specific system components and to organize them into a thorough systematic model. Three factors lead to the use of this methodology in this investigation. In order to produce a systematic model of a complex system by breaking the latter down into various components, ISM first employs experts’ knowledge and experience to develop a collective understanding of interactions between elements [27]. Second, no prior knowledge of the complex system under study’s past is necessary for ISM. Finally, although individuals can also use ISM, it generally functions as a collective learning process [28]. In numerous research, ISM has been utilized to model and comprehend the interactions between obstacles.

For instance, Abuzeinab et al. [29] investigated the challenges and connections in using green business models in the UK construction industry. ISM was utilized by Abuzeinab et al. [29] to model the obstacles to green supply chain management in Indian SMEs. ISM is used to model obstacles in managing renewable energy in Indonesia [30]. ISM has several restrictions. First, ISM only considers a small number of variables since more variables make the model excessively complex and difficult to interpret [31]. Second, variables and relationships are not given any consideration by ISM. Also, the results may be skewed due to the (sample of) users' and responders' knowledge and experience [32].

As environmental protection becomes more widely recognized, pressure is mounting on municipal governments to follow the green trend of resource conservation and environmental protection. Due to rapid scene changes, environmental and social challenges are becoming more significant in waste management. CE is an excellent strategy for anticipating environmental issues and resource shortages brought on by conventional waste management techniques. The circular economy strategy is crucial and plays a significant part in fostering stakeholder efficiency and collaboration, supporting environmental performance, minimizing waste, and improving the ecological efficiency of businesses and stakeholders. As environmental protection becomes more widely recognized, pressure is mounting on municipal governments to follow the green trend of resource conservation and environmental protection. Due to rapid scene changes, environmental and social challenges are becoming more significant in waste management. CE is an excellent strategy for anticipating environmental issues and resource shortages brought on by conventional waste management techniques. The circular economy strategy is crucial and plays a significant part in fostering stakeholder efficiency and collaboration, supporting environmental performance, minimizing waste, and improving the ecological efficiency of businesses and stakeholders. As a result, ISM is a tried-and-true method for determining connections between specific parts that characterize challenges or problems with implementing a circular economy in Indonesia. Therefore, this study examines how rural communities implement a circular economy in waste management based on limiting variables. It is important to remember that this study aims to implement CE-based waste management practices based on a clear strategic framework.

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2. METHOD

This study was conducted at Tempur Village, Jepara Regency (Figure 1), Central Java Province, Indonesia, between November 2022 and October 2022. With a total size of 19.64 Km2, Tempur is a village in the Jepara Regency, Central Java, Indonesia. It is 500-700 meters above sea level and has a stunning natural view. Geographically, this village is bordered by the villages of Kunir and Damarwulan to the north. Furthermore, in the south, it is bordered by Kudus Regency. To the West, it is bordered by the villages of Sumanding and Dudakawu. Meanwhile, to the East, it is bordered by Pati Regency. 25 Neighborhood Units (RT) and 6 Community Units (RW) comprise Tempur Village. These Neighborhood Units are divided into several hamlets, including Duplak, Miren, Petung, Pekoso, Nglagah, Karang Rejo, and Nggodang. About 25 kilometres separate the capital of the Keling District from Tempur Village. According to data from the Central Bureau of Statistics (BPS) Keling District, Jepara Regency, 3548 people were living in Tempur Village, 1820 of whom were men and 1728 women.

