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Interlinkage of Circular Economy in Waste Management, Environmental Quality, and Public Health in Indonesia

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Abstract

The circular economy is an economic model for regenerating wastes into goods with additional value. This research aims to determine the relationship between the Indonesian circular economy and waste management, as well as its influence on environmental quality and public health. The study technique used is the SEM-PLS approach, which is a multivariate analysis used to analyze several factors in order to determine the simultaneous influence of multiple variables on the item. The quantitative technique uses time series data from data sources like BPS, World Bank, and SIPSN (National Waste Management Information System). The findings indicate that an increase in population may lead to an increase in garbage creation, with the percentage of waste generated in urban regions being larger and the issues in urban areas being more complicated than in rural areas. Unmanaged waste creation will result in a decline in environmental quality and may create harmful pollutants, but if trash generation is correctly managed, environmental quality will be preserved. It is possible for waste management to promote public health by reducing the quantity of pollutants generated by trash. By adopting the circular economy idea in the 3R (Reduce-Reused-Recycle) application, effective and efficient waste management may boost people's income. The potential of a circular economy might generate investments in recycling (green entrepreneurs), which can promote jobs and preserve the environment. The government and business owners work together to promote distribution and marketing channels and to continue fostering independence.

Keywords: circular economy, waste management, public health, environmental quality, SEM-PLS

1. Introduction

Waste is an issue for every person on earth, as the amount of trash items continues to grow daily and year. In the World Bank's annual report for September 2019, global garbage growth continues to climb (Zhao et al., 2017). According to the analysis based on the statistics, there were 2.01 billion tons of rubbish in the globe in 2018. Taking into account the pace of expansion of the earth's population, notably urbanization growth of up to 70%, it is anticipated that by 2050, global waste creation would reach 3.4 billion tons (The World Bank, 2021). For industrialized nations, waste management and reuse has become an essential and significant sector. However, this is not the case in developing nations, which continue to struggle with waste management and disposal issues, particularly in the community and household sectors (Sassanelli et al., 2020).

The global garbage dilemma is the result of inefficient, wasteful industrial practices and a failure to recycle products (Zhang et al., 2019). Waste is a significant concern if it is not handled effectively (Wilson et al., 2015). Household and industrial waste management programs such as prevention, minimization, source reduction, improved waste management, and expanded recycling options may be used to combat the global waste challenge (Clapp, 2016). Household garbage and plastic waste are the leading causes of production-related difficulties. 1950 marked the beginning of widespread plastic garbage manufacturing, which is expected to have reached 8.3 billion tons in 2014, of which 2 billion may still be recycled. Nearly 80 percent of the remaining waste is transported to landfills or pollutes the environment, especially the seas, where it will take generations to disintegrate and will never vanish. Plastic is not the only global pollution problem, but it is likely the most significant. Priority number one in combating marine pollution is plastic pollution, followed by chemical pollution and climate change (Economist, 2021). In the circular economy plan, plastic waste is a crucial concern. To monitor the processing of plastic trash, suitable indicators are required.

The circular economy is a new economic model that aims to minimize or eliminate the effect of created trash

(Tomić & Schneider, 2020). This idea refers to an economic system that prioritizes environmental friendliness and resiliency and strives to preserve the value of a product so that it may be reused by reducing it to its lowest point (minimum waste). This system generates and maintains three crucial factors: economic potential, social innovation, and the environment (Andrews, 2015). This notion is the outcome of the establishment of sustainable development objectives, which emphasize economic, social, and environmental components of sustainable development from a global, national, and regional perspective (Banaite & Tamošiuniene, 2016). The circular economy idea aims to minimize production and consumption waste/waste and boost resource efficiency (Ogunmakinde, 2019). According to the findings of Plastinina et al. (2019), the government must formulate industrial waste management policies using the LCA (Life Cycle Analysis) method to evaluate the economic efficiency of production activities at various stages of waste recycling by considering the externalities of the waste generated. The study findings are mainly focused on the industrial sector's ability to manage and handle the trash they generate. The findings of Huysman et al., (2017) about the circular economy case study in Japan focus on macroeconomic policies linked to the degree of 3R (Reduce, Reuse, Recycle) and the research was performed using country-specific metrics. using the quantitative Ordinary Least Square (OLS) approach. Reichel et al., (2016) performed a case study in Norway focusing on cooperation amongst industrial sectors pertinent to industry production by applying environmentally friendly business models. The research was done with the participation of 15 enterprises using qualitative methodologies such as FGDs and interviews.

