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Green Economy of Plastic Value Chain Opportunity from Circular Economy Perspective

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Abstract

This study aims to examine the recycled plastic industry's competitiveness and supply chain strategy in Indonesia mediated by import regulations to improve the company's financial performance. Building the concept of circular economy in the green supply chain management framework. Optimizing the management and development of the recycled plastic industry also provides a multiplayer effect on product competitiveness, creates a green economy and green environment, and contributes to reducing virgin plastic import consumption. This research is based on quantitative methodology with population data from business people and employees within the scope of recycling plastic industry activities in the DKI Jakarta area. The Slovin formula produces a purposeful random sampling method for the respondent sample data collecting approach. This research was conducted by collecting questionnaires from respondents. The data was processed using SEM analysis tools on the SmartPLS 3.3 statistical application program. The results showed that innovation, investment, and import and export regulations from the government were able to increase the competitiveness of domestic plastic recycling products from a circular economy perspective. In addition, supported by good green supply chain management, it can improve the company's financial performance.

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1. INTRODUCTION

Plastic trash's pollution of land and marine habitats is one of the most concerning issues. The Ministry of Environment and Forestry (KLHK)'s National Trash Management System (SIPSN) data indicates that by 2023, the nation's overall trash volume will reach 72.4 million tons, with approximately 18.9%, or 14.2 million tons, coming from plastic garbage. The amount of waste made of plastic has increased by 11% since 2010. According to existing data, around 24% or around 16 million tons of waste has not received management from (Direktorat Jenderal Pengelolaan Sampah Limbah dan Bahan Beracun Berbahaya, 2019) until now. Only about 7% of this waste is successfully recycled after passing through the Final Processing Site (TPA). As a result, there has been an increase in waste volume that has reached the highest level in the last four years.

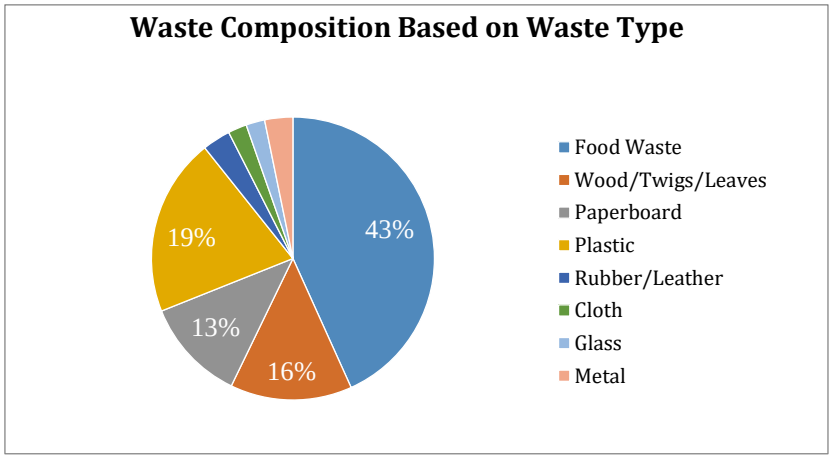
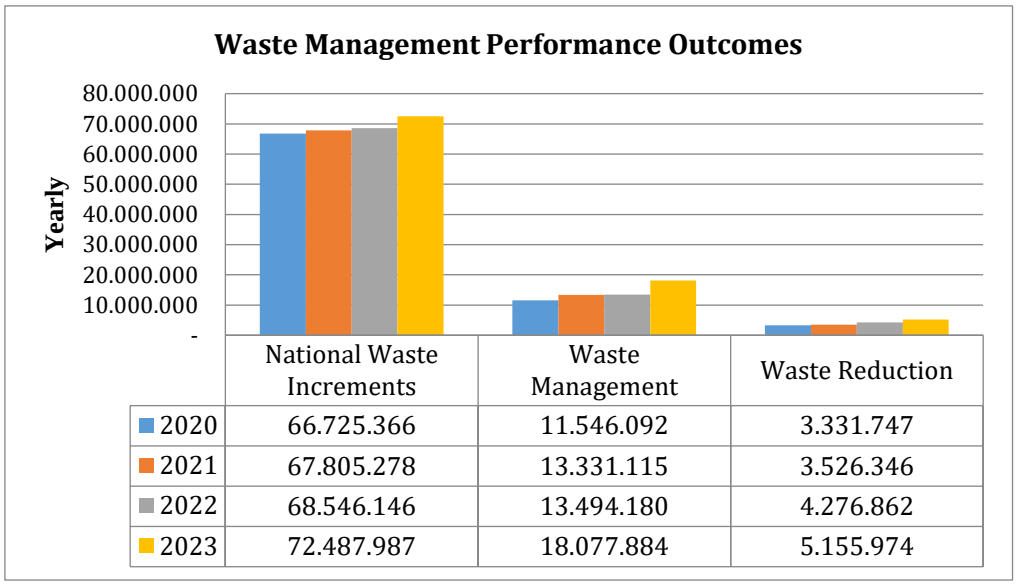


