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Harnessing Biogas and Green Accounting for Sustainable Livestock Waste Management in Waru Barat Village

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Abstract: Environmental degradation due to human activities, especially in Indonesia, is a significant challenge, often linked to the lack of environmental education and waste management in low-income communities. This study focuses on the Rizki Jaya Farmers Group in Waru Barat Village, Pamekasan Regency, which utilizes biogas technology to process livestock waste into renewable energy. By applying a qualitative approach with ethnomethodology, the research explores how green accounting principles are integrated into biogas production. The findings indicate that while the group reduces environmental pollution and saves on energy costs, they lack formal green accounting practices. The study emphasizes the importance of integrating environmental costs into financial reporting to enhance sustainability and community welfare, offering insights into the potential of green accounting in rural development.

Keywords: Environmental degradation, biogas, green accounting, livestock waste, sustainability, renewable energy, community welfare.

Introduction

Environmental degradation due to human activities has become a pressing global issue. In Indonesia, one contributing factor to environmental damage is the lack of knowledge and access to education, especially among low-income communities who focus on survival rather than considering environmental impact (Lailia, 2000). To address this, the government has enacted Law No. 32 of 2009 concerning Environmental Protection and Management (UUPPLH), aiming to protect and manage the environment comprehensively through systematic efforts, including oversight and law enforcement.

According to data from Statistics Indonesia (BPS), environmental pollution in Indonesia affects thousands of villages, with the highest pollution levels recorded in Kalimantan (Nuraini, 2019). This pollution includes water, soil, and air contamination, much of which stems from domestic waste and livestock activities (Adityawarman et al., 2015). Without proper management, livestock waste has the potential to pollute water and soil resources and increase methane (CH_4) levels in the air—a gas with a greater greenhouse effect than carbon dioxide (Hastuti, 2009).

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Biogas emerges as a renewable energy solution that not only addresses livestock waste but also reduces reliance on fossil fuels. This technology can be implemented in rural communities, especially those engaged in livestock farming, as an economical and environmentally friendly alternative energy source (Bappeda Grobogan, 2014). Specifically, 1 m^3 of biogas is estimated to be equivalent to 0.62 liters of kerosene, which helps communities save on energy expenditures (Fahri, 2011 in Zalizar et al., 2013).

In Pamekasan Regency, East Java, Waru Barat Village has implemented livestock waste processing into biogas through the Rizki Jaya Farmers Group initiative. This area is known for its substantial Madura cattle population, totaling 194,182 heads in 2021 (Gusti et al., 2022). The biogas program is considered a strategic measure to address waste issues and support environmental sustainability in the village. Through the green accounting approach, this program has the potential to provide insights into the environmental costs and benefits of waste management, which can improve community welfare (Cohen & Robbins, 2011).

Green accounting, which uses the triple bottom line principle, measures not only financial profits but also environmental and social impacts. This is relevant for farming groups that are conscious of maintaining environmental standards in their production activities. This study references previous research emphasizing the importance of managing environmental costs in various sectors, such as health and industry, as explored by Dewi (2017) and Chairia et al. (2022), who found that environmental reporting is still done voluntarily in many sectors.

The study also notes the challenges in implementing green accounting, including the lack of specific environmental accounting information and support from human resources with expertise in this area (Moorthy & Yacob, 2013). Additionally, the study by Andriawan & Purnasari (2022) on waste management at Awal Bros Hospital in Palangka Raya serves as an inspiring reference for this research to explore green accounting practices in a different context, namely biogas production.

Therefore, this research aims to examine the impact of green accounting implementation in the biogas program at the Rizki Jaya Farmers Group, Waru Barat, Pamekasan Regency, through a qualitative approach and ethnomethodology. This approach is expected to provide an in-depth understanding of how the farmers' group applies environmental accounting principles in managing waste generated from livestock farming and its implications for community welfare.

