Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol.44 No. 6 (2023)

IoT and Green Accounting are a Necessity

Retno Martanti Endah Lestari[1], Yuary Farradia[2], Shabriena Nindya Kusumawardani [3], Ratih Puspitasari[4], Abdul Talib Bon[5]

[1, 2, 3] *Universitas Pakuan, Indonesia*

[4] *Institut Bisnis dan Informatika Kesatuan, Indonesia*

[5] *University Tun Hussein Onn Malaysia, Malaysia*

Abstract:- The food and beverage industry face major challenges in waste management, requiring sustainable strategies to reduce waste and improve environmental and economic outcomes. The Internet of Things (IoT) has the potential to revolutionize waste management practices in the food and beverage industry. By integrating IoT devices, industries can improve traceability, reduce inefficiencies, and contribute to more sustainable production and distribution processes. The results of this research explain the differences between small and medium scale and medium and large-scale food and beverage industries implementing green accounting as well as strategies that can be used using IoT to address these differences. Mann Whitney analysis was carried out on five dimensions, namely Attention to the Environment, Environmental Responsibility dimension, Environmental Accounting Reporting dimension, Environmental Audit dimension, and Green Marketing dimension, to see whether there are differences in the implementation of Green Accounting in small-medium industries and medium-sized industries. big. This test is the most powerful test among nonparametric tests. Samples were taken from 126 MSMEs in the F&B industry and a systematic literature review, analyzing various sources to explore the development of IoT when used in realizing green accounting. The test results state that if we look at the Attention to the Environment dimension and the Environmental Responsibility dimension, there is no mean difference in the implementation of Green Accounting in small-medium industries and medium-large industries. Meanwhile, if we look at the Environmental Accounting Reporting dimension, the Environmental Audit Reporting dimension and the Green Marketing dimension, there are mean differences in the implementation of Green Accounting in small-medium industries and medium-large industries. Our findings show that there are still differences in the implementation of green accounting between all levels of industry, it is necessary to look for various potential technology-based solutions to overcome these problems that are related to the environment and have practical consequences for policy makers, industry players and environmental advocates. Our research offers practical insights into how the use of Internet of Things (IoT) can help companies achieve the goal of significantly reducing environmental costs and waste, as more businesses place a higher priority on sustainability.

Keywords*: Green Accounting, Green Marketing, Internet of Thing (IoT), Sustainibility.*

1. Introduction

Indonesia is a country that ranks third in the world's largest producer of waste. Plastic waste is the second most waste produced after food waste, which is 15%[1]. Kusumastuti[2] explained that the industrial and financial sectors are one of the targets that must be applied to the green concept. The financial industry must also pay attention to the green concept in recording and bookkeeping financial statements where the concept of green environmental preservation is applied to all human activities, applied in accounting science, known as Green Accounting[3]. To protect the environment, the accounting sector has an influence on the green environment in terms of recording and financial reporting, including company activities in obtaining profits[4]. If environmental costs in the context of plastic waste management are considered by the company, in the long run financial performance will increase by disclosing environmental costs in its financial statements and improving the company's image for stakeholders[5]. The concept of green accounting or better known as environmental

accounting is important in playing a role in improving the performance and sustainability of the company's environment[6].

Declaration that the concept of green economy can answer the challenge of environmental damage[7]. For the EPA (*Economic Partnership Agreement*), green accounting is the same as environmental accounting. Jianmu Ye[8], stated that various environmentally conscious companies design strategies to reduce carbon emissions and negative impacts of business activities on the environment by reducing costs and increasing energy efficiency, using natural resources as well as possible, caring for the environment. EPA states that green accounting/environmental accounting is the process of identifying, prioritizing, quantifying, qualifying, and integrating environmental costs into business decisions. Green *Management Accounting* is a combination of financial accounting & cost accounting using environmental expense data & environmental performance for business decisions and planning, evaluation, and control of management to improve process efficiency and use of inputs, reduce the company's negative impact on the environment and reduce environmental protection costs, commitment of financial reporting entities to the triple bottom line': *people, planet, and profitability*, as its stated by Lestari[9].

The background of research on the application of the Internet of Things (IoT) in food and beverage industry waste management is closely related to the need to increase efficiency, reduce environmental impact, and meet sustainability standards. The food and beverage industry tends to generate significant amounts of waste, including organic, packaging, and chemical waste.

The application of IoT technology can provide innovative solutions in waste management, ranging from real-time monitoring and measurement to automation of waste management processes. This research aims to identify potential applications of IoT and analyze its impact on operational efficiency and waste reduction. Some previous studies [10]-[12] has highlighted the successful application of IoT in other industries and its positive impact on waste management, as the use of IoT sensors to monitor production and optimize the use of raw materials can reduce the waste generated. The application of automation with the help of IoT can also improve the efficiency of recycling and waste treatment processes. As such, the research is expected to provide deep insights into how IoT can revolutionize waste management practices in the food and beverage industry, with a focus on sustainability and operational efficiency.

2. Method

Descriptive statistical data processing is also carried out to describe or provide an overview of the objects studied through sample or population data [13]. The use of descriptive statistical methods in this research uses distribution tables for the answers of managers in large and medium industries regarding environmental problems in their regions. Responses from respondents are measured on a Likert scale of 1 – 5, the higher the value indicated, the higher the level of measurement of each variable.

