

Competence of cattle farmers to support sustainable livestock development

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Abstract. This study aimed to analyze the competence of cattle farmers in their business and to analyze the factors that influence it. This research was conducted in Karanganyar Regency, considering that the cattle population in this district is high, namely 66.779 beef cattle. Respondents of the study were 60 farmers who had at least two beef cattle. The research design used a descriptive quantitative method with survey technique. Data were collected from interviews with cattle farmers, then the data were analyzed descriptively and multiple linear regression test. The results of multiple regression analysis is $Y = 15.376 + 0.425X_1 + 0.563X_2 + 0.187X_3$. The results of the F-test showed that the value of $F\text{-count} > F\text{-table}$ namely 142.908, which means that the variable of personal characteristics, motivation, and the external factors have simultaneous effect on the competence of cattle farmers. The T-test results showed that personal characteristics, motivation, and the external factors partially affecting the competence of cattle farmers. This research concluded that the personal characteristics, motivation, and the external factors had an influence on cattle farmers' competence in Karanganyar Regency to support sustainable livestock development.

1 Introduction

Sustainable livestock farming is an integral part of agricultural development that remains a national issue to this day, as it relates to food self-sufficiency in Indonesia. The strategy for sustainable livestock farming is aimed at optimizing local resources and increasing the production and consumption of animal-based food products. In beef cattle farming, there are still various problems, one of which is the low level of competence among farmers, especially smallholder beef cattle farmers. Smallholder beef cattle farms generally have characteristics such as conventional husbandry patterns, minimal production costs, relatively low profits, and limited livestock husbandry scale [1].

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Competence is the ability of each individual to demonstrate their skills and performance in their work based on their understanding of science. In the field of farming, especially beef cattle farming, a farmer's competence is a must in order to achieve success in their business. The types of beef cattle farmer competencies that can improve their business performance are technical, managerial, and entrepreneurial competencies [2]. A farmer's level of competence generally plays a role in determining the future success of their livestock business. In reality, to date, the competence of local beef cattle farmers is still considered to be low. This is due to several factors, such as low levels of education, an unstable economy, limited land, limited access to livestock technology and capital, low farmer motivation, low levels of participation in livestock groups, and limited participation from livestock extension workers [3]. Basically, the existence of livestock groups, livestock extension agencies and government agencies, and capital assistance providers plays an important role in facilitating farmers to improve their competence so that the performance of their livestock businesses can be improved [4].

The motivation and external environmental entities of a farmer, such as the support of livestock extension agencies and institutions, livestock farmer groups, and capital institutions, basically have a significant influence on the differences in their knowledge, abilities, and skills in managing livestock businesses so that they can continue to innovate and develop. Previous studies have focused more on personal characteristics, such as age, education level, gender, farming experience, number of livestock owned, and main occupation, which can be determining factors in the level of competence of a farmer in entrepreneurship [5]. However, studies examining the three factors of personal characteristics, motivation, and external environment that can influence the competency level of beef cattle farmers have not been widely conducted.

Beef cattle populations are spread across several regions in Indonesia, one of which is in Central Java Province. The total beef cattle population in Central Java Province is 1.910.864, and specifically in Karanganyar Regency, the beef cattle population was recorded at 66.779 in 2022 [6]. Most of the national development in Karanganyar Regency focuses on the sustainable livestock sector, as can be seen from the data on the population of Karanganyar Regency, which shows that 131,043 people out of a total of 955.116 people work as farmers and ranchers. Karanganyar Regency is a region with considerable potential for developing beef cattle farming, due to the availability of agricultural land as a source of forage for livestock. In addition, the local government has also provided supporting facilities for beef cattle farmers in Karanganyar Regency, including 1) artificial insemination posts; 2) livestock markets; 3) veterinary personnel in each sub-district; 4) livestock extension workers; and 5) various agencies that provide business capital assistance for livestock farming.

