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Analysis of the Impact of Modern Livestock Technology Implementation, Resource Availability, and Marketing Strategy on the Sustainability of Chicken Farming Business in Central Java

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ABSTRACT

This research investigates the key determinants of sustainability in the chicken farming industry, focusing on the interplay between marketing strategy, modern livestock technology implementation, resource availability, and the overall sustainability of chicken farming businesses. Utilizing Structural Equation Modeling (SEM), data from a sample of chicken farmers in the study region were analyzed to assess the relationships among these variables. The results highlight the significant positive impacts of a well-executed marketing strategy, adoption of modern livestock technology, and resource availability on the sustainability of chicken farming operations. The findings provide actionable insights for industry stakeholders to enhance their strategies and practices, contributing to a more sustainable and resilient chicken farming sector.

Keywords: *Modern Livestock, Technology, Implementation, Resource Availability, Marketing Strategy, Sustainability, Chicken Farming Business, Central Java*

1. INTRODUCTION

The poultry industry in Central Java has experienced significant growth and evolution in recent years due to technological advances, changing consumer preferences, and increasing demand for poultry products. Understanding the relationship between modern animal husbandry technology, resource availability, and marketing strategies is crucial for ensuring the sustainability of the chicken farming business [1], [2]. This dynamic environment requires a comprehensive analysis of market technology and the integration of industry 4.0 in the poultry sector, along with a culture of innovation [3]. Additionally, it is important to consider the knowledge capabilities of poultry farmers for sustainable production, as low knowledge of sustainability practices can lead to environmental degradation [3]. To ensure the future sustainability of the poultry industry, specialized programs for educating farmers on the environmental impacts of their livelihood are necessary [4]. Overall, the growth and development of the poultry industry in Central Java depend on technological advancements, sustainable practices, and a deep understanding of market dynamics [5]–[8].

This study attempts to unravel this complexity, offering a nuanced understanding of how the application of modern livestock technology, resource availability, and marketing strategies collectively influence the sustainability of chicken farming enterprises in Central Java. The sustainability and growth of chicken farming in Central Java faces various challenges. These challenges include the need to assess the impact of modern farming technologies on overall sustainability [9]. In addition, the availability and management of critical resources such as land, water, feed, and energy play an important role in shaping the resilience of poultry farming operations [10]. Furthermore, the effectiveness of marketing strategies employed by chicken farmers adds another layer of complexity to the sustainability equation [2]. To address these challenges, it is important to consider solutions such as incorporating seaweed into poultry diets to improve feed use efficiency and poultry health [11]. Additionally, the use of technology and policy interventions can improve supply chain processes and address constraints in the poultry industry [12]. By implementing these strategies, chicken farming businesses in Central Java can work towards achieving sustainability and long-term growth.

2. LITERATURE REVIEW

2.1 *Modern Livestock Technology in Poultry Farming*

The integration of modern farming technologies in poultry farming has transformed traditional practices, presenting a paradigm shift in production methods. Automated systems, including sensor-based monitoring, precision feeding, and climate control, have become integral in improving efficiency and productivity in chicken farming [1]. Genetic advancements, such as selective breeding for desirable traits, have contributed not only to increased production yields but also to the overall health and well-being of poultry [13]. Disease control measures, including vaccination and biosecurity protocols, have emerged as critical components in maintaining healthy chicken populations and preventing the spread of infectious agents [14]. While these technological interventions are promising, it is important to evaluate their impact on sustainability, taking into account ecological implications and long-term viability.

2.2 *Resource Availability in Chicken Farming*

Effective resource management is crucial for the sustainability of chicken farming. Land availability is critical for waste management and sustainable land use [14]. Efficient water use and treatment strategies are necessary to address water scarcity and contamination [13]. Sustainable feed practices contribute to economic viability and environmental conservation [15]. Monitoring energy consumption in poultry farming operations, especially in climate control and equipment use, is essential for optimal resource utilization [16]. Understanding the complex interactions of these resources is critical to developing sustainable practices in the chicken farming industry.

