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Accounting for the Green Economy: Integration of Biological Asset Accounting and Green Accounting Practices in Horticultural SMEs in Sikka Regency

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ABSTRACT

This study aims to evaluate gaps in biological asset and environmental accounting practices in horticultural SMEs in Sikka Regency and to develop an integration model suitable for these SMEs' characteristics. This study uses a mixed-methods approach, combining qualitative analysis through in-depth interviews and documentation with quantitative analysis to measure the gaps between existing practices and applicable accounting standards. The research results indicate that most SMEs have not adopted PSAK 69 standards on the recognition and measurement of biological assets, and that they lack environmental cost recording in their financial statements. Based on these findings, this study develops an integrated model of biological asset accounting and environmental accounting, which is expected to enhance transparency and accountability and support the principles of a green economy in SME practices. This model is expected to help SMEs produce more accurate, relevant, and sustainable financial statements, thereby supporting environmentally friendly strategic decision-making.

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INTRODUCTION

Horticultural MSMEs in Sikka Regency serve as the backbone of the local economy, with a significant contribution to labour absorption and community food security. However, the accounting practices used by MSMEs are still limited to simple record-keeping and thus have not fully supported the principles of the green economy, particularly in the management of biological assets and environmental costs. The green economy is an economic development model that aims to enhance human welfare and social equity while significantly reducing environmental risks and ecological scarcity. According to the United Nations Environment Programme (UNEP, 2011), a green economy can be defined as: "An economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities." In other words, a green economy emphasises inclusive economic growth, efficient use of resources, low carbon emissions, and environmental sustainability.

The application of accounting to the recognition of biological assets, focusing on the life cycle of plants, as well as to environmental aspects, emphasising the ecological costs inherent in that cycle, can strengthen the principles of the green economy. The Green Economy principles include resource use efficiency, fairness and inclusivity, ecosystem protection, and sustainable production and consumption practices (Barbier, 2016).

Therefore, accounting not only serves as a financial recording tool but also as a strategic instrument to promote socially and ecologically responsible business practices.

Previous research indicates that biological assets, such as horticultural plants, are often not recognized in accordance with PSAK 69 due to a limited understanding of fair value measurement techniques. For example, a study on chilli agriculture SMEs in North Sumatra indicated that 15% partially applied PSAK 69, citing the complexity of valuing biological assets (Amelia et al., 2024). A similar phenomenon was identified in Sikka Regency, where horticultural farmers rely more on cost-based recording rather than fair value measurement. Additionally, environmental aspects in the accounting practices of horticultural SMEs remain neglected. Horticultural production waste, including leftover fertilizers, pesticides, and plastics, has not been considered part of accounting responsibility. Research on tempeh processing SMEs in Sikka Regency revealed that 80% of business actors charge environmental costs (such as wastewater treatment) as "overhead costs" without explicit separation in financial statements (Lolan *et al,* 2024).

This condition creates ecological information asymmetry. PSAK 69 emphasises the application of fair value without considering the environmental impact of agricultural practices (IAI, 2018). In contrast, the concept of green accounting emphasises the recording of environmental costs and effects in the accounting reporting system, including pollution, soil degradation, and carbon emissions (Schaltegger & Burritt, 2017). This gap in practice has the potential to hinder the achievement of Sustainable Development Goal 12, which is responsible consumption and production, as well as the Prabowo-Gibran Government programs, particularly Asta Cita 2, which emphasises strengthening food security through the implementation of a green economy.

Therefore, a conceptual and technical integration between biological asset accounting (PSAK 69) and environmental accounting (green accounting) is needed to produce financial statements that are not only financially accountable but also environmentally sustainable. In other words, biological asset accounting (PSAK 69), which focuses solely on recognising the fair value of plants, needs to be complemented by environmental accounting to record costs and ecological impacts.

Based on the description of the phenomenon, previous research findings, and the identified practice gap, this study aims to evaluate the gaps in biological asset accounting practices and green accounting in horticultural SMEs in Sikka Regency in relation to the applicable accounting standards. Additionally, this study aims to develop an integrated model of biological asset accounting and green accounting that aligns with the characteristics of horticultural SMEs in Sikka, providing a solution to address these gaps. The results of this study are expected to yield an integrated model of biological asset accounting and green accounting that aligns with the characteristics of horticultural SMEs in Sikka and supports the principles of a green economy.

