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## Assessing Domestic Waste Composting for Sustainable Agriculture in South Sumatera

Muhammad Arbi<sup>1\*</sup> , Sriati<sup>1</sup> , Muhammad Yamin<sup>1</sup> , Tertarto Wahyudi<sup>2</sup> 

<sup>1</sup> Social Economic Department, Faculty of Agriculture, Universitas Sriwijaya, Palembang 30128, Indonesia

<sup>2</sup> Accounting Department, Economic Faculty, Universitas Sriwijaya, Palembang 30128, Indonesia

### ABSTRACT

Environmental control and conservation are essential to achieving the United Nations' Sustainable Development Goals (SDGs), particularly in waste management and sustainable resource use. The Gasing Industrial Area in Banyuasin Regency, South Sumatra, Indonesia, hosts approximately 72 industries and 1726 households engaged in manufacturing, palm oil processing, livestock, and other activities. Despite its economic contribution, the area lacks a formal management body, resulting in unmanaged domestic waste, limited implementation of reduce–reuse–recycle (3R) practices, and minimal composting initiatives. This study analyzes how stakeholder perspectives influence domestic waste management performance in the Gasing Industrial Area, with particular attention to the potential conversion of organic waste into compost to support sustainable agriculture. Structural Equation Modeling (SEM) was applied to assess direct and indirect relationships among variables, including government policy, waste-processing infrastructure, socio-economic characteristics, public behavior, and environmental management outcomes. The results show that government policy, infrastructure availability, and socio-economic background significantly shape public behavior, which is the strongest determinant of overall waste management performance. The findings highlight the urgent need for integrated stakeholder collaboration to strengthen domestic waste processing, promote composting practices, and enhance agriculture–industry linkages. Strengthening policy implementation, improving infrastructure,

**\*CORRESPONDING AUTHOR:**

Muhammad Arbi, Social Economic Department, Faculty of Agriculture, Universitas Sriwijaya, Palembang 30128, Indonesia; Email: arbiarka@fp.unsri.co.id

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and increasing community participation are critical to transforming domestic waste into valuable compost and achieving sustainability in the region.

**Keywords:** Sustainability; Domestic Waste Management; Compost; Structural Equation Modeling

## 1. Introduction

Sustainable waste management has become a pressing global issue in the twenty-first century, especially in the context of rapid industrialization and urban expansion. The United Nations’ Sustainable Development Goals (SDGs), particularly Goal 12 on responsible consumption and production and Goal 11 on sustainable cities and communities, emphasize the importance of integrating waste reduction, recycling, and resource recovery into national and local development agendas. Domestic waste, if poorly managed, poses risks of environmental degradation, greenhouse gas emissions, and health hazards. On the other hand, when properly treated, domestic waste—particularly its organic fraction—can be transformed into compost and reused to support sustainable agriculture, thereby closing the loop in the circular economy framework<sup>[1–3]</sup>.

In developing countries such as Indonesia, the challenge of managing domestic and industrial waste has intensified in parallel with industrial development. Rapid growth in industrial parks and surrounding settlements generates large amounts of solid waste that are often not segregated, leading to increased pressure on landfill sites, waterways, and air quality. This situation is particularly evident in South Sumatra Province, where industrial development is expanding while waste management systems remain underdeveloped. Integrating waste-to-compost initiatives into industrial areas presents both a challenge and

an opportunity to reduce waste volumes while providing a sustainable input for agriculture<sup>[4,5]</sup>.

The Gasing Industrial Area, located in Gasing Village, Talang Kelapa Sub-district, Banyuasin Regency, exemplifies this dual challenge. With a planned coverage of 5091.33 hectares, making it the second largest industrial estate in Banyuasin Regency out of a total of 18,502.84 hectares, the Gasing area has already attracted approximately 72 industries and is home to around 1726 families<sup>[6]</sup>. The industrial composition includes manufacturing, palm oil plantations, livestock husbandry, and processing industries. These industries play a vital role in the local economy by providing employment opportunities, often guided by local government regulations that encourage the hiring of local workers. However, this concentration of industries and residential areas in close geographic proximity also generates substantial volumes of mixed domestic and industrial waste, creating significant pressure on environmental management.

The scale of the waste problem in Banyuasin Regency can be illustrated by the composition of domestic waste recorded in 2020 and 2022 (**Table 1**). Food waste consistently represents the largest fraction, followed by paper and plastics, while wood, rubber, textiles, glass, and metals constitute smaller shares. Although the proportion of food waste slightly increased between 2020 and 2022, other categories, such as paper and plastics, showed marginal decreases, indicating limited progress in waste reduction efforts.

**Table 1.** The Details of Recorded Domestic Waste in Banyuasin Regency.

Waste Type	Gross Weight Percentage 2020	Gross Weight Percentage 2022
Food Wastes	38.12	39.15
Papers	16.65	16.00
Plastics	13.39	13.28
Woods	8.46	8.53
Rubbers	1.97	1.99
Textiles	1.25	1.57
Glasses	1.26	1.40
Metals	0.95	0.98
Others	17.95	17.10

These figures suggest that nearly 40% of waste is organic and therefore has strong potential to be recycled into compost to support local agriculture. However, in practice, composting is rarely implemented at scale in industrial areas. In the case of Gasing Industrial Area, the absence of a dedicated private institution to manage waste systematically results in poor waste handling practices. It is still common to find piles of rubbish left on the roadside, with minimal application of the reduce, reuse, and recycle (3R) principles. This lack of effective waste processing not only undermines environmental quality but also represents a lost opportunity for producing compost as an agricultural input.

Managing waste in areas where industrial activities and residential settlements meet is inherently challenging. Industries consume large volumes of natural resources and generate various types of waste, from plastics and packaging to organic and even hazardous materials. At the same time, nearby households also contribute substantial amounts of domestic waste, most of which is organic and could be converted into compost if sorted and handled properly. Addressing these issues requires cooperation among multiple actors: governments need to set clear regulations and enforce compliance, industries must strengthen internal recycling efforts and CSR programs, and communities are expected to adopt better consumption habits and practice waste segregation at home<sup>[7,8]</sup>. Compost used in agriculture must be evaluated carefully for its maturity and quality, a point that underlines the importance of developing reliable composting practices in the Gasing Industrial Area as part of a broader move toward sustainable waste management<sup>[9]</sup>.

The effectiveness of compost applications in agriculture depends greatly on accurate assessment of compost maturity and quality. This insight supports the relevance of promoting composting initiatives in the Gasing Industrial Area as part of a more sustainable waste management system. The Environmental Service Department of Banyuasin Regency serves as the local authority responsible for environmental conservation and control. Its mandate includes granting environmental permits to industries, enforcing environmental impact assessments (AMDAL), and ensuring compliance with regulations on air and water quality, emission standards, and waste management practices<sup>[10]</sup>. While such regulatory frameworks exist, their implementation in industrial areas often faces challenges, including

limited enforcement capacity, weak coordination between stakeholders, and insufficient infrastructure for waste segregation and recycling. As a result, waste streams from both industries and households remain underutilized, with minimal transformation into compost or other value-added products.