Figure 1. Waste portion classification
Source: sipsn.menlhk.go.id (2023)



	National Waste Increments	Waste Management	Waste Reduction
2020	66.725.366	11.546.092	3.331.747
2021	67.805.278	13.331.115	3.526.346
2022	68.546.146	13.494.180	4.276.862
2023	72.487.987	18.077.884	5.155.974

Figure 2. Waste maps of management
Source: sipsn.menlhk.go.id (2023)

The Plastic Stewardship Index shows Indonesia lags behind 25 other countries in plastic management, including Vietnam, Thailand, and Malaysia. It is believed that plastic waste management capabilities can be improved by reducing the use of plastic in packaging and daily activities and recycling plastic waste. To handle plastic trash, numerous nations have embraced the principles of the circular economy. Unlike in an economy that involves purchasing, utilizing, and discarding, plastic waste can be recycled into new products in a circular economy. Reduce, Reuse, Recycle, Recovery, and Repair, or the 5R strategy, is a fundamental component of the circular economy idea (Artha et al., 2023).

Table 1. Circular Economy well done in few countries

No	Country	Year
1	European Union	2018
2	Netherlands	2018
3	Japan	2000
4	Italy	2020
5	France	2020

Source: ikft.kemenperin.go.id (2023)

In Indonesia, the recycling process of plastic waste is still minimal, less than 11%, about 9-10%. As a result, about 90% of plastic waste is still not recycled and scattered in different places. About 30% of municipal plastic waste is dumped into drains that reach the sea and cause marine pollution. The Indonesian government has pledged to reduce national waste by 30% by limiting waste production, recycling, and reusing unused items (Wibowo et al., 2023). At the same time, it is hoped that the target of 70% of all national waste will be realized through the separation, collection, transportation, treatment, and finalization of waste (Direktorat Jenderal Pengelolaan Sampah Limbah dan Bahan Beracun Berbahaya, 2019).