Literature Review

Green Accounting

Green Accounting integrates environmental and social considerations into financial reporting. Originating in Europe during the 1970s, its primary goal is to help businesses minimize environmental damage and promote sustainability. Green accounting not only tracks financial data but also measures environmental and social impacts (Bebbington, 1997; Hamidi, 2013). It encourages companies

to identify environmental costs and opportunities, thus fostering ecological, social, and economic sustainability (Almilia, 2007).

Key Challenges: Implementing green accounting faces hurdles like the need for new accounting standards, educating stakeholders, and integrating environmental data into financial reports (Lako, 2018).

Pillars of Green Accounting

Green accounting is built on three pillars:

- Environmental Accounting: Tracking environmental costs and impacts.
- Social Accounting: Reporting social responsibilities and community engagement.
- Financial Accounting: Traditional financial information, including assets and liabilities (Elkington, 1997).

Principles of Green Accounting

Six principles guide Green accounting:

1. Sustainability: Report environmental and social impacts to ensure long-term profit and ecological balance.
2. Asset Recognition: Environmental and social expenditures are recognized as assets if they yield future benefits.
3. Liability Recognition: Environmental liabilities must be recognized when companies are responsible for damage.
4. Matching: Measure costs and benefits across periods, not just in one accounting cycle.
5. Integrated Accounting: Align financial and environmental data systematically.
6. Integrated Reporting: Report all aspects—financial, social, and environmental—together.

Objectives

Green accounting enhances transparency and accountability in environmental and social reporting, supporting companies in improving public image and competitiveness (Rachmawati & Karim, 2021).

Evolution in the 4.0 Era

In the digital age, accountants must shift from simple bookkeeping to becoming strategic analysts, considering environmental risks and sustainability in decision-making (Firmialy, 2020).

Biogas

Biogas is a renewable energy source created from organic waste through a process called methanization. It produces methane (CH_4), a potent fuel that helps reduce reliance on fossil fuels and lowers greenhouse gas emissions (Rahayu et al., 2015).

Biogas Formation Process

- Hydrolysis: Breaks down organic materials.
- Acidogenesis: Forms organic acids.
- Methanogenesis: Converts organic acids into methane gas.

Benefits
Biogas offers:

- Direct: Replaces traditional fuels for cooking and power.
- Indirect: Reduces pollution and greenhouse gas emissions.

Social Welfare

In Indonesia, social welfare involves meeting basic needs (material, social, spiritual) to ensure a decent life for all. It is measured through indicators like income, health, education, and housing (Sugiharto et al., 2007).

Biosentrism Theory

Biosentrism asserts that all forms of life have intrinsic value. It stresses that humans are part of an interconnected life community, with equal moral rights for all species, not just humans (Hudha et al., 2019).

Ecocentrism Theory

Ecocentrism views ecosystems as the primary focus, with all components—biotic and abiotic—holding intrinsic value. It challenges anthropocentrism by arguing for the moral rights of the entire ecosystem, not just humans (Suka, 2009).

Triple Bottom Line (TBL) Accounting

Triple Bottom Line (TBL) accounting evaluates a company's performance based on three criteria: social, environmental, and financial. It encourages businesses to consider not only profits but also their impact on society and the environment (Firmialy, 2020).

Previous Research

Studies highlight the environmental, social, and economic benefits of biogas. For instance, Rivaldi et al. (2022) show biogas from livestock waste has a lower environmental impact than organic waste. Haryati (2006) emphasizes its role as a clean energy source, and Rounagi (2020) discusses how Green accounting helps identify environmental costs and measures sustainability.

Methods

Research Object

This research focuses on the Rizki Jaya farmer group in Waru Barat Village, Waru District, Pamekasan Regency, which is involved in biogas production. The object of the study is aimed at understanding the practices and impact of biogas production on local community development.

Research Type

This study uses a qualitative approach, which focuses on understanding social phenomena through natural settings. The researcher acts as the primary instrument, gathering data through unstructured interviews and observations.

The research is guided by ethnomethodology, a method that looks at how people construct meaning through everyday actions and interactions.