Previous studies in Banyuasin have primarily focused on environmental degradation in aquatic ecosystems. For example, emphasized the importance of the 3R (reduce, reuse, recycle) principle to improve waste management performance in the regency<sup>[11]</sup>. More recent studies have reported increasing accumulation of heavy metals (Pb, Hg, Cu, and Cd) in gastropods from aquaculture zones in the Musi River estuary<sup>[12]</sup>, while highlighting the socio-economic and ecological benefits of agricultural waste processing for farmers in Banyuasin Regency<sup>[13]</sup>. Collectively, these studies point to environmental risks and opportunities in the region but do not address the specific role of industrial areas in domestic waste processing or the integration of composting into sustainable agricultural practices.

At the methodological level, Structural Equation Modeling (SEM) has become a powerful tool for analyzing complex interactions among government, industries, and communities in environmental management. SEM has been widely applied to topics such as marine plastic reduction in Manila<sup>[14]</sup>, green business practices in Bangladeshi garment industries<sup>[15]</sup>, textile wastewater management<sup>[16]</sup>, electronic waste treatment<sup>[17]</sup>, and broader assessments of environmental performance across multiple industrial sectors<sup>[17–20]</sup>. These applications demonstrate SEM's ability to capture direct and indirect effects between latent variables such as awareness, compliance, resource efficiency, and environmental outcomes. Yet, there has been little application of SEM to investigate waste-to-compost systems in industrial contexts in Indonesia, particularly in relation to sustainable agriculture.

This gap highlights the novelty of the present study. While composting has been examined in rural agricultural settings, its potential within industrial areas—where domestic waste from residential settlements intersects with industrial CSR initiatives—remains underexplored. The Gasing Industrial Area offers a unique case study due to its scale, industrial diversity, and proximity to agricultural land. Investigating the challenges and opportunities of transforming domestic waste into compost in this context is crucial for designing integrated solutions that align with

Indonesia’s sustainability agenda and global SDGs.

Therefore, this study aims to analyse the practical challenges and opportunities of developing a domestic waste industrial park for composting in the Gasing Industrial Area, Banyuasin Regency, South Sumatra. Specifically, it seeks to:

- (1) identify key barriers faced by industries, communities, and government institutions in implementing waste-to-compost programs;
- (2) explore opportunities for linking compost production with sustainable agricultural practices;
- (3) apply SEM to model the relationships between stakeholder roles, environmental management practices, and the feasibility of compost-based circular economy initiatives.

The findings are expected to contribute both theoretically—by expanding SEM applications in industrial ecology research—and practically, by offering policy-relevant insights for local governments, industries, and communities working toward sustainable waste management and agricultural development.

## 2. Literature Review

### 2.1. Existing System of Domestic Waste Management in Gasing Industrial Area

Domestic waste in Talang Kelapa Subdistrict is man-

aged by the local Environmental Service, which conducts household waste collection every two days. In accordance with Indonesian Government Regulation No. 22 of 2021, industries within the regency are obligated to submit environmental management strategies and commitments for approval and oversight by the Environmental Service <sup>[21]</sup>. Furthermore, they are required to report the performance of their environmental management every six months through environmental permit documentation. Complementing government efforts, numerous small local enterprises contribute by transporting waste from households and industries to temporary waste collection points (TPS). From these collection points, dump trucks operated by the Environmental Service transport the waste to designated landfill facilities. In Banyuasin Regency, three active landfills (**Table 2**) are currently in operation, accommodating domestic waste generated across all subdistricts within the regency <sup>[21]</sup>.

Research conducted by the Banyuasin Environmental Service in 2023 indicates that residents’ waste management behavior is influenced by the distance of their homes from the landfill. Environmentally unfriendly disposal practices remain relatively common <sup>[22]</sup>. Among households located within a 1 km radius of the landfill, 46.7% still dispose of their waste by burning it. In other words, open burning remains the predominant alternative for waste disposal, even among households situated near formal waste management facilities (**Table 3**).

**Table 2.** List of Active Landfills in Banyuasin Regency.

Landfill	Location	Area (Ha)
Terlangu	Terlangu Village, Banyuasin III Subdistrict	15.0
Semuntul	Semuntul, Rantau Bayur Subdistrict	15.7
TPA TBL	Sidomulyo Village, Air Kumbang Subdistrict	2.0

**Table 3.** Methods Used by the Banyuasin Residents to Process Their Domestic Waste <sup>[22]</sup>.

Residences’ Behavior to Manage Their Domestic Waste	Percentage (%)	
	House to Landfill > 1 km	House to Landfill ≤ 1 km
Collected and then transported by the environmental service’s janitor	33.2	6.7
Collected and then individually transported to the waste shelter or landfill	31.5	13.3
Sold for Reduce, Reuse, or Recycle	0.3	0.0
Composting	0.5	6.7
Throw into river/sea	4.3	26.7
Buried	2.5	0.0
Burned	26.4	46.7
Discarded haphazardly	1.3	0.0

## 2.2. Theoretical Framework and Hypothesis Development

### 2.2.1. Perspective that Representing the Perceived Reality

Theoretical frameworks that examine the relationship between perspectives and reality emphasize the significant influence of cognitive processes, social constructs, and individual beliefs in shaping environmental behavior. One such framework is Social Cognitive Theory, which posits that individuals learn and model behavior through observation within their social environment<sup>[23]</sup>. In the context of environmental behavior, this theory underscores the role of observational learning in shaping perceptions and responses to environmental challenges. Exposure to environmental practices whether through media, peers, or community role models can shape individuals' perspectives and, in turn, influence their likelihood of adopting sustainable practices.

In addition, Ecological Systems Theory provides a broader perspective by considering the influence of multiple environmental systems on individual behavior<sup>[24]</sup>. It highlights how microsystems (immediate surroundings), mesosystems (interactions between microsystems), exosystems (external systems indirectly affecting the individual), and macrosystems (cultural contexts) collectively shape reality. The theory suggests that interventions at different ecological levels can foster meaningful behavioral change by reshaping individuals' perspectives within their complex socio-ecological contexts.

### 2.2.2. Government Policy and Public Behavior

Government policies play a critical role in managing environmental quality within their respective jurisdictions. These policies consist of standards and guidelines that shape how societies interact with their natural surroundings, both individually and collectively. They provide a regulatory framework that guides industries, businesses, and individuals in their interactions with the environment<sup>[25]</sup>. In addition, the government plays a major role in promoting environmental education to the public. Information technology—particularly social media—has the potential to enhance the delivery of environmental education to society at large<sup>[26]</sup>.

Conversely, public participation—whether in the form of support, criticism, or advocacy—plays a crucial role in policy implementation. Public awareness and engagement are powerful drivers of environmental policy formulation. Environmental advocacy, grassroots movements, and public demand for sustainability often lead to the creation or amendment of policies. When individuals and communities raise concerns about air and water quality, deforestation, or wildlife protection, policymakers are compelled to respond with legislation and regulations that address these issues<sup>[27,28]</sup>.

The Environmental Service of Banyuasin Regency manages waste transportation from temporary collection points (TPS) to landfill facilities. Given the regency's relatively large area, small population, and limited road infrastructure, waste collection is carried out less frequently, averaging once every two days. Most industries in the regency hire third parties to transport their waste from temporary shelters to landfills, a model that is gradually being adopted by higher-income households. By contrast, lower-income residents often burn their waste independently, typically without standardized incinerators. In addition, small illegal waste shelters are sometimes found along roadsides, awaiting collection and disposal at landfill sites<sup>[29]</sup>.