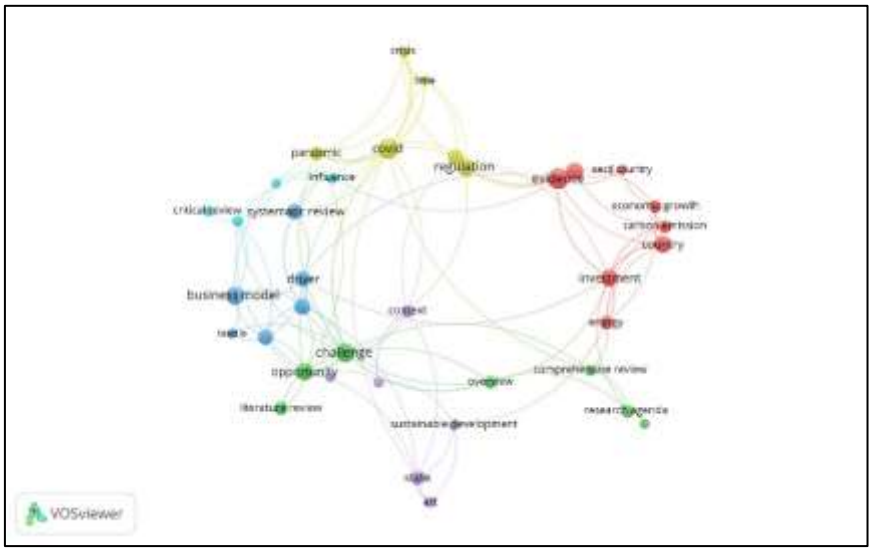


Figure 3. Network research of circular economy
Source: Data Processed (2024)

From a circular economy perspective, plastic waste management can improve companies' competitiveness by implementing recycling and reuse practices (Djaini et al., 2023). Some factors to consider involve understanding the concept of circular economy, the economic benefits that can be generated from plastic waste management, and implementing integrated management measures in the context of circular economy (Anastasia, 2019). Johansen et al. (2022) explained that economic benefit management can be achieved through import and export activities. This reflects that plastic waste can be considered a commodity, and its economic value can be increased through recycling and reuse. This includes green production and supply chain management, which ultimately has long-term benefits for the environment and the economy (Darmastuti et al., 2021; Permana et al., 2023). This process can also shorten and simplify supply chains and improve customer awareness. However, many studies, such as those Listyadewi (2023) and Subekti (2023), have different opinions, and some say that more technology and human progress are needed to implement a circular economy system.

For this reason, some companies are reluctant to introduce a circular economy system due to concerns about increased production costs and neglect of waste management and recycling. In addition, innovation should be carried out so that the original plastic can be reused, recycled, or decomposed so that all plastic products remain within economic limits and do not pollute the environment (Khairunnisa, 2021). Masruroh and Fardian (2022) explained that export activities could establish circular economy standards, reduce plastic leakage, and create a better system for economic, environmental, and social conditions, including cost assessment and greenhouse gas emissions. However, Syberg et al. (2021) argues that ineffective import regulations can result in plastic waste that cannot be processed or recycled, causing environmental contamination.

This research is based on the gap in earlier studies. To minimize plastic pollution, the first concern is applying circular economy principles to managing plastic trash, the research of shows that corporate competitiveness and sustainable supply chain management are designed for business sustainability and reduce negative impacts on the environment. The second gap lies in the circular economy's consideration of resource utilization and efforts to reduce waste. Susiati et al. (2023) revealed that implementing import regulations can reduce the presence of microplastics and create a more efficient system in terms of economy, environment, and society.

1.1. Literature Review

The grand theory used in this research is industrial ecology theory. Industrial ecology studies the systemic relationship between society, the economy, and the natural environment. The focus is on using technology to reduce environmental impact and reconcile human development (Purwanto, 2020).

a. Circular Economy

The circular economy is a strategy for economic systems that emphasizes resource efficiency, waste reduction, and resource return to the production cycle, according to the Ministry of Environment and Forestry (KLHK). The circular economy concept is described as optimizing the use and value of products, components, and raw materials to support sustainable economic operations (Triantika, 2022). Access to new markets, increased energy efficiency, a favorable brand image, and ecologically responsible products are just a few advantages of implementing a circular economy. The following are the parameters used to assess the circular economy: 1) More efficient use of raw materials; 2) Use of renewable energy; 3) Use of green technology; Increased community involvement in waste management. The following are the factors that influence the implementation of a circular economy: 1) Public Awareness; 2) Government Policy; 3) Environmentally Friendly Technology; 4) Availability of Recycled Raw Materials; 5) Cooperation Between Related Parties; 6) Incentives for Companies.