This research uses the Mann Whitney Test, a non-parametric test used to compare two population means from the same population[14]. Even though it is categorized as a non-parametric form of independent test, the Mann Whitney test does not test the difference between the mean (average) of two groups like independent tests in general but is used to test the difference in median (middle value) between two groups. The Mann Whitney test is a non-parametric test used to compare two population mean values originating from the same population [15]. A scientific approach to measuring and analyzing competitiveness can be carried out through a qualitative approach and a quantitative approach[16]. In this research, the Mann-Whitney Test was used to determine whether there were differences in perceptions regarding the implementation of Green Accounting in small-medium industries and medium-large industries. This test is the most powerful test among nonparametric tests[17]. After conducting an analysis based on financial reports related to the implementation of Green Accounting, it is known that there is no difference in the implementation of Green Accounting between small-medium industries and medium-large industries. For this reason, a Mann Whitney analysis is needed to see the comparison between the two industry categories.

The Mann-Whitney test is used to analyze whether there are significant differences between two independent samples. Where to determine the hypothesis of this research, namely:

H0: $\mu 1 \geq \mu 2$

H1: $\mu 1 < \mu 2$

Information,

$\mu 1$ = implementation of Green Accounting in small-medium industries

$\mu 2$ = implementation of Green Accounting in medium-large industries

Where the development of this study's hypothesis is, namely,

H0: The implementation of Green Accounting in small-medium industries and medium-large industries is the same (no significant changes)

H1: The implementation of Green Accounting in small-medium industries and medium-large industries is not the same (there are significant changes)

This Mann Whitney analysis was carried out on five dimensions, namely Attention to the Environment, Environmental Responsibility dimension, Environmental Accounting Reporting dimension, Environmental Audit dimension, and Green Marketing dimension, to see whether there are differences in the implementation of Green Accounting in small-medium industries and medium-big sized industries.

A systematic literature review with a descriptive and qualitative approach was also carried out to find references regarding the use of the Internet of Things (IoT). The main objective is to examine various sources of literature related to technology related to green accounting in reducing environmental costs.

Literature review, as a research methodology, can be characterized as a systematic and methodical approach to collecting and synthesizing previous research[18]. This approach is supported by leading scholars such as Baumeister and Leary and Tranfield, Denyer, and Smart [19],[20]. A well-conducted literature review will provide a solid foundation for advancing knowledge and facilitating the development of a theoretical framework, as emphasized by Webster and Watson[21].

This literature review regarding IoT is taken from several writing samples over the past five years, which are indexed by Scopus. These keywords include “Digitalization” or “Technology”, “Efficiency” or “Sustainability” or “Green Accounting” or “Internet of Things (IoT)” or “Waste”.

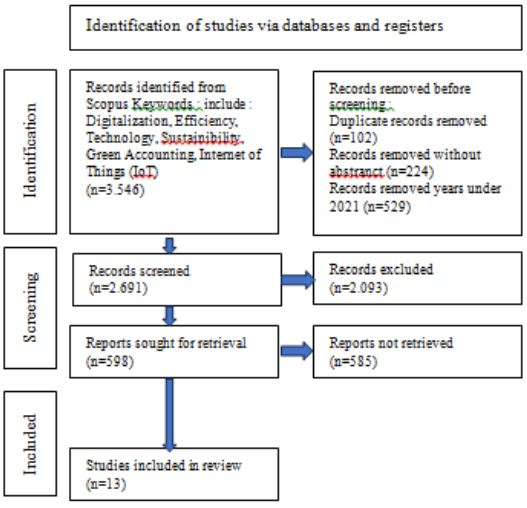

Figure 1. Identification of studies

3. Result

The Characteristics of Research

The survey was conducted on the F&B industry located in 6 sub-districts, Bogor City, West Java, Indonesia with small-medium and medium-large scale divisions.

The population in this research is the F&B industry throughout the city of Bogor. The data sample used in this research came from the results of distributing questionnaires with samples taken. The technique or sampling used in this research is purposive sampling. The research sample is respondents who are directly involved in implementing green accounting, have a background in accounting, marketing, and finance.

The number of samples in this study was 145 respondents, this number has exceeded the number of respondents based on the theory of Hair et al. (2014), namely the sample size requirement that must be met is at least 5-10 times the number of indicators. The 28 research indicators are multiplied by 5 (the minimum criteria limit) so that the minimum number of respondents in this study is 140 respondents.

Hypothesis Testing Results

Indicators of environmental attention according to Teoh and Thong in Yousef[22] this variable is measured by indicators of the existence of regulations regarding the environment, the philosophy of top managers, suggestions from other company associations, oneself, labor unions, customers, environmental institutions such as WALHI and suggestions from the environmental community. The results of descriptive statistical analysis showed that of the 108 respondents who were samples of small and medium industries, an average of at most 58% of respondents chose the agree category in answering statements about environmental attention with the highest indicator regarding self-motivation which can increase the company's attention to environmental problems. as many as 68 respondents (63%). Meanwhile, of the 18 respondents who were samples from medium and large industries, an average of at most 63% of respondents chose the agree category in answering statements about environmental concerns with the highest indicator being encouragement from environmental institutions such as WALHI (Indonesian Forum for the Environment) with 13 respondents (72%). So, it can be concluded that companies, both large and industrial, are motivated to pay attention to environmental problems around them.

Social and environmental responsibility is specifically regulated in Article 74 of Law Number 40 of 2007 that Social and Environmental Responsibility as referred to in paragraph (1) is the Company's obligation which is budgeted and calculated as the Company's costs, the implementation of which is carried out by paying attention to decency and fairness. According to Teoh and Thong (1986) in Yousef[22] this variable is measured by the indicator that the company always produces environmentally friendly products, the company has adequate availability of human resources and economic resources that are linked to environmental responsibility, the company's efforts in dealing with company waste despite the company experiences losses and within the company there is a process of reducing or limiting waste.