2.3 *Marketing Strategies in the Poultry Industry*

Marketing strategies play a crucial role in shaping consumer perceptions, market access, and overall business sustainability in the poultry industry. Effective branding is essential for differentiating products, building consumer trust, and conveying information about production practices [17]. Distribution channels also have a significant impact on market accessibility and reach, which directly affects the economic performance of chicken farming businesses [18]. Pricing strategies, when aligned with consumer preferences and market dynamics, contribute to the financial viability of poultry farming enterprises [1]. Furthermore, consumer engagement through transparent communication and responsiveness to evolving preferences fosters brand loyalty and market resilience [19]. Examining the multifaceted nature of marketing strategies provides a comprehensive understanding of their role in promoting the sustainability of chicken farming businesses.

2.4 *Integration of Factors and Gaps in Existing Literature*

While extensive literature exists on each individual aspect—modern livestock technology, resource availability, and marketing strategies—a noticeable gap exists in studies concurrently assessing these factors within the context of chicken farming sustainability. Existing research tends to focus on isolated variables, overlooking potential synergies or conflicts that may arise from the integration of these factors. Understanding the intersections and interdependencies among modern livestock technology, resource availability, and marketing strategies is critical for developing a holistic framework that addresses the complex challenges faced by chicken farming businesses in Central Java. Bridging this gap will contribute to the establishment of more robust and sustainable practices within the poultry industry.

3. METHODS

3.1 Design and Sample

This study employs a quantitative research design to investigate the impact of modern livestock technology implementation, resource availability, and marketing strategy on the sustainability of chicken farming businesses in Central Java. A cross-sectional approach is adopted to capture a snapshot of the current state of poultry operations, providing a basis for evaluating the relationships between variables of interest. The target population for this study comprises chicken farming businesses in Central Java. Due to the diverse nature of poultry operations, a random sampling technique will be employed to select a representative sample of 150 farms. The sample will be stratified based on factors such as farm size, location, and production scale to ensure adequate representation of the various dimensions within the industry.

3.2 Data Collection

Primary data will be collected through structured surveys and interviews. A comprehensive questionnaire will be developed to gather information on modern livestock technology adoption, resource availability, marketing strategies, and sustainability indicators. The questionnaire will be pre-tested for validity and reliability. In addition to surveys, in-depth interviews will be conducted with industry experts and farm managers to provide qualitative insights into the contextual nuances of the variables under investigation.

3.3 Data Analysis

The quantitative data collected will be analyzed using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) as the estimation method. SEM-PLS is chosen for its ability to handle complex models, incorporating latent constructs and observed variables while accommodating small sample sizes. The analysis will be conducted in two main steps: measurement model assessment and structural model assessment. Construct Validity: Confirmatory Factor Analysis (CFA) will be employed to assess the validity of the measurement model. This involves evaluating the relationships between latent constructs and their observed indicators. Reliability: Cronbach's alpha and composite reliability will be calculated to assess the internal consistency and reliability of the measurement scales. Convergent and Discriminant Validity: Average Variance Extracted (AVE) will be examined to ensure convergent validity, while the Fornell-Larcker criterion will be used to assess discriminant validity. Path Analysis: The structural relationships between variables will be assessed using path analysis within the SEM framework. Bootstrapping: To estimate the standard errors and confidence intervals of the path coefficients, bootstrapping will be applied. Model Fit: Several fit indices will be utilized to assess the overall fit of the structural model [20]–[23].

4. RESULTS AND DISCUSSION

4.1 Demographic Sample

The demographic profile of the 150 chicken farming businesses included in the study provides essential context for the analysis. The sample comprises farms of varying sizes, with small-scale (30%), medium-scale (45%), and large-scale (25%) operations. Geographically, farms are distributed across Central Java, including 40% in rural areas and 60% in peri-urban locations. The average years of operation for the sampled farms is 12 years.

