Research Article

Empowerment Strategies for Improving Broiler Farmers' Welfare: Implications for Livestock Policy in Indonesia

Alima Bachtiar Abdullahi[1*], Ahmad Wadi[1], Sriwati Malle[2], Asrianti Sani[3], Zahraeni Kumalawati[4], Fitriana Akhsan[1], Khaeriyah Nur[1], Ummul Masir[1], Jumatriatikah Hadrawi[1], Anita Sari[1], Basri[1], Yuliadi[3], Athhar Manabi Diansyah[5]

[1]Department of Animal Science, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia, 90655; [2]Department of Agricultural Technology, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia, 90655; [3]Department of Aquaculture, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia, 90655; [4]Department of Agricultural Production Technology, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia, 90655; [5]Faculty of Animal Science, Hasanuddin University, Indonesia. Jl. Perintis Kemerdekaan 10, Tamalanrea, Makassar, South Sulawesi, Indonesia. 90245.

Abstract | This study examines how five empowerment practices affect broiler farmer welfare: Technical capacity, access to production inputs, biosecurity and animal health, market access and price information, and farmer group and networking support. A quantitative explanatory approach with a cross-sectional survey design was conducted from October to December 2025. Primary data were collected from 120 broiler farmers using a structured questionnaire measured on a five-point Likert scale. Data analysis included descriptive statistics, reliability testing using Cronbach's alpha, Pearson correlation analysis, multicollinearity diagnostics (tolerance and variance inflation factor), and multiple linear regression. All constructs demonstrated acceptable internal consistency (Cronbach's alpha > 0.70). Correlation analysis indicated positive associations between empowerment dimensions and farmers' welfare, and multicollinearity diagnostics confirmed no concerns (VIF values close to 1). The regression model was statistically significant ($F = 27.846$, $p < 0.001$) and explained 55.0% of the variance in welfare ($R^2 = 0.550$; Adjusted $R^2 = 0.530$). All empowerment dimensions were positively and significantly associated with farmers' welfare ($p < 0.001$), with technical capacity showing the largest coefficient ($\beta = 0.399$), followed by access to production inputs ($\beta = 0.358$). Biosecurity and animal health ($\beta = 0.288$), farmer group and networking support ($\beta = 0.284$), and market access and price information ($\beta = 0.278$) were also positively associated with welfare outcomes. Overall, the findings indicate that empowerment-related capacities are positively associated with broiler farmers' welfare, particularly through strengthening technical skills and ensuring stable input access, supported by improved biosecurity, market facilitation, and networking reinforcement.

Keywords | Broiler farmers, Empowerment, Farmers' welfare, Biosecurity, Multiple linear regression

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***Correspondence** | Alima Bachtiar Abdullahi, Department of Animal Science, Pangkep State Polytechnic of Agriculture, South Sulawesi, Indonesia, 90655; **Email:** alimababdullahi@polipangkep.ac.id
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INTRODUCTION

Broiler farming has become one of the most important livestock subsectors in supporting food security, rural employment, and household income in many developing countries. In the context of South Sulawesi, Indonesia, broiler farming is predominantly operated by small- to medium-scale households managing between 1,000 and 5,000 birds, often under partnership or contract arrangements with integrator companies. These households typically rely on poultry farming as a primary or supplementary source of income, with welfare commonly reflected in their ability to maintain stable production cycles, meet daily household needs, finance children's education, and avoid debt related to input procurement. Housing conditions are generally modest, and farm operations are closely tied to daily routines involving feeding, monitoring flock health, and maintaining basic biosecurity practices. However, farmers frequently identify unstable input supply, disease risks, price volatility, and limited bargaining power as the main barriers to achieving a more secure and "decent" livelihood. As consumer demand for poultry meat continues to increase, broiler production is expected to deliver both higher productivity and more stable livelihoods for farming households. Nevertheless, broiler farmers particularly small- to medium-scale producers often face persistent challenges that limit welfare improvement. These challenges include inadequate technical capacity, limited access to quality production inputs, weak biosecurity and animal health management, fluctuating market prices, and limited institutional or networking support (Indrawan *et al*., 2020). Such constraints make broiler farming highly vulnerable to production shocks, disease outbreaks, and economic instability, which ultimately affects farmers' welfare outcomes (Pramuwidyatama *et al*., 2023). Therefore, empowerment-based interventions are increasingly viewed as a strategic approach to strengthening broiler farmers' resilience and improving welfare.

In agricultural development, empowerment broadly refers to processes that enhance farmers' capabilities, resources, decision-making autonomy, and social support to improve farming outcomes and living standards. Empowerment is not limited to knowledge transfer through training but also includes facilitation of resource access, institutional strengthening, and enabling environments that support farmers in managing production and market uncertainties (Hanggana, 2024). In the broiler farming context, empowerment may take the form of technical training on production management, facilitation of input access (e.g., DOC, feed, vaccines, medicines), promotion of biosecurity practices, provision of market access and price information, and strengthening farmer groups and networks. While empowerment is often expected to improve welfare through multiple pathways, its outcomes are not always uniformly positive and may vary depending on local conditions, implementation quality, and farmers' capacity to adopt interventions (Azizah *et al*., 2016).

A growing body of literature has examined empowerment-related interventions and their socioeconomic impacts across agricultural settings. Several studies report that technical capacity building improves farmers' performance by enhancing knowledge and skills related to farm management, resulting in better productivity and income outcomes (Syam *et al*., 2023). Other research highlights that access to production inputs is critical for farm continuity, where input shortages or delays can disrupt production cycles and reduce profitability (Ramukhithi *et al*., 2023). In livestock systems, particularly poultry, biosecurity and animal health interventions have been emphasized as key determinants of sustainability because disease outbreaks can generate significant losses and threaten farmers' livelihoods (Souillard *et al*., 2025). Moreover, market access and price information are increasingly recognized as essential empowerment components that reduce uncertainty in selling processes, strengthen farmers' bargaining position, and support income stability (Kumar, 2025). Farmer group participation and networking support also play important roles by facilitating collective learning, information sharing, and access to development programs, which can enhance farmers' adaptive capacity (Rondhi *et al*., 2020). However, some studies also report mixed or limited impacts of empowerment interventions, where training programs are not fully adopted, benefits are unevenly distributed, or farmer groups may unintentionally create exclusion among members, highlighting that empowerment outcomes are context-dependent rather than universally positive.

