

## **Waste Management Strategies in the Tofu Industry through Green Accounting Approaches**

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### **Abstract**

The tofu industry in Suci Village, Karangpawitan District, Garut Regency, contributes significantly to the local economy, but also causes environmental problems due to suboptimal waste management. This study aims to evaluate the implementation of green accounting and identify the potential for green innovation in tofu industry waste management in Suci Village. The research method used is descriptive qualitative with a case study approach, where data validity is tested using source triangulation techniques to ensure data accuracy and reliability. The results show that most tofu industries have utilized solid waste as animal feed, but liquid waste management is still a major challenge. This study recommends the development of an integrated waste management system, including the construction of a communal Wastewater Treatment Plant (WWTP) and the utilization of liquid waste to produce value-added products such as biogas and organic fertilizer. The implementation of green accounting and green innovation is expected to improve the environmental and economic sustainability of the tofu industry and contribute to the achievement of the Sustainable Development Goals (SDGs) particularly SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

**Keywords:** Environmental Cost, Environmental Sustainability, Green Accounting, Waste Management.

### **Abstrak**

Industri tahu di Desa Suci, Kecamatan Karangpawitan, Kabupaten Garut, memberikan kontribusi signifikan terhadap perekonomian lokal, namun juga menimbulkan masalah lingkungan akibat pengelolaan limbah yang kurang optimal. Penelitian ini bertujuan untuk mengevaluasi penerapan green accounting dan mengidentifikasi potensi inovasi hijau dalam pengelolaan limbah industri tahu di Desa Suci. Metode penelitian yang digunakan adalah deskriptif kualitatif dengan pendekatan studi kasus, di mana validitas data diuji menggunakan teknik triangulasi sumber untuk memastikan keakuratan dan keterpercayaan data. Hasil penelitian menunjukkan bahwa sebagian besar industri tahu telah memanfaatkan limbah padat sebagai pakan ternak, namun pengelolaan limbah cair masih menjadi tantangan utama. Penelitian ini merekomendasikan pengembangan sistem pengelolaan limbah terpadu, termasuk pembangunan Instalasi Pengolahan Air Limbah (IPAL) komunal dan pemanfaatan limbah cair untuk menghasilkan produk bernilai tambah seperti biogas dan pupuk organik. Implementasi green accounting dan inovasi hijau diharapkan dapat meningkatkan keberlanjutan lingkungan dan ekonomi industri tahu serta berkontribusi pada pencapaian Sustainable Development Goals (SDGs) khususnya SDG 6 (Air Bersih dan Sanitasi Layak), SDG 9 (Industri, Inovasi dan Infrastruktur), SDG 12 (Konsumsi dan Produksi yang Bertanggung Jawab), serta SDG 13 (Penanganan Perubahan Iklim).

**Kata kunci:** Biaya Lingkungan, Green Accounting, Keberlanjutan Lingkungan, Pengelolaan Limbah.

## **INTRODUCTION**

In an increasingly uncertain global economic environment, the non-oil and gas processing industry demonstrated growth of 4.69% throughout 2023 (Sasongko & Alipudin, 2023). One of the

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key drivers of this growth is the small and medium enterprise (SME) sector. This sector plays a crucial role in the national economy, contributing significantly to economic growth, job creation, and poverty reduction. According to data from the Ministry of Cooperatives and SMEs in 2023, there were 65 million SMEs in Indonesia, contributing 61% to the Gross Domestic Product (GDP) and employing 97% of the national workforce (BPS, 2024).

The phenomenon of the increasing number of MSMEs in the processing sector, which is in line with the increase in production activities, has consequences in the form of increasing environmental burdens due to large-scale waste production (Anshar & Bangun, 2023; Gunawan et al., 2020; Salim et al., 2024). Waste is the remainder or waste from raw materials in the production process that harms the environment if not managed properly (Hoornweg & Bhada-Tata, 2012). The impacts of waste include water pollution, air pollution, and human health. Therefore, this is a new challenge in environmental management (Hoornweg & Bhada-Tata, 2012; Reno, 2015).