Although the Karanganyar Regency government has provided various facilities and infrastructure aimed at facilitating farmers' activities in managing their businesses, it is still possible that there are many problems in the Karanganyar Regency area, such as the lack of knowledge and skills of farmers in managing their livestock businesses. In general, this can trigger new problems, namely the obstruction of the sustainable livestock development process. Based on the above description, this study aims to identify and analyze the factors that influence farmer competence through personal characteristics, motivation, and the external environment in order to support the sustainable livestock development program in Karanganyar Regency, Central Java Province.

2 Materials and methods

This study uses a quantitative descriptive method, which is generally used to interpret regional conditions in numerical form. This research was conducted in Karanganyar

Regency, Central Java, in June-July 2025. The research sample was determined using the *cluster random sampling* method, resulting in the subdistricts of Jatiyoso, Jenawi, Mojogedang, and Gondangrejo as the data collection areas. This location was determined based on the largest cattle beef population in the north, east, west, and south in Karanganyar Regency. This study involved 60 respondents, namely beef cattle farmers with the criteria of raising at least 3 beef cattle and having at least 1 year of farming experience.

In this analysis method, a questionnaire was needed as a research instrument, so validity and reliability tests were required to test whether the questions in the questionnaire were valid and reliable. In addition, this study used multiple linear regression analysis to explain the factors that influence the competence of beef cattle farmers. The equation applied in this type of regression analysis is as below:

$$Y=a+b_1X_1+b_2X_2+b_3X_3+e \tag{1}$$

Description:

- Y : Competence of beef farmers
- a : Constant
- X₁ : Personal characteristics
- X₂ : Motivation
- X₃ : External environment
- e : Error

The requirements that must be met to perform multiple linear regression analysis are that the data must be normally distributed and homogeneous, so classical assumption testing is required, including normality testing, multicollinearity testing, and heteroscedasticity testing. All of the variables such as personal characteristics, motivation, external environment, and competence of beef farmers were analyzed by using likert scale in order to change the results of the interview into a statistical form.

3 Results and discussion

3.1 General Conditions of the research location

Karanganyar Regency is a potential area for beef cattle entrepreneurship. This can be seen from the large population of beef cattle in Karanganyar, which numbered 66.779 in 2022 [6]. In addition, Karanganyar Regency has a climate suitable for beef cattle farming, with an average daily temperature of 22-31°C. The ideal temperature for beef cattle farming in a tropical climate is 25-37°C. Karanganyar Regency itself has an area of ± 77.378.64 ha, which is administratively divided into 17 sub-districts, 162 villages, and 15 urban villages. The sub-districts of Jatiyoso, Jenawi, Mojogedang, and Gondangrejo, which were the locations of the study, are part of the 17 sub-districts located in Karanganyar Regency.

The research locations in the subdistricts of Jatiyoso, Jenawi, Mojogedang, and Gondangrejo basically represent beef cattle farms in the southern, eastern, northern, and western parts of Karanganyar Regency. Mojogedang Subdistrict is still the center of the largest beef cattle population in Karanganyar Regency, with a population of 7.790 in 2023. Jatiyoso Subdistrict itself ranks second as a center for beef cattle in Karanganyar Regency with a total population of 5.731. Most of the residents in Mojogedang and Jatiyoso subdistricts generally work as beef cattle farmers to meet their daily needs. Meanwhile, the beef cattle population in Jenawi and Gondangrejo subdistricts in 2023 was 5.060 and 3.911 head, respectively.

3.2 Respondent Characteristics

The characteristics of the respondents analyzed in this study include age, education level, farming experience, number of family members, number of livestock owned, and livestock ownership status. Everything such as attitude, mindset, and personality can be considered characteristics. The characteristic of respondents in this research are shown in Table 1.

Table 1. Characteristic of beef farmers in Karanganyar Regency.