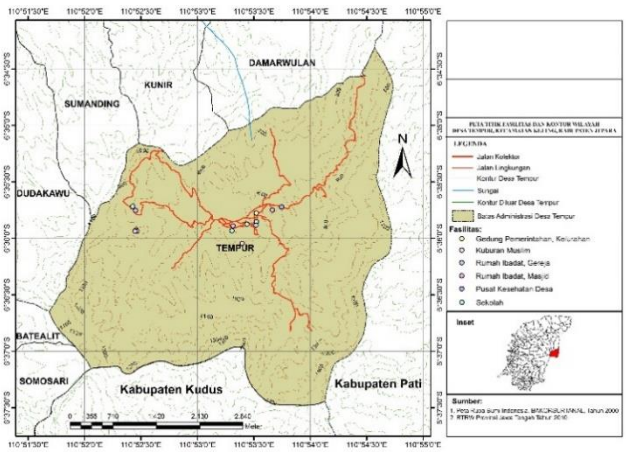

Figure 1. Tempur village, Jepara District

Furthermore, the model implementation approach is evaluated using a questionnaire with specialists in solid waste management activities. Some sources of expertise are local governments, regional environmental services, non-governmental organizations, and scholars. The questionnaire was created using a literature review of prior research and was modified for the Tempur Village region. The literature review results were gathered from various articles about the challenges different nations face when implementing the circular economy. The outcomes of this literature study were then assembled into a pairwise comparison questionnaire and given to professional respondents. This questionnaire asks respondents to compare their answers in pairs for each factor. This questionnaire compares the following variables:

a. Unregulated methods of removing hazardous materials
b. Government initiatives to make decisions about implementation
c. Location and terrain characteristics
d. insufficiently qualified waste management personnel
e. Absence of accountability due to lack of training.
f. The budget is insufficient; the cost of developing an efficient system for collecting, storing, treating, and disposing of waste; and the absence of a strategic strategy for MSW
g. Insufficient motivation and a lack of knowledge about environmental issues
h. Public attitudes toward trash management are not favorable
i. No use in wasting anything negative impression of the system
j. Population increase
k. Cost for waste pickup
l. Absence of commitment to and engagement in activities

m. Conflicts of interest
n. incorrect method of waste disposal
o. Inconsistency and a lack of waste-separating infrastructure and technology
p. Shoddy legal system
q. Insufficient and incorrect waste collection,
r. Investment hazard

Using the ISM technique, the management model's successful implementation was examined. ISM is a group learning technique that produces structural models to represent intricate systemic issues through graphic and language-thought-out patterns accurately. ISM techniques have been employed by numerous notable firms and highly qualified consultants to assist their customers in understanding difficult situations and locating answers to complex challenges across numerous industries. Huang et al. [33] presented a multi-dimensional scale for a complex system divided into subsystems with dependency and feedback that are often present but whose weights are difficult to determine. They integrated ISM with the analytic network technique to deal with subsystem interaction and feedback. Based on driving and dependent power variables, Agarwal et al. [34] used ISM to help manage strategic planning for enhancing supply chain agility. This paper uses ISM techniques to assist expert groups such as local government, academics, non-governmental organizations, and environmental services. This expert group will assess the factors that hinder the implementation of a circular economy in solid waste management from meeting the study objectives and providing a driving force and dependability.

The stages of the research were as follows:

a. Find sources of information that can provide an overview of the borders, subject, developments, and issues in the livestock sub-sector, as well as knowledge of the region and strategic management. Based on this information, formulate objectives to guide the implementation of the research.
b. Employ an expert survey to research and identify the essential components of implementing a circular economy in actual waste management. Also, identify the inhibiting factors of the selected circular economy, which are used as the subject of system development studies. At this stage, a questionnaire will be distributed to four experts. This questionnaire is a comparison matrix between the factors inhibiting the implementation of the circular economy.
c. Using Interpretative Structural Modeling to design a structuring system after researching and identifying the essential components of development (ISM)

The ISM-VAXO approach has the following stages (Table 1):

1. Creation of the VAXO's structural self-interaction matrix (SSIM-VAXO)
2. Conversion of SSIM-VAXO into binary integers for the Reachability Matrix (RM)
3. The transitive matrix test, third
4. Sub-element classification based on Driver Power (DP) and Dependence (D)
5. A hierarchy based on the rank of the sub-elements

Table 1. Lists the relationship symbols and definitions for each ISM-VAXO element

Symbol of the contextual relationship between elements i and j (e_{ij})	Definition of the contextual relationship between elements (e_{ij})
V	The element i causes a contextual relationship with j but not the other way around → (e_{ij} = 1 and e_{ji} = 0)
A	Element j causes a contextual relationship with i but not vice versa →(e_{ij} = 0 and e_{ji} = 1)
X	Elements i and j cause contextual relationship → (e_{ij} = 1 and e_{ji} = 1)
O	Elements i and j, and vice versa, do not cause a contextual relationship →(e_{ij} = 0 and e_{ji} = 0)