Traditional food processing industries such as tofu factories have experienced rapid growth, with the number of business units reaching 84,000 in various regions (Putri et al., 2022; Yosiska, Tia. Nasution, 2024). Despite its vital role in food security, this significant growth has serious environmental consequences. The liquid and solid waste produced, especially from the traditional tofu production process (Laksono Putro et al., 2021; Mufarida & Setiawan, 2020; Ningsih et al., 2024), contains high organic matter and has the potential to cause eutrophication of waters if not managed properly (Hoornweg & Bhada-Tata, 2012; Laksono Putro et al., 2021; Mufarida & Setiawan, 2020; Reno, 2015). This threatens the local ecosystem and poses risks to public health and the long-term sustainability of the tofu industry.

Liquid tofu waste contains high organic materials, temperatures reaching 40 °C- 46 °C, BOD5 levels (6,000-8,000 mg/1), COD (7,500-14,000 mg/1), TSS, and pH, which are also quite high (Avia et al., 2022; Kaswinarni, 2012). If directly discharged into water bodies, it will degrade water quality and harm aquatic ecosystems. Hence, the tofu industry requires waste treatment to reduce the risk of existing pollution loads. The gases commonly found in tofu waste are nitrogen gas (N<sub>2</sub>). Oxygen (O<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), ammonia (NH<sub>3</sub>), carbon dioxide (CO<sub>2</sub>), and methane (CH<sub>4</sub>)(Avia et al., 2022; Kaswinarni, 2012). These gases come from the decomposition of organic materials contained in wastewater.

To address the increasingly critical problem of tofu industry waste, the government has taken several strategic steps by establishing policies such as Environmental Law No. 46 of 2017 concerning environmental economic instruments, as well as presidential decrees and ministerial regulations that encourage awareness and responsibility for waste management (Indonesia, 2017). This increased awareness empowers tofu industry businesses to transform waste into valuable products, mitigating environmental impact. Liquid waste produced from the tofu production process can be processed through a series of physical and chemical processes. Common processing techniques include filtration, sedimentation, and flotation (Widayat et al., 2019). Through these stages, liquid waste can be converted into effluent that meets environmental quality standards, thereby minimizing negative impacts on aquatic ecosystems. The application of appropriate waste processing technology not only provides benefits to the environment but can also increase production efficiency and the competitiveness of the tofu industry (Faisal et al., 2016).

Effective waste management necessitates significant financial investment from companies. The concept of green accounting offers a robust framework to manage environmental costs associated with the production process (Eze & Knwo, 2024; Shetty et al., 2022). In the context of

the tofu industry, green accounting emphasizes the importance of allocating funds for waste management as an integral part of production costs (Yosiska, Tia. Nasution, 2024). This includes not only direct costs such as wastewater treatment and equipment maintenance, but also indirect costs such as mitigating long-term impacts on the ecosystem. By implementing green accounting, companies can more transparently record the impact of production activities on the environment and must recognize wastewater treatment costs, processing equipment maintenance costs, and environmental quality monitoring costs as production costs in the financial statements.

This study reveals that the implementation of the green accounting concept in the tofu industry in Suci Village has begun, but several challenges persist. Several factories have successfully integrated environmental costs into solid waste management, such as using buckets to collect waste for animal feed, but the management of liquid waste, especially that containing high organic matter and hazardous chemicals, remains a significant challenge. Liquid waste that is not optimally processed has the potential to pollute groundwater and surface water sources, thus harming the ecosystem and public health. This gap between the ideal and the practical implementation of green accounting highlights the need for further research to identify specific obstacles faced by the tofu industry in managing liquid waste and to evaluate the effectiveness of various waste management strategies.