**H1.** *The quality of government policies positively influences public environmental behavior.*

### 2.2.3. Government Policy and Performance of Environment Management

Government policies are designed to mitigate the negative impacts of human activities on the environment and promote sustainable practices<sup>[26]</sup>. The effectiveness of government policies in preserving or enhancing environmental quality is influenced by their design, implementation, and enforcement. In essence, the relationship between government and environmental quality as a result of environmental management is interdependent. Effective policies can lead to improved environmental quality. On the other hand, the state of the environment can shape the direction and urgency of policy responses. An accurate measurement of the feedback from environmental quality will play an important role in making the right call to create the right direction of the policies<sup>[25,27]</sup>.

**H2.** *The quality of the government policies will positively affect the performance of the environment.*

### 2.2.4. Waste Infrastructure and Public Behavior

Waste infrastructure refers to the systems and facilities in place for the collection, disposal, and recycling of waste materials. The Effective waste infrastructure not only promotes proper waste management but also significantly influences how individuals and communities interact with their environment<sup>[29,30]</sup>. The availability of the domestic waste transport and processing facility also reflects the commitment of the environmental management from the public to keep their environment clean.

Public behavior regarding waste disposal, recycling, and consumption patterns is profoundly shaped by the availability and accessibility of waste infrastructure. When well-designed waste collection systems, recycling centers, and disposal facilities are readily accessible, individuals are more likely to dispose of their waste responsibly. This can lead to reduced littering, illegal dumping, and pollution, contributing to cleaner and healthier environments<sup>[31]</sup>. On the other hand, an inadequate or poorly maintained waste infrastructure can lead to negative public behavior. When disposal options are limited or inconvenient, individuals may resort to improper waste disposal practices, harming the environment. Additionally, the absence of recycling facilities can discourage sustainable behaviors, such as recycling paper, plastic, and electronic waste<sup>[32]</sup>.

The relationship between waste infrastructure and public behavior is not one-sided. Public attitudes and behaviors also influence the development and improvement of waste infrastructure. When communities demand better waste management services and recycling options, governments and organizations are often spurred to invest in upgrading existing infrastructure or developing new facilities<sup>[33]</sup>.

**H3.** *The quality of the waste infrastructure availability will positively affect the public behavior on the environment.*

### 2.2.5. Waste Infrastructure and Performance of Environment Management

Waste infrastructure includes the facilities, tech-

nologies, and operational practices used to collect, treat, recycle, and dispose of waste. The condition of this infrastructure plays a crucial role in maintaining environmental quality. When waste systems are well planned and properly managed, they can reduce pollution, limit the release of harmful substances, and lower risks to ecosystems and public health<sup>[30,31]</sup>. Effective landfill management and appropriate treatment facilities also help prevent contaminants from reaching the soil and groundwater<sup>[34]</sup>. In the agricultural context, soil fertility and ecosystem stability are key foundations of sustainable production. Other researchers believe that the use of organic amendments, including compost, is one of the most effective ways to improve soil health. This reinforces the importance of converting domestic organic waste into compost, which could provide meaningful benefits for agricultural areas surrounding the Gasing Industrial Region<sup>[35]</sup>.

The relationship between waste infrastructure and environmental quality is multidirectional. On one hand, environmental quality can influence the development and improvement of waste infrastructure. Environmental regulations and concerns often drive innovation in waste management technologies and practices. On the other hand, the effectiveness of waste infrastructure has a direct bearing on environmental quality, influencing the extent to which ecosystems can thrive, natural resources can be protected, and human health can be safeguarded<sup>[31]</sup>. Effective waste management practices and well-maintained infrastructure are essential for preserving and enhancing environmental quality while mitigating the adverse impacts of waste generation on ecosystems and communities.

**H4.** *The quality of the waste infrastructure availability will positively affect the performance of environmental management.*

### 2.2.6. Social-Economic Demography and Public Behavior

The relationship between socioeconomic demographics and public behavior concerning environmental issues is a dynamic interplay that profoundly influences the trajectory of environmental sustainability. Socioeconomic demographics encompass factors such as population, environmental knowledge level (education level), occupation,

and household income, which play a pivotal role in shaping individuals' and communities' attitudes and behaviors towards the environment<sup>[34]</sup>.

Income and education often shape the way people view and respond to environmental issues. Those who earn more or have a higher level of schooling usually have better access to information and tend to be more willing—or able—to adopt practices such as recycling, conserving energy, or supporting environmental regulations<sup>[36,37]</sup>. Their financial capacity also makes it easier for them to choose environmentally friendly technologies and products, which strengthens their overall sustainable behavior. Consistent with this idea, Ahsan et al note that the improvement of waste segregation and resource recovery systems, including organic waste composting, plays a key role in boosting environmental performance in fast-growing regions. This underscores how crucial knowledgeable and capable communities are in advancing effective waste management<sup>[38]</sup>.

Occupation and employment also influence public behavior regarding environmental issues. Individuals in certain professions, such as environmental science, may have a heightened awareness of ecological challenges and contribute to finding sustainable solutions<sup>[36]</sup>. Moreover, industries and businesses can significantly impact the environment through their practices, and public scrutiny and regulatory responses may vary depending on socioeconomic factors<sup>[38]</sup>.

**H5.** *The social-economy demography will positively affect the public behavior on environmental activity.*

### 2.2.7. Social-Economic Demography and Performance of Environment Management

Income disparities often have a profound impact on environmental quality. Lower-income communities may face disproportionate environmental burdens, such as exposure to pollution and inadequate access to clean water and green spaces. Conversely, higher-income areas may have the resources to invest in cleaner technologies and advocate for environmental protection, potentially leading to improved environmental conditions<sup>[36,37]</sup>.

Education levels are closely linked to environmental awareness and the ability to engage in sustainable practices. Higher educational attainment is associated with a

greater understanding of environmental issues and a higher likelihood of adopting eco-friendly behaviors. Educated individuals and communities are often more inclined to support policies and initiatives aimed at preserving and enhancing the environment<sup>[38]</sup>.

Occupational factors also contribute to the relationship. Some industries may have a more significant environmental footprint than others, depending on their practices and regulations. For example, industries involved in natural resource extraction may have a considerable impact on local ecosystems. The behavior of these industries, often influenced by economic factors, can shape environmental quality<sup>[39]</sup>.

Geographic location plays a crucial role in environmental quality. Population density can affect pollution levels, energy consumption, and access to green spaces. Rural areas may face distinct environmental challenges, such as agricultural runoff. The socioeconomic demographics of these areas can influence how communities interact with their unique environmental contexts<sup>[40]</sup>.

