



Circular Economy Implementation: A Case Study in Indonesia

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Abstrak:

Circular economy has become a trend as an approach in many countries to achieve sustainability. Indonesia as one of the most populous countries also implement Circular Economy for environmental purpose. The number of research publication has been increasing for the past several years in Indonesia, however review of such publication from the perspective of SLR (Systematic Literature Review) has been lacking. This research will identify and illustrate how far the circular economy implementation has been done in Indonesia. This research applies systematic literature review, mapping analysis, and bibliometric analysis to answer the gap. The database in this research based on Scopus Indexed publication from 31.453 publication, in which this research successfully extracted 35 publications. The key findings in this research were Circular Economy implementation in Indonesia mainly on Agriculture and Household sector within Java Island by using reduce, reuse, recycle strategy dominantly. The bibliometric analysis shown that there is strong relationship between circular economy implementation and waste management that gave impact on sustainability. This research reveals the research gap for circular economy by geographical, strategy, and topics as potential future research. This research carries some weight to support Indonesia future implementation on Circular Economy.

Keywords: Circular Economy, Indonesia, Implementation, Case Study

Introduction

Nowadays, circular economy became a popular approach for many countries to achieve better environmental quality, economic prosperity, and social equity (Mensah, 2019). Circular Economy also could contribute to sustainability. Circular economy is an economic system which affect 'end-of-life' concept starting from production until consumption and waste management process, circular economy applies on micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation, and beyond), with the main objective to achieve sustainable development (Kirchherr et al., 2017). Circular Economy emphasizes on resource

consumption in the production process by implementing 5R (Reduce, Reuse, Recycle, Refurbish, and Renew) and the aim is to increase the resource efficiency (Reuter et al., 2019), therefore the resource required and waste output from the process will be minimized.

Indonesia as one of the large countries in Asia and consists of more than 17000 islands with the ranked 4th most populous country. Indonesia generates around 95.9-ton waste in 2019 and the number expected to rise up to 155.3-ton waste by 2030. The circular economy implementation will result in CO₂ emission and water usage reduced by 125 million-ton CO₂ and 6.3 billion m³ water by 2030. Implementation also gives an impact on GDP increase up to IDR 45 billion (around \$2.8 million USD) alone (Al Zadjali et al., n.d.). That is why the Indonesia Government drives each sector to implement circular economy.

This research objective is to identify and illustrate the current situation of circular economy implementation in Indonesia (Fatimah et al., 2020). In order to achieve the objective, our paper will review and analyse systematically on Scopus publication with the topic that discussed Circular Economic implementation in Indonesia. So far to the knowledge of the authors, there is limited review on the implementation of circular economy in Indonesia. Therefore, this manuscript will give a significant contribution for circular economy in Indonesia, and to provide review for further implementation of the concept within the country (Ngan et al., 2019).

Methods

Systematic Literature Review (SLR) used in this research to analyse current circular economy implementation in Indonesia. The PRISMA procedure (Preferred Reporting Items for Systemic Reviews and Meta-Analysis) also implemented in this SLR to select the correlated journal for the research. Literature used in this research will be based on Scopus indexed database as they are categorized as peer reviewed journal and conference papers indexed in Scopus. The search conducted in Scopus page by entering keywords “circular economy”, “Indonesia”, limited to the affiliation country: Indonesia, “case study” or “Implementation”. Boolean searches for the Scopus search were TITLE-ABS-KEY ((circular AND economy) AND Indonesia AND (case AND study) OR implementation OR application) AND (LIMIT-TO (AFFILCOUNTRY, "Indonesia")). Firstly, the keyword “Circular Economy” entered and around 31.453 article shown. Next, the second keyword “Indonesia” entered and limited to affiliation country “Indonesia” resulted in 120 articles remained. Then, the third keyword “case study” or “implementation” or “application” entered and resulting in 64 articles remained. Lastly, the remaining 64 articles were selected furthermore with the exclusion criteria as shown in Table 1. The detail for systematic literature search can be seen in Figure 1

