Al-Hiwalah: (Sharia Economic Law)
Volume 5 No. 2. July-December 2026
E-ISSN : 2963-0304
Page : 120-149
DOI : 10.47766/al-hiwalah.v5i2.8226
https://journal.uinsuna.ac.id/index.php/AlHiwalah

Analysis of Production Costs and Sustainability Accounting in Broiler Chicken Farming: Perspectives of Fiqh Muamalah and Hifz al-Bi'ah to Support Carbon Emission Reduction (SDG 13)

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Abstract: Broiler chicken farming contributes to food supply and economic activities; however, its production activities also generate environmental pressures through energy consumption, waste generation, and transportation. This study aims to analyze production costs, operational emission sources, and sustainability accounting practices in two broiler farms with capacities of 12,000 and 6,000 birds in Dusun 8 Penggalangan using the perspectives of *fiqh muamalah* and *hifz al-bi'ah*. A descriptive qualitative approach was employed through observation, interviews, documentation, and operational data analysis. The results show that production costs are dominated by feed and DOC. The 12,000-bird farm incurred total production costs of IDR 280,000,000 (IDR 23,333/bird), while the 6,000-bird farm incurred IDR 147,000,000 (IDR 24,500/bird). Environmental pressures were identified from electricity consumption, poultry manure management, and transportation activities. Quantifiable electricity emissions reached 3,384 kg CO_2/month for the 12,000-bird farm and 1,912 kg CO_2/month for the 6,000-bird farm, while manure and transportation emissions could not be calculated due to limited activity data. Sustainability accounting implementation remains at an early stage because environmental costs, resource indicators, and emission information have not been systematically integrated into farm records. From the perspective of *fiqh muamalah*, resource efficiency reflects *amanah* and the prevention of *israf*, while waste utilization supports *maslahah* and *hifz al-bi'ah*. This study recommends gradual integration of

Keywords: Sustainability Accounting, Broiler Chicken Farming, Production Costs, *Fiqh Muamalah*, *Hifz al-Bi'ah*

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Submitted: 24-08-2026 Accepted: 24-09-2026 Published: 27-09-2026

environmental costs, resource consumption, and emission records to support sustainable farming practices and SDG 13.

Abstrak: Usaha peternakan ayam broiler berperan dalam penyediaan pangan dan ekonomi, namun aktivitas produksinya juga menimbulkan tekanan lingkungan melalui konsumsi energi, limbah, dan transportasi. Penelitian ini bertujuan menganalisis biaya produksi, sumber emisi operasional, dan penerapan akuntansi keberlanjutan pada dua usaha ayam broiler berkapasitas 12.000 dan 6.000 ekor di Dusun 8 Penggalangan dengan perspektif *fikih muamalah* dan *hifz al-bi'ah*. Penelitian menggunakan pendekatan kualitatif deskriptif melalui observasi, wawancara, dokumentasi, dan analisis data operasional. Hasil penelitian menunjukkan bahwa biaya produksi didominasi pakan dan DOC. Usaha 12.000 ekor memiliki biaya produksi Rp280.000.000 (Rp23.333/ekor), sedangkan usaha 6.000 ekor sebesar Rp147.000.000 (Rp24.500/ekor). Sumber tekanan lingkungan berasal dari konsumsi listrik, pengelolaan kotoran ayam, dan transportasi. Emisi listrik yang dapat dihitung mencapai 3.384 kg CO_2/bulan pada usaha 12.000 ekor dan 1.912 kg CO_2/bulan pada usaha 6.000 ekor, sedangkan emisi limbah dan transportasi belum dapat dikalkulasi karena keterbatasan data. Penerapan akuntansi keberlanjutan masih berada pada tahap awal karena biaya lingkungan, indikator sumber daya, dan informasi emisi belum terintegrasi dalam pencatatan usaha. Perspektif *fikih muamalah* menunjukkan bahwa efisiensi sumber daya mencerminkan *amanah* dan pencegahan *israf*, sementara pengelolaan limbah mendukung *maslahah* dan *hifz al-bi'ah*. Penelitian ini merekomendasikan pengembangan pencatatan biaya lingkungan, konsumsi sumber daya, dan emisi secara bertahap untuk mendukung keberlanjutan usaha dan SDG 13.

Kata Kunci: Akuntansi Keberlanjutan, Peternakan Ayam Broiler, Biaya Produksi, *Fikih Muamalah*, *Hifz al-Bi'ah*

INTRODUCTION

The broiler chicken sector plays an important role in providing animal protein and supporting economic growth; however, increased production also creates environmental pressures through feed, water, energy consumption,

transportation, and production waste.[1] Therefore, business performance should be assessed not only based on production and profitability but also on resource efficiency and environmental impact management.[2]

This issue is relevant to broiler farming in Tebing Syahbandar District, which recorded a population of 165,456 birds in 2024 and requires sustainable resource management.[3] Although farm records include production costs such as feed, DOC, labor, medicines, energy, and housing depreciation, the information remains economically oriented. Environmental costs related to energy consumption, water use, waste management, and pollution control have not been systematically integrated, highlighting the need for sustainability accounting approaches that support decision-making by incorporating both economic and environmental aspects.[4][5]

The limitation of environmental cost recording prevents a comprehensive understanding of the relationship between production costs, resource utilization, and environmental impacts. This issue is increasingly important in the context of climate change, as livestock activities contribute to

[1]Jeffrey Unerman, Jan Bebbington, and Brendan O'Dwyer, *Sustainability Accounting and Accountability*, 3rd ed. (London: Routledge, 2021), https://doi.org/https://doi.org/10.4324/9781315848419.