b. Innovation

Innovation can be defined as the development and implementation of a new idea by someone in a job or service (Madiya & Yasa, 2023). Rogers defined innovation as ideas, thoughts, and actions considered new and accepted by an individual or group for implementation. According to Kuniyoshi Urabe, the new project is not a one-time event but a long and comprehensive process. Innovation indicators are parameters or measures used to assess the extent to which an innovation is successful. Some commonly used innovation indicators include 1) Speed of Innovation Services, 2) Level of Innovation Adoption, 3) Level of Innovation Success, 4) Level of Creativity, and 5) Level of Efficiency. Factors that influence innovation can be grouped into internal and external factors; internal factors are as follows: 1) Control Center; 2) Tolerance; 3) Values; 4) Creativity; 5) Ability to Take Risks; 6) Ability to start up. The external factors are: 1) Role Model; 2) Activities; 3) Opportunities; 4) Market Growth; 5) Level of Competition; 6) Environmental Factors.

c. Investment

An investment is a step or series of actions that involves allocating significant resources (such as money, time, and energy) to an asset or project to obtain future returns. According to Permana et al. (2023), investing is the act of investing capital, usually for the long term, to acquire all assets or to buy shares or other financial instruments to make a profit. Here are the investment indicators: Capital Investment: 1) Portfolio Investment; 2) Direct Investment; 3) Private Investment; 4) Foreign Investment; 5) Government Investment; 6) Income Investment; 7) Mutual Fund Investment. Some factors that influence investment involve 1) Economic Conditions, 2) Political Stability, 3) Changing Market Trends, 4)

Government Policies, 5) Knowledge, 6) Motivation, 7) Facilities, 8) Labor Availability, and 9) Market Factors.

d. Import and Export Regulations

Import and export regulations refer to rules governments make to oversee international trade activities, including buying and selling goods or services between countries (Fasa, 2021). These rules cover various aspects such as import-export procedures, international regulatory standards, tariffs, and quality requirements in export destination countries. Indicators of import and export regulations include 1) Export and Import Growth, 2) Product Diversification, 3) Export Markets, 4) Tariffs, 5) Export and Import Commodities, 6) Business Actors, and 7) Import and Export Control.

1.2. Research Framework

a. The Circular Economy Perspective on the Impact of Innovation on the Plastic Value Chain Opportunities.

According to the circular economy perspective, advancements in the plastic waste domain within the plastic value chain have the potential to mitigate plastic waste, mitigate adverse environmental effects, and foster sustainable economic growth. However, it is essential to remember that these innovations must be appropriately designed and permanent to avoid any adverse effects (Ramadoni et al., 2023). In addition, implementing a circular economy system that efficiently uses and adds value to raw materials, components, and products can reduce plastic waste and its adverse environmental effects (Wong, 2020).

Innovation in using plastic waste in plastic production can contribute to plastic reduction, reduce environmental impact, and promote sustainable economic development (Arena, 2018). However, it must be done efficiently and effectively to avoid negative impacts. Social media and circular economic programs can help improve community participation and enhance local environmental sustainability (Li, 2020).

H1: Innovation Affects of the Plastic Value Chain Opportunities from a Circular Economy Perspective.

b. The Circular Economy Perspective on the Impact of Investment on Plastic Value Chain Opportunities.

We aim to become an ecologically conscious and sustainable industrial facility by supporting the circular economy by building plastic waste processing facilities. According to Masruroh and Fardian (2022) research, investments in plastic waste processing will enhance prospects in the plastic value chain from a circular economy standpoint by concentrating on value retention and extending the life of raw materials. Investment in plastic waste management facilities supports circular economic activities and serves as an industry focused on environmental sustainability and resource management. However, it also requires infrastructure development and regulation to optimize its benefits from a circular economic perspective. This study by Gawankar (2020), Saberi (2018), Ramadoni et al. (2023) supports this.

H2: Investment Affects in the Plastic Value Chain Opportunities from a Circular Economy Perspective.

c. The Circular Economy Perspective on the Impact of Import and Export Regulations on the Plastic Value Chain Opportunities.