METHODS

Type of Research

This type of research uses a combination of qualitative and quantitative approaches (mixed methods) with content analysis techniques as the main method. According to Creswell and Clark (2018), mixed methods research is an approach that integrates qualitative and quantitative data to gain a more comprehensive understanding of a research phenomenon. The qualitative approach in this study is evident in the data collection, which includes in-depth interviews and documentation of biological asset records for horticultural SMEs in Sikka Regency. The qualitative data is then analysed using content analysis to identify categories of recording practices in accordance with accounting standards (PSAK 69).

According to Krippendorff (2018), content analysis is a research technique used to make reproducible and valid inferences from texts or documents to their context. A quantitative approach is used when the results of content analysis coding are converted

into numerical form by calculating the percentage of conformity levels and/or gaps in SMEs' practices against biological assets (PSAK 69) and environmental accounting.

The coding categories were developed through an inductive process, beginning with a thorough reading and understanding of the data to identify emerging themes and patterns in the practice of accounting for biological assets and environmental costs. Initial categories were established based on the research objectives, which focus on the recognition, measurement, presentation, and disclosure of biological assets and environmental costs in accordance with PSAK 69 standards and green accounting concepts. These coding categories were designed to cover key areas, including cost recording, fair value measurement, recognition of biological assets, and recognition and presentation of environmental costs. After the basic categories were established, the researcher conducted iterations by further categorizing the data, refining existing categories, and adding new categories that emerged during the analysis.

To ensure coding reliability, this study employed source and method triangulation. Source triangulation was conducted by comparing interview results with financial records and existing reports to ensure data consistency. In addition, method triangulation was used by combining data from interviews, documentation, and literature. Coding reliability was also validated by involving two independent researchers in the coding process to assess consistency. Any discrepancies in coding that arose between researchers were then discussed and resolved to reach an agreement. Furthermore, validation was conducted by confirming the analysis results with relevant literature and accounting regulations, such as PSAK 69 and green accounting principles, to ensure that the developed categories covered aspects in accordance with applicable standards.

Population and Sample

A population is a generalised area consisting of objects or subjects that have certain qualities and characteristics, as determined by the researcher, to be studied and conclusions drawn from (Sugiyono, 2017). The population in this study consists of all Micro, Small, and Medium Enterprises (MSMEs) in the horticultural sector operating in Sikka Regency, with the target population being horticultural MSMEs that practice green economy, develop partnership patterns with religious, governmental, and academic institutions, as well as maintain identifiable financial records, totalling 28 MSME actors.

A sample is a part of the population that is used as the research subject and is considered to represent the characteristics of the entire population (Arikunto, 2019). In this study, the sampling technique employed is total sampling, where the entire population serves as the sample. Considering the relatively small number of identified horticultural SMEs, which totals 28 SMEs, this approach is suitable.

Research Location and Time

The research was conducted in the Sikka Regency area, East Nusa Tenggara, focusing on MSMEs engaged in the production of vegetables, fruits, and horticultural food crops. The research period was from July to August 2025.

Data Collection Techniques

Data collection techniques were employed through interviews, documentation, and literature reviews. Interviews were conducted with horticultural SME owners to gather information about accounting practices for biological assets and environmental costs. Documentation was undertaken to review accounting records, financial statements, and SME transactions. Literature studies were conducted to examine literature on PSAK 69, green accounting, the green economy, and previous research.

Data Analysis Techniques

Data analysis techniques are carried out using content analysis with the following

stages (Elo & Kyngäs, 2008):

1. Data Collection

Data was obtained from the financial records of horticultural SMEs and interviews with business actors.

2. Data Reduction

The collected data was selected and focused on relevant information, namely practices of biological asset accounting and environmental accounting according to the horticultural plant cycle and accounting standards.3.

3. Determining Categories and Coding

The data was analyzed by grouping it into categories and assigning codes.