In some countries, such as China and particularly Beijing, the waste problem has not been completely resolved, and the circular economy model has not been implemented optimally due to a lack of public awareness. This has led to an increase in pollutant levels from household waste, high emission levels, and a decline in the quality of public health, particularly among those who do not recycle. right governance procedure (Li et al., 2020). The amount of garbage produced by the community is proportional to the community's annual population growth. During the process of economic activity conducted to fulfill the requirements of the society, waste products / trash and waste are produced. Population growth, shifting socioeconomic situations, and deteriorating environmental quality all contribute to a continuing rise in the volume of trash produced (Al-khatib et al., 2015). Population growth that is unchecked, particularly in developing nations, is associated with a rise in waste and pollution that may lead to high levels of toxicity. Depending on the number and quality of toxins that damage the environment, the degree of toxicity has an influence on the public health repercussions (Ndanguza et al., 2020).

Waste management must be effectively handled beginning at the micro level, i.e. the community, in a sustainable way, since in the long run it will create health concerns for the community, particularly in densely populated areas (Guzzo et al., 2022). The application of the circular economy concept with indicators of per capita municipal solid waste, municipal waste recycling rate, packaging waste recycling rate by type of packaging, organic waste recycling rate, and e-waste recycling rate can boost economic growth and inclusive GDP growth while reducing the consumption of natural resources and enhancing environmental protection (Grdic et al., 2020; Kristianto & Nadapdap, 2021). The government provides a public service to the society by ensuring proper trash management. The government and the community share responsibilities for waste management, including collection, transportation, and disposal operations related to municipal and industrial activity (Ogunmakinde, 2019). This tries to lessen the negative effects of trash on public health, such as pediatric cancer and leukemia ((Nwogwugwu & Ishola, 2019). The degree of public health is determined by how individuals dispose of their trash. Using the services of a trash collection agent may help limit the spread of infectious illnesses caused by garbage by raising public knowledge about proper waste disposal and providing access to government waste collection services (Jerumeh, 2020).

On the basis of the information provided, it is intriguing to investigate the components and interrelationships of the circular economy in waste management and its impact on Indonesia's air quality, water quality, and public health. The purpose of this study is to construct a model and determine the relationship between the circular economy in waste management and its impact on air quality, water quality, and public health in achieving sustainable economic growth, from the perspectives of local to national governments, households, entrepreneurs, academics, and activists environment. The use of the circular economy model to waste management may have an inclusive effect on national sustainable economic development, environmental quality, and public health quality.