**H6.** *The social-economy demography will partially affect the performance of environmental management.*

### 2.2.8. Public Behavior on Environment and Performance of Environmental Management

Public behavior and engagement play a crucial role in influencing environmental quality, and on the other hand, environmental quality can shape public behavior. When individuals and communities actively participate in environmentally responsible behaviors, such as recycling, reducing energy consumption, and supporting conservation efforts, they contribute positively to environmental quality<sup>[39]</sup>. These collective actions can reduce pollution, conserve natural resources, and protect ecosystems, ultimately leading to cleaner air and water, enhanced biodiversity, and improved overall environmental health. On the other hand, Environmental degradation, pollution, and the consequences of climate change can prompt individuals and communities to become more environmentally aware and engaged<sup>[40]</sup>. Environmental crises often lead to calls for action, activism, and support for policies that aim to mitigate further damage and restore environmental quality<sup>[41]</sup>.

Public behavior and participation are not only responsive to environmental challenges but can also drive proactive change. Advocacy, public awareness campaigns, and community-based initiatives can lead to more stringent environmental regulations, increased conservation efforts, and sustainable resource management practices. Engaged and informed citizens can influence policymakers and hold industries accountable for their environmental impact<sup>[42]</sup>.

**H7.** *The public's behavior on the environment will partially affect the performance of environmental management.*

### 3. Materials and Methods

#### 3.1. Data Collection Methods

The data is collected through several methods, which are assembled into a conceptual framework in **Figure 1**. To identify the relationship between factors that influence environmental performance through the stakeholders' perspectives on the domestic waste management system, the data is collected through in-depth interviews, questionnaires, and secondary data collection. The in-depth interviews and online survey were conducted with the stakeholders from the local government, industrialists, and local society.

The online surveys were conducted in November

2023 via Google Form, involving 300 respondents, consisting of 100 respondents from the respective stakeholders. The respondents were selected through a targeted sampling based on their roles and experience in their respective organizations. A similar approach was conducted for the in-depth interviews, which were also conducted in the same interval as the in-depth interviews. The results from the in-depth interview and secondary data collection were used to direct the questions in the questionnaire and to confirm the validity of the existing condition of the society, as reflected by the results of the questionnaire. The questionnaire data will be processed through CFA and SEM formulation using SPSS Amos 22<sup>[43]</sup>.

#### 3.2. Path Diagram

For testing the hypothesis that has been formulated, there are 8 relationships between the components that affect environmental quality, which are both directly and indirectly affecting (**Figure 2**), and the List of Manifest Indicators of the SEM Model can be seen in **Table 4**. These components would become the latent variables in structural equation modeling. The result of this study will formulate the suggestions that can be applied for upgrading the management system applied by each stakeholder to increase the environmental quality.

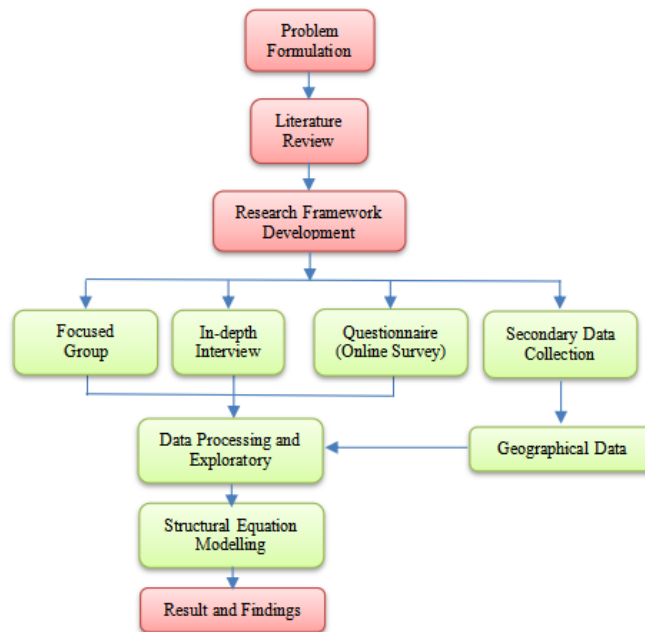


Figure 1. Research Framework.

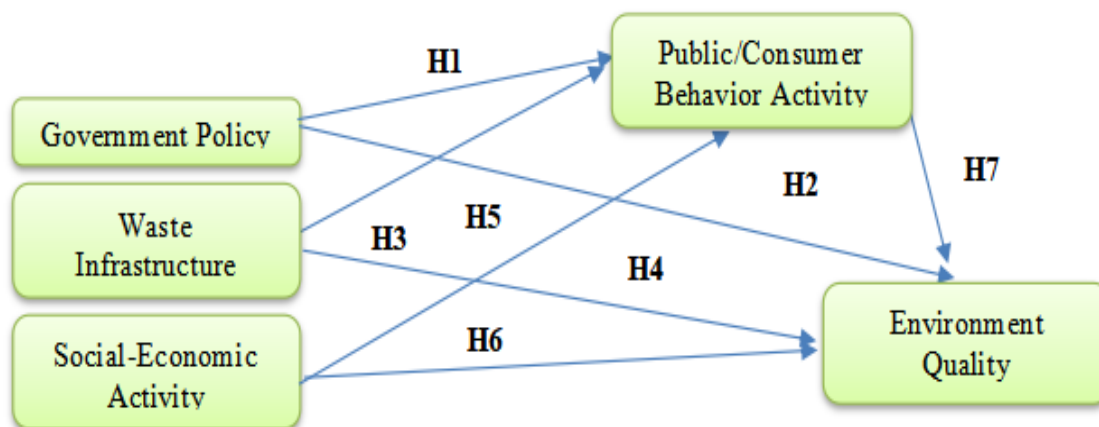


Figure 2. Path Diagram for the Structural Equation Model.

Table 4. The List of Manifest Indicators of the SEM Model.

Latent Factors	Acronym	Description
Government Policy	GovP1	Policy Objectives
	GovP2	Regulation Implementation
	GovP3	Social Development Program
Waste Infrastructure	WIn1	Waste-Sorting Facility
	WIn2	Landfill Capacity
	WIn3	Waste Transporting Availability
	WIn4	Recycling and Diversion Facility
Social-Economic Background	SosEc1	Population
	SosEc2	Household Income
	SosEc3	Education Level (Environmental Knowledge)
Public Behavior	PubB1	Environmental Awareness
	PubB2	Community Service Programs from Industry
	PubB3	Waste Recycling and Diversion Behavior
	PubB4	Support for Waste Processing Policy
Performance of Environmental Management	PEM1	Soil Contamination
	PEM2	Air Quality
	PEM3	Drainage System Quality
	PEM4	Water Quality

### 3.3. Data Analysis Methods

The data analysis framework of SEM is processed at various stages. The collected data from the questionnaire would be processed through statistical methods and standardization. The descriptive analysis in this study will be extracted from exploratory data analysis from the questionnaire, which was validated through the depth interview. The questionnaire results were standardized by weighting the questionnaire score in the range of 1–5 to be properly processed in the next step. The confirmatory data analysis

and SEM formulation were conducted with SPSS AMOS version 22 using the latent factors and indicators that we stated in **Table 4**, which would be assessed with confirmatory factor analysis (CFA) with SPSS AMOS version 22.