[2] Rob Gray, "Is Accounting for Sustainability Actually Accounting for Sustainability...and How Would We Know? An Exploration of Narratives of Organisations and the Planet," *Accounting, Organizations and Society* 35, no. 1 (2010): 47–62, https://doi.org/10.1016/j.aos.2009.04.006.

[3] Badan Pusat Statistik, "Kecamatan Tebing Syahbandar Dalam Angka 2024.," Badan Pusat Statistik, 2024.

[4] Mulyadi, *Akuntansi Biaya*, 6th ed. (Yogyakarta: UPP STIM YKPN, 2020).

[5] Stefan Schaltegger and Roger Burritt, *Contemporary Environmental Accounting: Issues, Concepts and Practice* (Sheffield: Greenleaf Publishing, 2000).

greenhouse gas emissions.[6] In the broiler chicken sector, environmental pressures arise from energy consumption, poultry manure management, transportation, and feed production chains. The FAO emphasizes that reducing livestock environmental impacts requires resource efficiency, waste management, and environmental recording systems that support decision-making.[7]

This approach aligns with SDG 13 on *Climate Action* through emission reduction and efficient resource utilization, as well as SDG 12 on responsible consumption and production through waste reduction and environmentally friendly production practices.[8][9] In Indonesia, environmental policies also emphasize pollution control and responsible resource management.[10] Therefore, sustainability accounting through the *triple bottom line* concept (*profit, people, planet*) provides an important approach for integrating economic, social, and environmental information in business management.[11]

The *triple bottom line* concept explains that organizational success is not solely determined by financial performance but also by social contributions

[6] The Physical Science Basis, *Intergovernmental Panel on Climate Change (IPCC). Climate Change 2021* (Cambridge: Cambridge University Press, 2021).

[7] "Food and Agriculture Organization of the United Nations, Tackling Climate Change through Livestock: A Global Assessment of Emissions and Mitigation Opportunities," FAO, 2013, https://www.fao.org/4/i3437e/i3437e.pdf.

[8] Judith E. Krauss, Andrea Jiménez Cisneros, and Marina Requena-i-Mora, "Mapping Sustainable Development Goals 8, 9, 12, 13 and 15 through a Decolonial Lens: Falling Short of 'Transforming Our World,'" *Sustainability Science* 17, no. 5 (2022): 1855–72, https://doi.org/10.1007/s11625-022-01112-3.

[9] Jan Bebbington and Carlos Larrinaga, "Accounting and Sustainable Development: An Exploration," *Accounting, Organizations and Society* 39, no. 6 (2014): 395–413.

[10] Kementrian Lingkungan Hidup dan Kehutanan, "1652777575," 2021.

[11] John. Green Swans Elkington, *The Coming Boom in Regenerative Capitalism* (London: Fast Company Press, 2020).

and environmental responsibility. In the context of broiler chicken farming, this approach provides a framework for assessing production efficiency while considering resource utilization, waste generation, and ecological impacts.[12] therefore, sustainability accounting is implemented through the identification of production costs, energy and water consumption, waste management, environmental costs, and emission source information, enabling a more comprehensive assessment of business efficiency.

At the local business level, the implementation of sustainability accounting can begin through simple recording of environmentally related activities, such as electricity consumption, fuel usage, waste volume, waste management costs, and utilization of production residues. These records serve as a foundation for identifying efficiency opportunities and supporting managerial decision-making.[13]

This approach is consistent with *environmental management accounting* (EMA), a method that connects physical resource consumption information with monetary environmental cost information. EMA assists organizations in understanding the relationship between resource utilization, operational costs, and environmental impacts, allowing business decisions to be directed toward sustainable efficiency.[14] Thus, sustainability accounting

[12] Cannibals with Forks John Elkington, *The Triple Bottom Line of 21st Century Business* (Oxford: Capstone Publishing, 1997).

[13] "Global Reporting Initiative, GRI Standards Consolidated Set 2021," Global Reporting Initiative (Amsterdam: Global Reporting Initiative, 2021).

[14] Peter James Martin Bennett and Leonie Klinkers, *Sustainable Measures: Evaluation and Reporting of Environmental and Social Performance* (Sheffield: Greenleaf Publishing, 1999).

functions not only as an economic control instrument but also as a mechanism for environmental accountability.[15]

The sustainability perspective is also closely related to the principles of *fiqh muamalah*, which emphasize the values of *amanah* (trustworthiness), *maslahah* (public benefit), prohibition of *israf* (wastefulness), and prevention of *darar* (harm). These principles direct economic activities to be conducted responsibly, avoid excessive resource consumption, and prevent environmental damage. In broiler chicken farming, these principles are relevant to the management of feed, energy, water, waste, and other production activities.