A significant gap exists between the theoretical framework of green accounting and its practical implementation in the tofu industry. To bridge this gap, a comprehensive sustainability strategy is essential. The tofu industry possesses significant potential for waste reduction and resource recovery, as solid waste such as tofu dregs can be transformed into value-added products like animal feed or organic fertilizer. Based on prior literature has demonstrated that tofu dregs processed into livestock feed helped reduce operational waste by up to 30%, and other results found that integrating tofu waste into composting systems significantly improved soil fertility and reduced environmental impact (Putri et al., 2022; Yosiska, Tia. Nasution, 2024). Similarly, liquid waste can be treated using advanced technologies like anaerobic bioreactors to generate biogas. Furthermore, regular monitoring and reporting of greenhouse gas emissions are crucial to assess the environmental impact of tofu production.

Previous studies on green accounting in tofu and food-processing industries have highlighted both its potential and challenges. found that while solid waste, such as tofu dregs, is often reused as animal feed or fertilizer, liquid waste remains largely untreated, posing environmental risks. Fikriyah and Wiyanti (2023) showed that green accounting positively influences firm value, yet its application in small industries is limited by a lack of awareness and infrastructure. Yuliana & Sulistyawati (2021) noted that although some MSMEs have implemented green accounting practices, most do not allocate specific green costs. Putri et al. (2022) emphasized the role of education and simple technologies in improving waste management practices. Unlike previous studies, this research develops an integrated waste management strategy for the tofu industry based on a green accounting approach, emphasizing community-based solutions such as the construction of communal Wastewater Treatment Plants (WWTPs) and the utilization of liquid waste to produce value-added products like biogas and organic fertilizer. This approach supports the achievement of SDGs 6 (Clean Water and Sanitation), 9 (Industry, Innovation, and Infrastructure), 12 (Responsible Consumption and Production), and 13 (Climate Action).

Building upon these efforts, ideal tofu factories also adopt various environmentally friendly technologies. The utilization of renewable energy sources like solar panels and biogas, coupled with

the implementation of international standards such as ISO 14001, can significantly enhance energy efficiency and reduce environmental impact. Additionally, advanced technologies like reverse osmosis can be employed to treat wastewater and produce reusable water. This study seeks to identify the gaps between these ideal practices and the current reality of tofu factories in Suci Village. By understanding these limitations, this research aims to propose strategies for optimizing green accounting implementation and promoting sustainable practices within the tofu industry.

The urgent need to address the environmental challenges posed by the tofu industry, particularly in Suci Village, underscores the urgency of this research. While some tofu factories have initiated the adoption of green accounting principles, their implementation remains limited, particularly in minimizing water pollution from liquid waste, air pollution from greenhouse gas emissions, and the unsustainable use of natural resources. This study aims to identify the obstacles faced by tofu MSMEs in implementing green accounting and to formulate effective strategies to improve production efficiency and sustainability. As a result, this research contributes to the achievement of sustainable development goals, particularly in terms of ensuring the availability of clean water and sanitation and responsible production and consumption.

## **RESEARCH METHOD**

According to Creswell & Poth (2017) research method is a systematic approach used to gather information to achieve specific objectives. Key concepts within this definition include information, scientific approach, purpose, and the relevance of the research. The case study approach is a research method designed to explore a specific case or phenomenon in-depth and intensively. These cases may involve individuals, groups, organizations, events, programs, or even locations. The primary aim of a case study is to gain a comprehensive and holistic understanding of the case within its unique context.

This method emphasizes an in-depth interpretation of naturally occurring phenomena without external intervention. The research design adopted in this study is descriptive analysis, a technique aimed at describing and explaining observed facts or phenomena in detail. This approach is particularly relevant for identifying the application of green accounting in tofu manufacturing plants, where researchers aim to understand its implementation, challenges, and provide an initial overview of the subject.

The types of data are categorized into three: subjective data, physical data, and documentary data. In this study, the researcher utilizes documentary data, which refers to information in the form of written records, such as company financial reports. Specifically, this research focuses on data related to the allocation of waste management funds as recorded in financial reports.