## 4. Results

### 4.1. Demographic Characteristics of the Respondents

The online survey was conducted by 300 respon-

dents who were chosen randomly. The respondents consist of 100 respondents from the local society, 100 respondents from the Department of Environmental Governance of Banyuasin Regency officials, and 100 respondents from industrialists and employees from the industries that operate at Gasing Industrial Area. The demographic information includes gender (male (63.33%) and female (37.63%)) and age group in years (under 25 years old (15%), 25–34 years old (30%), 35–44 years old (40%), and over 45 years (15%)). Most of the respondents have graduated from High School (30.8%) and Undergraduate studies (35.3%). Most of the occupations of the respondents are private sector employees (40.2%), civil servants (35.4%), and entrepreneurs (24.4%).

#### 4.2. Descriptive Analysis

The questionnaire was conducted on 300 respondents in the Gasing Industrial Area. The range of the result of the questionnaire was set on 1 at minimum, and 5 at maximum, which indicated the mean of scores given by respondents to a question. A score = 1 indicated that a respondent fully disagreed with the statements in the question, while a score = 5 symbolized that the respondent fully agreed with the statement. The statements used in the questionnaire are positive statements that indicate

a positive state of the environment. The scores are calculated as the mean of the scores from all of the questions representing a variable.

Government Policy (GovP) indicators show respondents evaluated policy effectiveness with mean scores ranging from 3.048 to 3.527. The variation in responses is relatively low, suggesting a general consensus about the perception of government policies. Waste Infrastructure (WIn) scores indicate perceptions of infrastructure adequacy with means between 2.751 and 2.988. These scores reflect moderate satisfaction with existing waste management facilities. Socio-Economic Background (SosEc) indicators, which assess the impact of socio-economic factors on environmental management, have means ranging from 2.848 to 3.256. The slightly wider range in responses suggests varying perceptions based on individual socio-economic status. Public Behavior (PubB) towards environmental management is measured, with mean scores from 2.751 to 2.857, indicating a slightly lower but consistent acknowledgment of proactive environmental behaviors among the public. Performance of Environmental Management (PEM), representing the outcomes of environmental strategies, shows mean scores from 2.732 to 2.769. These scores suggest there are ongoing challenges in achieving high environmental performance (**Table 5**).

**Table 5.** Descriptive Analysis of the Questionnaire Results.

Parameters	N	Minimum	Maximum	Mean	Std. Deviation
GovP1	300	2.000	4.667	3.382	0.532
GovP2	300	2.333	4.667	3.527	0.444
GovP3	300	2.000	4.333	3.048	0.489
WIn1	300	2.000	3.667	2.751	0.334
WIn2	300	2.000	4.333	2.878	0.403
WIn3	300	2.000	4.333	2.966	0.460
WIn4	300	2.000	4.000	2.988	0.446
SosEc1	300	2.000	4.667	3.256	0.623
SosEc2	300	1.667	4.000	2.848	0.526
SosEc3	300	1.667	4.000	2.870	0.537
PubB1	300	2.000	4.333	2.857	0.522
PubB2	300	1.667	4.667	2.824	0.524
PubB3	300	2.000	4.333	2.797	0.510
PubB4	300	2.000	4.667	2.751	0.537
PEM1	300	1.667	4.667	2.769	0.542
PEM2	300	2.000	4.667	2.732	0.521
PEM3	300	1.667	5.000	2.748	0.561
PEM4	300	1.667	4.667	2.738	0.534

The assessment of multivariate normality and multicollinearity was conducted using SPSS Statistics 22 by examining each indicator's P–P plot, Q–Q plot, skewness, and kurtosis. The P–P and Q–Q plots were closely aligned with the straight line, indicating that the observed values approximate a normal distribution. The skewness and kurtosis values for all indicators were within the acceptable range of  $-2$  to  $+2$ . In addition, no correlation coefficient greater than 0.8 was identified in the correlation matrix for any of the observed indicators.

### 4.3. Verification and Reliability of the Latent Factors

The reliability test for all 18 manifest variables was conducted using SPSS Statistics 22, yielding a Cronbach's alpha of 0.891 ( $\alpha > 0.70$ ), which indicates strong internal consistency of the data<sup>[44]</sup>. The reliability of individual latent factors was as follows: GovP ( $\alpha = 0.88$ ), WIn ( $\alpha = 0.778$ ), SosEc ( $\alpha = 0.679$ ), PubB ( $\alpha = 0.933$ ), and PEM ( $\alpha = 0.931$ ). Four of these factors exceeded the minimum threshold of 0.70<sup>[45]</sup>, while SosEc fell slightly below the cutoff but remained within a nearly acceptable range, likely due to the wide variation in respondents' socioeconomic backgrounds. Bartlett's test of sphericity was also conducted to assess the null hypothesis that the original correlation matrix is an identity matrix. The test result was highly significant ( $\chi^2 = 3689.982$ ,  $df = 153$ ,  $p < 0.001$ ), confirming the suitability of the data for further analysis.

## 4.4. Confirmatory Factor Analysis

### 4.4.1. Measurement Model

The critical (C.R.) value describes the ratio of the estimate to its standard error. A value of 1.96 indicates the two-sided significance at the 5% level, where the null hypothesis is rejected if the critical ratio for a regression weight is more than 1.96, indicating that the path is significant at the 0.05 level. The estimates of the factor loading were standardized between  $-1$  and  $1$ . The corresponding manifest variables were all significant at  $p < 0.001$ . The standardized estimates for manifest variables for the latent factor GovP were within 0.82–0.86 for 3 manifest variables. The standardized regression weight estimates for latent factor WIn vary from 0.57 to 0.75 for 4 manifest variables. For latent factor SosEc, the values vary from 0.27 to 0.94 from 3

manifests, with the value of 0.27 from the SosEc1, 0.86 for SosEc2, and 0.95 from the SosEc3. For latent factor PubB, the values vary from 0.87 to 0.91 across 4 manifests. The PEM latent factor's manifest have the estimated regression values of 0.86–0.91. The measurement model is assessed by a variety of parameters using AMOS version 22 (**Figure 3**).

The model fit measures significantly with Comparative Fit Index (CFI = 0.983), Standardized Root Mean Square Residual (SRMR = 0.045) and Tucker-Lewis Index (TLI = 0.980), Chi-Squared/Degree of Freedom (1.485) and RMSEA (0.040), which are still in an acceptable range. The indicators of both measurement and structural models have a good fit to estimate the regression coefficient, critical ratio, and  $p$ -value of the models to expose the relationship between variables in this study (**Table 6**).

### 4.4.2. Convergent and Discriminant Validity

The convergent and discriminant validity was assessed by using the Fornell and Larcker criterion<sup>[46]</sup>. The observed latent variables for our study have an Average Value Extracted (AVE) above 0.50, and the Composite Reliability (CR) is above the 0.70 threshold. The values of the CR, AVE, and Cronbach's Alpha are described in **Table 7**.

From the result of the Fornell-Lacker criterion, our latent variables have a good convergent validity, with all of the variable values of  $CR > 0.60$  and a Cronbach's Alpha coefficient of 0.70. The Fornell-Lacker criterion from the data used in structural equation modeling has already passed the criterion, which means that most of the squared root of the Average Variance Extracted (AVE) from each construct has a bigger value than the value of the correlation between other constructs.