From an Islamic economic perspective, production represents human responsibility as *khalifah* (steward) in managing resources. Activities that cause wastefulness or environmental degradation contradict the principles of balance (*mizan*) and social responsibility in Islam.[16] Therefore, sustainability encompasses not only economic and technical dimensions but also moral dimensions.

The concept of *hifz al-bi'ah* strengthens the ecological dimension of Islam by positioning environmental protection as part of *maqasid al-shari'ah*. Environmental degradation may affect the protection of life, lineage, wealth, intellect, and human existence more broadly.[17] Thus, waste management, energy

[15] Unerman, Bebbington, and O'Dwyer, *Sustainability Accounting and Accountability*.
[16] Yusuf Al-Qaradawi, *Ri'Ayat Al-Bi'Ah Fi Shari'at Al-Islam* (Cairo: Dar al-Shuruq, 2001).
[17] M. Khusnul Khuluq and Asmuni Asmuni, "Hifz Al-Bi'ah as Part of Maqashid Al-Shari'ah and Its Relevance in the Context of Global Climate Change," *Indonesian Journal of Interdisciplinary Islamic Studies* 7, no. 2 (2025), https://doi.org/10.20885/ijiis.vol7.iss2.art3.

efficiency, and pollution control in livestock production can be understood as implementations of *maqasid al-shari'ah* values.[18]

Environmental responsibility from a sharia perspective applies at both individual and social levels.[19] In livestock businesses, the management of energy, waste, and emission sources is not merely a technical aspect but also part of ethical responsibility within economic activities (*muamalah*). Sustainability accounting plays a role in translating the principles of *fiqh muamalah* and *hifz al-bi'ah* into decision-making information through the recording of energy consumption, water usage, waste management costs, and emission sources. Therefore, accounting does not only function as an economic recording system but also as a form of moral accountability toward humans and the environment.[20]

Previous studies have shown that the environmental impacts of broiler production are closely associated with feed utilization, energy consumption, and waste management. Mostert et al. demonstrated that changes in production systems can influence greenhouse gas emissions based on a *life cycle assessment* approach.[21] Usva et al. explained that the broiler production chain, particularly the feed supply chain, contributes significantly to climate change impacts and

[18] Jasser Auda, *Maqasid Al-Shariah as Philosophy of Islamic Law: A Systems Approach* (London: International Institute of Islamic Thought, 2008).

[19] Norita Mohd Nasir, Mahendhiran Sanggaran Nair, and Pervaiz Khalid Ahmed, "Environmental Sustainability and Contemporary Islamic Society: A Shariah Perspective," *Asian Academy of Management Journal* 27, no. 2 (2022): 211–31, https://doi.org/10.21315/aamj2022.27.2.10.

[20] Fazlun Khalid, *Signs on the Earth: Islam, Modernity and the Climate Crisis* (Birmingham: Kube Publishing, 2019).

[21] P. F. Mostert et al., "The Impact of Changing toward Higher Welfare Broiler Production Systems on Greenhouse Gas Emissions: A Dutch Case Study Using Life Cycle Assessment," *Poultry Science* 101, no. 12 (2022): 102151, https://doi.org/10.1016/j.psj.2022.102151.

resource utilization.[22] Meanwhile, Beal et al. showed that integrating economic and environmental analyses can support improvements in business efficiency and sustainability.[23]

These findings indicate that sustainability evaluation in livestock production cannot rely solely on production output and profitability but must consider the entire production cycle (*life cycle thinking*). This approach helps identify sources of environmental impacts, such as feed utilization, energy consumption, waste generation, and transportation activities, as the basis for efficiency strategies and emission reduction.[24] In broiler production systems, feed represents a dominant factor because it requires substantial energy and resources. Feed efficiency improvements through better *feed conversion ratio*, feed formulation optimization, and reduction of nutrient losses can reduce environmental impacts without decreasing productivity.[25]

Although sustainability studies on broiler chicken production continue to develop, most existing research still applies *life cycle assessment* (LCA) to quantitatively measure environmental impacts. This approach has not fully connected environmental information with cost accounting systems and

[22] Kirsi Usva et al., "Environmental Life Cycle Assessment of Finnish Broiler Chicken Production – Focus on Climate Change and Water Scarcity Impacts," *Journal of Cleaner Production* 410, no. April (2023): 137097, https://doi.org/10.1016/j.jclepro.2023.137097.

[23] Colin M. Beal et al., "Economic and Environmental Assessment of U.S. Broiler Production: Opportunities to Improve Sustainability," *Poultry Science* 102, no. 10 (2023): 1–14, https://doi.org/10.1016/j.psj.2023.102887.

[24] Matthias Finkbeiner et al., "Towards Life Cycle Sustainability Assessment," *Sustainability* 2, no. 10 (2010): 3309–22, https://doi.org/10.3390/su2103309.