The data sources used in this study align with who classifies data is classified into primary and secondary sources. This research relies on secondary data, specifically company financial reports, and primary data obtained through interviews with stakeholders in the tofu processing industry.

Data collection is a critical step in research, as the primary goal is to gather relevant data. The methods employed in this study are as follows:

1. Documentation Research

Sugiyono, (2016) defines documentation as records of past events. This involves collecting data from documents, books, electronic records, printed media, and other relevant files related to the research object. For this study, the collected documents include financial reports concerning waste management fund allocations.

2. Library Research

Library research, as described by (Sugiyono, 2016) involves theoretical analysis and other references related to rules, traditions, and values within the research environment. This method plays a vital role in observation, as analysis or observation inherently depends on scientific literature.

3. Interviews

Interviews are used to gather information by directly interacting with individuals who are knowledgeable about the subject matter. In this study, structured interviews, guided by a prepared framework, are conducted with tofu industry stakeholders. These interviews aim to uncover various issues related to the research object, providing raw data that will be further analyzed qualitatively. In this study, interviews were conducted with six key informants from the tofu processing industry in Suci Village, including two factory owners, two workers responsible for waste management, and two community members living near the production sites. The interview design followed a structured format, with questions grouped into three thematic areas: (1) knowledge and awareness of green accounting, (2) current waste management practices and challenges, and (3) perceptions and readiness for adopting environmentally friendly innovations such as biogas production and wastewater treatment. These questions aimed to explore stakeholders' understanding and experiences in implementing sustainable practices and their involvement in decision-making related to waste management.

Data analysis refers to the process of transforming collected data into actionable and comprehensible information. According to Bogdan and Biklen (as cited in Moleong, 2014), data analysis involves examining data gathered through interviews, observations, relevant documents, and other sources. The techniques used in this study include:

1. Data Reduction: Filtering and summarizing collected data to ensure relevance for the research report.
2. Triangulation: Verifying data accuracy by comparing interview results with other relevant data, such as observations and documents (Creswell & Poth, 2017)
3. Data Presentation: Structuring data in narrative, graphical, or tabular forms to facilitate comprehension.
4. Conclusion Drawing: Synthesizing critical findings from the research into concise, understandable summaries.
5. Recommendations: Offering suggestions related to implementing green accounting and environmentally friendly innovations, particularly in waste management within tofu factories.

To ensure the validity of the collected data, this study employs methodological triangulation, which involves cross-verifying information obtained from different methods on the same subject. For instance, data from interviews conducted at the research site are compared with observations and archival records. If discrepancies arise, follow-up interviews are conducted to

clarify and validate the information. Alternatively, if all data aligns, the researcher considers different perspectives to confirm its accuracy.

