

# Economic Evaluation of Waste Management and Environmental Performance in SMEs Using GRI 300

*Waste Management and Environmental Performance in SMEs*

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## **ABSTRACT**

*Waste is commonly defined as the residual output of production processes, which varies across industrial sectors depending on operational activities. Small-scale food industries, including tofu and tempeh manufacturing, generate significant solid, liquid, and gaseous waste that may contribute to environmental pollution if not properly managed. This study aims to identify, measure, and analyze operational activities and waste management practices using the GRI 300 environmental performance standard at the tofu and tempeh manufacturing SME in Jayapura Regency. The research employs a qualitative case study approach to obtain an in-depth understanding of sustainability practices within business operations. The findings reveal that sustainability implementation remains limited and has not been systematically integrated into operational management. The use of materials, energy, and water occurs at a relatively high level without adequate recording, measurement, and evaluation systems, limiting the ability to assess resource efficiency and environmental impact reduction. In conclusion, the enterprise has not yet optimally implemented structured environmental management practices, indicating the need for systematic monitoring, reporting mechanisms, and improved sustainability strategies to enhance environmental performance and operational efficiency.*

**Keywords:** *Environmental Performance, GRI 300 Standard, SME Sustainability, Tofu and Tempeh Industry, Waste Management.*

## **INTRODUCTION**

Waste is generally defined as the residue of a production process (KBBI, 2025). Production processes across various industrial sectors generate different types of waste depending on their operational activities and production characteristics. For instance, waste produced from mining operations includes arsenic, smoke, sulphuric acid, lead, mercury, quicksilver, rocks, heavy metals, carbon monoxide, radioactive materials, and various other hazardous substances. Mining waste is commonly classified into three forms, namely solid, liquid, and gas (Limbah.id, 2024). Similarly, manufacturing industry waste consists of solid, liquid, and gaseous waste generated from diverse sectors such as the automotive, electronics, food and beverage, and chemical industries, among others. Each industry applies different systems and management practices to control and minimize the environmental impact of waste on ecosystems and surrounding communities.

However, waste management practices aimed at reducing environmental impacts have not been fully implemented by industries in Indonesia. One example of inadequate industrial waste management involved a textile company located in Pasuruan, East Java, which in September 2024 was proven to have caused environmental pollution and was consequently required to pay a fine of IDR 48 billion (Mongabay.co.id, 2024). Another incident occurred in December 2024 when a tanker truck owned by CV Yasindo Multi

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Pratama transported 20,000 liters of caustic soda liquid NaOH-48%, commonly known as lye, which spilled along an 8-kilometre road segment, causing burns to motorists and damaging hundreds of vehicles (Kompas.com, 2024). These incidents demonstrate weaknesses in waste management systems and environmental governance in Indonesia. Government regulations addressing these issues are stipulated in Law Number 32 of 2009 concerning environmental protection and management, which guarantees every citizen's right to a good and healthy environment as part of broader ecosystem protection. In addition to national regulations that establish acceptable environmental standards, the independent international organization Global Reporting Initiative (2022) provides a sustainability reporting framework covering economic, environmental, and social aspects, enabling organizations worldwide to disclose information regarding material use, waste generation, and carbon emissions that affect economic performance, biodiversity, and society.

Companies from various industries listed on the Indonesia Stock Exchange are responsible for disclosing sustainability reports. However, it should be noted that companies that have disclosed Sustainability Reports are companies with high revenues and capital, as well as operational activities that have an impact on society and the environment. This is an obstacle for Micro, Small, and Medium Enterprises (MSMEs) that have limited income and capital, resulting in MSME players having minimal knowledge and efforts to minimize the impact of industrial waste on the environment. For example, tofu factories produce solid waste in the form of tofu pulp and liquid waste in the form of wastewater. If this waste is not managed before being discharged into the community's environment, it will have a negative impact on air and water quality and public health. Lolo et al. (2021) revealed that tofu factories tend to cause pollution, and the study assessed the Life Cycle Assessment (LCA) method as a tool for identifying environmental pollution through life cycle assessment. The recommended results are to make efforts to improve water efficiency during the tofu production process, including the need to clean the crust inside the steam boiler to increase the volume of steam produced, so that water and energy use are more efficient. Another study by Kusumawardhany (2022) is about the form of social responsibility in MSME Tofu Industries in Kediri Regency. The study indicates that the implementation of social responsibility is motivated by the social spirit, volunteerism, and kinship principles possessed by business owners.