According to the circular economy theory, Import and export laws impact the flow of plastic waste along the plastic value chain. Substantial restrictions on the import and export of plastic waste can affect a country's recycling practices and implementation of plastic waste management. According to Anastasia (2019), in order to minimize waste and increase the useful life of products, plastic waste management should be optimized to maximize the use and value of raw materials, components, and finished goods. The areas of plastic waste

in the plastic value chain are impacted by the management of plastic waste and the use of circular economy concepts (Liu et al., 2018). Regulations related to import and export in the plastic value chain when viewed from a circular economy perspective (Liu et al., 2018). Strict restrictions on the import and export of plastic waste can influence the implementation of plastic recycling and management practices in a country (Syberg et al., 2021). Supportive regulations can encourage the implementation of circular economy practices in plastic waste management (Rossi, 2020).
H3: Import and Export Regulations Affecting in the Plastic Value Chain Opportunities from a Circular Economy Perspective.

d. The Circular Economy Perspective on the Impact Of Innovation, Investment, Import And Export Regulations on the Plastic Value Chain Opportunities

To minimize waste and increase the useful life of the end product, plastic waste management in the framework of a circular economy must be optimized to maximize the use and value of raw materials, components, and products (Subekti, 2023). Thus, new initiatives, financial commitments, and export-related laws and regulations may have an impact on the plastic waste segments of the plastic value chain, according to the circular economy perspective (Wibawa, 2021). The circular economy and plastic waste management need to be optimized by maximizing the utilization and value of raw materials, components, and products, so as to reduce waste and increase product life, a number of sources also address the issue of plastic waste and its impact on ecosystems and human health (Baldassarre, 2019).
H4: Innovation, Investment, Import and Export Regulations Affect in the Plastic Value Chain Opportunities from a Circular Economy Perspective.

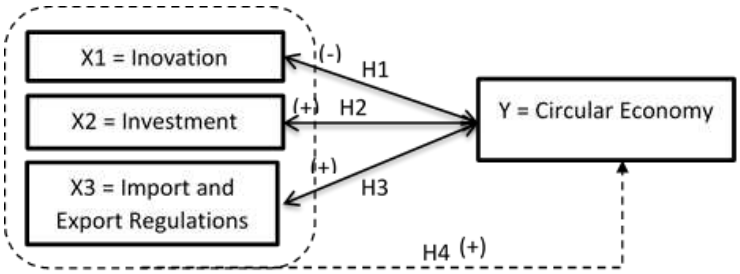


Figure 4. Research Framework
Source: Data Processed (2024)

2. METHODS

This study uses a survey to gather quantitative data and measure and derive survey results using questionnaires and statistical analysis. The data collection method is through questionnaires, where respondents provide answers to questions designed in the form of choices, and the scale of questions uses a Likert scale (1-5). The causal or influential relationship model was the one employed in this investigation. This study uses a causal or influencing model, SEM (structural equation modeling) for hypothesis testing, and a quantitative analysis method (SEM). The questionnaire is used to validate and reliability, and the hypothesis is tested with a 5% alpha level. The study also employs descriptive and quantitative methods to describe a specific group, conduct statistical analysis, and collect data through questionnaires. The data analysis method is SEM PLS, using SmartPLS 3.3. In addition to SEM, this study also uses multiple linear regression (MLR) to understand the relationships between several independent variables and one dependent variable. Multiple linear regression helps determine how changes in the independent variables affect the dependent variable.

In contrast, quantitative approaches focus on identifying relationships between variables, expressing values in numerical form, and processing data in numerical form through mathematical methods using statistical formulas. The population refers to all those who own a property that can be estimated, while the sample refers to the portion of the population for which the property is tested. In this survey, the population consisted of Indonesian Plastic Recycling Association members. On the other hand, the research sample deals with questions based on the number and characteristics of the population. The results of this model can be used to make decisions and apply to the general population. Convenience sampling is the sample strategy employed in this study, which gathers data from people who are willing to participate in the sampling process (Sekaran, 2017). Therefore, in this study, 100 respondents were selected as a representative sample of the population.