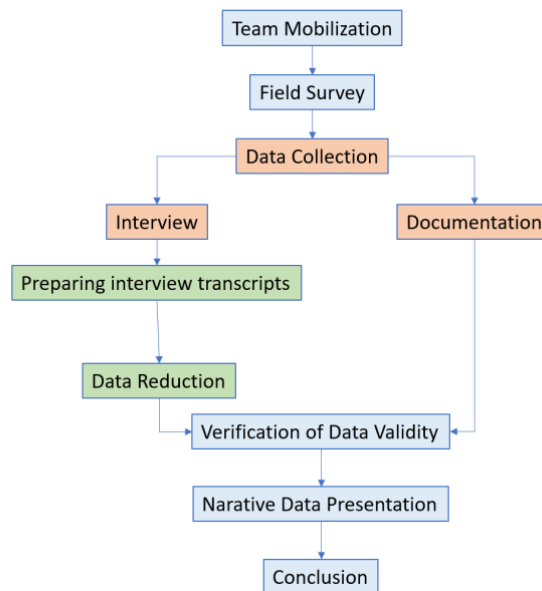


Figure 1. Research Stages

## RESULTS AND DISCUSSION

Pabrik Tahu Ibu Cucu, established in 1993, is a prominent small-scale tofu producer located in Kampung Balong Wetan, Desa Suci, Kecamatan Karangpawitan, Kabupaten Garut, West Java. Desa Suci, with a population of 13,932 as of 2023, is characterized by diverse occupational activities, and the tofu industry significantly contributes to its local economy. Named after its founder, Ibu Cucu, the factory specializes in producing yellow tofu and has grown from modest beginnings, with an initial daily production of 10 kilograms, to a current capacity of 120 kilograms per day. The tofu is offered in various sizes and sold at prices ranging from IDR 500 to IDR 1,000 per piece, depending on size.

The factory employs six dedicated workers and employs a direct marketing approach, distributing its products through local markets and on-site sales. This strategy not only ensures product accessibility but also enhances customer satisfaction through direct engagement. The operational structure is organized efficiently, with distinct roles divided among the production and marketing departments. Key production tasks include soybean washing, grinding, boiling, filtering, molding, and coloring, each performed by specialized personnel to maintain quality standards. The marketing team focuses on connecting producers and consumers, ensuring timely delivery and market penetration.

The Tofu Industry Ibu Cucu, a well-established small-scale enterprise in Desa Suci, Garut, has demonstrated consistent growth and commitment to quality since its inception in 1993. Beyond its operational success, the industry recognizes the importance of sustainable practices in maintaining product excellence and environmental responsibility. One such approach is the application of green accounting, which emphasizes cost management strategies to minimize waste

and optimize resource efficiency. A key aspect of this practice is the implementation of prevention costs, which aim to prevent production defects and ensure high product quality while supporting long-term sustainability.

Prevention Costs represent expenditures incurred by the Tofu Industry Ibu Cucu Garut to prevent defective products or quality issues in tofu production. These costs include the following:

1. **Machine Maintenance Costs.** These are expenses allocated for the maintenance of machinery used in the tofu production process to ensure the production of high-quality products and enhance customer satisfaction. The machine maintenance costs incurred by the Tofu Industry Ibu Cucu Garut include routine machine inspections, replacement of spare parts, lubrication, and cleaning of machinery.
2. **Raw Material Maintenance Costs.** These costs are expended to maintain the quality of raw materials (soybeans) before they are used in the production process. Raw material maintenance is a critical factor contributing to the final product quality, as the industry must ensure the use of high-quality and safe-to-consume raw materials. The raw material maintenance costs incurred by the Tofu Industry Ibu Cucu Garut include inspecting the quality of soybeans, ensuring proper storage, and controlling temperature or humidity levels.
3. **Production Equipment Maintenance Costs.** These are costs incurred to ensure the smooth operation of production equipment, keeping it in optimal condition to enhance product quality and ensure workplace safety. The production equipment maintenance costs incurred by the Tofu Industry Ibu Cucu Garut include replacing damaged or unfit equipment and cleaning production tools after use.
4. **Employee Training Costs.** These costs are allocated to improve employees' knowledge, skills, and competencies, enabling them to perform their tasks effectively and efficiently in the production environment. The employee training costs incurred by the Tofu Industry Ibu Cucu Garut include training sessions for employees involved in the manual molding process using batiste cloth. Training is conducted periodically, as most employees already possess experience in the production process.

Through these preventive measures, the Tofu Industry Ibu Cucu Garut aims to integrate green accounting principles into its operations while improving product quality and maintaining customer satisfaction. Pabrik Tahu Ibu Cucu continues to thrive and adapt to market dynamics while striving for consistent quality improvements and customer satisfaction. With a vision of sustained growth and resilience, the business aims to establish itself as a leading tofu producer in Garut and the surrounding regions.