The studies by Lolo et al. (2021) and Kusumawardhany (2022) provide new insights into optimizing the use of water, energy, and social responsibility to maintain business sustainability. The study has not yet shown environmental impact measurements using the Global Reporting Initiative (GRI) 300 standard, which measures and assesses the energy used to carry out operational activities, the waste produced, and the impact of waste on biodiversity. Researchers note that research in Indonesia is still limited in terms of examining the measurement and assessment of the impact of waste on the environment using the GRI 300 standard. Therefore, this urgent research will measure and assess the impact of waste from the Satria Tahu dan Tempe in Jayapura Regency using the GRI 300 standard.

## **LITERATURE REVIEW**

### **Triple Bottom Line Theory**

The Triple Bottom Line (TBL) theory is a conceptual framework that assesses a company's performance more broadly, not only from a financial perspective, but also in terms of its social contributions and environmental impact (Parera et al., 2024; Hristov & Searcy, 2025). Introduced by John Elkington in 1998, this concept focuses on three main pillars, namely people, planet, and profit. Through this approach, companies are encouraged to integrate social interests and environmental sustainability into their business decision-making processes. Therefore, TBL is an important basis for the preparation of sustainability reports that aim to present comprehensive information on the impact of company activities on various stakeholders (Felisia & Limijaya, 2014; Hadorima & Sugianto, 2025).

Within the framework of sustainable development, the TBL theory serves as a strategic reference for companies in formulating business policies and strategies that are not only oriented towards profit, but also towards creating social value and preserving the environment. The implementation of the triple bottom line concept in sustainability reports is increasingly relevant amid global demands that require companies to be responsible for the social and environmental consequences of their operational activities (Andersson et al., 2022; Silaban, 2025). Along with this, the TBL concept is increasingly being applied in the management practices of companies and other organizations because it is able to describe the basic principles of sustainable development through multidimensional evaluation of company performance (Antonio et al., 2020; Hamsir et al., 2021; Nogueira et al., 2025).

### **Legitimacy Theory**

The legitimacy theory developed by Bosetti et al. (2023) and Al-Janabi et al. (2024) asserts that the concept of legitimacy plays a crucial role in understanding the reciprocal relationship between organizations and their social environment. In carrying out their operations, organizations seek to align the social values inherent in their activities with the norms and patterns of behavior that prevail in the social system in general (Putra et al., 2024). When this alignment is achieved, organizations are more likely to secure continued support, resources, and acceptance from stakeholders. Conversely, a perceived legitimacy gap may trigger reputational risks, public scrutiny, and pressures for organizational change to restore societal approval.

Chandra and Shauki (2024) explain that organizational legitimacy can be maintained through alignment between actions taken and the collective beliefs held by society. Companies' efforts to gain legitimacy are driven by two main objectives. First, to build credibility while maintaining operational continuity. Organizations that do not carry out activities that are considered socially acceptable are at greater risk of acquiring a negative stigma as entities that are neglectful of their responsibilities. Second, companies seek to gain support from stakeholders, where the level of legitimacy demands will be relatively lower if the support targets are limited to certain groups. Conversely, if companies expect broader public involvement, the legitimacy standards that must be met will be higher. From the perspective of legitimacy theory, the preparation and disclosure of sustainability reports that refer to GRI standards serve as a means for companies to demonstrate their commitment and responsible operational practices in maintaining environmental, social, and economic sustainability (Amer & Obradovic, 2022; Nora et al., 2023).

