

Sustainability of Duck Farming Business in Indramayu Regency: MDS Analysis Approach

Keberlanjutan Usaha Ternak Bebek di Kabupaten Indramayu: Pendekatan Analisis MDS

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ABSTRACT

This study aims to analyse the level of sustainability of duck farming in Indramayu District by considering environmental, economic and social impacts. In addition, this study also focuses on identifying and understanding the factors that hinder the sustainability of the business, assessing the influence of technology use and institutional support, and knowing the strategic steps that can be taken to improve the sustainability of duck farming. The research method used is quantitative method. The research was conducted in Sliyeg and Sindang sub-districts, in January to February, 2025, involving 96 participating respondents that are randomly selected. The analysis method used in this study is Multidimensional Scaling (MDS), which is applied to determine the sustainability status of duck farming. The results research showed that the level of sustainability of duck farming is still lacking, with varying sustainability index values in each dimension. Factors such as low technology adoption, financial constraints and limited access to training are the main challenges that need to be overcome. Institutional support and the application of modern technology are expected to improve production efficiency and business sustainability. The resulting strategic recommendations include enhancing farmers' access to training on modern duck farming practices, providing subsidized loans for infrastructure improvement, and facilitating partnerships with feed suppliers. For example, implementing regular government-led training programs in each sub-district could increase awareness and adoption of efficient feeding systems, while financial assistance can help farmers build better housing facilities.

Keywords: sustainability, duck farming, multidimensional scaling, economic and social

ABSTRAK

Penelitian ini bertujuan untuk menganalisis tingkat keberlanjutan usaha peternakan itik di Kabupaten Indramayu dengan mempertimbangkan dampak lingkungan, ekonomi, dan sosial. Selain itu, penelitian ini juga berfokus untuk mengidentifikasi dan memahami faktor-faktor yang menghambat keberlanjutan usaha, menilai pengaruh penggunaan teknologi dan dukungan kelembagaan, serta mengetahui langkah-langkah strategis yang dapat diambil untuk meningkatkan keberlanjutan usaha peternakan itik. Metode penelitian yang digunakan adalah metode kuantitatif. Penelitian dilakukan di Kecamatan Sliyeg dan Sindang, pada bulan Januari sampai dengan Februari 2025, dengan melibatkan 96 responden partisipan yang dipilih secara acak. Metode analisis yang digunakan dalam penelitian ini adalah Multidimensional Scaling (MDS), yang diterapkan untuk mengetahui status keberlanjutan usaha peternakan itik. Hasil penelitian menunjukkan bahwa tingkat keberlanjutan usaha peternakan itik masih kurang, dengan nilai indeks keberlanjutan yang bervariasi di setiap dimensi. Faktor-faktor seperti rendahnya adopsi teknologi, kendala keuangan dan terbatasnya akses pelatihan merupakan tantangan utama yang perlu diatasi. Dukungan kelembagaan dan penerapan teknologi modern diharapkan dapat meningkatkan efisiensi produksi dan keberlanjutan usaha. Rekomendasi strategis yang dihasilkan mencakup peningkatan akses petani terhadap pelatihan tentang praktik peternakan bebek modern, pemberian pinjaman bersubsidi untuk perbaikan infrastruktur, dan fasilitasi kemitraan dengan pemasok pakan. Misalnya, penerapan program pelatihan rutin yang dipimpin pemerintah di setiap kecamatan dapat meningkatkan kesadaran dan adopsi sistem pemberian pakan yang efisien, sementara bantuan keuangan dapat membantu petani membangun fasilitas perumahan yang lebih baik.

Kata kunci: keberlanjutan, peternakan bebek, penskalaan multidimensi, ekonomi dan sosial

INTRODUCTION

Duck farming is one of the important subsectors in livestock development in Indonesia. Duck production, both in terms of eggs and meat, has great potential to meet national food needs while contributing to increasing the income of rural communities. West Java Province has the largest duck population in Indonesia, reaching 11,465,893 ducks in 2023 (Central Bureau of Statistics, 2023). Indramayu Regency is recorded as the region with the largest duck population in the province, contributing around 27.9% of the total duck population in West Java. The duck farming system in Indramayu Regency is still semi-intensive, namely at night grazed in the rice fields. The grazing location moves according to the rice fields that have entered the post-harvest period (Bakrie et al., 2023).