The results of descriptive statistical analysis showed that of the 108 respondents who were samples of small and medium industries, an average of at most 59% of respondents chose the agree category in answering statements about environmental responsibility with the highest indicators regarding the availability of human resources and economic resources which were sufficiently linked. with environmental responsibility as many as 69 respondents (64%). Meanwhile, of the 18 respondents in the sample of medium and large industries, an average of at most 60% of respondents chose the agree category in answering the statement about environmental responsibility with the highest indicator regarding the availability of human resources and economic resources that are sufficiently linked to environmental responsibility and The company's efforts to deal with company waste even though the company experienced losses were 12 respondents (67%). So, from the overall data obtained, it can be concluded that management's perception of corporate responsibility regarding the environment in large industries is higher than in medium industries.

Measuring this variable uses 10 question items developed from research by Dunk[23]. The indicators used to measure this variable are: There is a process of reducing or limiting waste, Tracking environmental activity costs, There is consideration of environmental aspects in investment decisions or exchange, The product design process is influenced by considerations of environmental aspects, The product design process is influenced by customers and other stakeholders, Always strives to meet environmental standards, Always strives to comply with environmental standards, Always supports the achievement of sustainable profit growth, Identifying product raw materials that are endanger the environment and reduce or limit raw materials that endanger the environment.

The results of descriptive statistical analysis revealed that of the 108 respondents who were samples of small and medium industries, an average of at most 56% of respondents chose the agree category in answering the statement regarding environmental accounting reporting with the highest indicator regarding the company always trying to meet environmental standards which are quite relevant. with environmental accounting reporting as many as 73 respondents (68%). Meanwhile, of the 18 respondents in the sample of medium and large industries, an average of at most 63% of respondents chose the agree category in answering statements regarding environmental accounting reporting with the highest indicator regarding the process of reducing or limiting waste, 14 respondents (78%). So, from the overall data obtained, it can be concluded that management's perception of environmental accounting reporting in large industries is higher than in medium industries.

An environmental audit is required as an evaluation process carried out by the person responsible for the business and/or activity to determine the level of non-compliance with laws and regulations in the field of environmental management related to the activity (Ministry of the Environment). According to Dunk[23], the indicators used to measure this variable are: Have carried out audits of annual financial reports regularly every year, have carried out audits of the company's performance related to the sustainability and safety of the surrounding environment and the results of the audit report are used as material for the company to consider in its activities. next.

The results of descriptive statistical analysis showed that of the 108 respondents who were samples of small and medium industries, an average of at most 50% of respondents chose the agree category in answering statements about environmental audits with the highest indicator being that the company had carried out regular annual financial report audits every year. 56 respondents (52%). Meanwhile, of the 18 respondents who were sampled from medium and large industries, an average of at most 56% of respondents chose the agree category in answering the statement regarding environmental audits with the highest indicator regarding 14 companies having conducted audits related to the sustainability and safety of the environment. respondents (78%). So from the overall data obtained, it can be concluded that management's perception of environmental audits in large industries is higher than in medium industries.

Davis in Elham & Wahid[24] explains the green marketing/advertising indicators that promotion begins with a statement of the company's concern for the environment, describing how the company has changed procedures to show concern and dedication in improving the environment as well as environmental care actions where the company is involved in these activities. and the result.

The results of descriptive statistical analysis revealed that of the 108 respondents who were samples of small and medium industries, an average of at most 45% of respondents chose the agree category in answering statements about green marketing with the highest indicator being that promotion begins with a statement of the company's concern for the environment, 51 respondents (51). 47%). Meanwhile, of the 18 respondents who were samples from medium and large industries, an average of at most 59% of respondents chose the agree category in answering the statement on green marketing with the highest indicator regarding how the company had changed procedures to show concern and dedication in improving the environment, 12 respondents (67%). Therefore, from the overall data obtained, it can be concluded that management's perception of green marketing in large industries is higher than in medium industries.

Table 1. Comparison of the implementation of Green Accounting in Small-Medium Inustries and Medium-Large Industries.

No	Attribute	Small - Medium Industry	Medium - Large Industry	P-value	W-value
1.	**Dimensions of Attention to the Environment**				
	A1a - A1b	4	4	0,1497	7784,5
	A2a - A2b	4	4	0,0617	7841,5
	A3a - A3b	4	4	0,4681	8025,0
	A4a - A4b	4	4	0,9404	8129,5
	A5a - A5b	4	4	0,3003	7849,0
	A6a - A6b	4	4	0,7752	7968,5
	A7a - A7b	4	4	0,5132	8036,5
	A8a - A8b	4	4	0,1494	7910,0
2.	**Dimensions of Environmental Responsibility**				
	B1a - B1b	4	4	0,1796	7926,0
	B2a -B2b	4	4	0,3042	7922,5
	B3a - B3b	4	4	0,2006	7936,0
	B4a - B4b	4	4	0,8226	8105,5
3.	**Dimensions of Environmental Accounting Reporting**				
	C1a – C1b	4	4	**0,0061**	7701,0
	C2a – C2b	4	4	**0,0480**	7824,0
	C3a – C3b	3	4	**0,0081**	7716,0
	C4a – C4b	4	4	0,6925	7951,0
	C5a – C5b	4	4	0,0933	7872,0
	C6a – C6b	4	4	0,5562	8047,0
	C7a – C7b	4	4	0,6539	8214,5
	C8a – C8b	4	4	0,4345	8016,0
	C9a – C9b	4	4	0,8787	8167,0
	C10a – C10b	4	4	0,4218	8012,5
4.	**Dimensions of Environmental Audit**				
	D1a – D1b	4	4	0,3953	8005,0
	D2a – D2b	4	4	**0,0088**	7721,0
	D3a – D3b	4	4	**0,0469**	7773,0