The discriminant validity is also assessed by the heterotrait-monotrait (HTMT) ratio technique, which was proposed as a modern approach to determining the discriminant validity between latent variables. The good HTMT ratio of each construct should be less than 0.90. The results of the HTMT ratio analysis are presented in **Table 8**. The findings indicate that all HTMT values meet the recommended threshold of 0.85, except for the relationship between Public Behavior and the Performance of Environmental Management constructs, which slightly exceeds the criterion. This shows that these constructs have a strong correlation with each other, which will be discussed further in the discussion section.

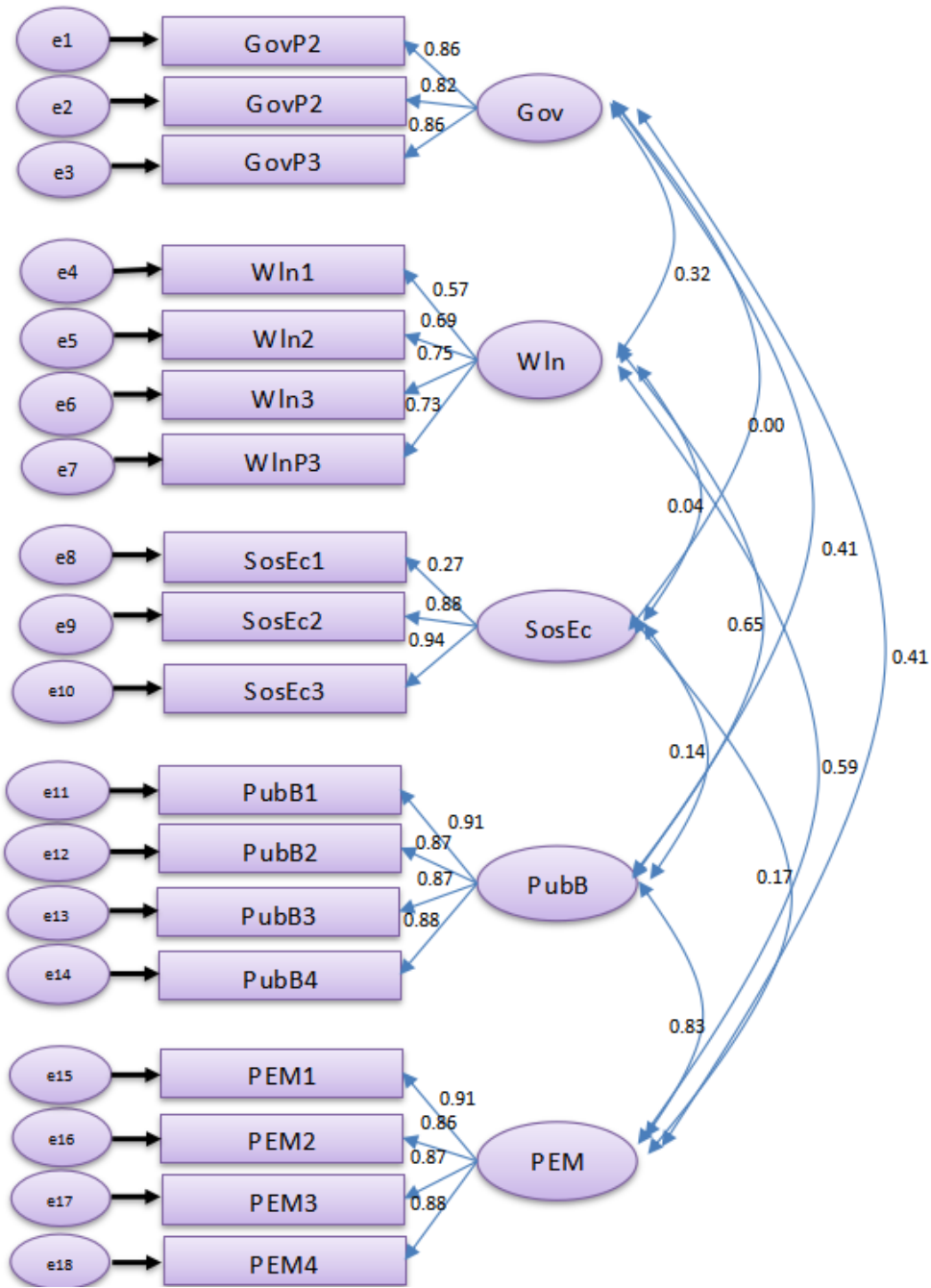


Figure 3. Measurement Model.

Table 6. Criterion of Measurement Model Fit.

Criterion of Model Fit	Values of Model Fit	Absolute Fit Acceptance	Test Result
$\chi^2/df$	1.485	<3.00	Established
CFI	0.983	$\geq 0.90$	Established
GFI	0.935	$\geq 0.90$	Established
AGFI	0.911	$\geq 0.90$	Established
RMSEA	0.040	<0.08	Established
SRMR	0.045	<0.045	Established
TLI	0.980	$\geq 0.90$	Established

Table 7. Fornell-Lacker criterion.

	CR	AVE	GovP	WIn	SosEc	PubB	PEM
GovP	0.8823	0.7143	0.8823	0.3220	0.0010	0.4080	0.3830
WIn	0.7825	0.4757	0.3220	0.7823	-0.0440	0.6520	0.6220
SosEc	0.7732	0.5735	0.0010	-0.0440	0.7726	0.1370	0.1620
PubB	0.9333	0.7774	0.4080	0.6520	0.1370	0.9332	0.8710
PEM	0.9310	0.7654	0.3830	0.6220	0.1620	0.8710	0.9288
Cronbach Alpha			0.880	0.778	0.679	0.933	0.931

Table 8. The HTMT Analysis.

	GovP	WIn	SosEc	PubB	PEM
GovP					
WIn	0.322202				
SosEc	0.004169	0.03947			
PubB	0.407629	0.652492	0.149749		
PEM	0.40599	0.588615	0.180907	0.828729	

## 5. Discussion

### 5.1. Path Analysis

The measurement model that was assessed by the confirmatory data analysis already has decent model fitting and reliability to be processed on the path analysis. The path model in this study is shown in **Figure 4**, which has zero degrees of freedom, and only has one solution of the model that can be extracted from the regression without being able to assess the model fitting criterion. The collective variables that were used in this path analysis were extracted from the mean of the respective manifest variables within the latent variable.

The model has 7 causal relationships that are being analyzed. There are 6 causal relationships that have statistically significant influence for the 5% error significance ( $p < 0.005$  and C.R.  $> 1.96$ ), they are GovP-PubB, WIn-PubB, SosEc-PubB, GovP-PEM, SosEc-PEM, WIn-PEM, and PubB-PEM (**Table 9**).

The further analysis of the direct and indirect implications from the path model is evaluated with the bootstrap method for mediation analysis with 5.000 bootstrap samples with a 95% BC confidence level using software AMOS 22 [47-49]. The mediation analysis result is shown in **Table 10**. From the path model mediation analysis, we got the relationship between GovP→PubB→PEM, GovP→WIn→PEM, and WIn→ SosEc→PEM.