[25] Tom Wassenaar Henning Steinfeld, Pierre J. Gerber, *Livestock's Long Shadow: Environmental Issues and Options* (Rome: Food and Agriculture Organization of the United Nations, 2006).

decision-making processes at the local farm level.[26] Furthermore, studies integrating economic, environmental, and Islamic ethical values remain limited. Economic studies generally focus on costs and profitability, while environmental studies predominantly examine ecological impacts without linking them to farm accounting practices. Meanwhile, studies on *maqasid al-shari'ah* and environmental issues are still largely positioned within normative discussions.[27]

Based on these research gaps, this study proposes an integrative approach by combining production cost analysis, environmental information, *fiqh muamalah*, and *hifz al-bi'ah* in assessing the sustainability of broiler chicken farming. Unlike previous studies that tend to separate economic and environmental aspects, this research connects financial efficiency with ecological responsibility and ethical resource utilization. In this study, cost efficiency is not merely understood as reducing production costs but also as an effort to prevent *israf* through proportional and responsible resource utilization. Sustainability accounting is employed as an instrument to translate operational activities into information regarding resource efficiency and environmental responsibility based on the principles of *amanah*, *maslahah*, and *hifz al-bi'ah*. Waste management, energy efficiency, and emission control are understood as implementations of Islamic values that are aligned with SDG 13 on *Climate Action*.

[26] Sara González-García and Luis Arroja Zaira Gomez-Fernández, Ana Cláudia Dias, Gumersindo Feijoo, Teresa Moreira, "Life Cycle Assessment of Broiler Chicken Production: A Portuguese Case Study," *Journal of Cleaner Production* 74 (2014): 125–34.

[27] Shahul Hameed Bin Mohamed Ibrahim Nabil Baydoun, Maliah Sulaiman, Roger Willett, *Social Responsibility Accounting*, 2018, https://doi.org/10.1002/9781119444480.ch9.

Based on this framework, this study aims to analyze the structure of production costs, identify operational emission sources, and evaluate the implementation of sustainability accounting in two broiler chicken farms with capacities of 12,000 and 6,000 birds in Dusun 8 Penggalangan. This study employs a descriptive qualitative approach through observation, in-depth interviews, documentation, and operational activity analysis to explain the relationship between business efficiency, environmental responsibility, and Islamic sustainability values.

METHODS

This study employs a descriptive qualitative approach to analyze the production cost structure, operational emission sources, and the implementation of sustainability accounting in broiler chicken farming. This approach was selected because the study does not only measure costs and resource utilization but also examines recording practices, waste management, energy use, and farmers' understanding of environmental responsibility.[28] The perspectives of *fiqh muamalah* and *hifz al-bi'ah* are used as interpretative frameworks to analyze the relationship between business efficiency, information transparency, resource management, and ecological responsibility.

The research was conducted at two broiler chicken farms located in Dusun 8 Penggalangan, with capacities of 12,000 birds and 6,000 birds, respectively. The locations were selected using a *purposive* sampling technique based on differences in business scale and their relevance to the research

[28] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D* (Bandung: Alfabeta, 2023).

objectives, namely comparing cost structures, resource utilization, emission sources, and environmental recording practices across different farm capacities.

The study was conducted from May to June with two main informants, namely the owners of broiler chicken farms with capacities of 12,000 birds and 6,000 birds. The informants were selected through *purposive sampling* based on their involvement and experience in managing production costs, resource utilization, waste management, transportation activities, and farm record-keeping. The research data consisted of primary and supporting data. Primary data were obtained through observations and in-depth interviews related to production processes, energy and water consumption, equipment utilization, waste management, production costs, and environmental information. Supporting data were obtained through documentation, including cost records, resource consumption records, livestock population data, and operational documents. The combination of these techniques was applied to obtain comprehensive data through triangulation.[29]

Production cost analysis was conducted based on the main cost components, including feed, *day-old chicks* (DOC), labor, medicines and vitamins, equipment, and housing depreciation. Efficiency comparisons between farm scales were assessed based on production costs per bird.

Production cost per bird = Total production costs ÷ Number of birds raised

However, efficiency was not assessed solely based on production costs but also considered resource utilization and environmental impacts. Environmental analysis was conducted by identifying three main emission

[29] Mohammad Adnan Latief Rukminingsih, Gunawan Adnan, *Metode Penelitian Pendidikan* (Yogyakarta: Erhaka Utama, 2021).

sources: electricity consumption in poultry houses, poultry manure management, and transportation and distribution activities. Electricity emissions were calculated based on electricity consumption and the national electricity emission factor using the following formula:

Electricity emissions = Electricity consumption (kWh) × Electricity emission factor (kg CO_2/kWh)

The emission factor refers to the determination issued by the Ministry of Energy and Mineral Resources, which corresponds to the electricity system in the research area.[30] Poultry manure was identified as a potential source of greenhouse gas emissions because its management may generate CH_4 and N_2O. However, these emissions were not converted into CO_2e due to limitations in data availability regarding livestock characteristics, manure quantity, management systems, and emission factors based on the IPCC methodology.[31] Transportation emissions could only be calculated if sufficient data regarding vehicles, fuel consumption, travel distance, and emission factors were available; therefore, when such data were unavailable, transportation was analyzed qualitatively as a potential emission source.

The implementation of sustainability accounting was analyzed based on information regarding energy consumption, water utilization, waste management, environmental costs, emission sources, and environmental recording practices in business decision-making. The analysis also considered resource intensity indicators, such as electricity and water consumption per bird, to compare efficiency between different farm scales.

[30] Kementrian Lingkungan Hidup dan Kehutanan, "1652777575."

[31] IPCC 2019 et al., *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Published: IPCC, Swi*, *Published: IPCC, Switzerland.*, vol. 4, 2019.