From an environmental aspect, the availability of feed is one of the main challenges. In a semi-intensive farming system, duck feed mostly comes from post-harvest rice residues such as unhusked rice, bran, and grains found in rice fields (Zhang et al., 2013). Dependence on these harvest residues makes the availability of natural feed highly dependent on the rice planting and harvest seasons. Furthermore, the sustainability of this livestock system is threatened by changes in land use, where agricultural land is converted into residential or industrial areas. These changes not only reduce the availability of grazing land but also suppress the duck population due to the decreasing availability of natural feed sources (Li et al., 2018).

The sustainability of duck farming in Indramayu Regency is greatly influenced by the interaction between environmental, economic, social, institutional, and technological aspects (Bakrie et al., 2023). Natural feed (drawn from harvest of rice) dependence is directly connected to changes of environmental conditions like conversion of agricultural lands influencing the economic balance of the farmers through the spike of prices of feed and duck products. While social and institutional aspects are all equally relevant in helping farmers become empowered by training and group strengthening, adoption of innovative technology may help in overcoming environmental and economic challenges.

Initially, the concept of sustainability focused more on environmental issues. However, over time, sustainability has increasingly adopted a triple bottom line approach, which includes ecological, economic, and social aspects (Mockshell & Kamanda, 2018). In addition, sustainability is also influenced by institutional and technological aspects, which are now important in supporting duck farming management (Amam & Harsita, 2019). Sustainable farming refers to the concept of sustainable agriculture, where a farming business is considered sustainable if it is ecologically healthy, economically viable, socially just, humane, and adaptive.

This research aims to determine the sustainability status of duck farming in Indramayu Regency using a multidimensional scale approach which includes environmental, economic, social, institutional and technological aspects. This research is important to provide a comprehensive picture of the sustainability status of duck farming and offers evidence-based solutions that can assist farmers and policy makers in formulating more effective and sustainable management strategies. The novelty of this study lies in its integrated approach in assessing the sustainability of duck farming businesses in Indramayu Regency by combining five main dimensions, namely environmental, economic, social, institutional, and technological aspects. This comprehensive assessment distinguishes it from previous studies that generally only focus on one or two aspects. In addition, the use of Multidimensional Scaling (MDS) as an analysis tool provides a methodological contribution, namely a visual and in-depth mapping of sustainability status. This study also has practical value by providing evidence-based solutions to support policy makers and farmers in formulating more effective, adaptive, and sustainable management strategies, especially in responding to challenges such as land use changes and the availability of natural food resource.

MATERIALS AND METHODS

The subjects of the study were duck farmers in Indramayu Regency, especially those engaged in small to medium-scale duck farming businesses. The focus of the study was to analyze livestock practices, economic challenges, environmental impacts, and sustainability prospects. Farmers were selected using purposive sampling to ensure representation from the main livestock areas. The study was conducted in Indramayu Regency, especially in Sliyeg and Sindang Districts, in January - February 2025, which are areas with the highest duck populations.

Data collection was carried out through structured interviews and questionnaires to 96 respondents using the Lameshow method because the population studied was unknown or difficult to identify with certainty. Primary data were collected through direct surveys of farmers, while secondary data were obtained from Government Reports, the Department of Agriculture, the Central Statistics Agency, and related literature.

Analysis method

To collect the data, the researchers interviewed duck farmers to find out about the performance of duck farming businesses and the resources that support them in Indramayu. This information was used to establish the main dimensions and attributes associated with sustainability in duck farming. Also, these dimensions and leverage attributes were integrated within a questionnaire that uses a Likert scale. Leverage attributes are values of many dimensions that affect research sustainability considerably. The questionnaire encompassed four dimensions with various attributes, and expert respondents rated them on a scale of 1 (poor), 2 (moderate), and 3 (good). Furthermore, MDS analysis was applied to process and interpret the collected data. MDS is a statistical technique used to identify patterns of similarity among attributes by transforming qualitative evaluations into quantitative spatial representations in a multidimensional space. The basic formula used in MDS involves calculating the Euclidean distance between objects:

$$d_{ij} = \sqrt{\sum_{k=1}^n (X_{ik} - X_{jk})^2}$$

Where:

d_{ij} = distance between objects i and j

X_{ik}, X_{jk} = score of object i and j on dimension k

n = number of dimensions or attributes

The analysis was conducted using Rapid Appraisal for Fisheries (RAPFISH) software (Lloyd Crispin et al., 2022), which facilitates visual interpretation of sustainability status through ordination diagrams and provides leverage and Monte Carlo analysis for validation.