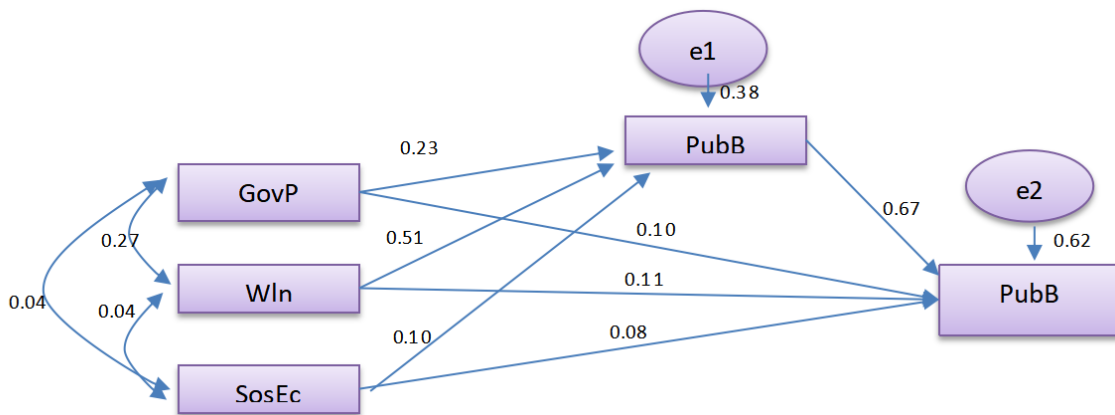


Figure 4. The Path Model.

**Table 9.** The Estimated Regression Weight of the Path Model.

Causal Relationship	Estimate	Standardized Estimate	Standard Error	Critical Ratio	p-Value
GovP→PubB	0.253	0.233	0.051	4.933	<0.001
WIn→PubB	0.757	0.508	0.07	10.75	<0.001
SosEc→PubB	0.113	0.104	0.049	2.294	0.022
GovP→PEM	0.11	0.098	0.043	2.533	0.011
WIn→PEM	0.086	0.077	0.04	2.121	0.034
SosEc→PEM	0.163	0.106	0.067	2.427	0.015
PubB→PEM	0.69	0.670	0.047	14.709	<0.001

**Table 10.** The Result of Mediation Analysis of the Path Model.

Relationship	Direct Effect (Unstd. Est (p-Value))	Indirect Effect	Confidence Interval		p-Value	Interpretation
			Lower Bound	Upper Bound		
GovP→PubB→PEM	0.110 (0.011)	0.175	0.109	0.248	<0.001	Partial Mediation
WIn→PubB→PEM	0.163 (0.015)	0.522	0.370	0.686	<0.001	Partial Mediation
SosEc→PubB→PEM	0.086 (0.034)	0.078	0.014	0.150	0.022	Partial Mediation

## 5.2. Structural Model Squared Multiple Correlations

The further analysis was conducted with the full-structural equation model using the exact relationship that was used in the path analysis, where the GovP, WIn, and SocEc would respectively affect the PubB and PEM, and then, PubB would affect the PEM. The structural model fitting is conducted on software AMOS 22 and gives the result shown in **Figure 5** and **Table 11**. Similar to the Path Analysis, from 7 causal relationships, there are 4 relationships that have statistically significant influence at a 95% confidence level ( $p < 0.005$  and C.R  $> 1.96$ ), those are GovP→PubB, WIn→PubB, SosEc→PubB, and PubB→PEM. On the other hand, the 3 other relationships have statistically not significant influence, those are GovP→PEM, WIn→PEM, and SosEc→PEM.

The assessment of the structural model fitting was conducted through the AMOS 22 software, which is pre-

sented in **Table 12**, and meets all the fitting criteria. The fitting criterion consisted of RMSEA (0.038), CFI (0.985), GFI (0.937), AGFI (0.914),  $\chi^2/df$  (1.44), SRMR (0.0442), and TLI (0.981). The indicators of both measurement and structural model have a good fit to estimate the regression coefficient, critical ratio, and p-value of the models to expose the relationship between variables in this study<sup>[50–53]</sup>.

The further analysis of the mediation analysis to dig out the direct and indirect implications from the structural model is evaluated with the bootstrap method for mediation analysis with 5000 bootstrap samples with 95% of BC confidence level using the software AMOS 22. The mediation analysis result is shown in **Table 13**.

From the path model mediation analysis, we got the relationship between GovP→PubB→PEM is a full mediation, which means GovP and PEM do not have a significant relation, but GovP→PubB and PubB→PEM have a statistically significant relation.

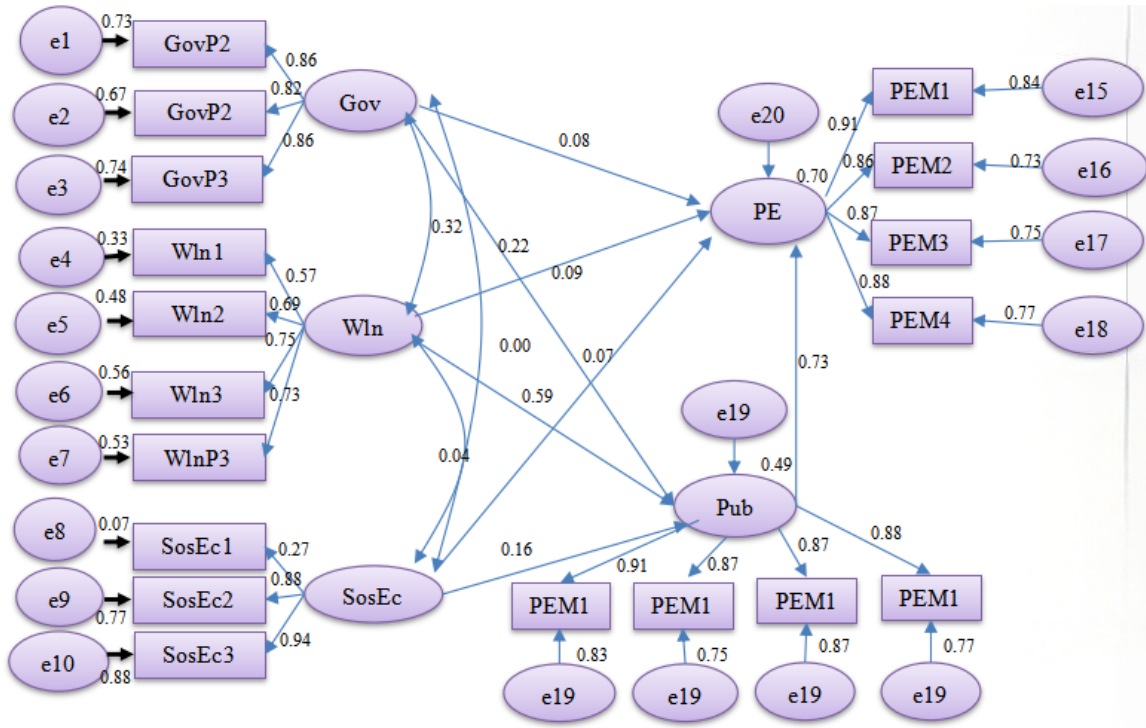


Figure 5. The Structural Model.

Table 11. The Estimated Regression Weight of the Structural Model.