2. Literature Review

2.1 Population, Waste Management and Circular Economy

The concept of a circular economy based on the concept of 3R (Reduce, Reuse, Recycle) with optimal production levels in utilizing natural resources by minimizing natural exploitation, minimizing environmental pollution, reducing emission and waste levels by implementing the concept is anticipated to be a solution for controlling the waste generated as a result of population growth (Strielkowski, 2016). This economic system is an alternative concept to a linear economy (production-consumption-disposal) that aims to maximize the potential of each waste material and can recover materials that have reached the end of their useful life through environmentally friendly technological innovations (Marino & Pariso, 2016). According to an empirical study undertaken by Idiano D'Adamo, Massimo Gastaldi, and Paolo Rosa (2020), the End of Life Vehicles (ELVs) indicators, which measure the amount of volume and material composition of waste streams, have attracted the interest of academics and industry actors. The objective and primary emphasis of this study is the examination and possible association between the flow of ELVs in Europe (in terms of volume produced and recycled) and two major factors (GDP and population – national-level demographic and migratory circumstances). Results indicate that a rise in GDP correlates with an increase in ELVs and the recycling rate per capita. In 2030, the future value of created and recycled ELVs was projected. The notion of the circular economy have received significant traction among academics and practitioners. Circular economy is defined as the combination of reducing, reusing, and recycling into a sustainable economic system by transforming waste resources into clearly associated economic goods. The explicit connection between circular economy and sustainable development focuses on waste-related negative externalities (Kirchherr et al., 2018). The primary goal of the circular economy is economic success, followed by environmental quality; long-term effects on social fairness and future generations. Korea implements regulations by passing laws governing the collection of tariff fees for waste disposal, incineration, and landfilling, and by jointly providing facilities and infrastructure for the recycling industry using the cradle to cradle method, which is a method of product processing that does not generate waste (Ghosh et al., 2020). The Italian government implements regulations in the form of strengthening the waste management hierarchy, beginning with prevention, reuse, recycling, recovery, and disposal, by tightening regulations, oversight, and consequences for the industrial and manufacturing world regarding extended producer responsibility (EPR), which is the responsibility of producers for the waste they generate. Currently, Malaysia has not fully implemented waste management legislation, but long-term investment in the recycling sector will be increased. Communication with the government is hindered by a lack of waste consciousness and people's trash-producing habits; one remedy is a continual campaign, socialization, and education about waste awareness (Kala et al., 2020). Citizen and local government engagement is essential to the operational effectiveness of trash management. From the socio-cultural angle of community participation in decision-making to increase public knowledge of apathy in order to help the government find the best answer (Maalla & Adipah, 2020).

2.2 Circular Economy and Environmental Quality

Environmental quality is a broad concept that refers to a variety of environmental features and characteristics, such as water, air, and soil conditions that impact the quality of human health as a consequence of human waste production (Nelen & Bakas, 2021). Environmental contamination is caused by an increase in economic activity that disregards the resilience and sustainability of the environment and natural resources. This issue has led to a high amount of water, air, and soil pollution, which has the potential to cause long-term damage to the nation and climate change (Dellink et al., 2014). The circular economy is a new economic paradigm that aims to minimize or eliminate negative effects. This idea refers to an economic system that prioritizes environmental friendliness and resiliency and strives to preserve the value of a product so that it may be reused by reducing it to its lowest point (minimum waste). This system generates and maintains three crucial factors: economic potential, social innovation, and the environment (Andrews, 2015). Due to a lack of public awareness, the circular economy model has not been implemented optimally, which has led to an increase in pollutants from household waste, a rise in emissions, and a decline in the quality of public health, especially among those who do not follow the correct management process (Xiao et al., 2020). In the framework of environmentally friendly development, resource efficiency is the best strategy for boosting sustainable economic growth (Hicks & Dietmar, 2007). The combination of economic growth in a circular economy and environmental protection in waste management may contribute to the investment and development of environmentally friendly technologies, which are the primary assets in the process of sustainable development (Busu & Trica, 2019).

2.3 Circular Economy and Public Health

Inadequate waste management contributes to the prevalence of illness in a population's area/settlement and is connected with inadequate environmental cleanliness. Numerous issues linked with trash disposal without discrimination may lead to groundwater pollution, unpleasant smells, uncontrolled disposal, and public health threats. Proper solid waste management reduces threats to public health by decreasing the likelihood of disease-causing trash entering water and soil systems (Jerumeh, 2020). In the circular economy idea, waste management is a sort of government service to the community. The government and the community share responsibilities for waste management including the collection, transportation, and disposal of garbage generated by industry and communal activities. This tries to lessen the negative effects of trash on public health, such as pediatric cancer and leukemia (Nwogwugwu & Ishola, 2019). Involving many stakeholders, an urgent implementation of an integrated waste management system for solid waste and comparable wastes is necessary to avoid the possibly hazardous spread of illness from communal garbage (Nor et al., 2019). Policies pertaining to waste management must emphasize environmental and community health implications, need oversight, preventative measures, and suitable remedies, and must be developed in collaboration and coordination with all relevant agencies (Shamshir, 2019).