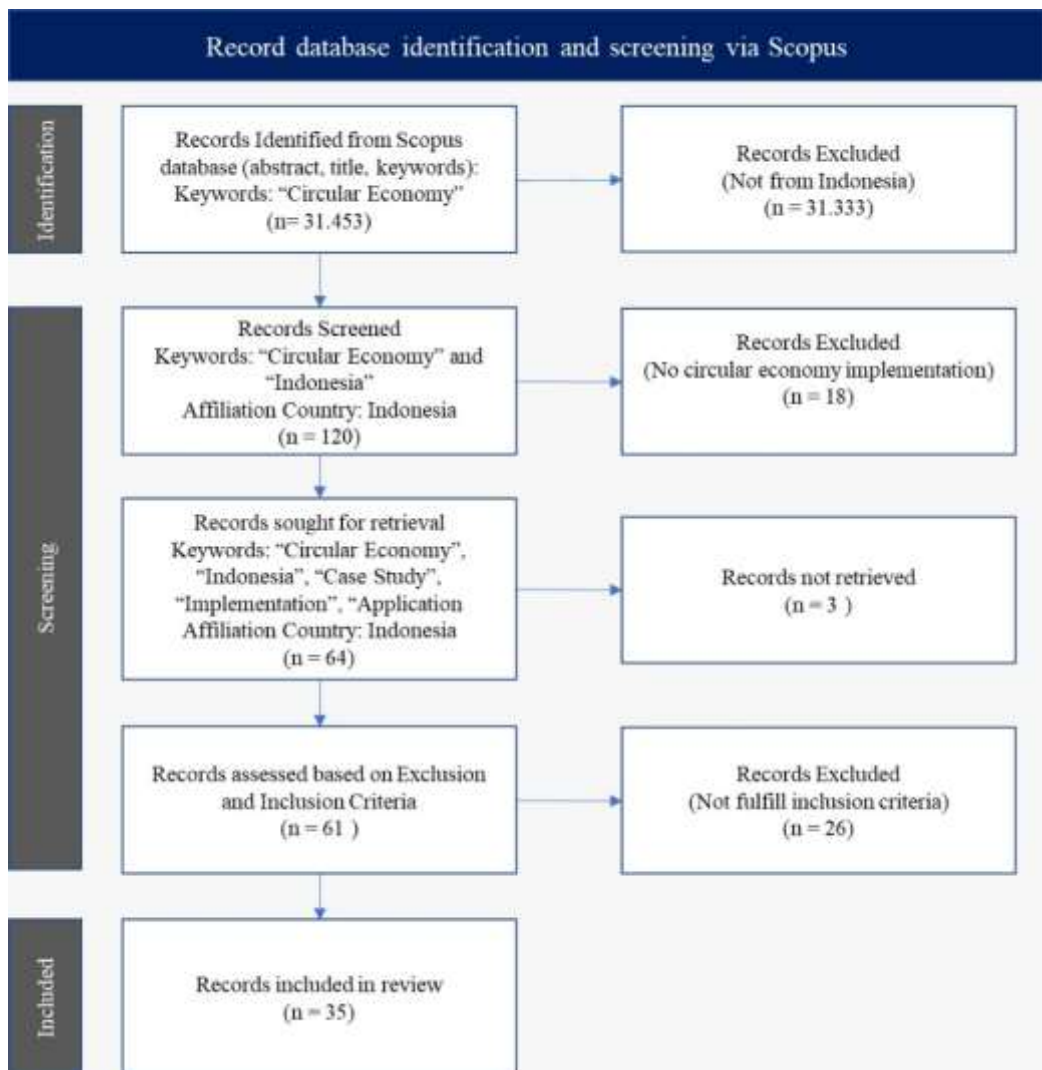


Figure 1 The Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) for this study

Table 1 Inclusion and Exclusion Criteria

Criteria	
Inclusion	Exclusion
Articles relevant to the research objective	Articles irrelevant to research objective
Articles reported the implementation of circular economy	Articles didn't report the implementation of circular economy
Circular economy	Circular economy

implementation within Indonesia	implementation outside Indonesia
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The article that did not meet the inclusion criteria was excluded and 35 paper used for further analysis. The article was read, checked thoroughly, and summarized in Table 2 based on circular economy level, strategies, implementation, result, and implemented location in Indonesia. Mapping analysis using in this study to analyse distribution of circular economy in each sector, distribution of circular economy implementation location in Indonesia, and implemented circular economy strategy. Aside from systematic literature review and mapping analysis, this research also used the bibliometric analysis using VOS viewer. From the result of bibliometric analysis, visualization of interlinked of the keyword from 35 key papers was obtained.