Farmer's age	Number of farmers (people)	Percentage (%)
<15 years	0	0.00
15-64 years	55	91.70
>64 years	5	8.30
Farmer's education		
Not pass elementary	12	20.00
Elementary school	19	31.70
Junior high school	14	23.30
Senior high school	8	13.30
Bachelor degree	7	11.70
Farming experiences		
<5 years	9	15.00
5-10 years	19	31.70
10-15 years	14	23.30
>15 years	18	30.00
Family labor		
1-3 people	13	21.70
4-6 people	43	71.70
>6 people	4	6.60
Number of cattle		
3-6	39	65.00
7-10	16	26.70
>10	5	8.30
Ownership status		
Personal property	57	95.00
Shared property	2	3.30
Family property	1	1.70

Each farmer generally has different indicators such as mindset, knowledge, and experience. This can be seen from the age factor of farmers, which can influence these indicators. As a farmer ages, they experience an increase in their mindset and maturity, which can influence how they run their livestock business so that it can develop in the future [7]. The majority of respondents' ages fall into the productive working age category, which is between 15 and 64 years old. Productive farmers tend to have high abilities and creativity due to the support of cognitive knowledge and a strong work ethic, enabling them to develop a strong work mindset and sense of responsibility for the work they are engaged in.

3.3 Validity and Reliability Tests

Validity and reliability tests are used to explain the accuracy and consistency of the reaserch questionnaires. The test outcomes of the validity and reliability this research be able to drawn in Table 2.

Table 2. Validity and reliability test outcomes.

Variables	Validity		Reliability	
	r-count	Desc	<i>Cronbach's alpha</i>	Desc
Personal Characteristics (X1)	0.705	<i>Valid</i>	0.767	<i>Reliable</i>
	0.650	<i>Valid</i>		
	0.619	<i>Valid</i>		
	0.644	<i>Valid</i>		
	0.833	<i>Valid</i>		
	0.643	<i>Valid</i>		
Motivation (X2)	0.850	<i>Valid</i>	0.699	<i>Reliable</i>
	0.649	<i>Valid</i>		
	0.674	<i>Valid</i>		
	0.606	<i>Valid</i>		
	0.578	<i>Valid</i>		
External Environment (X3)	0.800	<i>Valid</i>	0.623	<i>Reliable</i>
	0.597	<i>Valid</i>		
	0.871	<i>Valid</i>		
Farmer Competence (Y)	0.914	<i>Valid</i>	0.865	<i>Reliable</i>
	0.883	<i>Valid</i>		
	0.881	<i>Valid</i>		

The number of respondents in the study was 60 (N=60) with a significance level of 5%, resulting in a value of r_{table} of 0.254. Based on the validity and reliability tests in Table 1, the research data is valid and reliable. The data in this study is reliable if the *Cronbach's Alpha* value is >0.6. The R Square (R^2) value in Table 3 is 0.884 or 88.4%. This indicates that the ability of independent variables such as farmer characteristics, motivation, and external environment in explaining the competence of beef cattle farmers in Karanganyar Regency is 88.4%, while the remaining 11.6% is assumed to be explained by other variables not studied, such as farm size and the cosmopolitanism level of farmers. The F test is intended to determine the level of significance of independent variables in simultaneously influencing dependent variables.

3.4 Multiple Linear Regression Analysis

Table 3 reveals the findings by the multiple linear regression analysis.

Table 3. Multiple linear regression test outcomes

Variables	Regression Coefficient	t	Significance
Personal Characteristics (X1)	0.425	6.923	<0.001
Motivation (X2)	0.563	11.135	<0.001
External Environment (X3)	0.187	3.648	<0.001
Farmer Competence (Y)	15.376	3.900	<0.001

Drawing by the data in Table 3, the regression equation is expressed as below:

$$Y = 15.376 + 0.425X_1 + 0.563X_2 + 0.187X_3 + e \tag{2}$$

The signifying of the multiple linear regression equation presented above be able to detailed as below:

- 1) The constant (α) is 15.376 that signifies that if the score of X_1 , X_2 , dan X_3 generated is zero, then the score of Y is 15.376.
- 2) The regression coefficient of the personal characteristics (X_1) is 0.425 that signifies that every one unit rise up be going to rise up the score of farmer competence (Y) by 0.425.
- 3) The regression coefficient of motivation (X_2) is 0.563 that signifies that every one unit rise up be going to rise up the score of farmer competence (Y) by 0.563.
- 4) The regression coefficient of external environment (X_3) is 0.187 that signifies that every one unit rise up be going to rise up the score of farmer competence (Y) by 0.187.