The data were analyzed using the interactive model developed by Miles, Huberman, and Saldaña, consisting of data condensation, data display, and conclusion drawing and verification.[32] The results of interviews, observations, documentation, and operational data were compared based on production costs, resource utilization, emission sources, and sustainability accounting practices. The findings were then interpreted through the principles of *amanah*, *maslahah*, *israf*, *darar*, and *hifz al-bi'ah*. Data validity was maintained through source and technique triangulation by comparing interview results, observations, and documentation before conducting the final analysis.

Table 1: Research Indicators

No	Variable	Dimension	Indicator
1	Production Costs	Cost Structure	Feed costs, labor costs, DOC costs, medicines and vitamins, equipment, and poultry house depreciation
2	Carbon Emissions	Energy, Waste, and Transportation	Electricity consumption, chicken manure management, transportation and distribution activities
3	Sustainability Accounting	Resource Use and Environmental Recording	Electricity consumption, water use, environmental costs, waste management, emissions recording, and environmental reporting
4	*Fiqh Muamalah* and *Hifz al-Bi'ah*	Interpretive Framework	*Amanah*, *maslahah*, *israf*, *darar*, and *hifz al-bi'ah*

Source: Researcher's Compilation, 2026.

RESULTS AND DISCUSSION

[32] Matthew B. Miles, A. Michael Huberman, and Johnny Saldana, *Qualitative Data Analysis : A Methods Sourcebook/ Matthew B. Miles* (California: SAGE, 2020).

The research findings from two broiler chicken farms in Dusun 8 Penggalangan reveal three main findings: the production cost structure is dominated by feed costs and *day-old chicks* (DOC), operational activities involve energy consumption and generate waste as well as potential emissions, and farm accounting practices remain primarily focused on economic aspects without systematic integration of environmental information. These findings were analyzed based on three main focuses: production cost structure, operational emission sources, and sustainability accounting practices, using the principles of *amanah*, *maslahah*, *israf*, *darar*, and *hifz al-bi'ah* as interpretative frameworks.

Production Cost Analysis in Broiler Chicken Farming

The production cost analysis includes feed costs, DOC, labor, medicines and vitamins, as well as equipment and housing depreciation costs. The results of observations, interviews, and documentation indicate that both farms have similar cost structures, with feed representing the largest cost component, followed by DOC, labor, equipment and housing depreciation, and medicines and vitamins.

Table 2: Broiler Chicken Production Costs

No	Cost Component	12.000 (Chickens)	%	6.000 (Chickens)	%
1	Feed	182.000.000	65%	94.000.000	63%
2	DOC	66.000.000	24%	33.000.000	24%
3	Labor	14.000.000	5%	9.000.000	6%
4	Equipment and Poultry House Depreciation	12.500.000	4%	7.500.000	5%
5	Medicines and Vitamins	5.500.000	2%	3.500.000	2%
	Total	**280.000.000**	**100%**	**147.000.000**	**100%**

Source: Authors' calculation, 2026.

Based on Table 2, feed costs represent the largest expenditure component in both broiler chicken farms. In the 12,000-bird capacity farm, feed costs reached IDR 182,000,000 or 65.0% of total production costs, while in the 6,000-bird capacity farm, feed costs amounted to IDR 94,000,000 or 64.0%. This dominance indicates that feed is the primary factor determining the cost structure of broiler chicken farming because it is continuously required throughout the production cycle and increases proportionally with the number of livestock.[33]

The high proportion of feed costs highlights the importance of feed utilization efficiency in controlling production costs. However, efficiency does not simply mean reducing feed usage but ensuring a balance between nutritional requirements, livestock health, and production targets. From the perspective of *fiqh muamalah*, the appropriate use of production inputs is closely related to the principle of avoiding *israf* or excessive resource consumption.

In addition to its economic dimension, feed efficiency also has an environmental dimension because feed production is one of the major factors contributing to the environmental impacts of broiler production. Mostert et al. demonstrated that input characteristics and production systems influence greenhouse gas emission levels in broiler production.[34] Therefore, feed efficiency contributes not only to improving cost efficiency but also to reducing unnecessary resource utilization.

The second-largest cost component is DOC. In the 12,000-bird capacity farm, DOC costs amounted to IDR 66,000,000 or 23.6% of total production

[33] Mulyadi, *Akuntansi Biaya*.
[34] Mostert et al., "The Impact of Changing toward Higher Welfare Broiler Production Systems on Greenhouse Gas Emissions: A Dutch Case Study Using Life Cycle Assessment."

costs, while in the 6,000-bird capacity farm, they reached IDR 33,000,000 or 22.4%. The substantial proportion of DOC costs, together with feed costs, indicates that decisions regarding purchasing quantity, chick quality, DOC prices, and chicken survival rates influence overall business efficiency.

Labor costs in the 12,000-bird capacity farm amounted to IDR 14,000,000 (5.0%), while in the 6,000-bird capacity farm they reached IDR 9,000,000 (6.1%). The difference in proportions indicates variations in relative cost burdens between farm scales, although these differences are not solely determined by production capacity. Labor productivity, task distribution, wage systems, and housing management practices also influence labor costs.