Result and Discussion

Systematic Literature Review

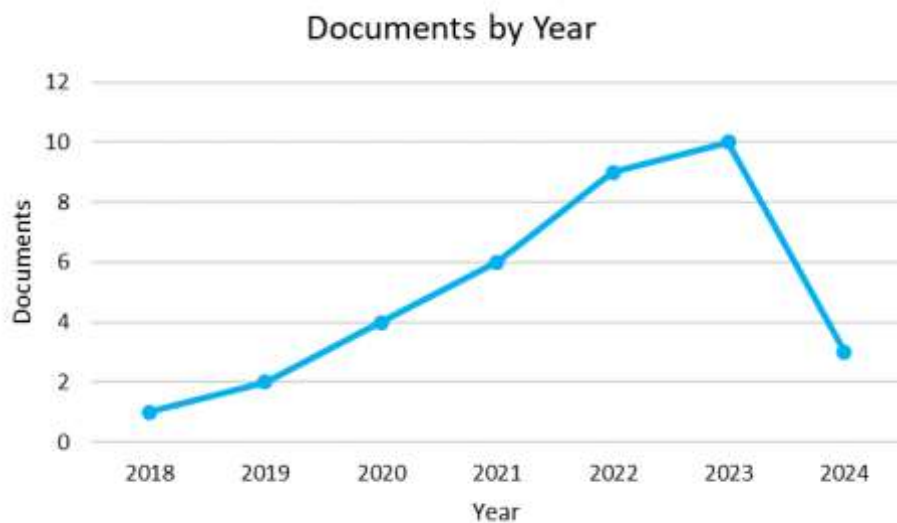


Figure 2 Circular Economy Case Study/Implementation in Indonesia Indexed Scopus Publication

Circular economy implementation in Indonesia become more popular topic each year. The number of published article increases each year and do so. Stakeholders (Researchers, Industries, and Government) are increasing the implementation each year to achieve 2030 Indonesia target. Understanding current Indonesia position becoming an important issue, because stakeholders need view and strategize based on current

Indonesia position to implement circular economy effectively and efficiently in order to enhance circular economy implementation benefit in Indonesia. The detail for the published article will be shown more detail in Figure 3.

Table 2 Mapping of Circular Economy Implementation in Indonesia, based on Selected Key Papers using The Scopus Database

No	Sector	CE Implementation	CE Level	Case Study Geographic			Ref
				Island	Province	Location	
1	Agriculture & Agroindustry	• Reuse agriculture/agroindustry waste for animal feed. • Reuse sack to fertilizer wrap • Reuse treated water from waste water treatment • Reuse waste hot steam from boiler to power generation • Recycle agriculture/agroindustry waste to fertilizer, paving materials, paper pulp • Converting agriculture/agroindustry waste (biomass) to Syngas, Bioethanol, etc which is utilized for fuels and electricity.	Meso Level	Java	West Java, East Java	Bandung, Depok, Jember	(Laili, Djatna, Indrasti, & Yani, 2024), (Laili, Indrasti, Yani, & Djatna, 2024), (Perdana, Kusnandar, Perdana, & Rahayu, 2023), (Latif, Cahyandito, & Utama, Circular Economy Concept at the Micro-Level: A Case Study of Taruna Mukti Farmer Group, Bandung Regency, West Java, Indonesia, 2023), (Latif, Cahyandito, & Utama, Dynamic System

									Modeling and Sustainability Strategies for Circular Economy-Based Dairy Cow Waste Management , 2023), (Harihastuti & Purnamastuti , 2022), (Suhartini, et al., 2022), (Trisyulianti, Prihartono, Andriani, & Suryadi, 2022), (Irsyadillah, Priadi, Tjahjono, Fitri, & Islami, 2020), (Nasution, Aula , & Ardiantono, 2020)
2	Household	- Recycle waste cooking oil to soap and other valuable products - Recycling plastic waste by plastic manufacturer into new plastic product or handcrafted item - Recycling packaging waste into pallet and construction	Macro Level	Java, Sulawesi	West Java, DKI Jakarta, Central Java, East Java, Banten, Southeast Sulawesi	Bandung, Kepulauan Seribu, Semarang, Salatiga, Karimun Jawa, Jepara, Malang, Tangerang , Wakatobi	(Rimantho, Syaiful, Nurfaida, & Sulandari, 2022), (Ratnasari, Mizuno, Herdiansyah , & Simanjutak, 2023), (Haumahu, Budihardjo,		