### **Global Reporting Initiative Standards**

In 2017, GRI GSSB began introducing GRI standards, which were then launched in Indonesia in 2017 and became effective on 1 July 2018. However, as of 1 January 2023, companies compile sustainability reports using the 2021 GRI standards. GRI standards enable an organization to publicly disclose the most significant impacts of its activities on the economy, environment, and society, including impacts on human rights and how the organization manages those impacts (Adams et al., 2022; Nial & Parashar, 2024). This increases transparency about the organization's impacts and enhances the organization's accountability (Global Reporting Initiative, 2022).

The standards contain disclosures that enable organizations to report information about their impacts in a consistent and credible manner (Ackers & Grobbelaar, 2022; Khan et al., 2023). This improves global comparability and the quality of information reported on these impacts, which supports information users in making assessments and decisions based on information about the organization's impacts and contributions to sustainable development. The GRI standards classify three main standards, namely standard 200 on economic performance, standard 300 on the environment, energy, and biodiversity, and standard 400 on employment and workers' rights. This study will focus on standard 300, which will then be used to identify, classify, and analyze operational

activities at tofu and tempeh factories that have an impact on the environment, biodiversity, and energy use in production activities.

## **RESEARCH METHODS**

This study adopts a qualitative research design using a case study approach to comprehensively examine environmental management practices and waste-related operational activities within the research object. The case study design is selected because it enables an in-depth exploration of contemporary phenomena within a real-life context, allowing researchers to understand operational processes and environmental practices holistically. Referring to Yin (2013), the case study approach connects current organizational events with multiple sources of evidence, including documents, interviews, observations, and organizational records. This design is considered appropriate for analyzing sustainability practices and environmental performance in small-scale manufacturing enterprises, particularly in understanding how waste management practices are implemented in daily operational activities.

The population of this study encompasses all operational activities, managerial practices, and environment-related processes carried out by the Satria Tahu dan Tempe located in Jayapura Regency. Rather than focusing on many respondents, the research centers on an embedded unit of analysis within a single organization, involving key informants with direct knowledge of production processes, financial management, and operational decision-making. These informants include business owners, production workers, and administrative staff who are directly involved in managing resources such as materials, energy, water usage, and waste disposal activities.

Data collection techniques involve both primary and secondary data to ensure triangulation and enhance research validity. Primary data are obtained through semi-structured interviews with key informants, direct observations of production and waste management processes, and analysis of financial reports provided by the enterprise. Interviews are conducted to capture experiential insights and managerial perspectives, while observations enable the researcher to directly assess operational practices and environmental conditions. Secondary data consist of internal documents and records from the finance and operations departments, as well as supporting references from books, academic journals, and other relevant online and offline sources to strengthen theoretical foundations and contextual analysis.

The data analysis technique applies a strategy based on theoretical propositions, where research objectives serve as the foundation for developing analytical propositions derived from research questions, literature reviews, and conceptual frameworks. Pattern matching is employed as a supporting analytical strategy by comparing empirical findings from interviews and observations with theoretical expectations. Through this process, consistencies and discrepancies between practice and theory are systematically identified. The final stage involves drawing conclusions by linking empirical evidence with relevant theoretical perspectives, thereby providing a comprehensive explanation of environmental management practices and sustainability performance within the enterprise studied.

## **RESULTS**

The GRI standard used as a reference for the analysis of the Satria Tahu dan Tempe is GRI Standard 300 on waste, energy, the environment, and biodiversity. The following are the findings from observations and interviews, which were then analyzed using GRI Standard 300. The GRI 301 standard examines the use of raw materials, recycled materials, and recycled packaging in production processes. The findings indicate that the factory relies heavily on soybeans sourced from suppliers outside Papua and transported via sea containers, with monthly usage reaching 23,400 kg, reflecting a production scale oriented toward market demand and economic sustainability. However, in line with GRI Standard 301-2, all materials are derived from virgin resources without the use of recycled inputs, while under GRI Standard 301-3, plastic packaging is still used, and quantitative