No	Attribute	Small - Medium Industry	Medium - Large Industry	P-value	W-value
5.	**Dimensions of Green Marketing**				
	E1a – E1b	4	4	**0,0297**	7792,5
	E2a – E2b	4	4	**0,0134**	7744,5
	E3a – E3b	4	4	**0,0449**	7819,5

Based on the results of the analysis in Table 1, it is known that the dimension of Attention to the Environment which consists of the factor that there are regulations regarding the environment can increase the company's attention to environmental problems, the factor that there is a philosophy from top managers that the environment is important can increase the company's attention to environmental problems, the factor that there is appeals from other company associations can increase the company's attention to environmental problems, the factor of encouragement from oneself can increase the company's attention to environmental problems, the factor of appeals from labor unions can increase the company's attention to environmental problems, the factor of desires from customers can increase the company's attention regarding environmental problems, the factor of encouragement from environmental institutions such as WALHI (Indonesian Forum for the Environment) can increase the company's attention to environmental problems, and the factor of having an independent party who always monitors can increase the company's attention to environmental problems, the P-value is obtained where the value is greater than the critical limit of 0.05 so the decision H1 is rejected, which means that if we look at it based on the Attention to the Environment dimension, it means there is no mean difference in the implementation of Green Accounting in small-medium industries and medium-large industries.

The Environmental Responsibility Dimension consists of the factor that the company always produces environmentally friendly products, the factor that the company has adequate availability of human resources and economic resources linked to environmental responsibility, the factor that the company has efforts to deal with company waste, and the factor that the company always handles waste. Even though the company experienced losses, the P-value was obtained where the value was greater than the critical limit of 0.05 so that the decision H1 was rejected, which means that if we look at it based on the Environmental Responsibility dimension, it means there is no mean difference in the implementation of Green Accounting in small-medium industries and medium-large industry.

Judging from the dimensions of Environmental Accounting Reporting which consist of: There is a process of reducing or limiting waste, Tracking the costs of environmental activities, There is consideration of environmental aspects in investment or exchange decisions, The product design process is influenced by considerations of environmental aspects, The product design process is influenced by customers and other stakeholders. , Always strive to meet environmental standards, Always strive to comply with environmental standards, Always support the achievement of sustainable profit growth, Identify product raw materials that endanger the environment and Reduce or limit raw materials that endanger the environment. The P-value is obtained where the value is smaller from the critical limit of 0.05 so that the decision H1 is accepted, which means that if we look at it based on the Environmental Accounting Reporting dimensions, it means there is a difference in the Mean and Median (there is an increase in the median value in medium-large industries).

Judging from the Environmental Audit dimension which consists of the company's factors conducting an audit of the company's performance related to the sustainability and safety of the surrounding environment and the factors resulting from the environmental performance audit being taken into consideration by the company in subsequent activities, the P-value is obtained where the value is smaller than the limit critical 0.05 so that the decision H1 is accepted, which means that if we look at it based on the Environmental Audit Reporting dimension, it means there is a mean difference in the implementation of Green Accounting in small-medium industries and medium-large industries. In this dimension, with the factor that the company has carried out

annual financial report audits regularly every year, a P-value is obtained where the value is smaller than the critical limit of 0.05 so that the decision H1 is accepted, which means that if we look at it based on the Environmental Audit Reporting dimension, it means there is a difference in the mean. on the implementation of Green Accounting in small-medium industries and medium-large industries.

If seen from the Green Marketing dimension which consists of company factors making promotions containing statements about environmental concern (go green), company factors making promotions by describing ways to change procedures that show the company's concern and dedication in improving the environment, and company factors making promotions by describes actions or actions that care about the environment, which depicts the company being involved in environmental activities and shows the results, a P-value is obtained where the value is smaller than the critical limit of 0.05 so that the decision H1 is accepted, which means that if seen based on the Green Marketing dimension, it means there is a difference Mean on the implementation of Green Accounting in small-medium industries and medium-large industries.

IoT Technology Integration for Green Accounting

To support environmentally friendly accounting (green accounting) integrated with other instruments, IoT plays a pivotal role in connecting various devices, including smart devices and sensors[10]. These systems leverage IoT technology to monitor variables related to waste control, carbon emissions, environmental monitoring, and sustainability[25]. This integration enhances operational efficiency and supports comprehensive corporate efforts in managing environmental impacts[26]. Therefore, IoT serves as a crucial foundation for addressing environmental challenges and implementing sustainable accounting practices [27].

Several platforms have already adopted this concept. For instance, Vilchez et al.[28] conducted a study on environmental monitoring using an application relying on sensor nodes for data acquisition, part of the LoRaTRUST back-end platform. The data transaction process involves blockchain technology, engaging a trusted provider, data producer, data consumer, and auditor. This work aligns with research by Yu Yang et al.[29] on accounting data integrity in resilient supply chains, also leveraging blockchain technology.

Additionally, Na Ma et al.[30] conducted an in-depth study shedding light on the implementation of BIN technology (Blockchain + IoT Network). This technological integration utilizes multiple instruments for continuous, real-time, and cost-effective measurements of Indoor Environmental Quality (IEQ) parameters and energy usage. The study delves into intricate details on how BIN facilitates seamless connections between these instruments[30]. The goal is to create an efficient infrastructure for monitoring and controlling indoor environmental conditions, ensuring data accuracy and providing valuable insights for energy management. The research emphasizes the significance of employing BIN for continuous monitoring, contributing to advancing the understanding and application of this integrated technology in various domains.