Causal Relationship	Estimate	Standardized Estimate	Standard Error	Critical Ratio	p-Value
GovP→PubB	0.228	0.289	0.059	3.886	<0.001
Wln→PubB	1.462	0.587	0.194	7.582	<0.001
SosEc→PubB	0.46	0.164	0.17	2.676	0.007
GovP→PEM	0.087	0.080	0.046	1.807	0.071
Wln→PEM	0.238	0.092	0.156	1.476	0.140
SosEc→PEM	0.21	0.072	0.119	1.641	0.101
PubB→PEM	0.756	0.726	0.067	11.154	<0.001

Table 12. Fitting Criterion of Structural Model.

Criterion of Model Fit	Values of Model Fit	Absolute Fit Acceptance	Test Result
$\chi^2/df$	1.44	<3.00	Established
CFI	0.985	$\geq 0.90$	Established
GFI	0.937	$\geq 0.90$	Established
AGFI	0.914	$\geq 0.90$	Established
RMSEA	0.038	<0.08	Established
SRMR	0.0442	<0.08	Established
TLI	0.981	$\geq 0.90$	Established

Table 13. The Result of Mediation Analysis of the Path Model.

Relationship	Direct Effect (Unstd. Est (p-Value))	Indirect Effect	Confidence Interval		p-Value	Interpretation
			Lower Bound	Upper Bound		
GovP→PubB→PEM	0.087 (0.071)	0.173	0.084	0.267	<0.001	Full Mediation
WIn→PubB→PEM	0.238 (0.140)	1.106	0.741	1.577	<0.001	Full Mediation
SosEc→PubB→PEM	0.210 (0.101)	0.348	0.132	0.786	0.007	Full Mediation

### 5.3. Discussion of the Results

In the Government Policy (GovP) latent factor, there is 3 manifest variables that played role as the observed variables, two variables have the highest value of the standardize regression coefficient of respectively 0.86 from the government policy objectives (GovP1) and the community development program (GovP3), the other observed variable, Regulation Implementation also have a relatively high value of regression coefficient of 0.82. Moreover, the GovP latent variable has two influences on two other latent variables, PubB and PEM. Both the Path Model and the Structural Model indicated that the GovP does not have a statistically significant influence on PEM. Therefore, H2 is not supported with CR = 0.739 and *p*-value of 0.46 (structural model) and CR = 1.548, *p* = 0.122 (path model). On the other hand, GovP was proven to have a statistically significant influence on PubB through the path model and structural model. Therefore, the H1 is supported.

The Waste Processing Infrastructure (WIn) latent factor consisted of 4 manifest variables. The waste transporting availability (WIn3) is the most influential variable with a regression coefficient of 0.75. The recycling and diversion facility (WIn4) and the landfill capacity (WIn2) have regression coefficients of 0.73 and 0.70, respectively. While the Waste Separation Facility (WIn1) has a regression coefficient of 0.57. Both the path model and the structural model indicate that the WIn is statistically significant in influencing the Public Behavior (PubB) latent factor with a regression coefficient of 0.558 with *p* = 0.001 (structural model) and 0.508 with *p* = 0.001 (path model). Therefore, H3 is supported. On the other hand, the direct impact of WIn on the Performance of Environment Management (PEM) has a slightly significant influence from the path model (CR = 3.021, *p*-ratio = 0.003), while through the structural model, the relationship is considered statistically not significant (CR = 1.834, *p*-ratio = 0.067).

Therefore, H4 is not supported.

The Social-Economic Background (SosEc) latent factor consisted of 3 manifest variables. The respondents' environmental knowledge (SosEc3) is the most influential variable with a regression coefficient of 0.95. The respondents' household income (SosEc2) has a regression coefficient of 0.86. While the population in the respondents' environment (SosEc1) has a regression coefficient of 0.27. Both the path model and the structural model indicate that the SosEc is statistically significant in influencing the Public Behavior (PubB) latent factor with a regression coefficient of 0.162 with *p* = 0.007 (structural model) and a coefficient of 0.104 with *p* = 0.022 (path model). Therefore, H5 is supported. On the other hand, the direct impact of SosEc on the Performance of Environment Management (PEM) has a slightly significant influence from the path model (CR = 2.036, *p*-ratio = 0.042), while through the structural model, the relationship is considered statistically not significant (CR = 1.534, *p*-ratio = 0.125). Therefore, H6 is not supported.

The Public Behavior plays the role of a mediator variable where this variable is acting as an endogenous variable from GovP, WIn, and SosEc and is acting as the exogenous variable for PEM. As the endogenous variable, the GovP, WIn, and SosEc are statistically significant in influencing the Public Behavior, with WIn having the highest value of correlation of 0.588 (structural model) and 0.508 (path model). On the other hand, PubB is statistically significant in influencing the PEM both from the structural model (CR = 12.63 and *p* = 0.001) and the path model (CR = 16.927 and *p* = 0.001). Therefore, H7 is supported. Within the PubB latent factor, which consists of 4 manifest variables, the Environmental Awareness (PubB1) has the largest regression coefficient of 0.83.

The Performance of Environmental Knowledge (PEM) is the output of our model that influenced by an-

other latent variables, which from the previous discussion, we have found that only PubB has a significant relationship with the PEM, while another direct implication from respectively GovP, WIn, and SosEc are not statistically significant from the structural model, while this variable are significantly affecting the PubB which it turned out to act as the full mediator latent factor in this model based on mediation analysis. Within the PubB latent factor, which consists of 4 manifest variables, the Soil Contamination (PEM1) has the largest regression coefficient of 0.91. The other manifest variables are respectively 0.89, 0.86, and 0.85 for the water quality (PEM4), the drainage system quality (PEM3), and the air quality (PEM2).

## 6. Conclusions

The relationship between the stakeholders' perspectives on the Domestic Waste Management in The Gasing Industrial Area in Banyuasin Regency, Indonesia was conducted using Structural Equation Modeling by conducting a questionnaire for 300 respondents, consisting of 100 local residents, 100 local government employees, and 100 local employees at the industry in the Gasing Industrial Area. The measurement model already confirmed that the result has already passed all the tests for the normality test, measurement model fitting, multicollinearity test, construct validity, and discriminant validity. The path analysis and the structural analysis at a 95% confidence level indicate that the Government Policy (GovP), Waste Processing Infrastructure (WIn), and Social Economic Background (SosEc) showed a statistically significant implication to the Public Behavior (PubB). Moreover, The Public Behavior is significantly influencing the Performance of Environmental Management (PEM). On the other hand, the direct implication from the GovP, SosEc, and PubB does not have a statistically significant implementation on the PEM from the structural model mediation analysis.

## Author Contributions

Conceptualization, M.A. and S.; methodology, M.A.; software, M.Y.; validation, M.A., S., and T.W.; formal analysis, M.A.; investigation, M.A.; resources, S.; data curation, M.Y.; writing—original draft preparation, M.A.;

writing—review and editing, S. and T.W.; visualization, M.Y.; supervision, S.; project administration, S.; funding acquisition, T.W. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

The study was conducted in accordance with ethical research standards. Ethical approval was waived by the Ethics Committee of Universitas Sriwijaya, as the study involved non-invasive procedures, anonymous questionnaires, and posed no risk to participants.

## Informed Consent Statement

Informed consent was obtained from all subjects involved in the study prior to their participation.

## Data Availability Statement

Data is unavailable due to privacy considerations.

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## Conflicts of Interest

The authors declare no conflict of interest.

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