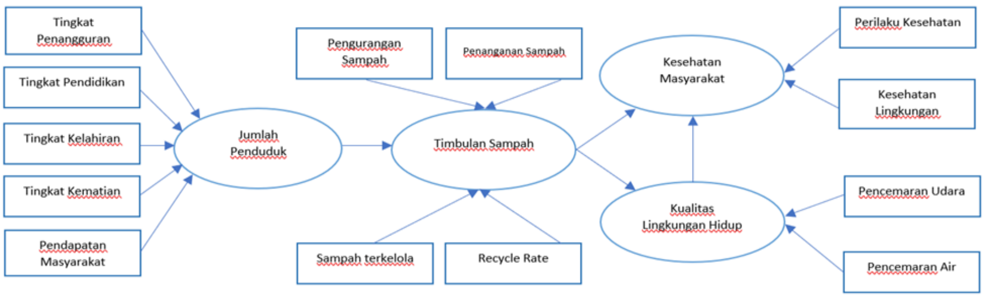

Figure 1. Conceptual Framework of Research

3. Research Methods

This study employs the quantitative method SEM-PLS (Structure Equation Model – Partial Least Square) for the period 2011-2020; the data used are primary data from KLHK, SIPSN, and BPS; and the variables used are the unemployment rate, education level, birth rate, level of mortality, GRDP, waste reduction rate, waste handling rate, managed waste level, recycle rate, air pollution level, water pollution level, and public health index in Indonesia. The objective of SEM-PLS is to evaluate and improve the predictive accuracy of a model; hence, this analysis gives the possibility to create a model route between variables and identify indicators for variables. SEM-PLS is composed of three model components:

a. The measuring model or outer model explains the association between the latent variable and its manifest counterpart (indicator). There are two sorts of models inside the outer model: the formative indicator model and the reflexive indicator model. The reflexive model arises when the manifest variable influences the latent variable, while the formative model posits that the manifest variable influences the latent variable in the opposite direction of causation. SEM-PLS equation for the reflexive indicator model:

$$x = \lambda x \xi + \varepsilon x$$

$$y = \lambda y \eta + \varepsilon y$$

Where:

x states indicators for exogenous latent variables (ξ)

y states indicators for endogenous latent variables (η)

λx, λy states a loading matrix that describes a simple regression coefficient that relates the latent variable to the indicator

While the equation for formative indicators is:

$$\xi = \Pi x \xi X i + \delta \xi$$

$$\eta = \Pi y \eta Y i + \varepsilon \eta$$

Where:

Πx, Πy states such as the multiple regression coefficient of the latent variable on the indicator

$\delta \xi$, $\varepsilon \eta$ state the measurement error rate (residual error)

b. The structural model or inner model describes a model of the connection between latent variables that is derived from the theory's content. Structural model equations for SEM PLS :

$$\eta j = \sum \beta j\ \eta i + \sum Yj\ \zeta b + \zeta j$$

Where:

- i. b : declares the index range along i and b
- j : states the number of endogenous latent variables
- βji : states the path coefficients connecting the endogenous latent variables
- (η) : with endogenous (η)
- Γjb : states the path coefficient that connects the endogenous latent variable
- (η) : with exogenous (ξ)
- ζ state the measurement error rate (inner residual variable)

c. This third component is unique to SEM with PLS and is absent from SEM based on covariance. The weight relation score demonstrates the association between the variance values of the indicators and their latent variables. The weight relationship equation is:

$$\xi b = \sum k\ wk\ xk$$

$$\eta i = \sum k\ wk\ yk$$

Where:

wkb, wki states the weight of k used to estimate the latent variable ξb and ηi.

4. Results and Discussions

Outer Model Evaluation

In this research, all concept variables are formative. The AVE, Fornell-Larcker criterion, Cronbach's alpha, and Composite reliability cannot be used to quantify formative constructs. The formative construct may be assessed in two ways: the dependability indicator with a minimum necessary value of 0.2 and the colinearity indicator with a VIF score below 10. The reliability indicator score may be determined using the outer weight PLS algorithm model measurement data. Using the PLS technique, the VIF score is also produced from the measurement model.