Despite these contributions, existing evidence remains fragmented. Many studies focus on one empowerment component at a time (e.g., training only, credit only, or group support only), limiting the ability to understand empowerment as a multidimensional intervention package. Furthermore, welfare is often measured indirectly using productivity or income proxies, whereas welfare as a broader household outcome covering economic stability, ability to meet basic needs, and perceived quality of life is less consistently operationalized (Shafieisabet and Mirvahedi, 2025). This indicates the need for more comprehensive empirical models that integrate multiple empowerment dimensions and directly link them to welfare outcomes.

Several gaps motivate the present study. First, while previous studies have examined multiple dimensions of agricultural empowerment and welfare (Fumey *et al*., 2022; Nath *et al*., 2024; Cascone *et al*., 2024), relatively few have simultaneously evaluated distinct and practice-oriented empowerment dimensions within a single integrated

framework in broiler farming systems, which involve high biological risk and market volatility (Azizah *et al.*, 2016). Second, compared to crop-based farming contexts, empirical studies on welfare improvement among broiler farmers remain relatively scarce, even though poultry production involves unique operational challenges such as rapid production cycles, high dependency on input quality, and vulnerability to disease outbreaks (Honig *et al.*, 2024). Third, empowerment impacts are highly context-specific, shaped by local institutional arrangements, market structures, and farming practices. This creates a need for region-specific evidence, especially in Indonesia where poultry farming is influenced by diverse production systems, partnerships, and local market dynamics (Asnawi *et al.*, 2023). Finally, many studies do not quantify which empowerment components contribute most strongly to welfare improvement, leaving limited guidance for policymakers and development agencies in prioritizing empowerment strategies (Azizah *et al.*, 2016).

This study addresses these gaps by offering a multidimensional empowerment framework tailored to broiler farming and empirically testing its welfare effects. Empowerment is operationalized into five key dimensions: Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN). Unlike studies that rely solely on productivity indicators, this research directly measures welfare as a multidimensional household outcome reflecting perceived improvements in income, ability to meet basic needs, economic stability, and quality of life (de Jong *et al.*, 2022). In addition, this study contributes empirical evidence from Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia, which provides insights from a broiler farming setting that remains underrepresented in empowerment and welfare literature. By applying multiple linear regression analysis, this study also estimates the relative contribution of each empowerment dimension to welfare, offering practical implications for designing targeted empowerment programs.

Theoretically, this study contributes to empowerment-based rural development research by demonstrating that empowerment can be treated as a measurable multidimensional construct that captures practical intervention mechanisms. It also expands welfare-related empirical evidence in livestock systems, where welfare outcomes may depend not only on production performance but also on risk mitigation, input continuity, and market stability. Practically, the findings provide evidence-based recommendations for extension services, government agencies, and development programs seeking to improve broiler farmers' welfare through more effective empowerment strategies.

Accordingly, the main objective of this study is to examine the effects of empowerment dimensions technical capacity, access to production inputs, biosecurity and animal health, market access and price information, and farmer group and networking support on broiler farmers welfare. The study further develops and tests five hypotheses corresponding to the proposed empowerment dimensions, to provide a clearer empirical understanding of empowerment mechanisms that enhance welfare in broiler farming communities.

Conceptual framework and hypothesis development

This study is grounded in the empowerment-based development perspective, which emphasizes that empowerment interventions are designed to enhance farmers' capacities, access to resources, and adaptive abilities, thereby improving their socioeconomic outcomes and overall welfare (Landicho and Ramirez, 2023). In the context of broiler farming, empowerment is conceptualized as a set of practical support mechanisms delivered through training, facilitation, and institutional strengthening, which may influence farmers' welfare through improved production performance, risk management, and market engagement (Hanggana, 2024). Accordingly, this study proposes a conceptual framework in which empowerment practices should positively affect broiler farmer welfare.

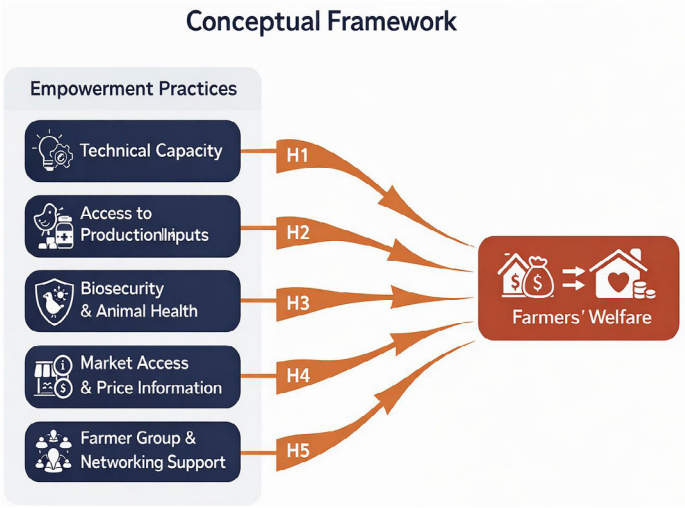

Figure 1: Conceptual framework.