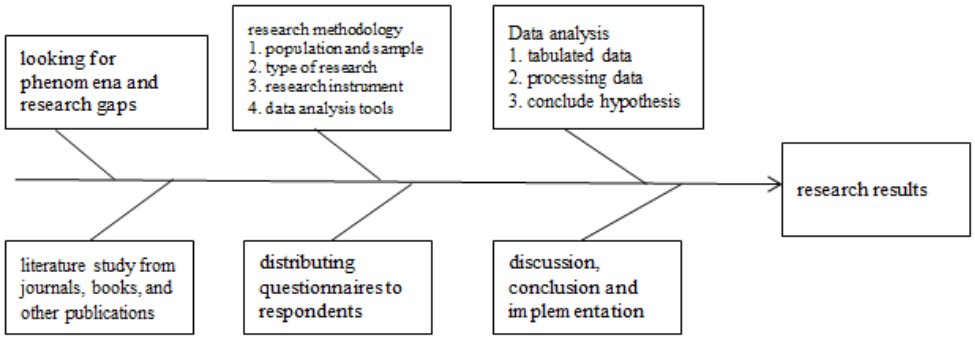


Figure 5. Research Stage
Source: Data Processed (2024)

3. RESULT AND DISCUSSION

3.1. Results

a. Descriptive Statistics Analysis

Table 2. Results of descriptive statistics analysis

Variable	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis
Innovation	4.218	4.000	1.000	5.000	0.831	0.900
Investment	4.073	4.000	1.000	5.000	0.969	0.826
Import and Export Regulations	4.232	4.000	2.000	5.000	0.775	-0.043
Circular Economy	4.214	4.000	2.000	5.000	0.787	0.107

Source: Data Processed (2024)

The import and export regulation variable has the highest mean value compared to other variables, namely the innovation, investment and circular economy variables with a value of 4.232. This shows that respondents relatively agree with the statements given on the import and export regulation variable. However, other variables have insignificant differences in mean values. The smaller mean value results in a higher standard deviation value or close to 1, meaning that the answers given by respondents are not varied.

b. Outer Model Test

Outer Model is related to testing the questionnaire as a research instrument, which tests the questionnaire to determine the feasibility of the questionnaire as a research instrument using Partial Least Square (PLS). Convergent validity is used to assess the validity of indicators in a study as research instructions, ensuring they accurately represent what should be observed. The loading factor on a variable depending on its indicators is

known as convergent validity. If the loading factor of the indicator's construction is > 0.60, individual reflexivity increases. Outer models consist of indicators with a loading factor > 0.60, making the indicator valid.

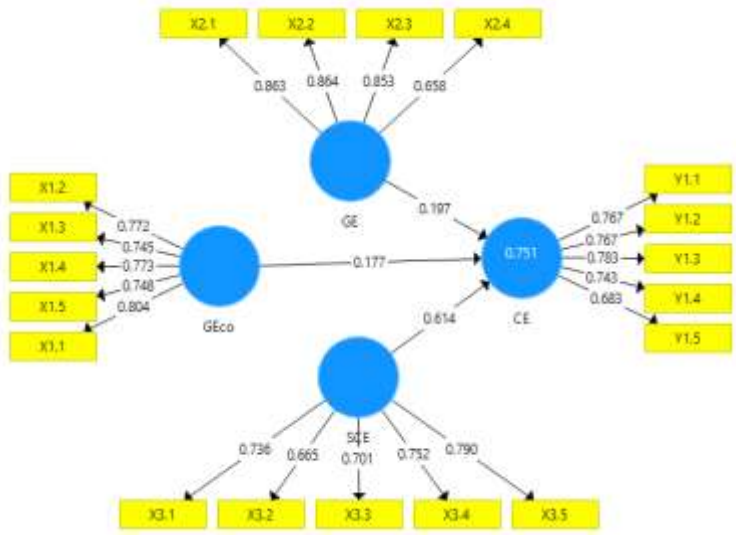


Figure 6. Convergent validity testing results
Source: Data Processed (2024)

The aforementioned test findings indicate that every research indicator for each variable is deemed valid, allowing the outer model test to move on to the next analysis step—the discriminant validity test. For every model structure, the Square Root of Average Variance Extracted (AVE) can be used to evaluate discriminant validity. According to Fornel & Larcker in (Afthanorhan et al., 2021) the reliability of latent variable component values can be assessed using the AVE value for discriminant validity. The results are more conservative than those of composite reliability, with AVE measurements greater than 0.50.