The prevention costs implemented at the Tofu Industry Ibu Cucu primarily focus on machine maintenance, including routine inspections and spare part replacements, raw material maintenance, such as quality checks and proper soybean storage, production equipment upkeep to ensure smooth operations, and employee training to enhance skills in the manual production process. These measures align with the theoretical framework proposed by William N. Lanen (2017), which defines prevention costs as including raw material inspection, process control, quality training, machinery inspection, and product design. The prevention cost data for the Tofu Industry Ibu Cucu in 2023 is presented in Table 1.

**Table 1. Prevention Costs at Tofu Industry Ibu Cucu Garut in 2023**

No	Prevention Cost	2023 Cost (IDR)
1	Machine maintenance	Rp. 31,200,000
2	Raw material maintenance	Rp. 12,480,000
3	Equipment maintenance	Rp. 9,360,000
4	Employee training	Rp. 700,000
<b>Total Prevention Costs</b>		<b>Rp. 53,740,000</b>

**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

Assessment costs, on the other hand, are related to evaluating the quality of products obtained or produced during the tofu production process. These costs typically include monitoring expenses incurred during production. At the Tofu Industry Ibu Cucu, the owner conducts product quality monitoring directly, allowing for cost efficiency while enabling hands-on oversight of the production process. This approach minimizes the risk of declining quality in raw materials or finished products, ensuring that the industry maintains its established quality standards.

The assessment costs at the Tofu Industry Ibu Cucu Garut are primarily focused on production supervision conducted directly by the factory owner. This approach relies heavily on the owner's personal experience and preference for overseeing the production process firsthand. While this practice is relatively simple, it proves effective in the context of a small-scale business like the Tofu Industry Ibu Cucu Garut. According to William N. Lanen (2017), "Assessment costs include production monitoring, sample selection, and field testing." The assessment cost data for the Tofu Industry Ibu Cucu Garut in 2023 is presented in Table 2.

**Table 2. Assessment Costs at Tofu Industry Ibu Cucu Garut in 2023**

No	Assessment Cost	2023 Cost (IDR)
1	Supervision Costs	Rp. 0
<b>Total Assessment Costs</b>		<b>Rp. 0</b>

**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

Internal failure costs at the tofu factory are associated with defects or non-conformities that occur during the production process or in products before they reach the end consumers. Notably, the Tofu Industry Ibu Cucu Garut incurs no internal failure costs because residual materials, such as tofu dregs or raw material waste, are repurposed as livestock feed. This practice not only eliminates waste but also generates additional income when the feed is sold.

The internal failure costs identified at the Tofu Industry Ibu Cucu Garut are primarily associated with residual materials, particularly tofu dregs, which are not discarded but instead utilized as livestock feed. By repurposing tofu dregs, the factory not only minimizes waste disposal costs but also creates added value from its residual materials. The internal failure cost data for the Tofu Industry Ibu Cucu Garut in 2023 is presented in Table 3.

**Table 3: Internal Failure Costs at Tofu Industry Ibu Cucu Garut in 2023**

No	Internal Failure Costs	2023 Cost (IDR)
1	Residual Material Costs	Rp. 0
<b>Total Internal Failure Costs</b>		<b>Rp. 0</b>



**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

External failure costs in the tofu factory relate to expenses incurred from product failures detected after production is completed. Remarkably, the Tofu Industry Ibu Cucu Garut has achieved high operational efficiency, effectively eliminating potential external failures. The factory has demonstrated exceptional quality control, ensuring no need for warranty repairs, no product liability issues, and no sales losses due to quality failures.

According to William N. Lanen (2017), "External failure costs encompass components such as warranty repairs, product liability, and sales losses." These costs arise when products delivered to consumers fail to meet expected quality standards, compelling the company to incur additional expenses for repairs or replacements and face reduced sales due to customer dissatisfaction. The absence of external failure costs at the Tofu Industry Ibu Cucu Garut highlights its successful implementation of quality assurance measures. The external failure cost data for the Tofu Industry Ibu Cucu Garut in 2023 is summarized in Table 4.