4. Analysis and Evaluation

Analysis and evaluation were conducted on the gaps between accounting in SMEs and the development of the Biological Asset and Environmental Accounting Integration Model as a solution to address these gaps.

The analysis results are presented in the form of qualitative descriptive (narrative) and supported by quantitative presentation (percentage of implementation).

Data Validity Check

To ensure validity, source and method triangulation techniques were employed, specifically comparing interview results with financial report documents and confirming the analysis results against relevant literature and accounting regulations (PSAK 69 and the concept of green accounting).

RESULTS AND DISCUSSION

Research Results

Accounting Recording Patterns for Biological Assets (PSAK 69) in Horticultural SMEs in Sikka Regency

The accounting recording pattern of biological assets in horticultural SMEs in Sikka Regency is shown in the following Table 1:

Table 1. Accounting Records of Biological Assets in Horticulture SMEs in Sikka Regency

Aspects That Are Analyzed	Indicator	Number of MSMEs	%
Recognition	1) Recognise biological assets from the time the plants are planted (in accordance with PSAK 69)	1	4%
	2) Recognise assets only when they are ready for harvest	17	61%
	3) No asset recording during the growth period	10	36%
Measurement	1) Using fair value less costs to sell (in accordance with PSAK 69)	1	4%
	2) Using a combination of historical cost + estimated selling value	12	43%
	3) Only using historical costs (seeds, fertilizer, labor)	15	54%
Presentation	1) Biological assets are presented separately in the financial statements	0	0%
	2) Simple presentation without a standard format	23	82%
	3) Not presented in the report	5	18%
Disclosure	1) There is a standard record (Description of biological assets, Measurement, and Change in Value)	**0**	0%
	2) Limited disclosure (Type of plants, number	16	57%

Aspects That Are Analyzed	Indicator	Number of MSMEs	%
	of seedlings, land area, estimated harvest)		
	3) No standard disclosure	12	43%

Source: Processed Data, 2025

Table 1 above illustrates the accounting recording patterns of biological assets for 28 horticultural MSMEs in Sikka Regency, which served as the sample for this study. The analysis of the accounting recording patterns of biological assets is reviewed based on four aspects of PSAK 69, which include recognition, measurement, presentation, and disclosure, and can be explained as follows:

1. Recognition Aspect

Most MSMEs (61%) only recognise biological assets when the crops are ready for harvest. As many as 36% do not record assets during the growth period, so information about asset values in that phase is not documented. Only 4% comply with PSAK 69, recognising assets from the time they are planted. This indicates that horticultural MSMEs in Sikka Regency focus more on the harvest results rather than the growth process, so recognition practices are not yet in accordance with accounting standards.

2. Measurement Aspect

The majority (54%) only use historical costs (seeds, fertilisers, labour) as the basis for recording. Some (43%) have begun to try combining historical costs with estimated selling prices, although not yet fully in accordance with PSAK 69. Very few (4%) use fair value less costs to sell as required by the standard. This suggests that the measurement of biological assets remains relatively straightforward and is primarily based on the cost approach, due to limitations in assessing their fair value.

3. Presentation Aspect

Most MSMEs (82%) present biological assets without standardised procedures. As many as 18% do not present them at all. None of the MSMEs present biological assets separately in the financial statements in accordance with PSAK 69. This indicates that the presentation of reports is still far from the standard and is more administrative in nature.

4. Disclosure Aspect

Most (57%) make limited disclosures, such as the type of crops, number of seedlings, land area, and harvest estimates. 43% do not make any disclosures at all. None of the MSMEs creates a complete standard record as a disclosure in accordance with PSAK 69. This suggests that disclosures remain limited and lack transparency, primarily consisting of technical information rather than financial information.