Review of Selected Paper

This review paper examines relevant research which is includes "Digitalization" or “Technology”, “Efficiency” or “Sustainability” or “Green Accounting” or “Internet of Things (IoT)” or “Waste”. Thirteen selected journal articles are analyzed, providing insights into how these technologies play a pivotal role in addressing environmental challenges, enhancing operational efficiency, and supporting comprehensive corporate efforts in managing environmental impacts. The integration of Internet of Things (IoT) and Blockchain technologies in the context of environmentally friendly accounting, with a focus on efficiency and sustainability.

The selected studies explore the relationship between environmental monitoring, waste reduction, and technology adoption in the food and beverage sector in Indonesia[10]. The research findings highlight the key role of Internet of Things (IoT) technology and Environmental Monitoring Systems in supporting sustainable waste reduction strategies[31]. The practical implication is the necessity to embrace cutting-edge technology, especially IoT, and implement efficient environmental monitoring systems to maximize waste reduction efforts. This research provides valuable insights for policymakers, industry players, and environmental advocates to understand how technology can be instrumental in achieving significant waste reduction targets.

Furthermore, these studies detail a proposed development of education-based accounting as a solution to address talent gaps in the accounting workforce during the knowledge economy era[32]. The focus is on the construction of an informatized accounting system under the Internet of Things (IoT) with integration between IoT and accounting tasks. The proposed model can enhance the intelligence of accounting tasks and expedite the informatization process[33]. Survey questionnaires indicate that an IoT-based accounting training platform has the potential to improve student learning, showcasing the effectiveness of this method in updating accounting education to meet the challenges and ongoing technological changes[34].

4. Discussions

Dimensions of Attention to the Environment

Based on the results of hypothesis testing using the Mann Whitney Test, it shows that the P-value is greater than the critical limit of 0.05, this shows that there is no difference in company attention between large and medium industries regarding environmental problems in the Bogor City area. This means that both industries are equally motivated to pay attention to environmental problems around them.

The results of this research are in accordance with the theory of environmental concern which states that efforts involve every citizen in growing and fostering awareness to preserve the environment based on values, namely the values of the environment itself with the philosophy of living peacefully with the natural environment. In every industrial development, it is very important that the company pays attention to the surrounding environment. This is to prevent pollution or environmental destruction to create a sustainable living environment and natural resources that can be well maintained.

There is still a perception from the industry that they still do not realize that "waste" is actually the same as "profit", or it could be the opposite, waste is a cost that must be incurred which reduces profits. If the waste problem is ignored, profits will not be reduced in the short term, but the future value of the company may be threatened. Such industry parties may not yet see the cost factors related to company value, especially the demands of buyers who realize that environmental management is important. As a result, business opportunities can be lost due to ignoring environmental aspects.

The results of the descriptive analysis show that respondents in large industries voted the most in the category of agreeing that there is encouragement from environmental institutions such as WALHI (Indonesian Forum for the Environment) and respondents in medium industries are concerned that encouragement from themselves can increase the company's attention to environmental problems. These two industries have different views in paying attention to environmental problems in the city of Bogor. Large industries are motivated to pay attention to environmental problems because there are independent parties who always monitor the company. In this case, independent parties such as stakeholders, the community and the government provide a lot of attention to various corporate environmental issues.

Therefore, significant changes will be required in this sector and the government must encourage large and medium-sized companies to ensure that the CSR activities undertaken are essential. Several large and medium scale industries have realized that they have a greater impact on the environment compared to other sectors because of their production processes or because of the total contribution of production in each business or location, so they have started making environmental management efforts. It can also be seen that the existence of environmental institutions such as WALHI greatly influences the company's behavior in paying attention to environmental problems around the company. This is different from small industries which emphasize self-motivation which can increase the company's attention to environmental problems.

Dimensions of Environmental Responsibility

Based on the results of hypothesis testing using the Mann Whitney Test, it shows that the P-value is greater than the critical limit of 0.05, which means there is no difference in corporate responsibility between large and medium industries regarding environmental problems in their regions. Both industries apply the same corporate responsibility to the environmental problems of Bogor City.

The application of responsibility to these two industries is in accordance with the theory of corporate responsibility which states that each industry is obliged and responsible for controlling and overcoming pollution caused by its industry[7]. Every industrial waste is the industry's obligation to manage it so that it does not pollute the environment. The waste produced must meet the required quality standards.

Corporate social environmental responsibility (CSR) arises as a response or proactive action taken by the company towards community expectations regarding the implementation of the activities carried out. The concept of social responsibility invites pros and cons among society. Those who are pro view the company as a socio-economic system that must be responsive to social interests, while those who are against view the company as an economic system that is only responsible to the company owner. Social responsibility, which is both a pro and a con, at least provides certainty for companies that whether they recognize it or not, they have a moral social responsibility which will have an impact on the increase or decrease in public sympathy for the company.

Small-medium sized companies are also an important factor in ensuring social welfare. However, initiatives related to corporate social responsibility have focused on multinational companies and large corporations. In fact, CSR is equally important for large and medium scale industries considering that SMEs also have stakeholders who have a significant impact on society. Therefore, significant changes are needed in this sector and the government needs to encourage awareness of small industries in carrying out CSR activities and this problem is solved. The amount of attention is also closely related to the company's responsibility for environmental problems.

The results of the descriptive analysis show that out of 18 large industries, 28% of respondents chose the strongly agree category in answering statement no. 1, which means that large industries are very responsible for the environmental problems around them as shown by the company producing environmentally friendly products. Apart from that, in large industries, 22% of respondents chose the category of strongly agree in answering statements no. 2 and 3, which means that large industries are responsible for environmental problems as indicated by the company having sufficient availability of human resources and economic resources so that the company's responsibility in Environmental problems such as dealing with waste will also get bigger. Meanwhile, of the 108 small-medium industries, only 18% of respondents who voted in the category strongly agree with producing environmentally friendly products. The availability of human resources and economic resources is sufficiently linked to environmental responsibility, while efforts to deal with company waste are 21%. This unequal responsibility between large and medium industries can also be shown in large industries having efforts to deal with waste, whereas in small-medium industries companies think that waste is a cost that must be incurred and reduces profits. Some industries feel that corporate social responsibility can have an impact on increasing costs if it is applied to small-medium companies, while their focus is at least survival/going concern, even though they believe that CSR is a form of environmental awareness for sustainability.