**Table 4:** External Failure Costs at Tofu Industry Ibu Cucu Garut in 2023

No	External Failure Costs	2023 Cost (IDR)
1	Sales Loss Costs	Rp. 0
<b>Total External Failure Costs</b>		<b>Rp. 0</b>

**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

Based on the analyzed data on quality costs, Table 5 provides an overview of the quality costs incurred by Tofu Industry Ibu Cucu Garut in 2023.

**Table 5.** Quality Costs of Tofu Industry Ibu Cucu Garut in 2023

Cost Categories	Quality Cost Categories	2023 Costs (IDR)
<b>Prevention Costs</b>	Machine Maintenance	Rp. 31,200,000
	Raw Material Maintenance	Rp. 12,480,000
	Equipment Maintenance	Rp. 9,360,000
	Employee Training	Rp. 700,000
<b>Total Prevention Costs</b>		<b>Rp. 53,740,000</b>
<b>Appraisal Costs</b>	Supervision Costs	-
<b>Total Appraisal Costs</b>		<b>Rp. 0</b>
<b>Internal Failure Costs</b>	Residual Material Costs	-
<b>Total Internal Failure Costs</b>		<b>Rp. 0</b>
<b>External Failure Costs</b>	Sales Loss Costs	-
<b>Total External Failure Costs</b>		<b>Rp. 0</b>
<b>Total Quality Costs</b>		<b>Rp. 53,740,000</b>

**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

The quality cost report presented in the table above indicates that Tofu Industry Ibu Cucu Garut has not yet fully implemented a detailed quality cost reporting system as identified by Putri et al. (2022). However, based on theoretical comparisons, it is evident that the factory has undertaken and recorded activities to maintain its product quality, albeit in a simplified manner.

Currently, Tofu Industry Ibu Cucu Garut engages in several activities aimed at improving quality, but it has not fully separated quality cost reporting from general cost reporting. The factory has demonstrated an awareness of quality-related costs, although these costs are still integrated into broader production or sales expenses. The financial recording system at Tofu Industry Ibu Cucu Garut remains rudimentary, limited to tracking general income and expenditures without detailed categorization of quality costs. This highlights the need for the factory to adopt a more structured approach to quality cost accounting to support its efforts in maintaining and improving product quality.

After identifying and calculating all quality costs at Tofu Industry Ibu Cucu Garut for the 2023 period, a report was prepared for each category of quality costs. Quality costs are critically important to the factory's financial management, as they allow for an easier representation of these costs as a percentage of net sales. The report on quality costs as a percentage of net sales for 2023 is presented in Table 6.

**Table 6. Quality Costs as a Percentage of Net Sales**

Description	Year 2023
Quality Costs	Rp. 53,740,000
Net Sales	Rp. 624,000,000
Cost as a Percentage of Sales	8.61%

**Source:** Tofu Industry Ibu Cucu Garut, processed by the author, 2024

Based on the table above, it is evident that the quality costs at Tofu Industry Ibu Cucu Garut in 2023 accounted for 8.61% of net sales. This figure includes all costs related to prevention, appraisal, internal failure, and external failure. This demonstrates that the factory has made a reasonable effort to manage its quality costs effectively.

The net sales for 2023 amounted to Rp. 624,000,000, indicating that the factory achieved a significant revenue from its product sales. This level of income underscores the factory's ability to maintain steady operations and invest in activities that support quality improvement. By linking quality costs to net sales, the factory gains a clearer understanding of how quality management impacts its financial performance.