3. RESULT AND DISCUSSION

3.1 Result

Table 2. Barrier factors for the implementation of a circular economy

No	Code	Factor	Source
1	B-1	Hazardous waste disposal practices that are unregulated	[35-42]
2	B-2	Initiatives by the government to decide on implementation	[1, 38, 41, 43)
3	B-3	Location and features of the terrain	[36]
4	B-4	Lack of skilled waste management professionals	[35, 36]
5	B-5	Training shortage	[35, 36]
6	B-6	Absence of responsibility	[35, 35]
7	B-7	Budget is insufficient	[35, 36, 44]
8	B-8	the price of constructing an effective garbage collection, storage, treatment, and disposal system	[35-38, 44]
9	B-9	lack of a strategic plan for MSW	[35-38]
10	B-10	Framework for governmental financial regulation	[35-38, 42]
11	B-11	Low drive and ignorance about environmental issues	[35, 36, 42-44]
12	B-12	Unfavorable public perceptions of waste management	[35, 36, 42-44]
13	B-13	No value in waste	[36, 44]
14	B-14	Unfavorable perception of the system	[36, 44]
15	B-15	Population growth	[36]
16	B-16	Fee for garbage collection	[36]
17	B-17	Lack of participation and dedication in activities	[36, 43]
18	B-18	Competing interests	[36]
19	B-19	Incorrect option for disposal of garbage	[36]
20	B-20	Inconsistency and a lack of waste separating technologies and infrastructure	[36, 38]
21	B-21	Poor judicial system	[36, 37, 42, 43]
22	B-22	Incorrect garbage collection and quantity,	[36, 42]
23	B-23	Investment risk	[41, 45, 46]

Based on the literature search related to the inhibiting factors for implementing a circular economy, information can be obtained, as shown in Table 2.

The literature review findings are collected from various articles related to obstacles to implementing a circular economy in various countries. After that, the results of this literature review were compiled into a pairwise comparison questionnaire distributed to expert respondents. The results of the pairwise comparison assessment are arranged in Table 3 of the Structural Self Interaction Matrix (SSIM). Furthermore, the results of the SSIM matrix are then converted into a Reachability Matrix (RM), as shown in Table 4.

Based on the results of calculations by applying the ISM method, information can be obtained that the critical factors of the obstacles to implementing a circular economy are the price for building an effective waste collection, storage, processing, and disposal system (B8) and the initiative by the government to decide on implementation (B2). Furthermore, based on the respondents' assessment, the cost of collecting waste (B16) and the practice of disposing of unregulated B3 waste (B1) are at the second level. Meanwhile, the third level lacks participation and dedication in activities (B17) and the government financial regulatory framework (B10). In addition, at the last level, there is a lack of skilled waste management professionals (B4). In total, the aspects that impede the implementation of a circular economy are shown in Figure 2.

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Table 3. Structural Matrix Self Interaction Matrix (SSIM)

	B1	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**	**B11**	**B12**	**B13**	**B14**	**B15**	**B16**	**B17**	**B18**	**B19**	**B20**	**B21**	**B22**	**B23**
B1		X	X	X	X	X	A	X	A	A	X	X	A	X	O	X	X	O	V	X	V	X	O
B2			X	O	O	V	V	X	X	V	V	V	O	O	X	V	V	V	V	V	O	V	A
B3				O	A	O	X	X	O	A	O	O	V	O	X	X	O	X	V	A	O	O	V
B4					X	O	O	O	O	O	X	A	O	O	O	O	O	O	O	O	O	O	O
B5						X	X	A	A	O	X	X	X	X	O	O	O	O	O	O	O	O	O
B6							O	A	A	O	A	X	O	O	O	O	O	O	O	O	O	V	A
B7								X	X	X	O	O	V	A	A	X	A	O	A	X	O	A	X
B8									X	X	O	O	V	A	X	X	X	V	X	X	O	O	X
B9										X	O	O	O	O	A	X	O	A	X	A	O	A	X
B10											O	O	O	O	X	X	X	X	V	X	X	X	X
B11												X	X	X	O	O	X	O	X	X	A	A	O
B12													X	X	O	X	X	O	X	O	X	A	O
B13														X	O	A	X	A	O	O	O	A	A
B14															O	A	X	A	A	O	O	A	V
B15																V	A	O	O	O	O	O	A
B16																	X	X	V	V	O	V	V
B17																		O	V	X	V	V	O
B18																			A	O	X	X	X
B19																				A	A	V	X
B20																					A	X	X
B21																						V	X
B22																							X
B23																							