Technical capacity refers to empowerment efforts that enhance farmers' knowledge and skills in broiler production management, including feeding practices, housing conditions, and the ability to reduce production losses. Farmers who benefit from technical empowerment are more likely to improve productivity and operational efficiency, which in turn strengthens their economic stability and welfare outcomes (Suryanti *et al.*, 2019; Hanggana, 2024). Therefore, the following hypothesis is proposed:

H1: Technical capacity positively influences broiler farmers' welfare.

Access to production inputs reflects empowerment support that facilitates timely availability of key inputs such as DOC, feed, vaccines/medicines, and essential equipment. Improved access to inputs reduces production disruptions and enhances continuity of farming operations, thereby supporting more stable income and better household welfare (Balogun *et al*., 2023; Nor *et al*., 2024). Based on this reasoning, the following hypothesis is formulated:

H2: Access to production inputs positively influences broiler farmers' welfare.

Biosecurity and animal health empowerment refers to empowerment interventions that strengthen farmers' capacity to implement farm biosecurity measures, sanitation routines, vaccination compliance, and disease prevention strategies. Since broiler farming is highly vulnerable to disease outbreaks and mortality risks, empowerment in biosecurity can contribute to production stability and reduce economic losses, ultimately improving welfare conditions (Vougat Ngom *et al*., 2025; Mahmood *et al*., 2026). Thus, the following hypothesis is proposed:

H3: Biosecurity and animal health empowerment positively influence broiler farmers' welfare.

Market access and price information represent empowerment practices that improve farmers' access to market channels, buyers, and relevant price information, enabling better marketing decisions such as selling time and negotiation outcomes. Empowered farmers with stronger market information and access are expected to reduce uncertainty in selling processes and achieve more favorable transaction outcomes, which contributes to improved welfare (Tang *et al*., 2015; Magesa *et al*., 2020). Accordingly, the following hypothesis is proposed:

H4: Market access and price information positively influence broiler farmers' welfare.

Farmer group and networking support refers to empowerment activities that strengthen cooperation, learning, and collective action among broiler farmers through farmer groups or associations. Strong farmer networks facilitate knowledge sharing, peer support, and improved access to programs or resources, which may enhance farmers' resilience and welfare outcomes (Knook *et al*., 2023; Michaelis *et al*., 2024). Therefore, the following hypothesis is formulated:

H5: Farmer group and networking support positively influence broiler farmers' welfare.

Overall, this study proposes a conceptual framework, in which empowerment practices technical capacity strengthening, input facilitation, biosecurity empowerment, market support, and networking reinforcement are expected to exert positive effects on broiler farmers' welfare. Any deviations in empirical findings are interpreted as reflective of local farming conditions and contextual constraints rather than inconsistencies in the conceptual argument (Azizah *et al*., 2016; Hanggana et al., 2024).

MATERIALS AND METHODS

Research design and study area

This study adopted a quantitative explanatory research design with a cross-sectional survey approach to assess the influence of empowerment practices on the welfare of broiler farmers (Jo *et al*., 2022). The research was conducted in Pangkajene and Kepulauan Regency, South Sulawesi Province, Indonesia, an area recognized as an important broiler production zone where farmers commonly engage in capacity-building and support programs related to poultry production and farm management. The study area was selected purposively to capture empirical evidence from farmers who have been exposed to empowerment interventions in real farming conditions. Primary data were collected through structured questionnaires administered to broiler farmers during October–December 2025, enabling the study to measure empowerment dimensions and welfare outcomes within the same observation period (Asnawi *et al*., 2023).

Population, sampling, and data collection

The study population comprised broiler farmers in Pangkajene and Kepulauan Regency who had been exposed to empowerment programs and support activities related to broiler farming. Respondents were selected using purposive sampling with inclusion criteria: (i) actively operating a broiler farm during the study period, (ii) having at least one production cycle experience, and (iii) participating in or receiving empowerment interventions such as training, input facilitation, biosecurity support, market information, or farmer group activities. A total of 120 farmers were surveyed, which is considered adequate for multiple linear regression analysis with five predictors. Data collection was conducted from October to December 2025 using a structured questionnaire based on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree) (Krova *et al*., 2025). The questionnaire was administered through direct field visits and guided interviews to ensure that all items were clearly understood and consistently answered by the respondents.

Research variables and measurement

Table 1 presents the operationalization of study variables used to measure empowerment practices and farmers' welfare. The five independent variables Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN)

Table 1: Operational definition of variables and measurement items.

Variable	Indicator (Code = Description)	Scale
Technical Capacity (X1)	TC1 = Empowerment programs improve my knowledge of broiler production management	Likert 1–5
	TC2 = Empowerment programs improve my skills in feeding management	
	TC3 = Empowerment programs improve my ability to manage housing conditions and stocking density	
	TC4 = Empowerment programs improve my ability to detect early signs of disease	
	TC5 = Empowerment programs improve my ability to reduce production losses	
Access to Production Inputs (X2)	API1 = Empowerment support improves timely access to DOC for broiler farming	Likert 1–5
	API2 = Empowerment support improves timely access to feed	
	API3 = Empowerment support improves timely access to vaccines and medicines	
	API4 = Empowerment support improves access to equipment/tools required for broiler farming	
	API5 = Empowerment support reduces input shortages that disrupt broiler production	
Biosecurity and Animal Health (X3)	BIO1 = Empowerment programs improve my implementation of farm biosecurity practices	Likert 1–5
	BIO2 = Empowerment programs improve sanitation and disinfection routines on my farm	
	BIO3 = Empowerment programs improve my compliance with vaccination schedules	
	BIO4 = Empowerment programs improve my ability to prevent and control disease outbreaks	
	BIO5 = Empowerment programs improve my use of protective measures (restricted access, hygiene, footbaths)	
Market Access and Price Information (X4)	MAPI1 = Empowerment interventions improve my access to market and price information for selling broilers	Likert 1–5
	MAPI2 = Empowerment interventions improve my access to buyers/marketing channels	
	MAPI3 = Empowerment interventions help me determine the best selling time	
	MAPI4 = Empowerment interventions strengthen my bargaining position with buyers/partners	
	MAPI5 = Empowerment interventions reduce uncertainty in selling and payment processes	
Farmer Group and Networking Support (X5)	FGN1 = Empowerment activities strengthen cooperation and learning within farmer groups	Likert 1–5
	FGN2 = Empowerment activities improve knowledge sharing among broiler farmers	
	FGN3 = Empowerment activities strengthen farmers' access to programs/resources through groups	
	FGN4 = Empowerment activities strengthen coordination for input procurement or marketing	
	FGN5 = Empowerment activities strengthen farmers' confidence through peer support	
Farmers' Welfare (Y)	WEL1 = My household income improves due to empowerment support	Likert 1–5
	WEL2 = My ability to meet basic household needs improves due to empowerment programs	
	WEL3 = My household economic stability improves due to empowerment interventions	
	WEL4 = My household quality of life improves after empowerment participation	
	WEL5 = Overall, my household welfare improves after empowerment programs/support	