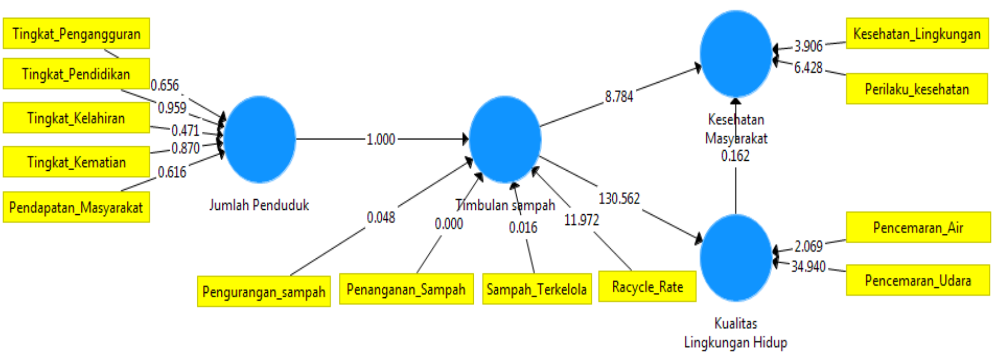

Figure 2. Processed outer model (2022)

Test of Indicator Reliability

The dependability score of this indicator may be determined based on the results of the PLS algorithm model measurement for the following outer weight section:

Table 1. Reability Indicator Test

	Population	**Waste Generation**	**Environmental Quality**	**Public Health**
Unemployment Rate	0.067			
Education Level	0.405			
Birth Rate	-0.031			
Mortality Rate	-0.482			
Community Income	0.166			
Waste reduction		-1.235		
Waste Handling		0.000		
Managed Waste		1.038		
Recycle Rate		1.121		
Water Pollution			-0.123	
Air Pollution			1.057	
Health behaviors				0.638
Environmental Health				0.383

The public health variable is shown in Table 1 as one of the four variables meeting the reliability indicator. As for the first indicator (unemployment rate) from the population variable, it does not meet the criteria because it only includes a value of 0.067, the third indicator (birth rate) from the population variable does not meet the criteria because it only has a value of -0.031, the fourth indicator (death rate) from the population variable does not meet the criteria because it only has a value of -0.482, and the fifth indicator (community income) from the population variable does not meet the criteria because it The score or value is significantly different from the stipulated minimum score of 0.2. The Waste generation variable's first and second indicators (Waste Reduction and Waste Handling) do not match the requirements since they are only worth -1.235 and 0.000. The score or value is significantly different from the stipulated minimum score of 0.2. The first indication of the Environmental Quality variable (Water Pollution) does not match the criterion, since its value is merely -0.123. The score or value is significantly different from the stipulated minimum score of 0.2.

Colinearity Indicator Test

In the approach for assessing the collinearity indicator criterion (Table 2), the VIF value is less than 10, indicating that the indicator variable does not include multicollinearity. The indications for the variables of Education Level, Waste Management, Recycle Rate, Air Pollution, Environmental Health, and Health Behavior are thus in a safe range. In other words, there is no multicollinearity between the variables' constituent indicators. According to the findings of the reliability indicator test and the aforementioned collinearity indicator, seven (seven) indicators do not match the criteria of the reliability indicator test: Unemployment Rate, Birth Rate, Death Rate, Community Income, Waste Reduction, Waste Handling, and Water Pollution. These indicators are known to score below the acceptable minimum, thus they must be eliminated from the model.