Based on the data presented in Tables 1 through 6, further analysis is conducted to interpret the implications of quality costs in relation to the implementation of green accounting and production sustainability. The findings presented in Tables 1–6 offer key insights into the implementation of green accounting and the challenges faced by tofu MSMEs, particularly in the case of Tofu Industry Ibu Cucu Garut. The dominant allocation of quality costs (Rp. 53,740,000) toward prevention efforts—specifically machine maintenance, raw material handling, equipment upkeep, and employee training—demonstrates the industry's proactive stance in minimizing environmental and production inefficiencies. However, Tables 2 to 4 show zero recorded costs for assessment, internal failure, and external failure, highlighting a potential weakness: the lack of a formalized quality monitoring and documentation system. This indicates that while green practices are intuitively applied, they are not yet institutionalized through structured financial reporting or standardized procedures. Table 5 confirms that all quality costs are concentrated in the prevention category, suggesting a simplified and informal accounting system, which could hinder long-term

sustainability planning. Lastly, Table 6 shows that quality-related expenditures constitute 8.61% of net sales, suggesting a strong but undocumented commitment to quality and sustainability. These insights reveal that the main obstacles to implementing green accounting include limited administrative capacity, absence of systematic cost reporting, and reliance on manual oversight. To enhance production efficiency and sustainability, MSMEs like Tofu Industry Ibu Cucu need capacity building in structured green accounting systems, supported by training, standardized documentation, and affordable technology for waste tracking and reporting.

Based on the findings, it is evident that while the Tofu Industry Ibu Cucu has intuitively implemented several green practices such as preventive maintenance and waste reuse—these activities are not yet supported by a structured green accounting system. The absence of detailed records for appraisal, internal failure, and external failure costs, along with the integration of quality-related expenses into general accounting, limits the factory's ability to fully monitor and evaluate its sustainability performance. Therefore, several strategic recommendations are proposed. First, tofu MSMEs should begin developing a formal green accounting framework that categorizes quality costs clearly and enables better cost control and environmental tracking. Second, financial literacy and basic green accounting training should be provided to owners and staff, enabling them to distinguish between production and sustainability-related costs. Third, the industry should implement standard operating procedures (SOPs) for quality control and waste monitoring, which would support the identification of hidden costs and prevent long-term inefficiencies. Fourth, investment in simple environmental innovations, such as biogas production from liquid waste, should be encouraged to generate added value while reducing pollution. Fifth, partnerships with local governments, universities, or NGOs can provide the technical support needed to design communal waste treatment systems or offer training in eco-accounting. Lastly, as the factory matures, it should begin digitizing its financial and environmental records, making it easier to track progress and demonstrate accountability in line with sustainable development goals.

## CONCLUSION

This study reveals that the tofu industry in Suci Village remains heavily reliant on traditional production methods, characterized by manual labor and simple equipment, which generate substantial amounts of solid and liquid waste. While some solid waste is repurposed as animal feed, the understanding and application of green accounting and green innovation remain limited, particularly in managing liquid waste. The direct discharge of untreated liquid waste into rivers has resulted in severe environmental pollution. To address these challenges, producers must enhance their awareness and capacity to adopt more sustainable production practices, including comprehensive waste management and the application of green innovations to transform waste into valuable resources. It is recommended that strategic steps be taken to optimize waste management, such as utilizing liquid waste for biogas production, which can serve as an alternative energy source and contribute to climate change mitigation, or converting it into value-added products like nata de soya and organic liquid fertilizers. Solid waste, such as tofu residue, can be processed into economically valuable products like *oncom* (fermented soybean), *tempe gembus* (fermented tofu pulp), and flour, providing alternative plant-based protein sources. Furthermore, establishing a communal wastewater treatment plant (WWTP) is crucial to treat liquid waste before discharge, reducing environmental impacts. Collaboration between tofu producers, the government, and related organizations is essential to develop efficient and eco-friendly waste processing technologies. Lastly, awareness campaigns and education programs should be conducted to emphasize the importance of proper waste management and its economic benefits.

For further research should also investigate the behavioral and institutional factors influencing the adoption of green accounting and green innovation practices among tofu MSMEs, including barriers related to knowledge, cost, and policy support. Longitudinal studies could be valuable to measure the environmental and economic impacts of these practices over time, providing evidence to inform policy and intervention programs.

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