Environmental Accounting Recording Patterns in Horticultural SMEs in Sikka Regency

The pattern of environmental accounting recording in horticulture SMEs in Sikka Regency is shown in the following Table 2:

Table 2. Environmental Accounting Records in Horticultural SMEs in Sikka Regency

Aspects That Are Analyzed	Indicator	Number of MSMEs	%
Recognition	1) Recording the costs of soil and water conservation from the beginning of horticultural activities	1	4%
	2) Recording waste processing costs	3	11%
	3) There is no special recording of environmental costs	24	86%
Measurement	1) Using historical cost	4	14%
	2) No measurement was taken	24	86%
Presentation	1) Environmental costs are separated in the financial statements	0	0%
	2) Simple presentation without a standard format	11	39%
	3) Not presented in the report	17	61%
Disclosure	1) There is a standard record of environmentally friendly activities	0	0%
	2) Limited disclosure (Type of conservation activities, amount of costs)	6	21%
	3) No disclosure	22	79%

Source: Processed Data, 2025

Table 2 above illustrates the pattern of environmental cost accounting records for 28 horticultural MSME actors in Sikka Regency who were sampled in this study. The analysis of ecological accounting recording patterns is viewed based on four aspects of green accounting, including recognition, measurement, presentation, and disclosure, and can be explained as follows:

1. Aspects of Environmental Cost Recognition

Only 4% of MSMEs have recorded soil and water conservation costs since the beginning of horticultural activities. About 11% have recorded waste processing costs. The majority (86%) do not keep special records related to environmental costs. This suggests that most MSMEs lack awareness or the capacity to account for environmental costs in their records. Conservation and waste processing costs are often considered operational technical activities rather than business expenses that require documentation in accounting.

2. Aspects of Environmental Cost Recognition

As many as 14% of MSMEs measure environmental costs using a historical cost approach or according to the actual expenses incurred. Meanwhile, 86% do not conduct any measurement at all. This suggests that environmental cost measurement remains minimal. The majority of MSMEs do not quantitatively assess the costs incurred for environmentally friendly activities. As a result, there is no information available to measure the cost efficiency or economic impact of these environmental activities.

3. Aspects of Environmental Cost Presentation ...

No SMEs separate environmental costs in their financial statements according to standard accounting practices. As many as 39% present them in a simplified manner that does not comply with standard guidelines. Meanwhile, 61% do not present environmental costs in their reports at all. This suggests that the presentation of ecological costs remains far from the standards of environmental accounting. The existing presentation is more administrative and internal, rather than a financial report that adheres to accounting standards. This makes information regarding environmental costs not clearly accessible to

external stakeholders.

4. Aspects of Environmental Cost Disclosure

No MSMEs have standard records regarding environmentally friendly activities. About 21% make only limited disclosures, covering only the types of conservation activities or specific costs. Meanwhile, 79% do not disclose environmental costs at all. This indicates that ecological cost disclosure is almost nonexistent among horticultural MSMEs in Sikka Regency. The available information is still very limited and of a narrative nature, rather than standard records in accordance with environmental accounting principles. This reflects the low level of transparency and accountability of MSMEs concerning ecological activities.

Integration of Biological Asset Accounting and Environmental Accounting

Based on Tables 1 and 2 above, it can be seen that horticultural MSMEs in Sikka Regency have not implemented biological asset accounting or environmental cost accounting in accordance with applicable accounting standards. In their agricultural practices, these MSMEs have adopted sustainable farming methods through the use of organic fertilisers, the utilisation of drip irrigation technology to conserve water, and the processing of plant leaves and stems into compost or animal feed. However, these activities are not yet aligned with accounting implementation. The accounting practices of horticultural MSMEs in Sikka Regency are not in accordance with accounting standards and therefore cannot fully support green economy principles. The researcher found that MSMEs have a limited understanding of biological asset accounting and environmental accounting.

"We do not understand how accounting should be done. We only focus on our plant cycle, which we need to take good care of in order to produce high-quality products that have market value." (RM – Horticulture entrepreneur, 2025)

The majority of MSME actors conveyed the same statement. This encouraged the researcher to develop a model integrating biological asset accounting and environmental accounting, which the researcher developed based on the horticultural crop cycle understood by horticultural MSMEs in Sikka Regency.