Table 2. Colinearity Indikator Test

	VIF
Education Levels	1.000
Managed Waste	4.527
Recycle Rate	4.527
Air Pollution	1.000
Environmental Health	6.128
Health behaviors	6.128

Structure Evaluation model (Inner Model)

After the model (outer model) is evaluated and it is determined that each construct satisfies the standards of the reliability indicator and the collinearity indicator, the structural model is evaluated by testing the path coefficient and R2. Examining the importance of the link between constructs or variables to test the structural model. The route coefficient, which measures the strength of the link between variable constructions, demonstrates this. The path's sign or direction (path coefficient) must be consistent with the hypothesised theory. To examine the coefficient of determination (R2), Effect Size (f2), Predictive Relevance Value (Q2), and T-statistics, structural model testing is performed. As seen in Figure 2 below:

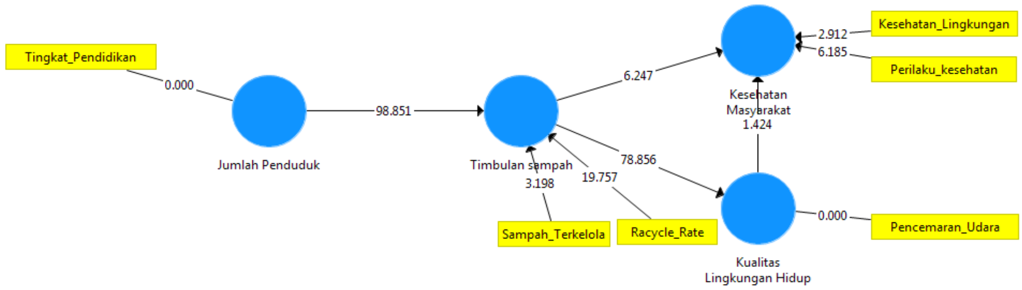

Figure 2. Result of Structural Model Test (Inner Model)

Coefficient of Determination (R^2)

Interpretation of the value of R^2 linear regression, or the extent to which exogenous factors can explain the variability of endogenous variables. The R^2 criterion has three categories, namely R^2 values of 0.67, 0.33, and 0.19 as strong (considerable), moderate (moderate), and weak (weak) (weak). Variations in R^2 may be used to determine if the influence of the external latent variable on the endogenous latent variable is substantial. R^2 measures the capacity of endogenous factors to explain the variety of external variables. Alternatively, to determine the influence of exogenous variables on endogenous variables. The outcomes of R^2 are shown in Table 3.

Table 3. Coeffisient of Determination (R^2)

	R Square	R Square Adjusted
Waste generation	0.918	0.916
Environmental Quality	0.921	0.918
Public Health	0.964	0.962

The R-square value of waste production is 0.918, or 91.6%, which indicates that 91.6% of the variation in waste generation can be explained by the population variable. Environmental Quality has an R-value of 0.921, or 92.1%, indicating that the variety of Environmental Quality variables can be described by the waste production variable. In other words, the R-square value of Public Health is 0.964%, indicating that the variety of Public Health variables can be described by the variables of Waste Generation and Environmental Quality.

Effect Size Test (F^2)

The F^2 values of 0.02, 0.15, and 0.35 indicate whether the predictors of the latent variable have a modest, moderate, or high impact on the structural level. The outcomes of F^2 are shown in Table 4.

Table 4. Result of Effect size F^2 Test

	Waste Generation	Environmental Quality	Public Health
Population	11.185		
Waste generation		11.584	1.425
Environmental Quality			0.074

The findings indicated that the population variable for trash production had an impact size of 11,185 in a broad category; hence, it can be concluded that population plays a significant influence in the increase of garbage creation. With an effect size of 11,584 in a wide category for the variable of trash production on environmental quality, it can be concluded that waste generation plays a significant influence in enhancing environmental quality. The impact sizes of waste production and environmental quality on public health are 1.425% and 0.074%, respectively, in the major and small categories. Therefore, trash generation and environmental quality play a significant enough role to promote public health.