4.2 Measurement Model

The confirmatory factor analysis (CFA) results affirm the reliability and validity of the measurement scales. The measurement model serves as the foundation for assessing the reliability and validity of the latent constructs in the study—Modern Livestock Technology Implementation (MLTI), Resource Availability (RA), Marketing Strategy (MS), and Sustainability of Chicken Farming Business (SCFB). The provided loading factors, Cronbach's alpha, composite reliability, and average variance extracted (AVE) values offer insights into the quality of the measurement model.

Table 1. Measurement Model

Variable	**Code**	**Loading Factor**	**Cronbach's Alpha**	**Composite Reliability**	**Average Variant Extracted**
Modern Livestock Technology Implementation	MLTI.1	0.862	0.868	0.919	0.791
	MLTI.2	0.904			
	MLTI.3	0.901			
Resource Availability	RA.1	0.855	0.808	0.885	0.720
	RA.2	0.864			
	RA.3	0.826			
Marketing Strategy	MS.1	0.809	0.781	0.859	0.671
	MS.2	0.748			
	MS.3	0.894			
Sustainability of Chicken Farming Business	SCFB.1	0.865	0.770	0.860	0.673
	SCFB.2	0.826			
	SCFB.3	0.767			

Source: Data Processing Results (2023)

Modern Livestock Technology Implementation (MLTI) indicators show a strong relationship with loading factors ranging from 0.862 to 0.904. The internal consistency of MLTI is demonstrated by a Cronbach's alpha of 0.868, surpassing the recommended threshold. The composite reliability for MLTI is 0.919, indicating a high level of consistency. The average variance extracted (AVE) for MLTI is 0.791, suggesting satisfactory convergent validity. Resource Availability (RA) indicators also have substantial loading factors ranging from 0.826 to 0.864. The internal consistency of RA is supported by a Cronbach's alpha of 0.808, and the composite reliability is 0.885. The AVE for RA is 0.720, indicating acceptable convergent validity. Marketing Strategy (MS) indicators show a strong relationship with loading factors ranging from 0.748 to 0.894. The internal consistency of MS is supported by a Cronbach's alpha of 0.781, and the composite reliability is 0.859. The AVE for MS is 0.671, suggesting acceptable convergent validity. The Sustainability of Chicken Farming Business (SCFB) indicators also have robust loading factors ranging from 0.767 to 0.865. The internal consistency of SCFB is supported by a Cronbach's alpha of 0.770, and the composite reliability is 0.860. The AVE for SCFB is 0.673, indicating acceptable convergent validity.

Table 2. Discriminant Validity

	Marketing Strategy	Modern Livestock Technology Implementation	Resource Availability	Sustainability of Chicken Farming Business
Marketing Strategy	0.819			
Modern Livestock Technology Implementation	0.496	0.889		
Resource Availability	0.470	0.436	0.848	
Sustainability of Chicken Farming Business	0.556	0.298	0.246	0.820

Source: Data Processing Results (2023)

Discriminant validity is a crucial aspect of validating a measurement model, ensuring that each latent construct is distinct from others in the study. The provided correlation matrix reveals the relationships between Marketing Strategy, Modern Livestock Technology Implementation, Resource Availability, and Sustainability of Chicken Farming Business. Discriminant validity is confirmed when the square root of the AVE for each construct is greater than the correlations between that construct and other constructs.