were each measured using five indicators reflecting farmers' perceived empowerment outcomes. The dependent variable, Farmers' Welfare (WEL), was also measured using five indicators capturing improvements in income, basic needs fulfillment, economic stability, quality of life, and overall welfare. All indicators were assessed using a five-point Likert scale, enabling consistent quantification of respondents' perceptions for subsequent reliability testing and multiple linear regression analysis (Abdullah *et al*., 2021).

Data analysis procedures

Data analysis was conducted in several stages. First, descriptive statistics (minimum, maximum, mean, and standard deviation) were used to summarize respondents' perceptions of empowerment dimensions and farmers' welfare. Second, instrument quality was evaluated through reliability testing using Cronbach's alpha, with values above 0.70 indicating acceptable internal consistency. Third, Pearson correlation analysis was applied to examine preliminary associations among variables, followed by multicollinearity diagnostics using tolerance and variance inflation factor (VIF), where tolerance > 0.10 and VIF < 10 indicate no multicollinearity concerns. Finally, the hypotheses were tested using multiple linear regression analysis to estimate the effects of empowerment dimensions technical capacity, access to production inputs, biosecurity and animal health, market access and price information, and farmer group and networking support on farmers' welfare. The regression model was specified as $WEL = \beta0 + \beta1TC + \beta2API + \beta3BIO + \beta4MAPI + \beta5 FGN + \varepsilon$ and statistical significance was assessed at $p < 0.05$. All statistical analyses were performed using SPSS Version 30 (Rahayu *et al*., 2022).

RESULTS

Respondent characteristics

Table 2 shows respondent demographic and farm characteristics. This profile is provided to contextualize the subsequent analysis of empowerment practices and farmers' welfare.

Table 2: Respondent characteristics (N = 120).

Characteristic	Category	n	%
Gender	Male	95	79.2
	Female	25	20.8
Age group (years)	<30	16	13.3
	30–39	40	33.3
	40–49	41	34.2
	≥50	23	19.2
Education	Primary	42	35.0
	Secondary	60	50.0
	Diploma/University	18	15.0
Farming experience	<3 years	22	18.3
	3–5 years	36	30.0
	6–10 years	38	31.7
	>10 years	24	20.0
Farm scale	Small (<3,000 birds)	53	44.2
	Medium (3,000–7,999)	46	38.3
	Large (≥8,000)	21	17.5

As shown in Table 2, the majority of respondents were male farmers (79.2%), indicating that broiler farming in the study context remains predominantly managed by men. Most farmers were in the productive age categories of 30–49 years (67.5%), suggesting that the sector is largely operated by economically active households. Half of respondents (50.0%) had secondary education, while only 15.0% held a diploma or university degree reflecting moderate formal education levels among broiler farmers. Regarding farming experience, the largest proportion had 6–10 years of experience (31.7%), followed by 3–5 years (30.0%), implying that most respondents possessed adequate practical exposure to broiler production. Farm scale distribution shows that small-scale farms (<3,000 birds) were dominant (44.2%), followed by medium-scale farms (38.3%), while large-scale operations represented a smaller segment (17.5%). Overall, the respondent profile suggests a relatively experienced farming population with moderate education levels and predominantly small-to-medium production capacity, which is relevant for interpreting the effectiveness of empowerment interventions and their potential contribution to farmers' welfare outcomes.

Distribution of total scores across empowerment dimensions and farmers' welfare

The distribution of respondents' perceptions toward empowerment practices and farmers' welfare is presented using total score aggregation. As shown in Figure 2, the total scores are classified into five categories (very low to very high) based on the class interval method.

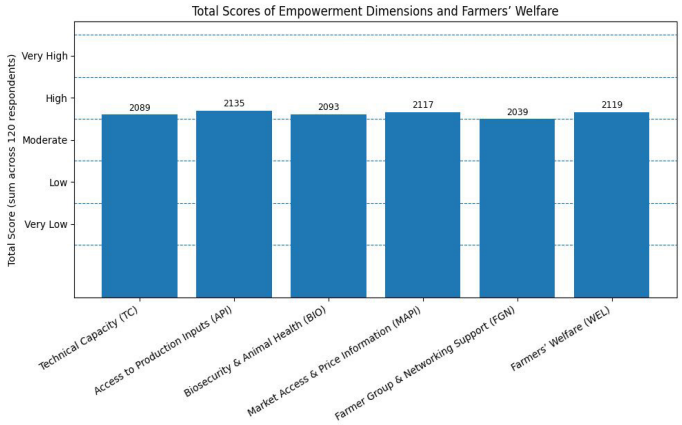

Figure 2: Distribution of empowerment dimensions and welfare scores based on a 5-point Likert scale classification. The figure illustrates general patterns of perceived empowerment and welfare levels among respondents.