records of packaging materials have not yet been systematically documented. This shows that material management remains focused primarily on operational and economic objectives rather than environmental impact measurement. From a legitimacy theory perspective, GRI 301 disclosure represents an effort to demonstrate transparency and accountability, although limited material efficiency and recycling practices may influence environmental legitimacy perceptions. Within the Triple Bottom Line framework, profit and people dimensions are evident, while the planet dimension requires improvement through better material monitoring and environmentally friendly management practices. Mufida et al. (2024) and Friske et al. (2024) highlight that continuous improvements in GRI 300 environmental standards reflect growing organizational responsiveness to stakeholder expectations and sustainability concerns.

The energy consumption of the Satria Tahu dan Tempe indicates a strong dependence on electricity and fossil fuels in production operations. Monthly electricity usage reaches 2,160 kWh, generating an energy intensity of 92.31 kWh per ton of finished product from a total output of 23.4 tons, while petrol consumption for transportation amounts to 360 liters per month, costing EUR200. However, indirect energy use, including fuel for soybean distribution from the USA and firewood supply processes, is not systematically recorded, resulting in incomplete measurement of total energy impacts. The absence of data also shows limited environmental disclosure and indicates that no energy reduction or efficiency initiatives have been implemented under GRI Standards 302-4 and 302-5. From a Triple Bottom Line perspective, production stability reflects the profit dimension, whereas environmental challenges remain in the planet dimension due to fossil fuel reliance, and the people dimension relates to community impacts from emissions and firewood use. Legitimacy theory suggests that improved disclosure is necessary to meet stakeholder expectations for transparency and responsibility. Asari and Bhayangkara (2025) and Rizki and Supratiwi (2025) emphasize that GRI Standard 302 supports transparency in sustainability, although implementation varies across organizations.

The Satria Tahu dan Tempe depends on groundwater extracted through boreholes for production activities, including soybean soaking, washing, pulp separation, and equipment cleaning. Although water use is monitored through storage containers, detailed quantitative measurements of water extraction are not recorded in accordance with GRI 303-1 and 303-5, indicating limited water resource management assessment. Liquid waste primarily originates from soaking, washing, extraction, and cleaning processes (GRI 303-2 and 303-4). However, the factory lacks wastewater volume measurement tools and has not conducted laboratory quality testing prior to direct discharge into waterways without a Wastewater Treatment Plant (*Instalasi Pengolahan Air Limbah/IPAL*). This demonstrates insufficient documentation and transparency in water and waste management disclosures under GRI standards. From a Triple Bottom Line perspective, environmental performance within the dimension of the planet remains weak despite maintained profit and people dimensions. Limited disclosure may influence stakeholder perceptions of environmental responsibility. According to legitimacy theory, improved transparency in water management can strengthen social legitimacy and regulatory trust. Andrian et al. (2022) and Kosasih et al. (2024) highlight persistent gaps in GRI 303 water disclosure practices in Indonesia's consumer industry despite increasing compliance, emphasizing the need for improved reporting.

The Satria Tahu dan Tempe is located approximately 3.2 km from the freshwater ecosystem of Lake Sentani, indicating potential interaction between production activities and the surrounding biological environment (GRI 304-1). Water-intensive processes such as soybean soaking, washing, wastewater discharge, and firewood use (GRI 304-2) may cause physical and chemical changes affecting groundwater quality and aquatic ecosystems that support local species. However, no habitat restoration, protection programs, or specific studies assessing wastewater impacts on biodiversity have been conducted (GRI 304-3 and 304-4), reflecting limited conservation efforts and environmental documentation. From the Triple Bottom Line perspective, the planetary dimension still requires significant improvement despite stable profit and people

dimensions. The absence of biodiversity protection initiatives and impact data may influence stakeholder perceptions of environmental responsibility. According to legitimacy theory, limited disclosure and conservation documentation can weaken social legitimacy as environmental transparency expectations increase. Retnowati et al. (2024) and Andira et al. (2024) emphasize that tofu factory waste contributes to river pollution, negatively affecting aquatic habitats and organism survival.