Informants

Informants are selected based on their direct involvement with biogas production and community activities. They include:

1. **H. Nasir** – Head of the Rizki Jaya farmer group
2. **Abdus Salam Ramli** – Head of Waru Barat Village
3. **Pak Mursyid** – Chairman of BUMDES Dasawarsa
4. **Bu Vira** – Treasurer of BUMDES Dasawarsa
5. **Muhammad Dahnan** – Member of Rizki Jaya farmer group
6. **Pak Hamid** – Member of Rizki Jaya farmer group

Data Sources

The research uses both primary and secondary data:

- Primary data: Collected through in-depth interviews and observations of the informants.
- Secondary data: Includes reports from local government agencies, such as the Statistics Agency, and BUMDES reports.

Data Collection Techniques

1. Interviews: Unstructured interviews with key informants, focusing on biogas production, its benefits, and its contribution to local development.
2. Observations: Direct observation of biogas production processes and community engagement.
3. Document Analysis: Review of related reports and documents, including green accounting records.
4. Literature Review: Studying relevant books, journals, and articles on green accounting and sustainable community practices.

Data Analysis Techniques

Data analysis follows Garfinkel's Conversation Analysis, which focuses on understanding the structure of interactions and the meaning behind everyday actions:

1. Indexicality: Identifying recurring themes in conversations and their context.
2. Reflexivity: Understanding the underlying reasons and meanings behind actions.
3. Contextual Action: Analyzing practical actions and behaviors observed in the community.
4. Social Structure: Understanding how these actions relate to broader social and cultural structures.

The research will combine these analysis techniques with green accounting principles to understand the impact of biogas production on local economic development and sustainability.

Findings

History of Biogas Implementation at Rizki Jaya

The Rizki Jaya Farmers Group, located in Waru Barat Village, specifically in Dusun Co' Gunung Barat, is a prime example of a successful community-based initiative that leverages eco-friendly technology. With 159 members, this group has embraced biogas technology as a solution for managing livestock waste while simultaneously generating alternative energy.

The story began when the Chairman of the Rizki Jaya Farmers Group, Mr. Mursyid, submitted a proposal to the provincial government to receive assistance. The proposal was approved, and in November 2018, the group received 10 cows and a complete biogas installation package. This biogas system not only helped reduce waste but also provided a practical energy source for the farmers. In an interview, Mr. Mursyid explained:

> "At first, the biogas project was implemented because of the assistance we received for the cows. We learned about the system from various references, including YouTube. Now, even though there are still many technical aspects we're unfamiliar with, the biogas project has proven to be beneficial."

Operational Activities in Biogas Production

Materials and Equipment

The key to the success of the biogas operation lies in the proper selection of materials and equipment. At Rizki Jaya, the primary raw material used is cow manure, which is mixed with water to produce slurry for processing in the digester. The core components of their biogas installation include:

- Cattle shed layout, measuring 3m x 3m to accommodate 10 cows
- Fix Dome digester size of 2 x 12 meters
- Wastewater treatment system (IPAL) with a 180-meter capacity
- Pressure gauge to measure gas pressure

Biogas Production Process

The biogas production process begins with collecting cow manure and mixing it with water to create slurry in a 1:1 ratio. The slurry is then placed in the digester, which acts as the site for anaerobic fermentation by bacteria. This process is simple yet highly effective:

1. Mix cow manure with water to form slurry.
2. Transfer the slurry into the digester, ensuring the initial filling reaches full capacity to kickstart the fermentation process.
3. After about 14 days, biogas begins to be produced and can be used to fuel stoves or other energy needs.

Subsequent slurry batches are added daily, with approximately 20 liters of slurry added in the morning and evening. The solid waste or sludge produced in the process is repurposed as organic fertilizer.

Benefits of Biogas Use

In addition to its environmental benefits, biogas also offers significant economic advantages. According to Sally et al. (2019), there are several primary benefits to using biogas:

1. Reduces greenhouse gas emissions, including CO2, contributing to the mitigation of climate change.
2. Utilizes livestock waste to generate energy, thereby reducing pollution.
3. Provides eco-friendly fuel, reducing dependence on fossil fuels.
4. Lowers operational costs for farmers and industries dealing with organic waste.