Predictive Relevance (Q^2) Test

The purpose of the predictive relevance test (Q^2) is to validate the model. This measurement is appropriate if the endogenous latent variable's measurement model is reflective. The predictive significance values for Q^2 are 0.002 (weak), 0.15 (moderate), and 0.35 (high) (strong). When the value of predictive relevance (Q^2) is greater than zero, it shows that the exogenous latent variable is suitable as an explanatory variable able to predict endogenous variables and vice versa. If the predictive relevance findings (Q^2) are less than zero, the model lacks predictive relevance. Table 5 displays the findings of the predictive relevance (Q^2) analysis conducted in this research. The value of Q^2 = 0.767 for the Waste production variable, Q^2 = 0.901 for the Environmental Quality variable, and Q^2 = 0.869 for the Public Health variable was determined using the build cross-validation redundancy test. The calculation results indicate that the anticipated relevance value is greater than zero, indicating that the model is viable and has a meaningful predictive value.

Table 5. Construct Cross-Validation Redundancy Test Results

	SSO	SSE	Q^2(=1-SSE/SSO)
Population	40.000	40.000	
Waste generation	80.000	18.644	0.767
Environmental Quality	40.000	3.960	0.901
Public Health	80.000	10.447	0.869

Validation of Hypothesis

The significance test is used to determine if exogenous factors have an influence on endogenous variables. The test conditions specify that if the T-statistics T-table (1.96), or the P-value is less than 5% or 0.05, it indicates that exogenous factors have a significant influence on endogenous variables (Basuki, 2017). Table 6 displays the results of the significance and model testing.

Table 6. Results of Testing Direct Effect Hypothesis

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Population -> Waste generation	0.958	0.958	0.010	98.851	0.000
Waste generation-> Environmental Quality	0.959	0.960	0.012	78.856	0.000
Waste generation -> Public Health	0.805	0.778	0.129	6.247	0.000
Environmental Quality -> Public Health	0.183	0.211	0.129	1.424	0.155

The outcomes of evaluating the research paradigm outlined in table 6 are as follows:

Total Population Against Waste Management

The total population has a t-statistic of 98,851 greater than 1.96, a p-value of 0.000 less than 0.05, and an original sample size of 0.958, so the null hypothesis (H1) is accepted, indicating that the population has a positive and statistically significant effect on the generation of waste in the community.

Generation of Waste Against Environmental Quality

Trash production has a t-statistic of 78,856 > 1.96, a p-value of 0.000 0.05, and an original sample of 0.959; hence, the null hypothesis H2 is accepted, indicating that waste creation has a positive and statistically significant influence on environmental quality.

Generation of Waste Against Public Health

Trash production has a t-statistic of 6247 that is more than 1.96, a p-value of 0.000 that is less than 0.05 and an initial sample size of 0.805, thus H3 is accepted, indicating that waste creation has a positive and statistically significant influence on public health.

Influence of Environmental Quality on Public Health

Environmental quality has a t-statistic of 1.424 1.96, a p-value of 0.155 > 0.05, and an initial sample size of 0.183; thus, the null hypothesis H4 is rejected, indicating that environmental quality has a positive but not statistically significant influence on public health. As for the examination of the mediating variable's impact, it can be observed in Table 7 below:

Table 7. Indirect Effect Hypothesis Testing

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	**P Values**
Waste generation -> Environmental Quality -> Public Health	0.176	0.203	0.127	1.383	0.167

Based on the outcomes of assessing the indirect effect of waste generation on public health via environmental quality, H5 is rejected due to a t-statistic of 1.383 1.96, a p-value of 0.167 > 0.05, and an original sample size of 0.176. This indicates that waste generation has a positive but not statistically significant effect on Public Health via Environmental Quality. This demonstrates that trash production may have a direct impact on public health and environmental quality.

Population's Influence on Waste Generation

Based on the results of the calculation, the t-statistic value is 98,851, which is greater than 1.96, and the value of sig. 0.000 is less than 0.05, indicating that the population has a positive and statistically significant influence on waste generation, i.e., changes in the value of the population have a causal effect on changes in waste generation, or if the population increases, the level of waste generation will increase and the effect is statistically significant. The path coefficient value of Population to trash production is 0.958, indicating a positive association between the population and the garbage created by the community.