Table 4. Reachability Matrix (RM)

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	Driven Power	Ranking
B1	1	1	1	1	1	1	0	1	0	0	1	1	0	1	0	1	1	0	1	1	1	1	0	16	2
B2	1	1	1	0	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1	0	17	1
B3	1	1	1	0	0	0	1	1	0	0	0	0	1	0	1	1	0	1	1	0	0	0	1	11	6
B4	1	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4	12
B5	1	0	1	1	1	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	10	7
B6	1	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	5	11
B7	1	0	1	0	1	1	1	1	1	1	0	0	1	0	0	1	0	0	0	1	0	1	1	11	6
B8	1	1	1	0	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	1	0	1	1	17	1
B9	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	11	6
B10	1	0	1	0	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	15	3
B11	1	0	0	1	1	1	1	0	0	0	1	1	1	1	0	0	1	0	1	1	0	0	0	11	6
B12	1	0	0	1	1	1	0	0	0	0	1	1	1	1	0	1	1	0	1	0	1	0	0	12	5
B13	1	0	0	0	1	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	7	10
B14	1	0	0	0	1	0	0	1	0	0	1	1	1	1	1	0	1	0	0	0	0	1	1	10	7
B15	0	1	1	0	0	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	8	9
B16	1	0	1	0	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	16	2
B17	1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	0	15	3
B18	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0	1	1	1	0	0	1	1	1	10	7
B19	0	0	0	0	0	0	1	1	1	0	1	1	0	1	0	0	0	1	1	0	0	1	1	10	7
B20	1	0	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1	0	1	1	0	1	1	12	5
B21	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	1	1	1	1	9	8
B22	1	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	1	0	1	0	1	1	12	5
B23	0	1	0	0	0	1	1	1	1	1	0	0	1	0	1	0	0	1	1	1	1	1	1	14	4
Dependence	18	7	11	6	11	9	15	14	12	13	13	13	13	11	7	12	11	10	14	12	7	12	13		
Hierarchy	1	9	6	10	6	8	2	3	5	4	4	4	4	6	9	5	6	7	3	5	9	5	4		

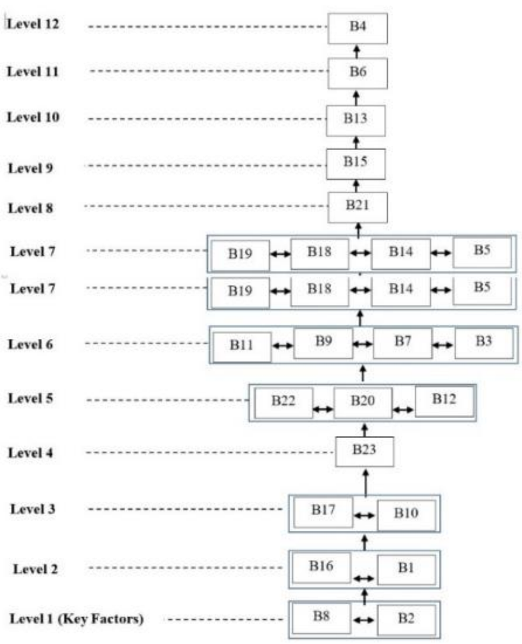

Figure 2. Critical factors of circular economy

In recent years, academics, towns, and politicians, among others, have become increasingly interested in the CE notion. It is evident from the study by Reike et al. [47] that the CE has focused on several fundamental ideas, namely waste management and recycling. By reducing the quantity of trash released into the environment, the CE seeks to bring economic value [48]. According to CE approaches, the main goals of advanced waste management are to decrease or stop trash production, promote recycling, and enhance waste recovery operations [49].