Based on GRI Standard 305 disclosures, the Satria Tahu dan Tempe has identified direct emissions from two petrol-fuelled operational vehicles, producing 0.64 tons of CO<sub>2</sub> per month. Production activities generate no direct emissions due to reliance on electricity; however, the monthly electricity consumption of 3,240 kWh contributes to indirect emissions from external power generation. Additional potential GHG sources include soybean transportation from outside Papua, product distribution, and the absence of a wastewater treatment plant (IPAL), which may produce methane emissions from liquid waste. Limited recording and the lack of quantitative data in disclosures 305-4 to 305-7 indicate that emissions measurement and management remain at an early stage and do not fully meet GRI transparency principles. From a Triple Bottom Line perspective, environmental performance (planet) lags behind economic stability (profit) and social contribution (people). Legitimacy theory suggests that limited disclosure and emission reduction efforts may weaken stakeholder trust. Sandy and Ardiana (2023) find that carbon disclosure is driven more by environmental reputation and legitimacy considerations than profitability, with SRI-Kehati Index companies reporting emissions more extensively.

The Satria Tahu dan Tempe generates two main types of waste: solid waste in the form of soybean pulp and liquid waste from washing, soaking, and equipment cleaning processes (GRI 306-1). Soybean pulp is reused as animal feed, reflecting waste reuse practices that reduce environmental burdens while creating economic value and indirectly supporting local farmers (GRI 306-2). However, liquid waste is neither treated nor recycled and is discharged directly into water bodies, indicating incomplete waste management despite the absence of landfill disposal activities (GRI 306-3 to 306-5). From a Triple Bottom Line perspective, solid waste utilization supports the planet, profit, and people dimensions, yet the lack of liquid waste treatment shows that environmental balance has not been fully achieved. Legitimacy theory suggests that while solid waste management demonstrates initial compliance with social expectations, untreated liquid waste may weaken social legitimacy. These findings align with Aphirta et al. (2024) and Hartini et al. (2024), who note that small-scale tofu and tempeh industries commonly reuse solid waste but still face challenges in managing liquid waste sustainably.

The factory's suppliers, PT FKS, Bola Biru, SGR, and Pagoda, are selected mainly based on price, quality, and supply availability (GRI 308-1), without formal environmental criteria, indicating a focus on economic efficiency rather than sustainable supply chain management. Although no negative environmental impacts have been identified (GRI 308-2), the absence of environmental evaluation limits sustainability oversight. Within the Triple Bottom Line framework, this practice prioritizes profit while insufficiently addressing the planet and people dimensions. Legitimacy theory highlights that lacking environmental standards may reduce alignment with growing societal sustainability expectations. Elanda et al. (2025) emphasize integrating environmental criteria such as waste management, energy efficiency, and emission reduction in supplier evaluation, while Wahyudi (2024) and Akhter et al. (2025) state that sustainability-based supplier assessment strengthens supply chain effectiveness and environmental commitment.

## **DISCUSSION**

The study findings indicate that the implementation of the GRI 300 Standards at Satria Tahu dan Tempe is still at an early stage and has not fully met the principles of environmental transparency and accountability as expected in sustainability reporting. Regarding the material aspect (GRI 301), soybean raw material usage reaches 23,400 kg

per month, all sourced from new imported materials, with no utilization of recycled materials. Furthermore, the use of plastic for packaging has not been quantitatively recorded. This condition suggests that material management is still oriented toward production efficiency and economic sustainability, while environmental dimensions have not yet become a strategic focus. These findings are consistent with Mufida et al. (2024) and Sari and Muslim (2024), who argue that environmental disclosure under GRI 300 continues to evolve in response to stakeholder demands, although its implementation varies across business entities.