		- material • Reuse used cloth for family member • Recycle organic waste into compost/fertilizer • Non-organic waste will be sent to third party for recycling • Food waste valorization to bioenergy (briquette, biogas, biodiesel, etc) • Integrating automatic segregation and digitalization at waste banks is efficient in terms of time					Priyambada, & Puspita, 2023), (Chandra & A Ismail, 2022), (Hartini, Sari, Utami, Widharto, & Ramadan, 2023), (Kurniawan, Meidiana, Dzarfan Othman, Goh, & Chew, 2023), (Suhartini, et al., 2022), (Jaya & Machdum, 2023), (Argo & Rachmawati, 2021), (Kurniawan, et al., 2021)
3	Furniture Industry	• Efficiency of material use, collaborate with supplier for reuse • Recycle waste wood material in manufacturing process	Meso Level	Java	Central Java	Jepara, Kudus, Blora, Semarang, Rembang, Surakarta	(Wicaksono, Naufal, Saptadi, & Susanty, 2021), (Susanty, Tjahjono, & Sulistyani, 2020)

Table 2 cont.

No	Sector	CE Implementation	CE Level	Case Study Geographic			Ref
				Island	Province	Location	
4	Construction Industry	• 3R CE (e.g cast of concrete floor rebate,	Micro Level		Indonesia (not specified location)		(Adi & Wibowo, 2020)

		work floor for putting utility equipment)					
5	Textile & Apparel's Industry	• Using Natural dye instead of synthetic color in Batik to minimize waste produced • Green Logistics: • Using transportation methods that reduce emissions • Giving the utilization of recyclable and reuse raw materials top priority • Promoting the use of recyclable and reused raw materials in product packaging • Increasing knowledge sharing from environme	Micr o Leve l	Java	West Java, Central Java	Ciwaringin, Klaten	(Uii & Sugarindra , 2023), (Muafi, 2021)

		ntal informatio n aspects through a network of logistic associatio ns for the acquisitio n of green production • Monitorin g and evaluating the environme ntal policies and practices					
6	Manufacture	• Electric vehicle (EV) and EV battery Industry	Micro Level			Indonesia (not specified location)	(Wulansari & Aziz, 2022)
7	Packaging Industry	• Recycle end of life product into corrugated paper or polyum board	Micro Level	Java	DKI Jakarta	Jakarta	(Kuo, et al., 2021)
8	Biodiesel Industry	• Minimize natural resource waste with maximize resource and energy circularity in biodiesel	Micro Level			Indonesia (not specified location)	(Veza, Muhammad, Oktavian, & Djamari, 2021)
9	Port and Fishing Industry	Integrated waste management Green Port: • Fish	Micro Level	Bali	Bali	Benoa	(Gurning & Tangkau, 2022)

	byproduct/solid waste used as fertilizer
	• Squid byproduct/solid waste used as fertilizer and reprocess into melanin, chitin, and biodiesel • Non-recyclable solid waste will be incinerated and remaining heat will be reused to generate electricity

Table 2 *cont.*

No	Sector	CE Implementation	CE Level	Case Study Geographic			Ref
				Island	Province	Location	
10	Electronics	• Promote used/worn product component for remanufacturing as new product • Implement electronics waste bank	Micro Level	Java	DKI Jakarta	Jakarta	(Rimantho, Syaiful, Nurfaida, & Sulandari, 2022), (Fatimah, Govindan, Murniningsih, & Setiawan, 2020)

		(e-bank)							
11	Services	• Reduce water use and water pollution through creating incentive and disincentive policy	Micro Level	Java	DKI Jakarta, West Java, Central Java	Jakarta, Magelang, Sukabumi, Semarang, Yogyakarta, Salatiga, Pati			(Yuana, et al., 2024), (Lindawati, Audrelia, & Firmansyah, 2022), (Fatimah, Govindan, Murniningsih, & Setiawan, 2020), (Eneng, Lulofs, & Asdak, 2018)