As illustrated in Figure 2, the total scores for all empowerment dimensions Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN) as well as Farmers' Welfare (WEL), are generally positioned within the high category based on equal interval classification of the five-point Likert scale. This classification is used for descriptive purposes to facilitate interpretation of score distribution rather than to indicate statistically significant differences between dimensions. Among the empowerment dimensions, API shows the highest total score, followed by WEL and MAPI, while BIO and TC also fall within the high range. In contrast, FGN shows the lowest total score among the empowerment variables. These differences should be interpreted as relative tendencies rather than definitive distinctions, as no statistical comparisons are made at this stage. Overall, the figure provides a descriptive overview indicating that empowerment dimensions and welfare are generally perceived at relatively high levels among broiler farmers.

Reliability analysis of measurement instruments

The reliability of the measurement instruments was assessed using Cronbach's alpha to evaluate internal consistency across items within each construct. The results are summarized in Figure 3, with a cut-off value of 0.70 indicating acceptable reliability.

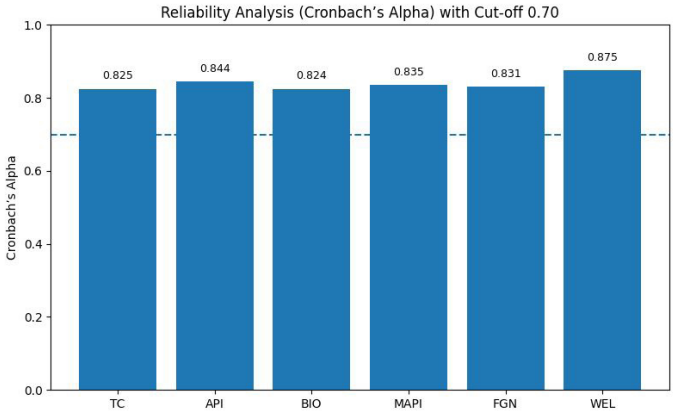

Figure 3: Reliability analysis of study constructs (Cronbach's Alpha) with a cut-off value of 0.70.

As shown in Figure 3, all study constructs demonstrate Cronbach's alpha values above the recommended cut-off of 0.70, indicating satisfactory internal consistency of the measurement instruments. Specifically, the reliability coefficients for the empowerment dimensions are consistently high, ranging from 0.824 to 0.844, including Technical Capacity (TC= 0.825), Access to Production Inputs (API = 0.844), Biosecurity and Animal Health (BIO= 0.824), Market Access and Price Information (MAPI= 0.835), and Farmer Group and Networking Support (FGN = 0.831). The dependent construct, Farmers' Welfare (WEL= 0.875), shows the highest reliability score, suggesting strong coherence among welfare indicators. Overall, these findings confirm that the items used in this study are reliable and suitable for further statistical analysis, including correlation and multiple regression testing.

Correlation analysis and multicollinearity diagnostics

To examine the preliminary relationships among the study variables, a Pearson correlation analysis was conducted. The correlation patterns are visualized in Figure 4 through a heatmap to provide a clearer overview of the strength and direction of associations among constructs.

As presented in Figure 4, Technical Capacity (TC) shows a positive correlation with Farmers' Welfare (WEL), indicating that empowerment practices improving farmers' technical skills tend to be associated with better perceived welfare outcomes. Access to Production Inputs (API) demonstrates the strongest positive correlation with WEL, suggesting that empowerment support facilitating timely access to key inputs (e.g., DOC, feed, vaccines/medicine) is closely linked to welfare improvement. Similarly, Biosecurity and Animal Health (BIO) is positively correlated with WEL, implying that empowerment related to disease prevention and health management contributes to more stable production conditions and welfare perceptions. Market Access and Price Information (MAPI) also showed positive association with WEL, suggesting that marketing support helps farmers. In addition, Farmer Group and Networking Support (FGN) is positively correlated with WEL, suggesting that empowerment through collective learning and networking may enhance farmers' resilience and welfare. Overall, the correlations among the independent variables appear relatively low to moderate, indicating this supports the distinctness of empowerment dimensions. Furthermore, the correlations among the independent variables are generally near-zero or slightly negative, indicating minimal overlap between constructs. These patterns provide evidence of discriminant validity, confirming that the empowerment dimensions capture distinct aspects of empowerment practices. We checked for multicollinearity using tolerance and variance inflation factor (VIF); Table 3 shows the results.

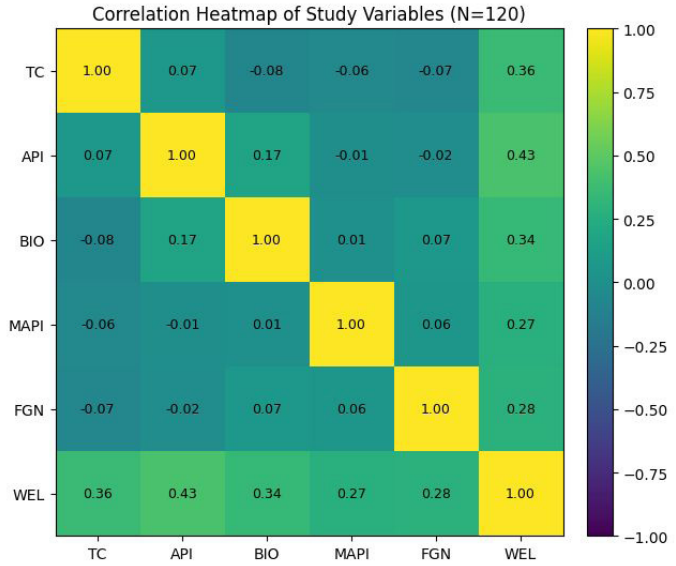

Figure 4: Correlation Heatmap of Empowerment Dimensions and Farmers' Welfare (N = 120). The color gradient represents Pearson correlation coefficients, ranging from darker tones (lower or negative correlations) to lighter tones (higher positive correlations).