Dimensions of Environmental Accounting Reporting

Based on the results of hypothesis testing using the Mann Whitney Test, it shows that the P-value is smaller than the critical limit of 0.05, which means that there are differences in corporate environmental accounting reporting between medium-large industries and small-medium industries related to environmental problems in the city of Bogor. The results of this research are in accordance with the theory of corporate environmental accounting reporting, which states that accountability can be fulfilled, and information asymmetry can be reduced if companies report and disclose their CSR activities to stakeholders. By reporting and disclosing CSR, stakeholders will be able to evaluate how CSR is implemented and provide awards or sanctions to the company according to the results of their evaluation. CSR reporting is not only beneficial for external parties, but also beneficial for the company. Making a self-assessment company CSR report can identify the company's strengths and weaknesses related to CSR activities in the company. Thus, the report is an organizational learning tool that causes dynamic changes in individuals and companies, ultimately encouraging increased organizational performance.

The results of this research are in accordance with research conducted by Yousef[22], which stated that companies are aware of environmental protection problems, but their commitment to environmental protection is still low. Several industries have reported the company's environmental performance.

From the results of the descriptive analysis, it shows that out of 18 medium-large industries, 22% of respondents chose the strongly agree category in answering question no. 1 which stated that in the company there is a process of reducing or limiting waste, while in small-medium industries only 8%. Research on environmental activity costs was carried out by 17% of respondents from medium-large industries who answered strongly agree, while in small-medium industries it was 7%, this shows that small-medium industries still lack attention in terms of sacrifices for environmental costs and their reporting. very simple and does not comply with generally accepted accounting rules. However, the efforts made by the two industries are not much different in terms of reducing or limiting raw materials that endanger the environment, namely 14% in small-medium industries and 11% in medium-large industries.

Dimensions of Environmental Audit

Hypothesis testing using the Mann Whitney Test shows that the P-value is smaller than the critical limit of 0.05, which means that there are differences in corporate environmental auditing between large and medium industries related to environmental problems in Bogor City. The results of this research are in accordance with the theory of corporate environmental auditing, which states that environmental audits are needed to increase efficiency and control emissions and pollutants which can ultimately increase the positive image of the public towards the company.

Environmental audit is a comprehensive examination tool in the environmental management system to objectively verify environmental management efforts and can help find remedial steps to improve environmental performance. Whether the performance of the environmental conservation program carried out by the company has been effective and efficient or not, an environmental performance audit is required. The results of this research are in accordance with research conducted by Ghofar[35], which states that differences in environmental accounting reporting also have an impact on differences in environmental audits.

From the results of the descriptive analysis, from 18 medium-large industries, as many as 22% of respondents chose the strongly agree category in answering the question which stated that the company had carried out environmental audits in the company's annual report regularly and the results of the environmental performance audit could be used as material. company considerations in subsequent activities. Meanwhile, of 108 small-medium industries, only 16% of respondents chose this category.

Dimensions of Green Marketing

Hypothesis testing using the Mann Whitney Test shows that the P-value is smaller than the critical limit of 0.05, which means there is a difference in green marketing between large and medium industries related to environmental problems in Bogor City. The results of this research provide a greater challenge regarding this concept, where according to Erni Yuningsih, Yulianingsih's use of an environmentally friendly product approach shows that there are various perspectives, namely related to price, product quality and the potential for post-consumer recycling. Apart from that, it also studies the production process of environmentally friendly products, including the marketing aspects, which are related to the environmentally friendly marketing model. This explains that environmentally friendly products are not only seen from the perspective of consumption, but also distribution, production and even recycling. So, the development of environmentally friendly product research tends to grow not only in advanced industrial countries, but also in developing countries and not only in large companies, even in SMEs.

Small-medium industries have many challenges in realizing the green concept in their businesses. The green marketing concept, which is not yet commonly implemented by most MSMEs, also tends to be considered a tiring change, coupled with business competition that sometimes commits fraud. Common fraud occurs by applying a green label, but not selling/carrying out environmentally friendly business activities so that the tagline is only used to improve the brand without improving quality.

The challenges of MSMEs are directly proportional to the challenges of losses to the environment. The Environmental Quality Index (IKLH) is used as an indicator of environmental management in Indonesia. IKLH is a combination of the Environmental Quality Index (EQI) concept and the Environmental Performance Index (EPI) concept. IKLH can be used to assess the performance of environmental quality improvement programs and as information material to support policy-making processes related to environmental protection and management (Annisa Mahfuzah).

From the results of the descriptive analysis, from 18 medium-large industries, as many as 28% of respondents chose the strongly agree category in answering the question which stated that the company made promotions containing statements about environmental concern (going green). Meanwhile, of 108 small-medium industries, only 9% of respondents chose this category. Also, regarding the company factor in making promotions by describing ways to change procedures that show the company's concern and dedication in improving the environment, 17% were answered strongly agree by medium-large industries, while 6% were answered by small-medium industries. No less important is the factor that companies make promotions by describing actions or actions that care about the environment, which depict the company being involved in environmental activities and showing the results. As many as 17% of medium-large industries answered strongly agree, but in small-medium industries only 9%. This provides a big job for all interests to socialize the importance of sustainability.