Impact of Waste Production on Environmental Quality

Based on the results of the calculations, the t-statistic is 78,856 which is greater than 1.96 and the value of sig. 0.000 is less than 0.05, indicating that waste generation has a positive and significant impact on environmental quality, i.e., changes in the value of waste generation have a causal effect on changes in environmental quality, or, if waste generation increases, environmental quality will also increase. The path coefficient value of waste production on environmental quality is 0.959, indicating a positive association between trash generation and environmental quality.

Public Health Effects of Waste Generation

Based on the results of the calculation, the t-statistic value is 6247, which is greater than 1.96, and the value of sig. 0.000 is less than 0.05, indicating that waste generation has a positive and statistically significant effect on public health, i.e., changes in the value of waste generation have a causal effect on changes in the level of public health, or, in other words, if waste generation increases, there will be an increase in the level of public health, and statistical The path coefficient value of waste production on public health is 0.805, indicating a positive association between trash creation and public health.

Public Health Effects of Environmental Quality

The t-statistic value is 1.424, which is less than 1.96, and the value of sig. 0.155 is less than 0.05, indicating that the quality of the environment has a positive but not significant effect on public health, i.e., changes in the value of the quality of the environment have a causal effect on changes in the level of public health and vice versa. Environmental Quality has a positive but not statistically significant link with Public Health, as shown by the path coefficient value of 0.183.

The Influence of Waste Production on Public Health as Determined by Environmental Quality

Based on the calculation results, the t-statistical value of 1.383 means 1.96 and the value of sig. 0.167 is above 0, indicating that waste generation has a positive but not significant effect on public health through the mediating variable of environmental quality, and that changes in the value of environmental quality have a unidirectional effect on changes in the effect of waste generation on public health, or if environmental quality increases, there is a positive effect of waste generation on public health. The path coefficient of trash production on public health through the mediating variable of environmental quality is 0.176, indicating that waste generation has a positive and statistically significant influence on public health via the mediating variable of environmental quality.

5. Conclusion

Population growth in both urban and rural areas has the potential to increase the quantity of trash produced, particularly liquid and solid household garbage. If this garbage is not correctly handled, it might possibly harm the environment. The findings of this research reveal that waste production has a positive and substantial influence on the population, which indicates that the growth in population causes an increase in the quantity of garbage creation; waste generation grows as the population increases. The creation of trash has a positive and substantial influence on the quality of the environment, thus a rise in the generation of controlled waste and a high recycling rate may have an impact on enhancing the quality of the environment. Without using the 3R (reduce-reuse-recycle) philosophy, however, improper waste management may degrade the environment. This demonstrates that each district has access to waste bank facilities (primary and unit) and TPS3R for the management of organic and inorganic waste. In addition to engaging with recycling sector entrepreneurs to use garbage as a tradeable resource, we will collaborate with the media as a promotional tool and provide online education (Flynn & Hacking, 2019). The creation of waste has a positive and substantial influence on public health, indicating that variations in the value of trash generation have a causal effect on variations in public health. The development of uncontrolled trash may result in water and air pollution, as well as the habit of burning rubbish, hoarding garbage, and tossing garbage into rivers, all of which have the potential to release particles that are harmful to public health. Improving environmental quality will result in an improvement in public health (Yang et al., 2017). Environmental quality has a unidirectional effect on the change in the impact of waste production on public health; as environmental quality improves, the amount of influence between waste generation on public health and integrated waste management will grow from upstream to downstream. In addition to educating the public on the significance of environmental health awareness and healthy lifestyle choices (Reames & Bravo, 2019).

6. Recommendations

Suggestions for future research include utilizing other techniques to specifically link the circular economy to the mitigation of air and water pollution, such as BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) from water pollution, and air pollutant particles such as CO2 (Carbon Dioxide) and CO (carbon monoxide) on the level of welfare. From the perspective of public health, the Life Expectancy Rate (AHH) may be connected to whether it has a direct influence or if there are still mediating elements that can be researched in more depth. Utilizing the system dynamics technique with a case study approach to prioritize social phenomena that occur in specific regional communities.

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