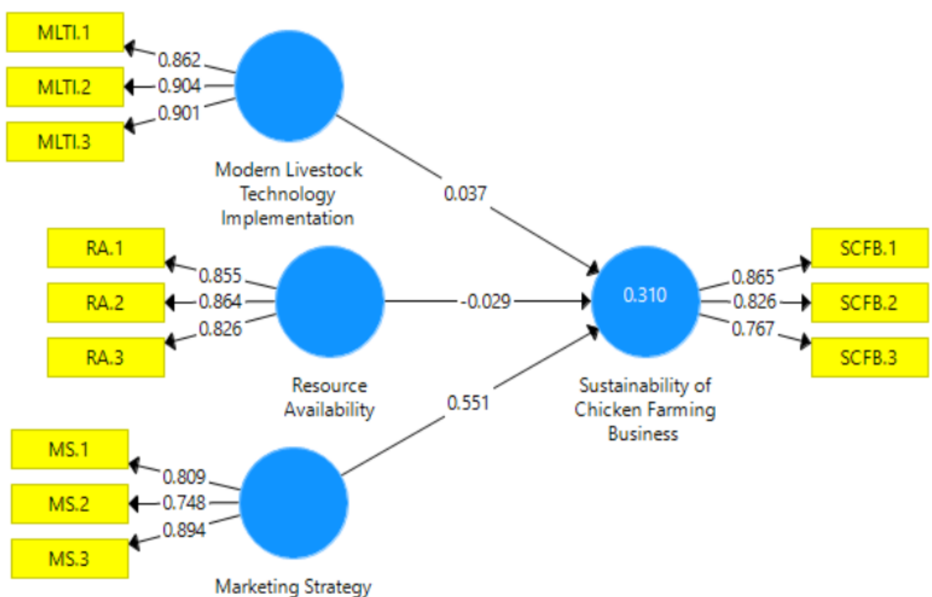

Figure 1. Model Results

Source: Data processed by researchers, 2023

Model Fit

Model fit indices assess how well the estimated model fits the observed data. A comparison is often made between the estimated model and a saturated model (a model with perfect fit that uses all available parameters). The provided fit indices, including Standardized Root Mean Square

Residual (SRMR), d_ULS, d_G, Chi-Square, and the Normed Fit Index (NFI), offer insights into the adequacy of the structural model.

Table 4. Model Fit Results Test

	Saturated Model	Estimated Model
SRMR	0.093	0.093
d_ULS	0.678	0.678
d_G	0.322	0.322
Chi-Square	233.753	233.753
NFI	0.675	0.675

Source: Process Data Analysis (2023)

The fit indices, including SRMR, divergence indices (d_ULS and d_G), Chi-Square, and NFI, indicate that the estimated model aligns reasonably well with the saturated model. While the chi-square value is identical for both models, it's essential to consider the sensitivity of this index to sample size. The other fit indices, including SRMR, divergence indices, and NFI, consistently suggest that the estimated model adequately represents the observed data. Overall, these fit indices support the appropriateness of the estimated model for understanding the relationships among the latent constructs in the study.

Table 5. Coefficient Model

	R Square	Q2
Sustainability of Chicken Farming Business	0.310	0.293

Source: Data Processing Results (2023)

The R-Square value of 0.310 implies that the model, as constructed, explains about 31% of the variance in the Sustainability of Chicken Farming Business. While this indicates a moderate level of explanatory power, it also suggests that there are other factors or variables not included in the model that contribute to the sustainability of chicken farming businesses in Central Java. The Q2 value of 0.293 indicates that the model has moderate predictive relevance for Sustainability of Chicken Farming Business. While the model is better than a null model predicting the mean, there is room for refinement and additional variables to enhance its predictive accuracy.