Economic Calculations for Biogas

To better understand the economic potential of biogas production, we can look at a simple calculation. Using 10 cows, which produce about 200 kg of manure per day, the biogas generated can replace the use of LPG gas in everyday life.

1. Daily manure volume:
   10 cows×20 kg/cow=200 kg/day10
2. Biogas production costs: Based on the calculations, the cost of producing biogas per liter is around IDR 6,075, with an estimated annual income of IDR 29,160,000.
3. Revenue and profit:
   The selling price of biogas can reach IDR 10,000 per liter, which results in an estimated annual revenue of IDR 48,000,000, with an operating profit of approximately IDR 18,840,000 per year.

From these calculations, it is clear that the Benefit-Cost Ratio (B/C) greater than 1 indicates that the biogas project is economically feasible and profitable in the long run.

Financial Reporting and Profit and Loss

Although the Rizki Jaya Farmers Group is operating the biogas system effectively, they currently do not have a formal accounting system. According to an interview with the group's chairman, Mr. H Nasir, while the biogas operation is running smoothly, they lack a structured financial record-keeping process. However, the estimated annual revenue from biogas sales is around IDR 48,000,000, with an operating profit of IDR 37,110,000 after subtracting operational costs.

Waste Management and Environmental Impact

The Rizki Jaya Farmers Group focuses not only on the economic aspects but also on the environmental impact of their operations. The waste produced from biogas processing, specifically the cow manure sludge, is repurposed into fertilizer for agriculture. Additionally, the wastewater generated from the biogas system is used as liquid fertilizer for crops.

Mr. Mursyid shared,

> "Managing the waste is very important for us. We strive to keep the surrounding environment clean by transforming waste into fertilizers that benefit our farms."

Green Accounting: Merging Finance with Environmental Stewardship
Unfortunately, while the Rizki Jaya group has made significant strides in managing the environment, they have not yet fully embraced Green Accounting—the process of recording and reporting environmental costs alongside financial ones. However, they have already implemented basic elements of Green Accounting informally, even though these have not been formally documented in their financial reports.

Identification, Recognition, Measurement, Presentation, and Disclosure
To improve transparency and operational efficiency, the Rizki Jaya Farmers Group could take several steps to formally adopt Green Accounting principles:

- Identifying environmental costs related to biogas production, such as maintenance costs for cattle pens and labor.
- Recognizing and measuring costs and revenues from waste management.
- Presenting financial reports more systematically, separating environmental costs from production costs.

Disclosing environmental efforts clearly in annual reports, showcasing how the group contributes to environmental sustainability.

Conclusion

Conclusion
The findings from this study reveal that the entrepreneurial actors are committed to environmental sustainability and have implemented green accounting practices. However, they lack awareness of the specific components of green accounting and how to properly incorporate them into their financial statements. This confusion stems from the farmers' unfamiliarity with green accounting standards in Indonesia, as well as limited educational resources available to them.

The study concludes that green accounting in biogas production has significant benefits, both environmentally and economically, contributing to the welfare of the community. Biogas usage is notably more cost-effective compared to LPG. However, it is important to note that continuous production is key to maintaining profitability; intermittent production could result in significant financial losses.

Research Limitations
The study's limitations include its narrow focus on the Rizki Jaya Farmers Group. This restricts the ability to assess the broader landscape of biogas producers, particularly distinguishing between those who practice green accounting and those who do not. As such, the findings cannot be generalized across all biogas entrepreneurs.

Recommendations
This research is expected to contribute to the development of accounting knowledge, particularly in the field of green accounting. Future research should aim to enhance the quality of studies and explore the following recommendations:

1. Future studies should examine green accounting from alternative perspectives, particularly exploring how it can contribute to the prosperity of farming communities beyond the scope of this research.
2. It is also recommended that future studies broaden the scope by using different sectors as research objects, enabling the generalization of findings and providing a more comprehensive understanding of green accounting in various contexts.

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