Reference Table 3 properly indicate that the regression model does not suffer from multicollinearity issues. All predictors show high tolerance values (ranging from 0.960 to 0.994), which are well above the commonly accepted threshold of 0.10. Likewise, the VIF values for all independent variables are close to 1 (ranging from 1.006 to 1.042) and remain far below the critical cut-off of 10 (or the more conservative threshold of 5). These results confirm that Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN) are sufficiently independent from one another and can be simultaneously included in the multiple linear regression model without inflating standard errors or biasing

coefficient estimates.

Table 3: Multicollinearity diagnostics (Tolerance and VIF).

Predictor	Tolerance	VIF
TC	0.980	1.020
API	0.965	1.036
BIO	0.960	1.042
MAPI	0.994	1.006
FGN	0.988	1.013

Notes: Tolerance > 0.10 and VIF < 10 indicate no multicollinearity problem. All tolerance values exceed 0.90, and all VIF values are near 1, confirming no concerns.

Multiple linear regression results

The overall adequacy of the multiple linear regression model was first evaluated using model fit statistics. The goodness-of-fit results, including R-squared, adjusted R-squared, and the F-test significance, are presented in Table 4 the Model Fit Summary.

Table 4: Model fit summary of the multiple linear regression model.

Statistic	Value
R-squared	0.550
Adjusted R-squared	0.530
F-statistic	27.846
Degrees of freedom (df1, df2)	5, 114
Prob (F-statistic)	<0.001
Standard Error of Estimate	0.512
Durbin–Watson statistic	1.94
N	120

Note: R^2 indicates the proportion of variance explained by the model. The F-test evaluates the overall statistical significance of the regression model. Degrees of freedom correspond to the number of predictors (df1 = 5) and residual degrees of freedom (df2 = 114). The Durbin–Watson statistic assesses residual independence.

The model fit results in Table 4 indicate that the regression model is statistically significant, as shown by the F-test (F = 27.846, p < 0.001). The model explains 55.0% of the variance in farmers' welfare (R^2 = 0.550), with an adjusted R^2 of 0.530, suggesting a strong explanatory power of the empowerment dimensions in predicting welfare outcomes. After establishing the adequacy of the model, the estimated regression coefficients and hypothesis testing results for each predictor are presented in Table 5.

Based on Table 5, all independent variables Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN) exert a positive and statistically significant effect on Farmers' Welfare (WEL), as indicated by positive unstandardized coefficients and p-values < 0.001 for all predictors. Technical capacity shows the largest coefficient (B = 0.448; β = 0.399; t = 6.282), followed by access to production inputs (B = 0.400; β = 0.358; t = 5.600). The remaining empowerment dimensions are also significantly associated with welfare outcomes, namely biosecurity and animal health (B = 0.327; β = 0.288; t = 4.484), farmer group and networking support (B = 0.302; β = 0.284; t = 4.485), and market access and price information (B = 0.293; β = 0.278; t = 4.407). Standardized coefficients (β) represent relative effect sizes rather than real-world magnitudes, as variables are measured on Likert scales. Overall, the coefficients indicate relatively comparable contributions across dimensions, and differences in magnitude should be interpreted with caution. In addition, the 95% confidence intervals for all predictors are entirely positive and do not cross zero, supporting the consistency of the positive associations between empowerment practices and broiler farmers' welfare outcomes.

Table 5: Multiple linear regression results on the effect of empowerment dimensions on farmers' welfare.

Predictor	B	Std. error	β	t	p value	95% CI (Lower)	95% CI (Upper)
Constant	-2.650	0.531	—	-4.988	<0.001	-3.702	-1.598
TC	0.448	0.071	0.399	6.282	<0.001	0.307	0.590
API	0.400	0.071	0.358	5.600	<0.001	0.258	0.541
BIO	0.327	0.073	0.288	4.484	<0.001	0.182	0.471
MAPI	0.293	0.066	0.278	4.407	<0.001	0.161	0.425
FGN	0.302	0.067	0.284	4.485	<0.001	0.169	0.435

Note: Dependent variable = Farmers' Welfare (WEL). B = unstandardized coefficient; β = standardized coefficient. CI= confidence interval for the unstandardized coefficient. All predictors are statistically significant (p < 0.001). Standardized coefficients (β) are presented to enable comparison of relative effect sizes across empowerment dimensions measured on different scales.

Hypothesis testing results

Hypothesis testing was conducted to examine the effects of empowerment dimensions on farmers' welfare. The results of the hypothesis testing based on the multiple linear regression analysis are presented in Table 6.

All five hypotheses were supported (Table 6), indicating that each empowerment dimension significantly contributes to improving farmers' welfare. Technical Capacity (H1) shows the largest coefficient (B= 0.448; β= 0.399; p < 0.001), followed by Access to Production Inputs (H2) (B=

0.400; β= 0.358; p < 0.001). These results indicate relatively similar effect sizes, and differences between coefficients should be interpreted cautiously, all confidence intervals do not overlap zero, supporting robust positive associations. The remaining hypotheses are also supported, showing positive and significant effects, including Biosecurity and Animal Health (H3) (B= 0.327; β= 0.288; p < 0.001), Farmer Group and Networking Support (H5) (B= 0.302; β = 0.284; p < 0.001), and Market Access and Price Information (H4) (B= 0.293; β= 0.278; p < 0.001). Overall, the findings confirm that empowerment practices related to technical strengthening, input facilitation, biosecurity improvement, market support, and farmer networking all play significant roles in enhancing broiler farmers' welfare outcomes.