RESULTS AND DISCUSSION

Overview of research location

Indramayu Regency, located in West Java, is a leading area for duck farming that contributes significantly to the agricultural economy in the area. The duck population in West Java reached 8,968,658 in 2024 (West Java Open Data, 2024), reflecting the high demand for duck meat and eggs.

In Indramayu, duck farming is an ordinary living especially in Sindang and Sliyeg Districts. This place has rich land, plentiful natural feed and easy access to water, which makes it perfect place for small and large scale duck farming. The local economy has the production of duck egg and meat as its forte for local and regional market supply.

The primary determinants of luck to duck farming are quality seeds, feed, housing, labor and congenial environmental conditions. Sliyeg and Sindang Districts are extremely suitable for duck farming due to their lowland topography, the hugeness of their land and natural feed that includes the rice fields' leftovers. Irrigation and small rivers are additional regions for livestock activities. Sliyeg District with 14 villages and is strategically located near Indramayu, Kertasemaya and Widasari Districts has an area 54.46 km². Sindang District equalling 32.48 km² and 10 villages has Pasekan, Lohbener, Cantigi and Arahon Districts at its borders. Both areas have varying land areas and possibility of sustainable duck farming.

Respondent Identification

The characteristics of duck farmers were analyzed to provide an overview of the demographic and socio-economic conditions that can affect the sustainability of duck farming businesses in Indramayu Regency. The characteristics considered included gender, age, education level, side jobs, farming experience, and the number of ducks owned.

Most respondents (97%) were male, indicating that duck farming is still dominated by men. This may be influenced by traditional roles in rural communities where men are often responsible for physically demanding tasks such as livestock management.

Table 1. Characteristics of Duck Farmers in Indramayu Regency (n = 96)

No	Characteristics	Category	Frequency	Percentage (%)
1	Gender	Male	93	97%
		Female	3	3%
2	Age	18–35 years	17	18%
		36–65 years	72	75%
		>65 years	7	7%
3	Education Level	Elementary School	17	18%
		Junior High School	72	75%
		Senior High School	7	7%
4	Side Occupation	None	15	16%
		Trading	22	23%
		Farming	34	35%
		Laborer	18	19%
		Livestock	6	6%
		Irrigation Worker	1	1%
5	Farming Experience (years)	0–14	58	60%
		15–28	29	30%
		29–40	9	9%
6	Number of Ducks Owned	<250	5	5%
		251–500	53	55%
		501–750	27	28%
		751–1000	11	11%

In terms of age, 75% of farmers were in the middle-aged adult group (36–65 years), 18% were young adults (18–35 years), and 7% were old adults (>65 years). The dominance of middle-aged farmers indicates that the workforce is mature and tends to have sufficient experience in managing the challenges of duck farming. However, this also indicates the potential for decreased physical capacity in the coming years, which requires additional labor support. The level of education of respondents was relatively low. As many as 75% only graduated from junior high school, 18% had elementary school education, and only 7% had graduated from high school. Education level is very important in influencing farmers' ability to access and implement better agricultural practices and technologies.

Regarding side jobs, 35% of respondents also work as food crop farmers, followed by 23% in trade, 19% as laborers, 6% in livestock, and 1% in irrigation. Meanwhile, 16% of farmers do not have other jobs. The diversity of side jobs reflects efforts to supplement household income and indicates dependence on various sources of income for economic stability.

Farming experience varies among respondents. About 60% of farmers have 0–14 years of experience, 30% have 15–28 years of experience, and 9% have 29–40 years of experience. More experienced farmers generally have greater technical knowledge and problem-solving skills, which contribute to better agricultural management and sustainability. The number of ducks owned by each respondent varied, with 55% keeping 251–500 ducks, 28% keeping 501–750 ducks, 11% keeping 751–1000 ducks, and only 5% having less than 250 ducks. This distribution suggests that most duck farmers operate at a medium scale, which may affect their capacity to access capital and technology.

Sustainability of Duck Farming

Sustainable agriculture, as a sustainable agricultural practice, plays an important role in sustainable development. Duck farming in Indramayu Regency was evaluated based on five main dimensions: (1) Environment, (2) Economy, (3) Social, (4) Institutional, and (5) Technology, with 24 related attributes. These dimensions and attributes can facilitate or hinder the adoption of agricultural innovations. The data collection process aims to assess the existing agricultural system, including the type of feed, availability of rice fields, and other feed sources. Indramayu has a fairly large availability of feed due to its extensive rice fields, which produce by-products such as rice bran and broken rice. In addition, as a coastal area, Indramayu has abundant sources of animal protein such as shrimp and snails. Commonly available feed ingredients include rice bran, dry grain, and ruca fish.