3.5 Coefficient of Determination Test

The range of the coefficient of determination score is generally among 0 and 1 by the closer the number 1, the better the model used. The test outcomes of the coefficient of determination (R^2) in this research be able to drawn in Table 4.

Table 4. Coefficient of determination test outcomes.

Model	R	R Square	Adjusted R Square	Std. Error of The Estimate
1	0.940 ^a	0.884	0.878	2.33113

The R Square (R_2) value in Table 4 is 0.884 or 88.4%. This indicates that the ability of independent variables such as farmer characteristics, motivation, and external environment in explaining the competence of beef cattle farmers in Karanganyar Regency is 88.4%, while the remaining 11.6% is assumed to be explained by other variables not studied, such as farm size and the cosmopolitanism level of farmers.

3.6 F-test

The F test is intended to determine the level of significance of independent variables in simultaneously influencing dependent variables. The level of significance commonly used in research is 5%. The test outcomes of the T test in this research be able to drawn in Table 5.

Table 5. Outcomes of the f-test.

Model	Sum of Squares	df	Mean of Squares	F	Sig.
<i>Regression</i>	2329.753	3	776.584	142.908	<0.001 ^b
<i>Residual</i>	304.313	56	5.434		
Total	2634.067	59			

The F test results in Table 4 show an $F_{(calculated)}$ value of 142.908. The $F_{(table)}$ value of this study with $N=60$ is 2.766. The data obtained in this study shows that the $F_{(calculated)}$ value is greater than the $F_{(table)}$ value, so it can be concluded that the variables of farmer characteristics, motivation, and external environment) simultaneously influence the competence of beef cattle farmers in Karanganyar Regency.

3.7 T-test

The T-test aims to analyze the extent to which the independent variables significantly influence the dependent variable partially. The $T_{(table)}$ value in this study with $df=56$ is 1.673. The test outcomes of the F test in this research be able to drawn in Table 6.

Table 6. Outcomes of the t-test.

Variables	T _{count}	Significance	Description
Personal Characteristics (X ₁)	6.923	<0.001	Substantial
Motivation (X ₂)	11.135	<0.001	Substantial
External Environment (X ₃)	3.648	<0.001	Substantial

The T test results in Table 5 show that the Tcount value of the farmer characteristics variable is 6.923, the motivation variable is 11.135, and the external environment variable is 3.648. Overall, the independent variables in the study have a T_(count) value > T_(table), so it can be interpreted that farmer characteristics, motivation, and the external environment partially influence the competence of beef cattle farmers in Karanganyar Regency.

3.8 Classical Assumption Test

Based on the results of normality testing using the *Kolmogorov-Smirnov non-parametric* test, which produced an *Asymp. Sig (2-tailed)* value of 0.200, which is greater than the significance value of 0.05. This indicates that the data is normally distributed. In general, a regression model can be said to be free from multicollinearity if it has a *tolerance* value > 0.10 and a *variance inflation factor (VIF)* value < 10. Thus, the results of the multicollinearity test show that there is no multicollinearity in each independent variable in this study. The criteria for a regression model to be considered free of heteroscedasticity is when *the scatterplot* does not form a clear pattern and is scattered above and below the number 0 on the Y-axis. Thus, the results of the heteroscedasticity test show that the regression model in this study does not exhibit heteroscedasticity.

3.9 Relationship between Personal Characteristics and Farmer Competence

Based on the results of hypothesis analysis using the t-test, personal characteristics have a positive and significant effect on the competence of beef cattle farmers in Karanganyar Regency. The educational level of farmers in the study location is still in the moderate category, as the majority are junior high school graduates, but there are also quite a few who have reached senior high school education. Beef cattle farmers in Karanganyar Regency actually already have good knowledge, but many still do not fully understand the skills needed to manage their farming businesses, ranging from feeding methods, barn management, disease control and prevention, to financial management. Education can shape a mindset that influences skills, knowledge, and useful adoption to improve the quality of their work [8].