Meanwhile, equipment and housing depreciation costs amounted to IDR 12,500,000 (4.5%) in the 12,000-bird capacity farm and IDR 7,500,000 (5.1%) in the 6,000-bird capacity farm. Medicine and vitamin costs represented the smallest cost components, amounting to IDR 5,500,000 (2.0%) and IDR 3,500,000 (2.4%), respectively. Although their proportions are relatively small, these components remain important because they support livestock health and ensure the continuity of production processes.

The comparison of production costs per bird was conducted to obtain an overview of cost efficiency between the two business units. The calculation was performed by dividing total production costs by the number of chickens raised.

Production cost per bird = Total production costs ÷ Number of birds raised

For the 12,000-bird capacity farm:

IDR 280,000,000 ÷ 12,000 = IDR 23,333 per bird

For the 6,000-bird capacity farm:

IDR 147,000,000 ÷ 6,000 = IDR 24,500 per bird

The results indicate a production cost difference of IDR 1,167 per bird. The production cost per bird in the 12,000-bird capacity farm was lower than that of the 6,000-bird capacity farm. Descriptively, this finding indicates that the 12,000-bird capacity farm had lower production costs per bird during the research period.

However, this difference cannot be used to conclude that larger-scale farms always achieve higher efficiency. This study only involved two business units; therefore, differences in production costs per bird may be influenced by various factors, including input prices, feed purchasing systems, housing conditions, labor productivity, mortality rates, DOC quality, and management practices implemented by each farm. Therefore, this finding should be interpreted as a difference in cost efficiency between the observed business units rather than as evidence of causal *economies of scale*.

Cost recording practices in both farms were still conducted in a simple manner and focused primarily on major expenditures, such as feed, DOC, labor, medicines and vitamins, as well as equipment and housing depreciation. However, these records have not systematically separated fixed and variable costs and have not identified environmental costs, such as energy consumption, waste management, and activities related to controlling environmental impacts.

The limitations of cost recording result in incomplete information regarding the relationship between production activities, resource utilization, and environmental impacts. From a sustainability accounting perspective, cost recording is not only intended to determine profitability but also to identify resource utilization patterns and efficiency opportunities through environmental cost management.

From the perspective of *fiqh muamalah*, more comprehensive recording reflects the principle of *amanah* through responsible management of information and resources. Increased transparency regarding costs, energy consumption, and waste management not only supports economic efficiency but also contributes to the implementation of *maslahah* and the prevention of *israf* in resource utilization.

The findings regarding cost structure provide a basis for environmental analysis because production activities, such as feed utilization, electricity consumption, housing facilities, and transportation, not only generate economic costs but also affect resource utilization and emissions. Therefore, the subsequent analysis focuses on identifying operational emission sources and assessing the environmental responsibility of broiler chicken farming businesses.

Operational Emission Analysis in Broiler Chicken Farming

The results of observations and documentation identified three sources of environmental pressure in broiler chicken farming operations, namely electricity consumption in poultry houses, poultry manure management, and transportation and distribution activities. Electricity consumption can be calculated based on available energy consumption data and emission factors, whereas emissions from poultry manure and transportation require additional data to be converted into greenhouse gas emissions. Therefore, this study distinguishes emission sources that can be quantified and emission sources that can only be identified qualitatively.

Table 3: Operational Emission Sources in Broiler Chicken Farming

No	Operational Emission Source	12.000 (Birds)	6.000 (Birds)	Analysis Status
1	Poultry house electricity consumption	3,600 kWh/month = 3,384 kg CO_2/month	2,034 kWh/month = 1,912 kg CO_2/month	Quantified
2	Chicken manure management	Identified as a potential source of CH_4 and N_2O	Identified as a potential source of CH_4 and N_2O	Identified, not yet quantified in CO_2e
3	Transportation and distribution	Identified	Identified	Identified, not yet quantified

Source: Authors' calculation, 2026.

Table 3 shows that electricity consumption is the operational emission source that can be directly quantified in this study because electricity consumption data are available for both farms. The 12,000-bird farm consumes 3,600 kWh of electricity per month, while the 6,000-bird farm consumes 2,034 kWh per month. Electricity is used to operate heaters, ventilation fans, lighting, and supporting equipment during the broiler rearing process.

The estimated emissions from electricity consumption were calculated using the following formula:

Electricity emissions = Electricity consumption × Electricity emission factor

This study uses the emission factor for the Sumatra electricity grid based on the Decree of the Minister of Energy and Mineral Resources Number 163.K/HK.02/MEM.S/2021. The value applied is the Ex-Post *Combined Margin* (CM), with an *Operating Margin* (OM) weight of 0.5 and a *Build Margin* (BM) weight of 0.5, amounting to 0.94 ton CO_2/MWh, equivalent to 0.94 kg

CO_2/kWh.[35] The Sumatra Grid specified in the decree includes North Sumatra and is therefore geographically more appropriate for the research location than a global emission factor. Using this factor, the estimated electricity emissions for the 12,000-bird farm are:

3,600 kWh × 0.94 kg CO_2/kWh = 3,384 kg CO_2/month

Meanwhile, for the 6,000-bird farm:

2,034 kWh × 0.94 kg CO_2/kWh = 1,911.96 kg CO_2/month

This value was rounded to 1,912 kg CO_2/month.