The sustainability of duck farming was assessed using the Multidimensional Scaling (MDS) method with the help of Rapfish software. Rapfish serves as a tool to evaluate sustainability and, in this study,

has been specifically adapted for duck farming as Rap-Duck. Each attribute underwent assessment and analysis to determine the sustainability index for each dimension. These indices are classified into four levels based on Fauzi & Anna (2005), as shown in Table 2.

Index	Indicator
0,00 – 25,00	Bad (not sustainable)
25,01-50,00	Poor (less sustainable)
50,01-75,00	Fair (sufficiently sustainable)
75,01-100,00	Good (sustainability)

The findings are illustrated in Figure 1-5, which presents an analysis of leverage factors from environmental, economic, social, institutional, and technological perspectives.

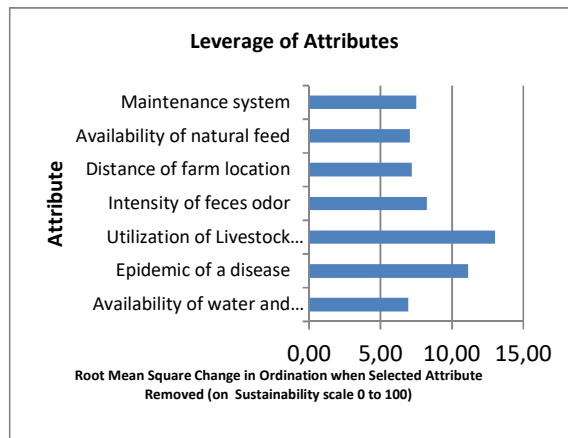


Figure 1. Leverage of Enviromental Attributes

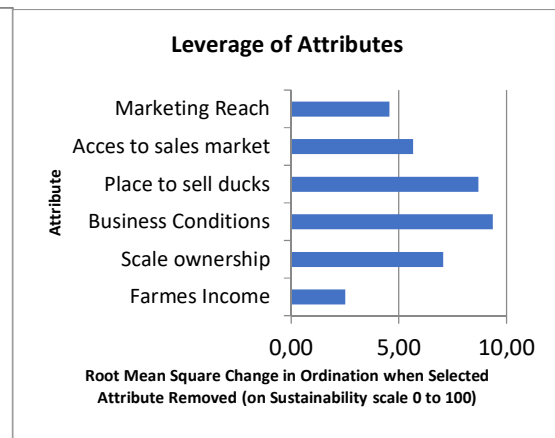


Figure 2. Leverage of Economic Attributes

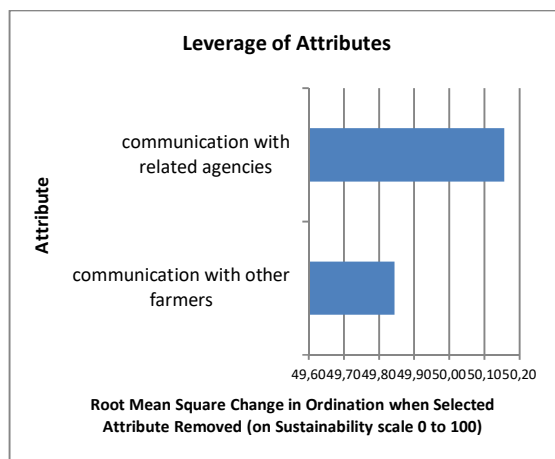


Figure 3. Leverage of Social Attributes

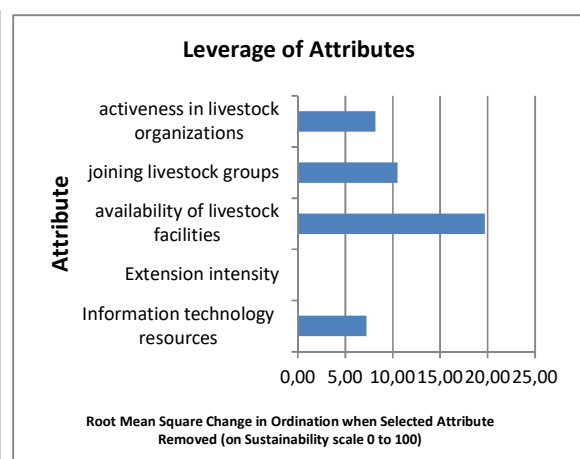


Figure 4. Leverage of Institutional Attributes

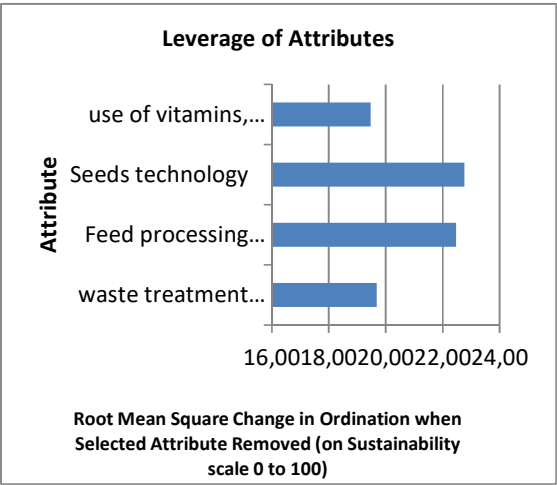


Figure 5. Leverage of Technology Attributes

Enviromental Dimension

The sustainability status of the environmental dimension based on the MDS analysis shows a sustainability index of 36.43%. Based on the sustainability classification, this shows that environmental conditions in Indramayu Regency are less sustainable. Based on the leverage analysis of environmental dimension attributes (Figure 1), two attributes were found to be sensitive to the sustainability index, namely the distance of the farm location, the availability of natural feed. The distance attribute of the farm location has the highest sensitivity value. A greater distance between the farm and residential areas provides benefits for public health because it reduces exposure to odors, noise, and flies (Peplinski, 2020). Conversely, farms that are integrated with residential areas can cause environmental disturbances, thus having a negative impact on the surrounding community. Feed is one of the most crucial factors in business sustainability, because it has a direct impact on livestock productivity. Quality and sufficient feed will increase production, besides affordable feed sources are also important. Feed costs contribute 60-70% of the total production costs (Bakrie et al., 2023). Mastery of feed technology is crucial for duck farmers to ensure sustainability. Indramayu has abundant natural feed sources, including bran, dry grain, and small fish, thus supporting the availability of cost-effective feed. By ensuring efficient feed management and strategic farm placement, the sustainability of duck farming in Indramayu can be improved.