DISCUSSION

This study examined how empowerment practices influence broiler farmers' welfare in Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia. The proposed empowerment–welfare relationship was conceptually framed in Figure 1, where empowerment is operationalized as five practical dimensions that directly strengthen farmers' production capacity and livelihood stability. The descriptive profile of respondents in Table 2 indicates that the study participants largely represent active broiler farmers with sufficient exposure to empowerment initiatives, supporting the relevance of the empirical setting. Furthermore, the descriptive score distribution shown in Figure 2 suggests that empowerment implementation and welfare outcomes are generally perceived at moderate-to-high levels, indicating that the constructs measured are meaningful and observable in the field.

Before discussing relationships, we checked whether our measures were reliable. The reliability results in Figure 3 demonstrate that all constructs exhibit Cronbach's alpha values above the recommended threshold, confirming internal consistency. The correlation heatmap in Figure 4 indicates positive associations between empowerment dimensions and welfare, while multicollinearity diagnostics in Table 3 show VIF values close to 1, confirming that predictors are sufficiently distinct. The model fit statistics in Table 4 indicate that the regression model is statistically significant and explains a substantial proportion of welfare variance. Finally, the regression coefficients in Table 5 and hypothesis testing summary in Table 6 confirm that all empowerment dimensions positively and significantly affect welfare. But statistical significance aside, the main point is understanding how each type of empowerment actually helps farmers. The standardized coefficients presented in the model reflect relative effect sizes rather than exact real-world magnitudes, particularly given that the variables are measured using perception-based Likert scales. Therefore, the results should be interpreted as indicating directional and comparative influences across empowerment dimensions rather than precise quantitative changes in welfare outcomes.

The results show that Technical Capacity (TC) has the strongest positive effect on Farmers' Welfare (WEL), as evidenced by the highest standardized coefficient in Table 5 and full support for H1 in Table 6. Although the regression coefficient indicates that a one-point increase in perceived technical capacity is associated with an approximate 0.45-point increase in the welfare score on the five-point scale, this statistical relationship reflects meaningful improvements in farmers' daily production management. In practical terms, stronger technical capacity enables farmers to better manage feeding schedules, housing conditions, disease prevention, and flock monitoring, which can reduce mortality risks, improve production stability, and minimize avoidable losses during production cycles. From a theoretical perspective, technical capacity can be understood as a form of human capital, where knowledge and skills function as productive assets that enhance farmers' efficiency and economic performance. In addition, drawing on the capability approach, improved technical capacity expands farmers' ability to make informed decisions, manage risks, and exercise greater control over their production systems, thereby strengthening their overall welfare. Theoretically, this supports the human capital and capability-based view that welfare outcomes depend on farmers' ability to convert knowledge into productive decisions (Azizah *et al*., 2016). In broiler production, improved technical capacity enhances farmers' control over key determinants of profitability such as feeding efficiency, housing conditions, and mortality management. When farmers possess stronger technical capacities, they tend to report more stable production conditions, lower perceived losses, and more predictable income stability (Khan *et al*., 2023; Hamed *et al*., 2025). From a policy perspective, this result suggests that practical skill-oriented training particularly in farm management, disease prevention, and production monitoring can translate into tangible improvements in farm stability and household livelihood security. Therefore, the strong TC–WEL relationship highlights that empowerment is most effective when it strengthens farmers' competence in day-to-day production management rather than providing general support without technical depth.

The study finds that Access to Production Inputs (API) is the second most influential predictor of welfare, as shown in Table 5, with H2 supported in Table 6. This indicates that empowerment initiatives that facilitate input availability, such as access to DOC, feed, vaccines, medicines, and production equipment significantly enhance welfare outcomes. From a theoretical perspective, this supports the

Table 6: Hypothesis testing results.

Hypothesis	Path	B	Std. Beta	p-value	Decision
H1	Technical Capacity (TC) → Farmers' Welfare (WEL)	0.448	0.399	<0.001	Supported
H2	Access to Production Inputs (API) → Farmers' Welfare (WEL)	0.400	0.358	<0.001	Supported
H3	Biosecurity and Animal Health (BIO) → Farmers' Welfare (WEL)	0.327	0.288	<0.001	Supported
H4	Market Access and Price Information (MAPI) → Farmers' Welfare (WEL)	0.293	0.278	<0.001	Supported
H5	Farmer Group and Networking Support (FGN) → Farmers' Welfare (WEL)	0.302	0.284	<0.001	Supported

resource-based empowerment argument, where empowerment becomes meaningful when farmers gain access to tangible resources that enable them to apply improved practices (Prastyanti *et al*., 2024). In broiler farming, input availability is not merely a supporting factor but a structural requirement for production continuity. Input disruptions can lead to delayed cycles, poor growth performance, higher mortality, and unstable revenues. Thus, empowerment initiatives that facilitate stable input access are associated with reduced operational uncertainty and protect farmers from income shocks (Rokhani *et al*., 2023). The significant API–WEL relationship suggests that welfare improvement is closely tied to whether empowerment interventions address farmers' resource constraints in a timely and reliable manner.

The regression results show that Biosecurity and Animal Health (BIO) has a significant positive effect on welfare, with H3 supported (Tables 5, 6). This finding is particularly important because broiler farming is inherently exposed to disease risks that can quickly translate into financial losses and household instability. From a theoretical perspective, this finding can also be linked to resilience theory, where biosecurity practices strengthen farmers' ability to withstand and recover from disease-related shocks. In addition, within a risk management framework, biosecurity functions as a preventive strategy that reduces the likelihood and impact of production losses, thereby protecting farmers' income stability. Theoretically, this aligns with resilience and risk management perspectives that emphasize welfare improvement through vulnerability reduction rather than productivity maximization alone (Dhakal *et al*., 2025). empowerment in biosecurity is associated with stronger preventive capacity through sanitation, disinfection routines, vaccination compliance, and farm access control which reduces mortality rates and outbreak probability. As a result, farmers are more likely to maintain stable production cycles and avoid catastrophic losses. Welfare improvement, therefore, emerges not only from higher output but also from reduced uncertainty and stress associated with disease-related production failure (Faroque *et al*., 2023; Maletić *et al*., 2023). The link between biosecurity and welfare suggests that empowerment programs must include strong animal health components to produce lasting gains.