Table 3. Development of an Integrated Model of Biological Asset Accounting and Environmental Accounting

Plant Cycle	Biological Asset (BA)	Environmental Cost Accounting (EC)
Land Preparation	BA = 0	nmental Costs as Expenses : Basic Organic Fertilization Costs Environmental costs as an Asset AL = Drip Irrigation Installation
Planting	Recognition as a biological asset and measurement based on fair value/market price at the time of planting BA.a = (MP x YP) – HC Keterangan : MP = Market price per unit of product (Rp/Kg) YP = Yield per plant (kg/plant x number of plants) HC = harvesting costs + transportation costs	Environmental Costs as Expenses EC.t= Initial Planting Organic Fertilization Cost

Growth and care	Re-measurement is carried out using the market price at the time of growth. This measurement is done close to the harvest period. BA.t = (MP x CY) – BP Apabila : BA.t > BA.a then there is an increase in biological assets/gains from biological assets. BA.t < BA.a there is a decrease in biological assets/loss of biological assets	Environmental Costs as Expenses = Plant Maintenance Costs (Organic Fertilizer Costs + Organic Pesticide Costs) Calculating the Total Environmental Expenses: B: = EC.p + EC.t + EC.r
Harvest	Biological Assets (BA) are transferred to Harvested Produce Inventory	-
Waste Management	-	Calculating Waste Treatment Costs as the EXPENSE for the current period.

Source: Author's Analysis, 2025

Table 3 above illustrates the development of a model for integrating biological assets and environmental cost accounting that aligns with the characteristics of horticultural SMEs in Sikka Regency at present. This integration is developed and formulated in accordance with the horticultural plant cycle to facilitate easier understanding. In its implementation, horticultural SMEs can produce financial statements as follows:

Table 4. Presentation in Financial Statements

Integration Model	Profit/Loss Report	Statement of Financial Position/Balance Sheet
Biological Asset Accounting and Environmental Accounting	Operating Expenses: Environmental Burden Waste Treatment Burden Other Income (Expenses): - Gain on Biological Assets - (Loss on Biological Assets)	Current Assets Biological Assets Inventory Fixed Assets - Drip Irrigation

Source: Author's Analysis, 2025

Table 4 above shows the relationship between the integration of the biological asset accounting model and environmental accounting with the presentation in financial statements, including the Income Statement and the Statement of Financial Position. Financial statements can provide financial information for horticultural SMEs in making strategic decisions regarding the sustainable development of horticultural businesses.

Discussion

Gap Analysis between MSME Practices and Biological Asset Accounting Standards

Biological asset accounting is a crucial aspect of the financial reporting for agricultural entities. The accounting standard that regulates this matter is PSAK 69, which adopts the International Accounting Standard (IAS) 41 Agriculture. This standard requires entities to recognise, measure, present, and disclose biological assets reliably and relevantly.

However, research results on horticultural SMEs in Sikka Regency indicate a significant gap between the accounting practices applied and the provisions of PSAK 69.

In the analysis of biological asset recognition, it was found that most SMEs (61%) only recognize biological assets when the plants are ready for harvest. At the same time, 36% do not record assets during the growth period. Only 4% comply with PSAK 69, which requires recognizing assets from the time of planting. This phenomenon reflects SMEs' limited understanding of the importance of recognizing biological assets throughout the plant's life cycle. Theoretically, proper recognition from the early planting stage should provide a more comprehensive picture of the value of biological assets and can support more strategic management decisions. The sustainability of MSME businesses, particularly in the horticulture sector, is greatly influenced by accurate and timely recording of biological assets, as this affects long-term planning and resource management (Sulistyowati, 2020). Therefore, recognition in accordance with PSAK 69 can reduce the uncertainty often faced by MSMEs in planning and evaluating their business performance.

The practical implication of this finding is the need for education and training for SMEs to implement biological asset accounting in accordance with standards. Proper recognition from the outset can enhance SMEs' accountability to stakeholders, including financial institutions, which often require reliable information to support investment or financing decisions.

Most SMEs (54%) only use historical cost as the basis for measuring biological assets, with a simple cost approach, such as the cost of seeds, fertilizer, and labor. Only a few SMEs (4%) apply fair value-based measurement as regulated in PSAK 69. The use of historical cost reflects the limitations of SMEs in understanding the concept of fair value and in implementing it. Theoretically, PSAK 69 requires fair value measurement to reflect a more relevant value for biological assets and to provide more accurate information for decision-makers.