Farming experience and the number of livestock owned can be major factors that influence a farmer's ability to run their business. The majority of beef cattle farmers in Karanganyar Regency already have considerable experience in running their livestock businesses. Farmers who have been in the business for a long time have more knowledge than farmers who have just started their businesses. This is because every farming business will encounter problems, so experienced farmers who tend to have large numbers of livestock generally know more about solutions to problems in farming. Livestock businesses can essentially grow if the farmers have additional skills and talents based on their experience in running their livestock businesses. In the past research, the competence of a farmer can also be seen from the number of livestock they own, because the more livestock they raise, the more knowledge and skills they have in managing their livestock business [9]. Age, education level, farming experience, and number of livestock are essentially crucial factors in

improving farmers' knowledge and skills in increasing livestock productivity and business financial management. Therefore, the characteristics of each farmer need special attention in order to improve the performance of the livestock business being run.

3.10 The Relationship Between Motivation and Farmer Competence

Based on the results of hypothesis analysis using the t-test, it shows that motivation has a positive and significant effect on the competence of beef cattle farmers in Karanganyar Regency. In this study, the measurement of motivation was based on Maslow's theory of motivation, which provides an understanding that the more a person has the ability to satisfy their higher needs, the more that individual will be perceived as having the ability and performance to achieve their individuality [10]. Farmer motivation based on this theory includes physiological needs, safety, social needs, esteem, and self-actualization. Motivation is essentially closely related to the success and performance of a business. This implies that a farmer with high motivation will certainly continue to strive to improve their abilities, knowledge, and skills in order to improve the performance of their farming business. Conversely, if the farmer's motivation tends to be low, it will affect their behavior and mindset in developing their farming business.

The majority of respondents in this study earn their living as beef cattle farmers. This indicates that beef cattle farmers in Karanganyar are highly motivated and dedicated to meeting their physiological needs by running their beef cattle farming businesses. Farmers are generally motivated to continue developing their farming businesses in order to meet the three basic needs of their family members, namely food, clothing, and shelter. In addition, beef cattle farmers in villages also tend to increase their savings in the form of livestock, which can be sold at any time in the future to meet sudden needs. Livestock savings have become a common practice for smallholder farmers to meet urgent needs, such as funding education and family celebrations.

The motivating factors arising from a farmer's need for security generally include climatic conditions that are suitable for supporting livestock productivity, an environment that is safe from livestock theft and wild animals, cleanliness of the barn, and a barn location that does not disturb the local community. A comfortable environment around the farm will certainly affect a farmer's enthusiasm and work ethic in developing their business. In general, the work environment can improve a person's abilities and skills at work. Previous studies have also explained that a clean pen environment can prevent fear and anxiety and improve farmers' concentration in caring for their livestock [11].

When physiological needs and a sense of security have been met, social needs arise that must be fulfilled in order to interact with other people. The social needs of beef cattle farmers in Karanganyar Regency are generally formed through socializing with other farmers, sharing information and knowledge with other farmers, and participating in various activities held in the local farming community. People tend to be motivated to socialize by joining a group or organization as a forum for discussion and problem solving in their neighborhood. In general, farmers who build good relationships with many other farmers tend to have greater opportunities to explore their knowledge and skills, especially in absorbing information and technology in the field of animal husbandry [12].

Recognition in the community for achievements, praise and support that build self-confidence, and a sense of being valued by the surrounding community are part of the need for recognition for farmers. Beef cattle farmers in Karanganyar Regency tend to be more motivated and enthusiastic about pursuing their livestock business activities when given positive responses such as praise and moral support for their efforts. Farmers generally feel proud of their achievements when they receive recognition from the people around them. Basically, every performance in livestock business activities refers to a farmer's motivation

to participate in supporting the government's program in creating sustainable livestock development. Motivation plays a big role in every individual's mindset and attitude. Without motivation, individuals are considered incapable of taking actions that lead to success.