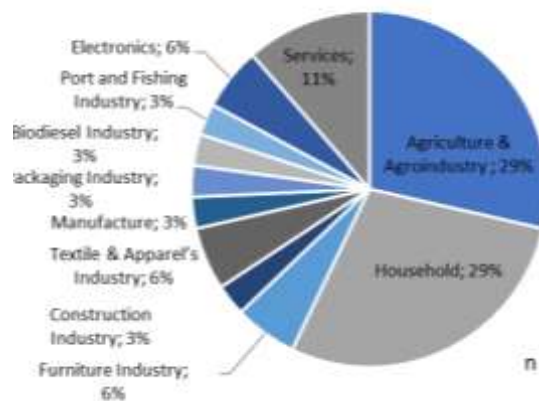


Figure 3 Circular Economy Industry Sector implementation in Indonesia

The main industry implementation for Circular Economy in Indonesia (based on Scopus database) are mainly in Agriculture & Agroindustry (29%), Household (29%), and Services Company (11%). These three sectors alone cover almost 70% of the sector implementation in Indonesia. These data resemble Indonesia as an agriculture country, whereas the major Indonesia people work in agriculture area. Which is why the agriculture & agroindustry remain as dominant sector for Circular Economy. Secondly the main sector for implementation is in the Household, this is due to Indonesia as one of the largest and populous country (ranked 4th in the most populous country in the world). One of the fastest ways to implement circular economy is through the people, especially the household waste. And lastly, in the services company as major industries in Indonesia. Indonesia applied waste treatment services that rely on community until recently the trend for circular economy become a popular approach to reduce waste. The implementation for the service industry are expected to become lower in the future, as the implementation in other industry will rise. This also will signify the Indonesia's changing trend in waste management.

Table 3 Circular Economy Strategies in Indonesia Sector

No	Sector	CE Strategy				
		Reduce	Reuse	Recycle	Refurbish	Renew
1	Agriculture & Agroindustry	√	√	√		√
2	Household	√	√	√		√
3	Furniture Industry	√	√	√	√	
4	Construction Industry	√	√	√		
5	Textile & Apparel's Industry	√	√	√		
6	Manufacture	√		√		√
7	Packaging Industry			√		
8	Biodiesel Industry	√				
9	Port and Fishing Industry	√	√	√		√
10	Electronics	√	√	√	√	
11	Services	√	√	√		

The majority of Circular economy Strategy in all sector depend on Reduce and Recycle Strategy (29% respectively), The next strategy implemented was using Reuse strategy (24%), followed by Renew (12%) and Refurbish (6%). According to several researches whereas Indonesia main approach is to use Reduce, Reuse, and Recycle method in the waste management. Based on this distribution it can be seen that Renew and Refurbish strategy can become quite a potential for Circular Economy Strategy to be applied in every sector.



Figure 4 Geographical distribution of Circular Economy Case Study/Implementation in Indonesia (Based on Scopus database)

From the perspective of general population, as picture in Table 4 in the form of percentage distribution, which being graphically shown in Figure 4, it is clear that the circular economy case study/implementation distribution focused mostly on Java Island. The circular economy activities on another large island in Indonesia such as Sumatra, Kalimantan, and Papua remain minimum.

Table 4 Percentage of Circular Economy Case Study/Implementation in Indonesia based on Island Distribution (Scopus Database)

Island	Percentage
Java	91.4%
Bali	4.3%
Sulawesi	4.3%
Sumatra	0%
Kalimantan	0%
Papua	0%

There was enormous difference from Java Island compared with another Island due to infrastructure disparity in other island compared with Java (Kusharjanto & Kim, 2011). The circular economy activities need to expand into other large Indonesian for better evenly circular economy distribution. The evenly distributed circular economy activities will accelerate Indonesia for achieving better in environment, economy, and social aspect. It is essential for researcher/government/industry to explore the potential for Circular Economy in others Island (Flint & Taylor, 2018).