According to Schaltegger and Burritt (2010), this simple measurement practice risks overlooking potential gains or losses throughout the life cycle of plants, which can ultimately affect business performance assessment. For business sustainability, especially in the context of a green economy, more accurate measurements that include fair value can enhance transparency and accountability (Patty, 2025). By implementing fair value measurement, SMEs can provide more relevant information about the potential gains or losses from their biological assets, thereby supporting more precise, data-driven decision-making.

In practice, measuring fair value requires market evaluation skills that SMEs may not always possess, making training on this topic crucial. Counseling and technical support in applying measurement methods in accordance with PSAK 69 will greatly assist SMEs in overcoming challenges in measuring biological assets more accurately (IAI, 2018).

From the presentation side, the analysis results show that almost all SMEs (82%) only present biological assets in a simple manner without a standard format, and 18% do not present biological assets at all in their financial statements. This practice indicates a lack of understanding of the importance of presenting biological assets separately, as regulated in PSAK 69. Theoretically, proper presentation enables greater transparency in financial statements and provides clearer information to stakeholders. According to Kurniawan (2019), limited disclosure or none at all can affect the credibility of financial statements, as external parties do not receive relevant information about biological assets and the sustainability of SMEs.

A presentation that complies with standards will increase stakeholders' trust, including investors, creditors, and customers, who may be interested in the sustainability aspects of MSME business practices (Kieso et al., 2019). For MSMEs that adopt green economy principles, transparency in the presentation and disclosure of biological assets is very important, as it demonstrates their commitment to sustainable management (Grubnic, 2014). For example, by presenting biological assets in accordance with PSAK 69, MSMEs

can demonstrate that they manage natural resources responsibly, thereby enhancing their reputation and competitiveness in a market that increasingly values sustainability.

Therefore, strengthening MSMEs' capacity to understand the importance of presentation and disclosure in accordance with accounting standards will have a positive impact on business sustainability and send a strong signal to external parties about the management and accountability of these MSMEs.

Gap Analysis between MSME Practices and Environmental Accounting Standards

Research results indicate that horticultural MSME farming practices in Sikka Regency have generally shown a commitment to supporting the implementation of a green economy. Most business actors apply environmentally sustainable farming practices. However, this study also indicates gaps between accounting practices and environmental accounting standards. To date, the International Accounting Standards Board (IASB) has not issued a specific Environmental Accounting Standard. Nevertheless, several IAS/IFRS contain provisions relevant to environmental accounting, particularly concerning the recognition, measurement, presentation, and disclosure of environmental costs.

The research results indicate that in terms of recognition, only 4% of horticultural SMEs in Sikka Regency recorded costs for soil and water conservation, and 11% recorded waste processing costs. The majority (86%) did not record any environmental costs. This condition reflects the low awareness among SMEs that environmentally friendly activities are not merely technical activities, but are part of business costs that need to be recognised in the accounting system. According to Ikhsan (2008), environmental accounting extends the function of accounting by incorporating social and ecological dimensions, so conservation and waste processing costs should be treated as environmental expenditures. International standards also emphasise the importance of recognising environmental costs. According to IFAC (2005) and the Environmental Management Accounting (EMA) guidelines, environmental costs should not be ignored, as they significantly impact profitability and sustainability. In the context of standards in Indonesia, although PSAK 1 on the Presentation of Financial Statements does not explicitly require the presentation of environmental cost items, entities are expected to provide relevant and material information for decision-making.

In terms of measurement, 14% of MSMEs measure environmental costs using a historical cost approach, while 86% do not conduct any measurement at all. This condition indicates a weak awareness of measuring environmental costs among horticultural MSMEs. According to Hansen & Mowen (2017), measuring environmental expenses is crucial for evaluating the efficiency and cost performance of an organisation. Without measurement, MSMEs lack a clear information basis to assess the economic benefits or burdens of conservation or waste management activities. Accounting standards provide a foundation that measurement should be based on historical cost or fair value, depending on the context of the transaction (Ikatan Akuntan Indonesia [IAI], 2018). However, the majority of MSMEs in Sikka Regency have not yet reached this stage, so their environmental accounting practices are still far from adhering to standard principles.