In the energy aspect (GRI 302), electricity consumption reaches 2,160 kWh per month, with an energy intensity of 92.31 kWh per ton of product, along with gasoline usage of 360 liters per month for operational vehicles. There are no energy reduction programs or recording of indirect energy use, such as imported raw material distribution and firewood usage. This indicates limitations in energy management and comprehensive disclosure. Asari and Bhayangkara (2025) emphasize that the application of GRI 302 reflects a company's commitment to transparency, although the level of disclosure largely depends on the awareness and internal management systems of each organization. Therefore, these findings suggest that the commitment to energy efficiency still needs to be strengthened.

Regarding water and wastewater management (GRI 303), the factory relies on groundwater as its primary production source without recording measurable volumes and disposes of wastewater directly into drainage systems without treatment through an IPAL. The absence of wastewater quality testing indicates weak control over environmental impacts. These results align with Kosasih et al. (2024), who note that water accounting disclosure in Indonesian consumer industries still exhibits transparency gaps and limited reporting detail. Moreover, Retnowati et al. (2024) highlight that tofu industry wastewater has the potential to pollute water bodies and disrupt aquatic habitats, which is relevant given the factory's proximity to Lake Sentani.

In the emissions aspect (GRI 305), direct emissions amount to 0.64 tons of CO<sub>2</sub> per month from operational vehicles, while indirect emissions from electricity consumption and transportation have not been comprehensively calculated. The absence of emission reduction strategies indicates that carbon management is not yet a priority. Sandy and Ardiana (2023) argue that environmental reputation perception influences the extent of carbon emission disclosure in sustainability reports, meaning that higher public legitimacy demands lead to broader corporate disclosure.

Regarding waste management (GRI 306), the utilization of soybean pulp as animal feed is a positive practice reflecting efforts to reduce solid waste. However, wastewater management remains inadequate. This finding aligns with Aphirta et al. (2024), who state that small-scale tofu and tempeh industries generally utilize solid waste but face limitations in treating liquid waste. Meanwhile, in the supply chain aspect (GRI 308), the absence of environmental criteria in supplier selection indicates that sustainability has not been integrated into supply chain management, as emphasized by Wahyudi (2024) and Elanda et al. (2025), who highlight the importance of integrating environmental criteria to support long-term sustainability. From a Triple Bottom Line perspective, the profit dimension has performed well, whereas the planet dimension still requires significant improvement. From the legitimacy theory perspective, enhancing transparency and environmental management is crucial to maintain social acceptance and ensure business sustainability in the future.

## **CONCLUSION**

The findings of this study indicate that the environmental performance of the Satria Tahu dan Tempe, assessed using GRI Standard 300 (301–308), remains limited and has not yet been systematically integrated into operational management practices. The use of materials, energy, and water is conducted at a relatively high level without adequate recording, measurement, and evaluation systems, making it difficult to identify opportunities for resource efficiency and environmental impact reduction. Although

positive practices are evident in solid waste utilization through soybean pulp reuse, liquid waste management, greenhouse gas emission control, and biodiversity protection, they have not fully aligned with sustainable environmental management principles. Furthermore, the absence of environmental criteria in supplier selection demonstrates that sustainability considerations have not yet been embedded within the company's supply chain strategy, reflecting a stronger emphasis on economic performance compared to environmental and social dimensions.

The study implies the need for strengthened environmental governance through structured monitoring systems, improved waste management practices, and the integration of environmental considerations into operational policies and supplier management to support long-term sustainability and organizational legitimacy. However, this research is limited to a single case study within one SME, which restricts the generalizability of the findings to broader industrial contexts. In addition, the limited availability of documented environmental data constrained the quantitative measurement of environmental performance indicators. Future research is recommended to involve multiple SMEs across different regions and industries, apply comparative or mixed-method approaches, and incorporate longitudinal assessments to better evaluate sustainability implementation over time and provide broader empirical evidence on the adoption of GRI-based environmental performance measurement in small and medium enterprises.

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