Effective waste management makes it possible to maintain the CE model. Additionally, identifying the main obstacles is crucial for enhancing waste management procedures. Many academics and industry professionals have lately recognized several potential obstacles that could prevent new waste management strategies from being successful. Veleva et al. [50] created a conceptual framework with 11 new CE metrics utilizing the Global Reporting Initiatives (GRI). They examined the zero waste management practices of eight biotech and pharmaceutical firms. The five primary dimensions for companies, business fundamental, operative, attitudinal, and scientific, are examined by Ritzén and Sandström as multi-dimensional and multi-domain hurdles to CE [51]. According to their research, the most significant impediments for an industrial organization are attitude and knowledge integration between functions, value chain structure, technology, value, and money. Crawford et al. [52] presented 22 assembly obstacles under four primary techniques to improve the environmental effectiveness of building and flattening waste management. They discovered that impediments to significant construction impacts included a lack of financial assistance, industrial culture, a lack of finance, a lack of time for trash disposal, and a lack of education. Academicians, residents, municipal officials, administrators, and organisers were among the participants in in-depth interviews conducted [53]. They also performed a SWOT analysis to evaluate internal and external elements and potential forthcoming obstacles to municipal solid waste.

3.2 The waste bank model is the embodiment of a circular economy

The circular economy model is one of the economic concepts put forth to the globe, and it allows for reprocessing consumed commodities (Reduce, Reuse, Recycle, Replace, Repair). The garbage is multiplied to lessen the influence of waste damaging to the earth and can be utilized as a raw material for other products or as a new product. A production economy strongly emphasizes linear calculations and can be contrasted with a circular economy. As a result, some factors are depressed due to continual production. The waste bank program is one household-level application of the circular economy. By reusing and digesting domestic waste, societies can become creators and clients. The sorting results can be used for daily requirements or sold to third parties.

The State Minister of the Environment's Regulation No. 13 of 2012 defines a trash bank as a location for gathering and sorting recyclable and economically valuable waste. The waste bank is one waste management strategy centered on the public and invites the typical community to participate in controlling environmental events [54, 55]. Waste management has many options to enable community members to handle their garbage independently in their homes and equally turn it into savings. The mechanisms must establish a mutual relationship for the public to relish and benefit from participation genuinely.

It is possible to use the Waste Bank (WB) as a collection or drop-off location for waste that can be sold, recycled, or use again and is subject to EPR regulations. The financial worth of garbage saved in a bank for waste motivates people to sort and collect waste. A waste bank is a collection/delivery point created as a starting point for recalls of product items already in progress and covered by EPR requirements from the producer's point of view. Further, it is easier for producers not to need to create additional collections or drop-off stations thanks to the waste bank. As a result, producers are required to fund the establishment of waste banks, which are communally approved and constructed on the quantity and cost of the waste products traded.

An alternative waste bank operates entirely with clients, bookkeepers, and management. Money is what the customer usually (usually) deposits in the bank. Therefore, waste has potential economic value when stored in waste banks by the public or consumers. Managers must be creative, innovative, and entrepreneurial to invite individuals to deposit waste through a waste bank.

3.3 Sustainable circular economic practices for waste banks

Environmental issues are directly tied to the idea of sustainable development. According to this theory, financial development still needs to be sustained since its social and ecological implications. A new understanding is needed concerning growing and developing economic concepts consistent with sustainable development. Given this urgency, the pursuit of sustainable development has turned its attention to green growth. Green growth aims to speed up economic growth without compromising its sustainability by using resources that are more robust, efficient, and clean [56].

A field of study, "green economies," examines initiatives to promote sustainable development through green economic expansion. By putting a circular economy into place, it is possible to generate green growth consistent with sustainable development. An economy centred on a fabrication-depletion organism that makes the most of the output from a linear energy production and consumption system is known as a circular economy [57].

The circular economy is built on a comprehensive strategy considering the necessary elements to depart from the traditional linear economic development paradigm [58]. The circular economy can be viewed as an alternate prototypical that will motivate manufacturers to devise creative ways to reduce waste output while promoting environmentally friendly practices and resource efficiency [59, 60].

The 5R principles—Reduce, Reuse, Recycle, Recover, and Revalue—are applied in economic operations in their physical form. According to projections, the recycling industry's application of the circular economy might lead to establishing of 1,000 new businesses and employing more than 3 million people in Indonesia. By 2030, it could contribute US$ 14 billion or Rp 200 trillion to GDP, cut waste by 50%, and cut greenhouse gas emissions by 29-41 per cent [61].