The results indicate that Market Access and Price Information (MAPI) positively and significantly affects welfare, with H4 supported (Tables 5, 6). This finding suggests that empowerment interventions related to marketing channels, buyer access, and price information improve welfare outcomes by strengthening farmers' market participation capacity. rom a theoretical perspective, this finding can be explicitly linked to transaction cost economics, where improved access to market information and buyers reduces search, negotiation, and uncertainty-related costs faced by farmers. In addition, by improving the availability and transparency of price information, empowerment interventions help reduce information asymmetry between farmers and market actors, enabling more efficient and equitable transactions. Theoretically, this supports market empowerment and transaction cost perspectives, where welfare depends on farmers' ability to reduce information asymmetry, secure fair prices, and manage market volatility (Marion *et al*., 2024). In broiler farming, selling decisions are time-sensitive, and price volatility can significantly influence net income even when production performance is stable. Empowerment that helps farmers optimize the timing of sales, negotiate better prices, and reduce uncertainty in payment processes. Consequently, welfare improvement becomes linked to improved market control and stronger bargaining power (Aji *et al*., 2023).

Finally, Farmer Group and Networking Support (FGN) also has a significant positive effect on welfare, with H5 supported (Tables 5, 6). This indicates that empowerment is not only technical and resource-based but also social and institutional. Theoretically, this aligns with social capital theory, which emphasizes that networks and group participation strengthen access to information, learning, and collective resources (Tuna *et al*., 2020). In addition, this finding can be linked to collective action frameworks, where farmer groups facilitate coordination, cooperation, and joint decision-making that enable members to achieve outcomes that would be difficult to attain individually. Through collective action, farmers can improve their bargaining power, share risks, and enhance access to external support and market opportunities. In practice, farmer groups enable peer-to-peer learning, collective coordination, and improved access to empowerment

programs. Although the effect size is smaller than TC and API, its significance suggests that networking functions as a supportive empowerment channel that strengthens resilience and welfare sustainability over time. Group-based empowerment may also improve farmers' confidence and psychological readiness to adopt better practices, negotiate with buyers, and seek support during crisis situations (Sihombing *et al*., 2024).

Taken together, the findings confirm that empowerment practices operate through multiple pathways that jointly enhance broiler farmers' welfare. The significant model fit reported in Table 4, combined with consistent regression evidence in Table 5, indicates that empowerment dimensions explain welfare outcomes in a complementary manner. Although Technical Capacity (TC) shows the largest standardized coefficient, the differences among the coefficients of the empowerment dimensions remain relatively moderate (0.278–0.399), suggesting that no single dimension alone fully determines farmers' welfare outcomes. Instead, the results indicate that the various empowerment components operate in a complementary manner, where improvements in technical capacity, input access, biosecurity practices, market engagement, and networking collectively contribute to welfare improvements. Meanwhile, Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN) remain essential supporting pillars that stabilize welfare through risk reduction, market strengthening, and institutional reinforcement. From a program design perspective, this implies that empowerment initiatives should avoid focusing exclusively on a single intervention but instead maintain a balanced strategy that simultaneously strengthens farmers' technical capabilities, resource access, and institutional support systems. In addition, the relationships are modeled as linear in this study; however, nonlinear patterns such as diminishing returns may exist (e.g., additional training yielding smaller marginal benefits), which were not explicitly tested and could be explored in future research. This supports the broader empowerment argument that welfare improvement is most likely when empowerment is implemented as an integrated package rather than isolated interventions (Indrawan *et al*., 2020; Souillard *et al*., 2025).

CONCLUSION

This study found that farmers who reported higher levels of empowerment also reported better welfare in Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia. The multiple linear regression results show that all empowerment dimensions Technical Capacity (TC), Access to Production Inputs (API), Biosecurity and Animal Health (BIO), Market Access and Price Information (MAPI), and Farmer Group and Networking Support (FGN) are positively and significantly associated with Farmers' Welfare (WEL), indicating that welfare is related to multiple complementary aspects of empowerment. Among these, TC and API show relatively larger coefficients, while BIO, MAPI, and FGN also demonstrate meaningful associations. Overall, the findings suggest that empowerment initiatives may contribute to farmers' welfare, and that a complementary and integrated approach may be beneficial, although this should be interpreted with caution. However, this study is based on a cross-sectional design, which limits the ability to establish causal relationships between empowerment and welfare. Future research using longitudinal approaches is recommended to better capture causal dynamics and changes over time.

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NOVELTY STATEMENT

This study provides a novel contribution by developing and empirically testing a multidimensional empowerment framework specifically tailored to broiler farming systems. Unlike previous studies that typically examine single empowerment components in isolation, this research integrates five key dimensions of empowerment technical capacity, access to production inputs, biosecurity and animal health, market access and price information, and farmer group and networking support within a single analytical model. Furthermore, the study directly measures farmers' welfare as a multidimensional household outcome rather than relying solely on productivity or income indicators. The findings also provide empirical evidence from Indonesian broiler farming systems, a context that remains underrepresented in the empowerment and rural welfare literature, while identifying the relative contribution of each empowerment dimension to welfare improvement.

AUTHOR'S CONTRIBUTION

ABA, AW, SM, KN and UM conceived and designed the research. AS, ZK FA JH AS, B and Y supervised and coordinated the research and provided clinical data. Statistical analysis was conducted by AMD. The initial draft of the manuscript was prepared by ABA, AW, FA, KN, UM and AMD. All authors critically reviewed and approved the final version of the manuscript.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors declare no conflict of interest with any financial, personal, or other relationships with other people or organizations related to the material discussed in the manuscript.

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