Bibliometric Analysis

Bibliometric analysis used to reinforce the findings from systematic literature review (Inamdar et al., 2021). Bibliometric analysis keyword from 35 key papers using circular economy implementation as the term, found 31 keywords. Interlinkage about that's keyword visualization in Figure 5, as an output from VOS viewer software. Interlinkage keyword from 35 key papers circular economy implementation is visualized in Figure 5, as an output from VOS viewer software. Four main distinct clusters are identified, namely: recycling municipal solid waste (Blue), sustainability

waste management in Indonesia (Red), circular economy and sustainable development (Green), and management practice (Yellow).

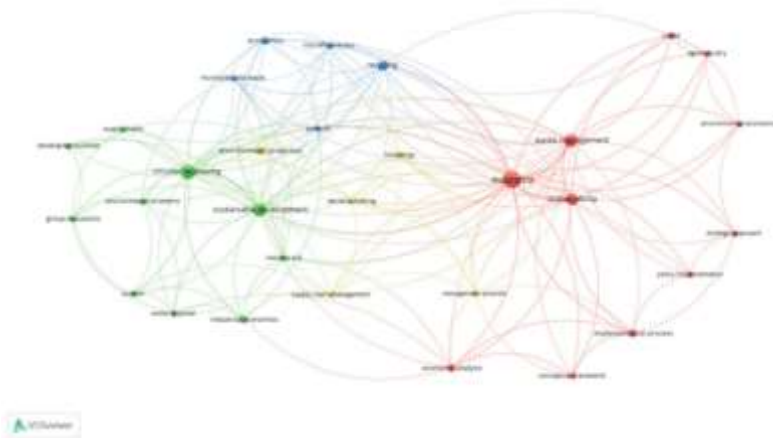


Figure 5 Interlinkage between Keywords of The Publications in Scopus Database related to Circular Economy Implementation in Indonesia

Table 5 Keywords based on 35 Scopus indexed publication

No	Keyword	Cluster	Weight
1	Circular economy	Green	21
2	Developing countries	Green	5
3	Environmental problems	Green	9
4	Group discussions	Green	7
5	Industrial economics	Green	8
6	Industry 4.0	Green	11
7	Supply chain	Green	7
8	Surveys	Green	2
9	Sustainable development	Green	20
10	Waste disposal	Green	9
11	Cost effectiveness	Blue	11
12	Economics	Blue	14
13	Municipal solid waste	Blue	10
14	Palm oil	Blue	9
15	Recycling	Blue	22
16	Agroindustry	Red	10
17	Coffee	Red	2
18	Conceptual framework	Red	6
19	Economic analysis	Red	10

20	Environmental economics	Red	6
21	Implementation process	Red	8
22	Indonesia	Red	62
23	Policy implementation	Red	5
24	Strategic approach	Red	6
25	Sustainability	Red	38
26	Waste Management	Red	21
27	Bioenergy	Yellow	14
28	Decision making	Yellow	11
29	Environmental protection	Yellow	4
30	Management practice	Yellow	10
31	Supply chain management	Yellow	10

Based on bibliometric visualization, each keyword weighted through VOSviewer and the weight result shown in Table 5. It can be seen that red and green cluster are dominant than the yellow and blue cluster. The weight from each cluster totalled into total weight to show the related topic. The red cluster (related to sustainability waste management in Indonesia) have 11 keywords with total weight 174, and the green cluster (related to circular economy and sustainable development) have 10 keywords with total weight 99. These findings due to circular economy implementation in Indonesia had a strong relationship with waste management and also impact on sustainability. This also align with other research, where circular economy gave a positive impact on sustainability and help create greater resilience (Piscicelli, 2023) (Mora-Contreras, Torres-Guevara, Mejia-Villa, Ormazabal, & Prieto-Sandoval, 2023) (Laureti, Massaro, Costantiello, & Leogrande, 2023).