Economic Dimension

The results of the Multidimensional Scaling (MDS) analysis show that the economic dimension of sustainability has an index value of 31.89%. Based on the sustainability classification, this percentage indicates that the economic dimension is in a less sustainable condition. The results of the leverage analysis for the environmental dimension (Figure 9) identified two attributes that had a significant impact on the sustainability index, namely: (1) livestock business conditions and (2) livestock sales locations.

The condition of the livestock business is a crucial factor, because businesses that generate sufficient profits and remain sustainable tend to be able to operate continuously and sustainably (Jukka et al., 2022). This in turn allows for business expansion and increased market reach. A business is said to be sustainable if its income exceeds expenses. Based on Table 2, the average income of livestock farmers is IDR 133,101,446.

Table 3. Average Annual Income

Average Total Cost	Average Income	Average Revenue
Rp.....		
Rp 86.428.189	Rp 219.529.635	Rp 133.101.446

Sustainability in livestock farming also depends on market demand and accessibility. The attribute of livestock sales location is crucial, as markets play a key role in fostering sustainable development (United Nations, 2015). Beyond ensuring food security, markets determine producers' ability to sell their products and consumers' access to food, both of which are fundamental to achieving a sustainable food system (Borsellino et al., 2020).

Social Dimension

The sustainability status of the social dimension based on the MDS analysis shows a sustainability index of 49.84%. Based on the sustainability classification, this indicates a low level of sustainability. Based on the leverage analysis (Figure 3), the attribute with the highest sensitivity value is communication with fellow farmers (50.16%). Effective communication plays an important role in business sustainability, in line with the findings of (Bakrie et al., 2023). According to (Hashem et al., 2021), maintaining good relationships and communication with various stakeholders supports the sustainability of livestock businesses in the long term. Strengthening farmer networks increases knowledge exchange, market access, and problem-solving capacity, which ultimately contributes to the resilience of the duck farming industry in Indramayu.