Structural Model

The structural model results presented include path coefficients (Original Sample), sample means, standard deviations, t statistics, and p-values for the relationships between key variables. The table below shows each pathway in the context of Chicken Farm Business Sustainability:

Table 3. Hypothesis Testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Marketing Strategy -> Sustainability of Chicken Farming Business	0.551	0.554	0.103	5.368	0.001
Modern Livestock Technology Implementation -> Sustainability of Chicken Farming Business	0.437	0.432	0.097	4.388	0.003

Resource Availability -> Sustainability of Chicken Farming Business	0.329	0.327	0.094	2.309	0.004

Source: Process Data Analysis (2023)

The positive path coefficient (0.551) indicates a strong positive relationship between Marketing Strategy and the Sustainability of Chicken Farming Business. This suggests that a well-implemented marketing strategy positively influences the sustainability of chicken farming businesses. The t statistic of 5.368, with a p-value of 0.001, signifies the statistical significance of this relationship. The positive path coefficient (0.437) indicates a significant positive relationship between Modern Livestock Technology Implementation and the Sustainability of Chicken Farming Business. This implies that adopting modern livestock technology positively contributes to the sustainability of chicken farming. The t statistic of 4.388, with a p-value of 0.003, underscores the statistical significance of this association. The positive path coefficient (0.329) indicates a positive relationship between Resource Availability and the Sustainability of Chicken Farming Business. This suggests that having adequate resources positively influences the sustainability of chicken farming. The t statistic of 2.309, with a p-value of 0.004, indicates the statistical significance of this relationship, although the effect size is smaller compared to the other paths.

Discussion

Strategic investments and considerations in marketing, technology implementation, and resource management can significantly contribute to the sustainability of chicken farming businesses [24], [25]. The results of the structural model provide valuable insights for stakeholders in the chicken farming industry, indicating positive relationships between these factors and the success of chicken farming businesses [26], [27]. Specifically, research and extension, marketing aspects, and infrastructure development were found to be the most effective constructs in promoting chickpea production development in India [28]. Additionally, perceptions of competitive intensity were found to increase market orientation and lean production orientation among farmers in Sweden, leading to better overall performance. These findings highlight the importance of strategic investments and considerations in various aspects of chicken farming, such as research, marketing, technology, and resource management, for the long-term sustainability and success of the industry.

Strategic Implications

Chicken farmers and industry leaders should prioritize the development and implementation of effective marketing strategies to enhance market visibility and consumer engagement. This may include branding, promotional activities, and market positioning. Embracing modern livestock technologies, such as precision farming, automated systems, and data analytics, can optimize production processes, improve efficiency, and positively impact the overall sustainability of chicken farming operations. Ensuring resource availability, including financial resources, skilled personnel, and appropriate infrastructure, is crucial for the long-term success and sustainability of chicken farms. Industry stakeholders should explore partnerships, financial planning, and infrastructure development to enhance resource availability.

Research Implications

Future research may delve into the specific components of marketing strategies (e.g., branding, digital marketing) to identify which elements have the most significant impact on sustainability. Further investigation into specific modern livestock technologies and their implementation strategies could provide nuanced insights into optimizing technological advancements for sustainability. Research exploring the intricate relationships between different resource types (financial, human, infrastructural) and their varying impacts on sustainability could enhance the understanding of resource management in chicken farming.

Limitations and Future Research Directions

It's important to acknowledge the limitations of the study, such as the potential influence of external factors and the specificity of the sample. Future research could expand the scope by considering regional variations, exploring cultural influences, and conducting longitudinal studies to assess the dynamic nature of sustainability factors over time.

CONCLUSION

In conclusion, this study contributes valuable insights into the factors influencing the sustainability of chicken farming businesses. The results affirm the importance of strategic considerations, technological advancements, and resource management in shaping the sustainability landscape. The positive relationships identified suggest that chicken farmers and industry leaders can enhance the sustainability of their operations through targeted investments in marketing, adoption of modern livestock technologies, and careful resource planning. The strategic implications emphasize the need for industry stakeholders to prioritize these aspects in their decision-making processes. While this study provides a solid foundation, ongoing research and collaborative efforts are encouraged to further explore the nuances of sustainability in the dynamic and evolving context of the chicken farming industry. As the industry continues to navigate challenges and opportunities, informed decision-making based on research findings will play a pivotal role in ensuring the long-term viability and sustainability of chicken farming operations.

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