In terms of presentation, this study found that not a single horticultural MSME in Sikka Regency presents environmental costs separately in their financial statements. Some only show it simply (39%), while the remaining 61% do not present it at all. This confirms that the presentation of environmental costs remains administrative in nature, rather than being part of financial statements that adhere to generally accepted accounting principles. According to PSAK 1 (IAI, 2018), financial statements must present information that is reliable, relevant, and comparable to meet the needs of the report's users. Presenting environmental costs separately is crucial for enhancing accountability to stakeholders. Burritt et al. (2023) emphasise that good environmental accounting will provide information for both internal management and external parties. Without a standardised presentation of ecological costs, horticultural SMEs in Sikka Regency lose the opportunity to demonstrate

their accountability and sustainability performance.

In terms of disclosure, it was found that no SMEs keep standard records regarding environmentally friendly activities, only 21% make limited disclosures, and 79% do not make any disclosure at all. According to Grubnic (2014), environmental disclosure in financial statements or annual reports is crucial for building public trust and enhancing an organisation's social legitimacy. The practice of limited disclosure among horticultural SMEs in Sikka Regency indicates that there is still a perception that environmental information does not have significant economic value. In contrast, international accounting standards, such as IAS 37 on Provisions, Contingent Liabilities, and Contingent Assets, provide entities with the opportunity to disclose information related to environmental obligations. Although not directly required for SMEs, the global trend of green accounting encourages all business entities, including SMEs, to improve the quality of environmental information disclosure.

Integration of Biological Assets Accounting and Environmental Accounting

The integration of biological asset accounting and environmental accounting models is designed to enable MSMEs to record, measure, present, and disclose information regarding biological assets and ecological costs in a comprehensive manner. This model is designed following the horticultural crop cycle in Sikka Regency to make it easier for MSMEs to understand and apply. This model is expected to enhance transparency, accountability, and the sustainability of horticultural MSME operations in Sikka Regency.

Analysis of Recognition and Measurement Aspects

Recognition is the initial stage in accounting record-keeping where an entity assesses whether an element should be recorded as an asset or an expense.

a. Recognition and Measurement Model of Biological Assets

Based on PSAK 69, biological assets are recognised when three criteria are met: control, future economic benefits, and the ability to be measured reliably (IAI, 2018). At the planting stage, crops are recognised as initial biological assets with measurement based on fair value or market value. The recognition of initial biological assets uses the following measurement formula:

$$\boldsymbol{BA.a = (MP \times CY) - SC}$$

Note:
BA.a = Initial Biological Assets
MP = Market price per unit of output (Rp/kg)
CY = Crop Yield (kg/plant × number of plants)
SC = Sales Costs (harvest costs + transportation fees)

This approach is consistent with PSAK 69, which stipulates that biological assets are recognised and measured at the commencement of control, at fair value less costs to sell (IAI, 2018).

Subsequent recognition and measurement are carried out during the growth and maintenance stages of the plants. Re-measurement of biological assets approaching harvest time needs to be conducted using the market price at the time of recording. This re-measurement enables SMEs to assess changes in the value of the plants during growth, which is crucial for informed managerial decisions and effective production control (Bebbington et al., 2021). The re-measurement formula is as follows:

$$\boldsymbol{BA.t = (MP \times CY) - SC}$$

Note:
BA.t = Biological Assets Approaching Harvest (Growth Stage)

MP = Market price per unit of output (Rp/kg)
CY = Crop Yield (kg/plant × number of plants)
SC = Sales Costs (harvest costs + transportation fees)