Table 3. Results of discriminant validity (AVE) testing

Variable	AVE
CE (Y)	0.562
GE (X1)	0.663
GEco (X2)	0.591
SCE (X3)	0.533

Source: Data Processed (2024)

The Average Variance Extracted (AVE) value of each construct is > 0.5, as shown in the above Table, indicating that there are no issues with convergent validity in the tested model. Then, the outer model test is continued with the composite reliability test, which consists of 2 types: internal consistency and Cronbach's alpha. Internal consistency is known from the composite reliability value, where constructs with a composite reliability value> 0.8 are defined as highly reliable constructs. It means that the construct has high reliability. Conversely, Cronbach's alpha measurement typically serves as a lower-bound reliability estimate. A construct with a Cronbach's alpha value > 0.7 is considered to have excellent dependability.

Table 2. Results of Composite Reliability testing

Variable	Composite Reliability	Cronbach's Alpha
CE (Y)	0.865	0.805
GE (X1)	0.886	0.828
GEco (X2)	0.878	0.827
SCE (X3)	0.850	0.779

Source: Data Processed (2024)

The test findings in the table indicate that the research model is undimensionality- and reliability-free.

c. Inner Model Test

The inner model test ensures that the built structural model is robust and accurate (Ghozali, 2018) and consists of the R square and hypothesis tests. When determining the degree of variation in changes in the independent variable on the dependent variable or the percentage of influence the independent variable has on the dependent variable, one can use the R Square value, which is the coefficient of determination on endogenous constructs (Ghozali, 2018).

Table 3. Results of R Square testing

	R Square	Adjusted R Square
CE (Y)	0.751	0.743

Source: Data Processed (2024)

Table 3 demonstrates that a variance in the substantive influence of the independent variable of 75.1 percent is indicated by the R Square value on the circular economy variable construct (Y) of 0.751. Other factors not included in the analysis have an impact on the remaining 24.9%. The following outcomes from the inner model test, which followed up on the hypothesis testing

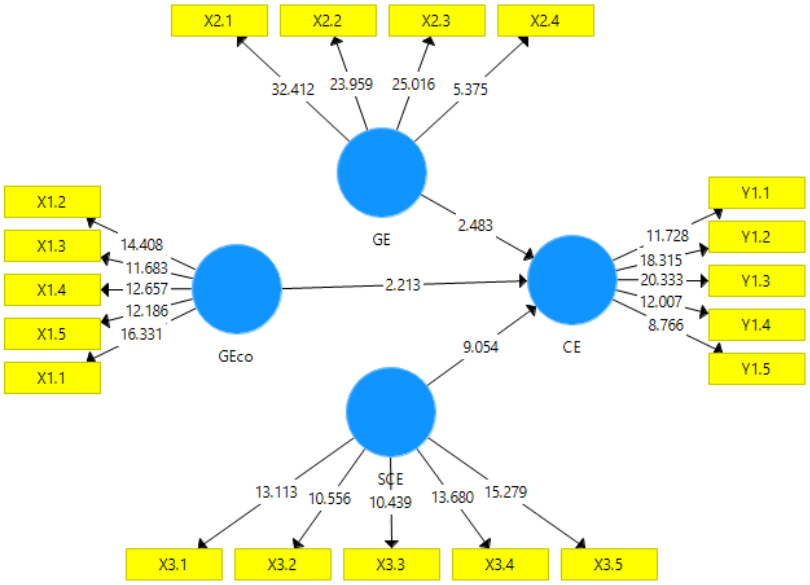


Figure 7. Hypothesis testing results
Source: Data Processed (2024)

Table 4. Results of Hypothesis testing

	Original Sample	$T_{statistics}$	P Values	Conclusion
GE → CE	0.197	2.483	0.013	Significant
GEco → CE	0.177	2.213	0.027	Significant
SCE → CE	0.614	9.054	0.000	Significant

Source: Data Processed (2024)

Table 4 presents the findings of the analysis. With the results of t statistics 2.483> t count and P values 0.013 <0.05, it can be explained that Hypothesis 1 is accepted because innovation (GE) has a positive and significant influence on the circular economy (CE). This means that the higher the innovation, the more it will affect the circular economy, as

evidenced by research (Susiati et al., 2023) showing that innovation affects the growth of green economy enterprises.