These results indicate that the absolute emissions from electricity consumption in the 12,000-bird farm are higher than those of the 6,000-bird farm. However, comparison based solely on absolute values is insufficient to assess environmental efficiency across different farm scales because the number of chickens raised differs. Therefore, electricity consumption and emissions also need to be assessed on a per-bird intensity basis.

For the 12,000-bird farm, electricity consumption per bird is:

3,600 kWh ÷ 12,000 birds = 0.300 kWh/bird/month

Electricity emissions per bird:

3,384 kg CO_2 ÷ 12,000 birds = 0.282 kg CO_2/bird/month

For the 6,000-bird farm, electricity consumption per bird is:

2,034 kWh ÷ 6,000 birds = 0.339 kWh/bird/month

Electricity emissions per bird:

1,912 kg CO_2 ÷ 6,000 birds = 0.319 kg CO_2/bird/month

The comparison of electricity consumption shows that the 12,000-bird farm generates higher absolute emissions but has lower electricity intensity per

[35] Kementrian Lingkungan Hidup dan Kehutanan, "1652777575."

bird than the 6,000-bird farm (0.300 kWh/bird/month compared with 0.339 kWh/bird/month). This finding indicates a difference in energy efficiency; however, it cannot be concluded that larger-scale farms are always more efficient because energy use is also influenced by equipment, ventilation systems, heating systems, housing conditions, and management practices.

From the perspective of *fiqh muamalah*, energy efficiency is related to the prohibition of *israf* through the proportional use of resources. Efficiency does not mean reducing necessary operational inputs, but rather optimizing energy consumption through proper equipment management and the use of energy-efficient technologies. This is also consistent with *hifz al-bi'ah*, as energy management contributes to reducing environmental pressure.

Poultry manure was identified as a potential source of CH_4 and N_2O emissions, but these emissions were not calculated in CO_2e due to limitations in data regarding waste characteristics, management systems, and emission factors required under the IPCC guidelines.[36] In the 12,000-bird farm, part of the poultry manure was utilized as organic fertilizer, while waste management in the 6,000-bird farm had not yet been optimized. Waste utilization reflects the principles of *maslahah* and *hifz al-bi'ah*, while inadequate management may potentially cause *darar*.

Transportation and distribution activities also represent sources of environmental pressure, but their emissions were not quantitatively calculated because sufficient data on vehicles, fuel consumption, travel distance, and emission factors were unavailable. Therefore, transportation was analyzed

[36] IPCC 2019 et al., *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Published: IPCC, Swi*.

qualitatively as a potential emission source. Overall, this study identifies three sources of environmental pressure: electricity consumption, poultry manure, and transportation. However, only electricity-related emissions could be quantified because verified activity data and emission factors were available. Developing systematic records of energy consumption, fuel use, waste generation, and resource utilization represents an initial step toward establishing an emissions inventory and supporting the implementation of sustainability accounting and SDG 13.

Sustainability Accounting in Broiler Chicken Farming

The research findings indicate that the implementation of sustainability accounting in both broiler chicken farms remains at an early stage. Farm records have included production cost components and some resource utilization data, particularly electricity and water consumption. However, information regarding environmental costs, waste management, and emission sources has not yet been systematically integrated into the farm accounting system. Both farms have also not prepared formal sustainability reports. This condition indicates that environmental data are actually available at the operational level but have not yet been fully processed into information that supports sustainability evaluation.

Table 4: Sustainability Accounting Indicators in Broiler Chicken Farming

No	Indicator	12.000 (Birds)	6.000 (Birds)
1	Electricity Consumption	3.600 kWh/month	2.034 kWh/month
2	Water Usage	120 m^3/month	70 m^3/month
3	Chicken manure management	Partially utilized as organic fertilizer	Management has not yet been optimized

4	Environmental cost recording	Not yet recorded separately	Not yet recorded separately
5	Emission recording	Not yet conducted systematically	Not yet conducted systematically
6	Sustainability reporting	Not yet available	Not yet available

Source: Authors' calculation, 2026.

Table 4 shows that both farms already possess basic data that can be used to develop sustainability accounting, particularly electricity consumption and water utilization data. In the 12,000-bird capacity farm, electricity consumption reaches 3,600 kWh per month, while the 6,000-bird capacity farm consumes 2,034 kWh per month. When compared based on livestock population, the electricity consumption intensity in the 12,000-bird farm is:

3,600 kWh ÷ 12,000 birds = 0.300 kWh/bird/month

Meanwhile, in the 6,000-bird farm:

2,034 kWh ÷ 6,000 birds = 0.339 kWh/bird/month

The results show that the 12,000-bird farm has higher absolute electricity consumption but lower electricity intensity per bird compared with the 6,000-bird farm. The use of intensity indicators provides a more proportional assessment because it considers differences in production capacity. These indicators can be used to monitor energy efficiency and identify increases in consumption that are not aligned with livestock population growth.

A similar pattern is observed in water consumption. The 12,000-bird farm uses approximately 120 m^3 of water per month, while the 6,000-bird farm uses approximately 70 m^3 per month. Water is used for chicken drinking needs, housing cleaning, sanitation, and equipment maintenance. Based on livestock capacity, water consumption intensity was calculated to compare resource utilization efficiency between different farm scales.