The ability of farmers to solve problems in their businesses, as well as their participation in training activities to improve their knowledge and skills, is a manifestation of the need for self-actualization. Although farmers in Karanganyar Regency still rarely receive extension materials from agencies or the government, the independence of farmers who have been able to find solutions to problems in their livestock businesses, especially during the Foot and Mouth Disease outbreak, shows that farmers in Karanganyar Regency are quite open to new knowledge and skills from the outside world, such as social media, experienced large-scale farmers, and veterinarians. One of the main factors that support the performance of a farm is the quality of its human resources, in this case, the farmers. This is because farmers' limited access to information and knowledge can trigger a decline in livestock productivity and a setback in their business.

3.11 The Influence of the External Environment on Farmer Competence

Based on the results of hypothesis analysis using the t-test, it shows that the external environment has a positive and significant effect on the competence of beef cattle farmers in Karanganyar Regency. The external environment can be defined as everything that comes from outside that can influence the competence of beef cattle farmers in Karanganyar Regency. The external environment analyzed in this study includes support from livestock extension workers, livestock groups, and capital institutions. Livestock extension is a form of effort to disseminate informal education about livestock science to a group/individual of farmers, with the aim of making farmers more educated in raising their livestock. Basically, education such as extension aims to increase the knowledge and skills of farmers so that in the future they will be able to realize sustainable livestock development [13]. Extension is generally used as a bridge in the process of disseminating education from the government to farmers. Although the frequency of visits by livestock extension workers is still uncertain, beef cattle farmers in Karanganyar are very enthusiastic about the material provided. This is because the farmers want to improve their competence so that they can build successful livestock farms in the future. In general, one of the factors that influence extension workers to rarely provide education to farmers is the lack of incentives and rewards from the government for extension workers. Extension workers are expected to be able to stimulate the mindset, attitude, behavior, insight, and skills of farmers.

The presence of livestock groups is basically able to improve the ability of farmers to increase the performance of their livestock businesses. Training in livestock groups generally aims to improve the structure and function of groups that lead to the goal of developing service functions in the livestock sector from upstream to downstream [14]. The majority of beef cattle farmers in Karanganyar Regency have joined livestock groups so that they have colleagues with whom they can exchange information and knowledge about their livestock businesses. Through livestock groups, farmers are expected to build good communication with other farmers, thereby bringing benefits such as knowledge sharing, increased livestock production, and the resolution of various problems in the livestock business. This is in line with the main functions of livestock groups, which are to serve as learning classes, cooperation vehicles, and production units for their members.

A common problem among beef cattle farmers, especially those with small-scale businesses, is difficulty in accessing capital loans and credit. This makes it difficult for farmers to provide livestock seeds, as well as facilities and infrastructure for their livestock businesses. Financial institutions are generally hesitant to provide financial assistance to farmers because the scale of livestock businesses tends to be small, so financial institutions

do not want to take the risk that farmers will be unable to repay their loans in the future due to a decline in their business. Basically, limited funds in a livestock business can affect the productivity of the livestock. Beef cattle farmers in Karanganyar Regency showed great enthusiasm for the existence of financial institutions because they believed that with capital assistance, the scale of their livestock businesses could be expanded. There are several main functions of financial institutions for agricultural and livestock businesses, including 1) increasing the economic value of the business; 2) accelerating the growth rate of the business; and 3) reducing the risk of failure in the business [15]. The intervention of financial institutions in livestock businesses is expected to improve the competence of livestock farmers, which in turn will improve the economy of the livestock businesses they run.

4 Conclusion

Based on the research conducted, the following conclusions can be drawn:

- a. Personal characteristics such as age, education level, farming experience, number of family members, number of livestock owned, and livestock ownership status can influence the level of competence of beef cattle farmers in Karanganyar Regency.
- b. Motivation based on needs is basically correlated with the level of competence possessed by beef cattle farmers in Karanganyar Regency.
- c. External factors affecting farmers, including support from livestock extension workers, livestock groups, and capital institutions, can influence the competence of beef cattle farmers in Karanganyar Regency.

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