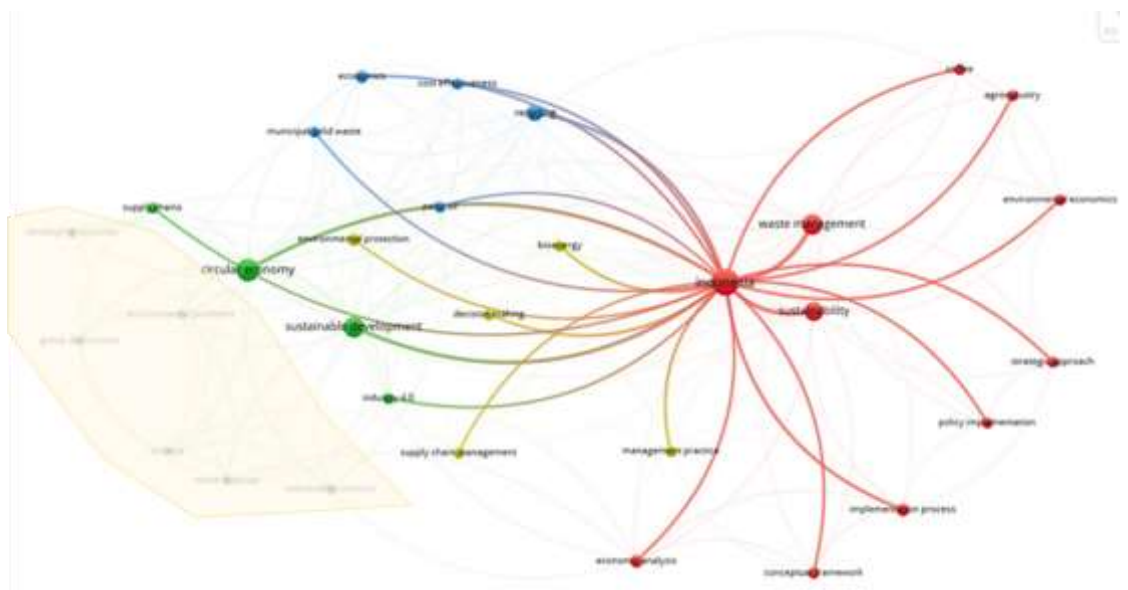


Figure 6 The Research and Publication Gap related to Circular Economy Implementation in Indonesia

Figure 6 shows the connection when “Indonesia” become the focus keyword. It can be seen that there are some areas shows no linkage or connection to Indonesia such as Waste Disposal, Industrial economics, environmental problem. These keywords indicate as research or publication gap in Indonesia. Therefore, the potential circular economy research area for future research around these topics.

Future Research

Based on the result and findings in previous section, there are some points that can be suggested as future researches which is:

- a. Renew and Refurbish as a potential approach in implementing Circular Economy in Indonesia (Kurniawan et al., 2021). The current implementation focuses on Reduce, Reuse, Recycle. There is some potential area that still can be explored by using these two approaches. Although these two approaches are presumed to be initiated from the industry, however it is very interesting to see how the future holds for these two approaches for Indonesia (Schouten & Bitzer, 2015).
- b. Other sectors beside Agriculture and Household hold prospective to be explored. Exploration for another sector will also accelerate the circular economic implementation (Ghisellini et al., 2016).
- c. The opportunity to explore outside Java Island for Circular Economy implementation (Fatimah et al., 2020). Current database on Scopus shows the implementation heavily focuses on Java Island. Indonesia has many potential unexplored areas for Circular Economy Case Study/Implementation. The other two most populous islands in Indonesia is Sumatra and Borneo, which is scarcely being explored for the concept of circular economy. It would be very interesting to see whether the implementation will work a bit similar or totally different with Java.
- d. Future research studies about waste disposal, industrial economics, and environmental problem interlinkage with circular economy (Goyal et al., 2021).

These future research recommendations will become important to reduce gap in the Circular Economy Implementation/case study especially in Indonesia.

Conclusions

Circular Economy has been reviewed in this paper through Systematic Literature Review, Mapping Analysis, and Bibliometric Review for Scopus Indexed Publications. This paper identified and extracted 35 publication from 31.453 entries in

Scopus by using keyword related to “circular economy”, “Indonesia”, “case study” or “Implementation” with affiliation country in Indonesia. These 35 publications were discussed and summarized in this paper. Circular economy implemented majorly in Java Island especially Agriculture & Household sector and circular economy dominantly applied by using reduce, reuse, and recycle strategy. It is revealed that there are many unexplored potential outside Java Island because Indonesia’s vastness in geographical and other sector require more exploration. Renew and Refurbish strategy also can be alternative approach for circular economy implementation. There are still some potential future researches surrounding circular economics regarding to waste disposal, industrial economics, and environmental problem. This paper is an attempt to shorten the gap for circular economy in Indonesia and help Indonesia stakeholder to have a better future.

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