Institutional Dimension

The sustainability status of the institutional dimension based on the MDS analysis shows a sustainability index of 53.63%. Based on the sustainability classification, this indicates a moderate level of sustainability.

Based on the leverage analysis (Figure 4), the two attributes with the highest sensitivity values are the availability of facilities and the intensity of extension services. The availability of adequate facilities and infrastructure plays an important role in determining sustainability, because it creates a multiplier effect on other attributes (Ramadhan et al., 2016). Important facilities such as agricultural equipment, production tools, and access to technology improve operational efficiency, increase productivity, and support the implementation of sustainability.

Institutional support is very important in maintaining the sustainability of duck farming. In addition to adequate facilities, the effectiveness of extension services plays an important role. Regular extension and training programs contribute to sustainability by improving farmers' skills and technical knowledge. These institutions serve as primary sources of information, providing training opportunities that help farmers adopt better agricultural practices. According to Genovese et al. (2017), strong institutions—such as well-structured livestock groups—significantly influence and support sustainable agricultural development. In line with this, Hutahaean et al. (2022) highlighted that duck farming in production centers can develop and be sustainable if supported by government initiatives, especially in strengthening institutions, advancing technology, and providing direction on technological innovation in intensive duck farming.

However, field observations show that extension services for the livestock sector are still very limited, because most programs prioritize food crop farming. Duck farmers need greater attention, especially considering the rapid progress in duck farming technology. Without effective dissemination of technical knowledge, the sustainability of duck farming in Indramayu could be threatened. Therefore, efforts to improve extension services and strengthen institutional support are essential to improve the long-term sustainability of duck farming in the region.

Technological Dimension

The sustainability status of the technology dimension based on the MDS analysis shows a sustainability index of 49.95%. Based on the sustainability classification, this indicates a low level of sustainability. Based on the leverage analysis (Figure 5), the most sensitive attribute is feed processing technology (22.76%). Semi-intensive duck farming often faces challenges related to high feed costs and seasonal availability. Utilization of local feed ingredients is the right solution to

maintain productivity. The application of feed processing technology can help overcome these challenges by increasing feed efficiency and availability (Bakrie et al., 2023).

The second most sensitive attribute is the selection of superior duck species. High-quality duck species guarantee better productivity and business sustainability, as long as they are supported by sufficient feed and proper management. Selective breeding and crossbreeding between duck species are needed to produce superior stock with high adaptability and productivity (Gebze et al., 2020). The quality and quantity of superior duck species are largely influenced by reproductive efficiency. The condition of the mother plays an important role in reproductive success, directly affecting the health and survival of her offspring (Sheng & Foley, 2012).

Sustainability Status of Duck Farming

The sustainability status of duck farming in Indramayu Regency is classified as less sustainable, with a sustainability index score of 45.59%. This classification is reflected in the sustainability index values for each dimension, as shown in Table 2.

Table 2. Sustainability Index Analysis of Duck Farming		
Dimension	Index (%)	Indicator
Ecology	36,43%	less sustainable
Economy	31,89%	less sustainable
Social	38,10%	less sustainable
Institution	53,63%	sufficiently sustainable
Technology	49,95%	less sustainable

The sustainability index values across these five dimensions are visualized in a spider web diagram (Figure 6).

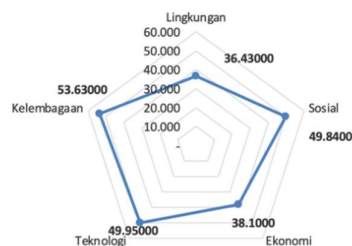


Figure 6. Spider Web Diagram Sustainability Index for Duck Farming Business

CONCLUSIONS

Based on the description above, the conclusions that can be summarized are as follows: (1) The level of sustainability of duck farming businesses in Indramayu Regency is classified as unsustainable. The sustainability index measured through five dimensions (environment, economy, social, institutional, and technology) shows a score below the ideal standard, indicating the need for improvements in the management of livestock businesses. (2) Several factors that hinder the sustainability of duck farming businesses in Indramayu Regency include traditional livestock practices, low adoption of modern technology, limited interest in learning among farmers, and limited access to capital. These factors limit innovation and operational efficiency. (3) The use of technology and institutional support have a significant impact on the sustainability of duck farming businesses. Support from government institutions in the form of policies, subsidies, and training can create a conducive environment for adopting new technologies. Therefore, collaboration between farmers and related institutions is very important to improve competence and access to technology.

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