The challenges of green accounting include lack of environmental awareness, shortage of environmental information, higher adaptation costs, and lack of clear guidelines.

Lack of awareness about environmental issues, the absence of financial incentive provisions like a reward or penalty, and limited access to recycling facilities such as recycling bins might influence a household’s participation in the recycling programme[36]. On the other hand, the mandatory requirement of waste segregation at the source under Act 672 might encourage households to participate in the programme.

One of the challenges in waste management among developing countries is identifying an appropriate solution for reducing waste generation, waste collection, treatment, and disposal[37]. Landfilling is the preferable method to manage waste due to its low cost of maintenance and operation and simple procedure to settle the collected waste.

Low 3R activity (i.e., reduce, reuse, and recycle) among the community is possibly due to the indigent attitude to participate in the programme. The willingness to participate in waste segregation programmes could be due to insufficient time, space and, accessibility to recycling facilities[37].

Muhamad Bakhar, Eko Budihartono's research[10] offers practical insight into how technology can help companies achieve their waste reduction goals significantly, as more companies place a higher priority on sustainability.

For restaurants, digital transformation, such as the application of techniques in preservation and processing to help food be fresher and used longer is essential. Restaurants can use IoT technology to automate maintenance and workflow processes and enable early fault identification, which can greatly reduce critical machine failures. This ultimately minimizes chiller downtime and thus reduces the potential for food waste due to property damage. To reduce food waste, restaurants should also use IoT in the supply chain. Better communication in the supply chain will help reduce the amount of waste generated, as each stage of the supply chain is in constant contact with each other to ensure our resources are managed effectively.

The Internet of Things (IoT) has the potential to revolutionize waste management practices in the food and beverage industry. By integrating IoT devices, the industry can enhance traceability, reduce inefficiencies, and contribute to more sustainable production and distribution processes. IoT applications in this sector range from supply chain optimization to real-time monitoring of production processes and inventory management. These technologies enable data-driven decision- making, facilitating more efficient resource utilization and waste reduction. While existing literature showcases successful applications of IoT in waste reduction across various industries, there is a lack of research on its specific impact on the food and beverage sector in Indonesia. Further

studies are needed to explore the nuances of IoT's influence on waste management practices in this context [26]– [34].

5. Conclusion

The test results state that if we look at the Attention to the Environment dimension and the Environmental Responsibility dimension, there is no mean difference in the implementation of Green Accounting in small-medium industries and medium-large industries. Meanwhile, if we look at the Environmental Accounting Reporting dimension, the Environmental Audit Reporting dimension and the Green Marketing dimension, there are mean differences in the implementation of Green Accounting in small-medium industries and medium-large industries.

It is necessary to look for various potential technology-based solutions to overcome these problems that are related to the environment and have practical consequences for policy makers, industry players and environmental advocates.

Our research offers practical insights into how the use of Internet of Things (IoT) can help companies achieve the goal of significantly reducing environmental costs and waste, as more businesses place a higher priority on sustainability.

References

[1] S. Dian Andryanto, “5 Negara ini Penyumbang Sampah Plastik Terbesar di Dunia, Indonesia Urutan Ke-3,” Tempo.co, 27 October 2021.

[2] Dora Kusumastuti, Wibowo Murti Samadi, Sutiyo, and Supriyanta, “Green Industry Policy in Indonesia,” International Journal of Business, Economics and Law, Vol 26, Issue 2, ISSN 2289-1552, April 2022.

[3] Lako A., “Akuntansi Hijau: Isu, Teori, dan Aplikasi”, Salemba Empat, 2018.

[4] Mustafa, Hasri, and Retno Martanti Endah Lestari, “A Review of The Agriculture Literature in Malaysian and Indonesian Accounting Journals,” Journal of Social Transormation and Regional Development, Vol 3, Number 2, 2021. https://doi.org/10.30880/jstard.2021.03.02.005

[5] Putri A.M., Hidayati N., and Amin M., “Dampak Penerapan Green Accounting Dan Kinerja Lingkungan Terhadap Profitabilitas Perusahaan Manufaktur Di Bursa Efek Indonesia,”, E-JRA, Vol. 8, Number 4, 2019.

[6] Kurniawan A and Mustafa UA, “Penerapan Akuntansi Lingkungan Badan Usaha Milik Desa Untuk Mewujudkan Green Accounting Badan Usaha Milik Desa Adijaya Lampung Tengah”, Jurnal Ilmiah Keuangan dan Perbankan, Vol. 5, Number 1, pp. 87-98, 2022.

[7] Hoesada J., “Analisis Akuntansi Hijau,” Komite Standar Akuntansi Pemerintahan (KSAP), 1 October 2022.

[8] Jianmu Ye and Efifania Dela, “The Effect of Green Investment and Green Financing on Sustainable Business Performance of Foreign Chemical Industries Operating in Indonesia: The Mediating Role of Corporate Social Responsibility,” Sustainability, Vol. 15, Number 14, July 2023.

[9] Lestari, Retno Martanti Endah, Wahyudin Zarkasyi, and Ida Farida, “The Influence of Biological Asset Accounting Policies and Corporate Governance Practices on The Financial Performance : Moderating Role of Knowladge About Renewable Energy,” International Journal of Energy Economics and Policy, 2020.

[10] Muhamad Bakhar and Eko Budihartono, “Impact Analysis of the Use of IoT Technology and Environmental Monitoring Systems on Waste Reduction in the Food and Beverage Industry in Indonesia,” West Science Interdisciplinary Studies, Vol. 1, Number 11, 2023.

[11] Santhosh Sivaraj, “IoT for Food and Beverage Manufacturing,” Integration of Mechanical and Manufacturing Engineering with IoT, pp.141-157, 2023.