Furthermore, according to the results of t statistics 2.213 > t count and P values 0.027 < 0.05, hypothesis 2 is also accepted with the justification that investment (GEco) has a positive and significant influence on the circular economy (CE). This means that the greater the investment made, the more it will affect the circular economy; according to the research of Masruroh and Fardian (2022), investment in reprocessing plastic waste can contribute to opportunities in the plastic value chain.

As evidenced by the findings of t statistics 9.054> t count and P values 0.000 <0.05, hypothesis 3 is accepted with a significant and positive impact. According to research by Masruroh and Fardian (2022), export activities can build circular economy norms, this implies that the more import and export rules are applied, the more they would effect the circular economy. Based on the three hypotheses above, the fourth hypothesis is accepted, assuming that innovation, investment, and regulation of import and export significantly affect the circular economy of 75.1% based on the R Square value.

3.2. Discussions

In the analysis of hypothesis one above, where it was found that there is a significant influence between innovation and plastic value chain opportunities from a circular economy perspective, this is in accordance with the purpose of implementing the CE concept as expected. This means that the implementation of the CE concept carried out in the research area is effective and has a significant impact so that it can contribute to the reduction of plastic waste, reduce adverse impacts on the environment, and promote sustainable economic development, this is in line with previous research conducted by Madiya and Yasa (2023) and Wong (2020)

Furthermore, for the second hypothesis which shows the results of the hypothesis are accepted so that there is an influence between investment on the plastic value chain in terms of circular economy. The investment applied to the waste recycling process is able to support the implementation of the circular economy, the concept of the circular economy emphasizes the maintenance of the value and life cycle of raw materials, so that based on the results of the second hypothesis, investment in plastic recycling processing can be in accordance with the principles of the circular economy. In line with research conducted by (Subekti, 2023) that investment affects the plastic value chain.

The third is the hypothesis that import and export regulations have a significant effect on the plastic value chain in terms of the circular economy, meaning that there is government support for plastic recycling in Indonesia, indicated by import and export regulations in Indonesia which can positively and significantly affect the implementation of the plastic value chain. in line with research from Liu et al. (2018) and Arsawan et al. (2022) which shows the same thing. Then if the implementation of GE, EG and SCE variables is carried out together, the research proves that 75.1% of the circular economy concept can be implemented properly.

4. CONCLUSION

This study, which focuses only on members of the Indonesian Plastic Recycling Association in the DKI Jakarta region, intends to ascertain whether innovation, investment, and export and import regulations significantly affect potential plastic value chain opportunities from a circular economy perspective. The findings supported hypothesis 1 by demonstrating how innovation significantly affects plastic value chain potential from a circular economy standpoint. Furthermore, H2 is approved, showing that, from the circular economy perspective, investment greatly expands plastic value chain potential. Furthermore, import and export laws are appropriately implemented, and H3 is approved, indicating a considerable growth in plastic value chain prospects from a circular economy

perspective. The fourth hypothesis is acknowledged, which explains how, from a circular economy perspective, innovation, investment, and import and export rules affect plastic value chain opportunities.

Given the limitations of the research findings, more investigation is advised to look at additional factors or constructions that could influence plastic value chain potential from the standpoint of the circular economy. Furthermore, it is imperative to do qualitative research on-site or employ mixed approaches to supplement, enhance, validate, and refute the findings of quantitative studies. It is recommended that researchers work with subjects that differ from those used in this study in the future.

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