Recognition Decision:
If BA.t > BA.a → increase in biological assets (gain)
If BA.t < BA.a → decrease in biological assets (loss)

b. Environmental Accounting Recognition and Measurement Model

Environmental cost recognition is carried out at the land preparation stage because it is at this stage that environmental accounting begins to play a significant role, particularly through the recognition of the cost of basic organic fertilisation as an ecological expense. Additionally, environmental investments, such as drip irrigation installations, can be categorised as fixed assets because they provide long-term benefits in terms of water efficiency and support business sustainability. This aligns with the concept of capitalising environmental costs (Burritt et al., 2023), which emphasises that certain ecological costs can be capitalised if they provide benefits over more than one period. The recognition of environmental costs at the planting stage and the plant maintenance stage involves recognising costs for organic fertilisation, organic pesticide costs, and other environmental costs incurred as expenses in the current period (Wada et al., 2025). Environmental cost measurement based on historical costs involves measuring actual expenses incurred. The formula for calculating total environmental burden is as follows:

$$\boldsymbol{EE = EC.p + EC.t + EC.r}$$

Note :
EE = Environmental Expense
EC.p = Basic Organic Fertilization Cost (Land Preparation Stage)
EC.t = Initial Organic Fertilization Cost at Planting Stage
EC.r = Organic Fertilization Costs + Organic Pesticide Costs (Maintenance Stage)

The recognition and measurement of environmental accounting is important for assessing ecological efficiency and the green competitiveness of SMEs. This concept aligns with Environmental Management Accounting (EMA), which emphasises the integration of environmental information into management accounting systems to support informed decision-making (Jasch, 2009).

The recognition and measurement of environmental accounting ultimately occur at the stage of plant waste processing. Costs incurred, such as the processing of plant residues (stems and leaves), are recorded as expenses of the current period using measurement based on historical costs or actual costs incurred.

Analysis of Presentation and Disclosure Aspects

Presentation involves how assets and expenses are recorded in financial statements to ensure they are informative and in accordance with established standards.

a. Presentation and Disclosure of Biological Asset Accounting

Biological assets are presented on the balance sheet in accordance with PSAK 69. At the harvest stage, biological assets are transferred to harvested produce inventory in accordance with PSAK 14. Disclosure of information regarding biological assets can be recorded in the Notes to the Financial Statements. Therefore, the financial statements can provide information on the economic value of the plants in accordance with applicable accounting standards.

b. Presentation and Disclosure of Environmental Accounting

Environmental costs can be presented in the income statement as production costs

or operating expenses. They can be reported in the statement of financial position (balance sheet) if classified as assets. Furthermore, the application of environmental accounting is disclosed in the Notes to Financial Statements (CALK) as a form of disclosure. The disclosure of environmental information is crucial for establishing social legitimacy, informing decision-making, and fostering trust among investors and customers (Grubnic, 2014). By including environmental costs in financial statements, SMEs can improve transparency and accountability to stakeholders. This aligns with the objectives of green accounting, which is oriented toward sustainability (Gray, 2010).

CONCLUSION

This study concludes that a gap exists between the practices of horticultural SMEs in Sikka Regency and the accounting standards related to biological assets and environmental accounting. The aspects of recognition, measurement, presentation, and disclosure of biological assets and environmental costs in horticultural SMEs in Sikka Regency are still low, especially in terms of measurement and disclosure. The presentation of environmental costs is not yet standardised according to regulations, limiting the information available to stakeholders. This study develops an integrated model of biological asset accounting and environmental accounting as a practical solution to address the gap. This integration model provides an accounting framework that combines the economic value of crops with environmental costs, thereby supporting sustainability-based decision-making. The integration of biological asset accounting (PSAK 69) with environmental cost accounting can offer a more comprehensive picture of the performance of horticultural SMEs.

The practical implications for SMEs include the need to implement more comprehensive accounting, including the recognition and measurement of biological assets in accordance with PSAK 69, as well as the recording of environmental costs more transparently. This will improve efficient resource management and support business sustainability. For regulators, the results of this study indicate the need to strengthen regulations on the accounting of biological assets and environmental accounting for SMEs, as well as to encourage the implementation of policies that promote transparency in financial reporting and support the green economy. For academics, this study opens up opportunities for further development in green accounting research and for integrating environmental accounting. It serves as a reference for research on sustainable accounting practices in the SME sector.

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