[12] Aytac and Korcak, “IoT based intelligence for proactive waste management in Quick Service Restaurants,” Journal of Cleaner of Production, Vol. 284, 15 February 2021.

[13] Martin G. Larson, "Descriptive Statistics and Graphical Displays," Circulation, Vol. 114, No. 1, pp. 76-81, July 2006.
[14] Nadim Nachtar, "The Mann-Whitney U: A Test for Assessing Whether Two Independent Samples Come from the Same Distribution," Tutorials in Quantitative Methods dor Psychology, Vol. 4, No. 1, March 2008.
[15] Jean D. Gibbons and Subha Chakraborti, "Comparisons of the Mann-Whitney, Student's t, and Alternate t Test for Means of Normal Distributions," The Journal of Experimental Education, Vol. 59, No. 3, pp. 258-267, April 2014.
[16] Arho Suominen, Arash Hajikhani, Antti Ahola, Yutato Kurogi, and Kuniko Urashima, "A quantitative and qualitative approach on the evaluation of technological pathways: A comparative national-scale Delphi study," Futures, Vol. 140, June 2022.
[17] Donald W. Zimmerman, "Increasing the Power of Nonparamethic Test by Detecting and Downweighting Outliners," The Journal of Experimental Education, Vol. 64, No. 1, pp. 71-78, 1995.
[18] Hannah Snyder, "Literature review as a research methodology: An overview and guidelines," Journal of Business Research, Vol. 104, pp. 333-339, November 2019.
[19] Roy F. Baumeister and Mark R. Leary, "Writing Narrative Literature Review," Review of General Psychology, Vol. 1, No. 3, pp. 311-320, 1997.
[20] Tranfield, D., Denyer, D., & Smart, P., "Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review," British Journal of Management, Vol. 14, No. 3, pp. 207-22, 2003.
[21] Jane Webster and Richard T. Watson, "Analyzing the Past to Prepare for the Future : Writing a Literature Review," MIS Quarterly, Vol. 26, No. 2, June 2002.
[22] Yousef F. H., " Green Accounting in Developing Countries : The Case of U.A.E. and Jordan," Manajerial Finance, Vol. 29, No. 8, 2003.
[23] Alan S. Dunk, "The Effect of Budget Emphasis and Information Asymmeetry on The Relation Between Budgetary Slack Participation and Slack," The Accounting Review, Vol. 68, No. 2, 1993.
[24] R. Elham and N. A, Wahid, "Investigation of Green Marketing Tools' Effect on Consumers' Purchase Behavior," Business Strategy Series, Vol. 12, No. 2, 2011.
[25] T. Kumar, Bharath, and Deepak Prashar, "Review on Efficient Food Waste Management System Using Internet Of Things," International Journal of Current Research and Review, 2021.
[26] Hongdam Han, Radha K. Shiwakoti, Robin Jarvis, Chima Mordi, David Botchie, "Acoounting and auditing with blockchain technology and artificial Intelligent : A Literature Review," International Journal of Accounting Information Systems , Vol. 48, 2023.
[27] Jian-Tao Song, "Quantitative Analysis of Internet of Things Technology on The National Economic Accounting : A Prediction Model Based on The FCM-BP Neural Network Algorithm," Computational Intelligent Neuroscience, 2022.
[28] Pedro Vilchez, Saulo Jacques, Felix Freitag, and Roc Meseguer, "LoRaTRUST : Blockchain-Enabled Trust and Accpountability Service for IoT Data," Electronics 2023, 2023
[29] Yu Yang and Zecheng Yin, "Resilient Supply Chains to Improve the Integrity of Accounting Data in Financial Institutions Worldwide Using Blockchain Technology," International Journal of Data Warehousing and Mining Vol. 19, No. 4, 2023
[30] Na Ma, Alex Waegel, Max Hakkarainen, William W. Braham, Lior Glass, and Dorit Aviv, "Blockchain + IoT sensor network to measure, evaluate and incentivize personal environmental accounting and efficient energy use in indoor space," Applied Energy, Vol. 332, 2023.
[31] Shu Chan, "Network Accounting Model in Intelligent Internet of Things Network Computing and Multimedia Environment," Scientific Program, 2022.
[32] Claudiu George Bocean and Anca Antoaneta Varzaru, "A Two-Stage SEM–Artificial Neural Network Analysis of Integrating Ethical and Quality Requirements in Accounting Digital Technologies," Systems 2022 Vol. 10, No. 121, 2022.

[33] Anna Karmanska, "Internet of Things Accounting Field, Benefit, and Challenges," Operation Research and Decision, Vol. 3, 2022.
[34] Zenovii-Mykhaylo Zadorozhnyi, Volodymyr Muravskyi, Nataliya Pochynok, and Uliana Ivasechko, "Application of The Internet of Things and 6G Cellular Communication to Optimize Accounting and International Marketing," Virtual Economics, Vol. 6, No. 1, 2023.
[35] Muhammad Ghofar and Dian Anita Nuswantara, "The Quality of Environmental Performance Assessed from Green Accounting Implementations in Companies in Indonesia," Ekspektra, Vol. 6, No. 1, July 2022.
[36] Lina Fogt Jacobsen, Susanne Pedersen, and John Thogersen, "Drivers of and barriers to consumers' plastic packaging waste avoidance and recycling – A systematic literature review," Waste Management, Vol. 141, No. 2, March 2022.
[37] Josfrin Uding Rangga, Sharifah Norkhadijah Syed Ismail, Irniza Rasdi, Karmegam Karuppiah, "Waste Management Costs Reduction and the Recycling Profit Estimation from the Segregation Programme in Malaysia," Pertanika Journal of Science and Technology, Vol. 30, No. 2, March 2022.