120 m^3 ÷ 12,000 birds = 0.010 m^3/bird/month, or 10 liters/bird/month

Meanwhile, in the 6,000-bird farm:

70 m^3 ÷ 6,000 birds = 0.0117 m^3/bird/month, or approximately 11.67 liters/bird/month

The data indicate that water consumption per bird in the 6,000-bird farm is higher than that of the 12,000-bird farm. However, this difference cannot be immediately categorized as inefficient resource use because it may be influenced by factors such as environmental temperature, livestock requirements, water delivery methods, sanitation practices, installation conditions, and housing conditions. This finding provides a basis for evaluating resource utilization efficiency in each farm.

The availability of electricity and water data demonstrates that sustainability accounting implementation can begin through simple recording of resource consumption, costs, and utilization intensity. Such information can be compared across periods to support efficiency evaluation and business decision-making.[37]

Poultry manure management shows differences between the two farms. In the 12,000-bird farm, part of the manure is utilized as organic fertilizer, giving it potential economic value, although it has not yet been specifically recorded. Meanwhile, the 6,000-bird farm still requires improvement in waste management practices. Waste recording should include volume, management methods, handling costs, and economic benefits so that the relationship between waste, costs, and added value can be identified.

[37] Unerman, Bebbington, and O'Dwyer, *Sustainability Accounting and Accountability*.

From the perspective of *maslahah*, waste utilization creates benefits from production residues, while *hifz al-bi'ah* relates to efforts to reduce environmental impacts through waste reuse and management. Conversely, inadequate waste management has the potential to cause *darar* to the environment. Both farms do not yet have specific environmental cost records. Costs related to energy, water, waste, sanitation, and environmental control are still included within general operational costs, making the contribution of environmental costs difficult to identify clearly. Separating these costs can be conducted through a simple recording system to help farms evaluate resource-intensive activities and identify opportunities for efficiency improvement.

Emission recording has also not been conducted routinely. Electricity data have enabled emission estimation; however, waste and transportation information remain insufficient for complete CO_2e emission calculations. Therefore, the development of sustainability accounting should begin by improving the quality of activity data, including energy consumption, water use, fuel consumption, waste volume, and waste management practices.

The implementation of sustainability reporting does not necessarily need to begin with a complex system. Local businesses can develop simple internal reports containing production costs, energy and water consumption, waste management activities, and measurable emissions. From the perspective of *fiqh muamalah*, such recording strengthens the principle of *amanah* through transparent resource management. The principle of *israf* encourages control over resource utilization, while *maslahah* and prevention of *darar* direct business activities toward generating benefits without causing environmental damage.

The concept of *hifz al-bi'ah* positions environmental protection as part of human responsibility in maintaining the continuity of life.[38] Ecological responsibility in Islam also has individual and social dimensions, meaning that economic activities should consider their impacts on the environment.[39] Overall, the implementation of sustainability accounting in both farms remains at an early stage because environmental information has not yet been routinely integrated into accounting records and reporting systems. However, basic data such as production costs, energy consumption, water utilization, waste generation, and operational activities are already available. The development of sustainability accounting can be carried out gradually through environmental cost recording, resource intensity indicators, and emission information as a basis for cost control, efficiency evaluation, and environmental accountability in support of SDG 13.

CONCLUSION

The findings show that production costs in both broiler chicken farming businesses are dominated by feed and day-old chicks (DOC). The farm with a capacity of 12,000 birds incurred total production costs of IDR 280,000,000, or approximately IDR 23,333 per bird, while the 6,000-bird farm incurred IDR 147,000,000, or approximately IDR 24,500 per bird. These findings indicate differences in cost efficiency between the two business units examined.

[38] Khuluq and Asmuni, "Hifz Al-Bi'ah as Part of Maqashid Al-Shari'ah and Its Relevance in the Context of Global Climate Change."

[39] Nasir, Nair, and Ahmed, "Environmental Sustainability and Contemporary Islamic Society: A Shariah Perspective."

From an environmental perspective, operational emission sources include poultry house electricity consumption, chicken manure management, and transportation and distribution activities. The emissions that could be adequately quantified in this study were electricity-related emissions, amounting to approximately 3,384 kg CO_2/month for the 12,000-bird farm and 1,912 kg CO_2/month for the 6,000-bird farm. Emissions from manure management and transportation were not quantified in CO_2e because the available activity data and emission factors were insufficient.

The implementation of sustainability accounting in both businesses remains at an early stage. Data on production costs, electricity consumption, water use, and waste management are already available, but they have not yet been systematically integrated into environmental cost records and emission information. From the perspective of *Fiqh Muamalah*, efficient resource management reflects the principle of *amanah* and the avoidance of *israf*, while the utilization of waste as fertilizer reflects *maslahah* and supports *Hifz al-Bi'ah*.

From a practical perspective, business operators should begin recording energy and water consumption, environmental costs, waste utilization, fuel use, and emission information on a regular basis. This study is limited to two business units in a single area, and emission quantification does not yet cover all identified sources. Future research should involve a larger number of broiler chicken farms and apply more comprehensive and standardized emission measurement methods.

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