Schroeder et al. [62] stated that numerous SDG objectives, such as goal 6, guaranteeing the resource and management of hygienic water, are thoroughly tied to the circular economy concept. Goal 7 also guarantees access to reasonably priced, trustworthy, sustainable, and contemporary energy. Target 8 advocates for comprehensive and productive employment opportunities, complete and ecological financial developments, and fair pay. To confirm ecological manufacture and depletion patterns, refer to target 12. Target 15 focuses on stopping desertification, correcting land degradation, encouraging sustainable forest management, and protecting, restoring, and using terrestrial ecosystems.

Furthermore, there are some difficulties and barriers to adopting a circular economy in Indonesia, even though doing so will enhance GDP and economic growth rates and environmental preservation. These issues and challenges generally include several things, for example, information literacy, consumer and producer behaviour adaptation, product markets, and capital. In addition, it is necessary to support ecologically approachable technological invention, staffing resource capability, infrastructure provision, and a proper, specific, and well-founded monitoring context.

Presidential Directive Number 83 of 2018 Regarding Marine Waste Management regulates waste management practices. An Accomplishment Strategy for Handling Marine Debris from 2018-2025 is contained in this Presidential Regulation. It is implemented through various strategies, such as a nationwide promotion to raise participant responsiveness, discarded management on land, waste management at sea, funding mechanisms, institutional strengthening, supervision, law enforcement, and study and improvement. Therefore, It is hoped that by 2025 it will reduce plastic waste by up to 70%.

Making a circular economy ready, the creation of the National Action Plan (RAN) is now in progress. This planning is crucial because adopting a circular economy requires more than just industry backing; it also needs a framework that policymakers, namely the government, can support. There are three critical areas of Regulation in the creation of circular economy policies: first, product fabrication, which encompasses the controlling of reprocessing, repair, recycling, and revalues in the manufacturing environment. Secondly, encourage the development of ecologically friendly technologies. The third step is establishing a market environment for green goods [63]. Risk mitigation must be used while establishing regulations because of its connection to environmental conservation efforts and societal considerations [64].

Because an upstream-to-downstream monitoring framework is required, the circular economy application strategy is multi-sectoral and necessitates the collaborative participation of appropriate parties. Within the quadruple helix paradigm framework, stakeholders in policy development include the government, commercial/manufacturing, university, and public culture. The government is a regulator by supporting the governance, finance, and legal framework [48]. Academics also participate in scientific suggestions, innovative projects, and research on eco-friendly technologies. The industrial business sector also creates new goods and business models and practices sustainable production. Additionally, civil society links collaboration networks, monitors and evaluates policies, and promotes information literacy among the general public.

4. CONCLUSIONS

The zero waste project and the concepts contained therein have recently been implemented in Jepara District, Central Java Province, Indonesia, and have carried out projects related to zero waste management. Indonesia's zero waste initiative is developing as a result of the country's determination to meet international environmental standards and achieve circular economy goals. However, current constraints make adopting zero waste management a challenge. Successful management of waste depends on identifying and accurately understanding these possible bottlenecks. No research examines the significant obstacles to organising and implementing circular economy-based waste management in Indonesia.

We created an efficient way to analyse potential barriers to real-world implementation of zero waste based on causal relative charts to address this gap in the literature. To do this, 23 potential barriers that need to be evaluated have been identified. The ISM model approach is then used to understand the structure of hierarchical and circumstantial relationships among the obstacles to zero waste management. The strength of the suggested approach is its ability to illustrate the problem using a causal relationship diagram highlighting the significance of each causal bottleneck. In addition, this model assists the authorities and stakeholders understand the fundamental barriers to effective zero waste management in Indonesia. An added advantage of this prototype is that it uses the extended ISM method to get the best alternative based on expert judgment. The results of this study can be a role model to be applied in other regions in Indonesia, considering that there are many similarities in the characteristics of the problems. Some of the limitations in this study include not explaining how high the relationship between potential factor constraints is in pairs and the structural relationship between obstacles to identify obstacles in implementing circular economy in zero waste management. Future research could examine the relationships between different types of stakeholders and compare potential barriers in pairs to determine causal correlations. Future studies should also examine the structural relationships between barriers to identify natural barriers to zero waste management. As a result, additional research is suggested to overcome the previously disclosed constraints and can be applied to Structural Equation Modeling (SEM) to increase the legitimacy of the suggested prototypes.

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