Research Article

Factors Influencing the Innovation Adoption Process of Jabres Cattle Farmers in Brebes Regency, Central Java Indonesia

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Abstract | Jabres cattle farmers in Brebes Regency engaging in small-scale and conventional farming systems commonly face challenges such as slower reproduction rates, insufficient genetic quality, limited feed availability during the dry season, and difficulties in managing livestock diseases. The government has implemented numerous initiatives to address these issues; nevertheless, farmers have not completely adopted the innovations. This study aims to identify the stages and the key factors influencing the adoption of innovations among Jabres cattle farmers in Brebes Regency, Central Java. The research location was determined purposively Bantarkawung Subdistrict, Brebes Regency, Indonesia, which is the breeding centre of Jabres cattle. The villages were selected through purposive sampling, focusing on those with Jabres cattle farmer groups, including Pangebatan, Pengarasan, Kebandungan, and Karangpari Villages. Respondents were selected purposively on the criteria of being active Jabres cattle farmers, and members of a group, with a total of 131 farmers included as respondents. Data were collected through interviews using questionnaires, with variables consisting of innovation adoption (Y), age (X1), education level (X2), farming experience (X3), and duration of membership (X4). The data was then analysed using descriptive analysis and multiple linear regression using SPSS. Most farmers are of productive age, with over 20 years of farming experience but limited formal education. The most adopted innovations are vaccination and artificial insemination. The implementation cost is the main constraint in the innovation adoption process among Jabres cattle farmers. The F-test results show that all independent variables (X) significantly influence the innovation adoption process among Jabres cattle farmers in the Brebes Regency (R^2 value: 26.91%). The t-test results indicate that only the variable of group membership duration significantly affects the innovation adoption process.

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Introduction

Indonesia has prodigious natural resources and diversity, including various local livestock breeds that could contribute to the animal source protein self-fulfilment program. One of those is Jabres cattle. Jabres cattle represents a potential local livestock genetic resource in Indonesia. This indigenous cow breed was established in Brebes Regency, Central Java. The potential of Jabres cattle farm is developed to contribute significantly to fulfilling national human needs for meat and animal protein. The average beef consumption in Indonesia remains low, averaging 0.27 kg per person per year (Suryana *et al*., 2019). The consumption is very low when compared to other Asean countries. National meat production through local breeds was expected to help improve consumption. The promising potential of genetic resources in development encounters a problem when most farmers run their livestock farms conventionally with a relatively low level of ownership. The strategy to improve this condition is to help the farmers overcome the problem by adopting farming innovation (Montes de Oca Munguia *et al*., 2021; Masere and Worth, 2022).

Adopting innovations is crucial for enhancing the productivity and welfare of farmers. By adopting innovation, farmers could take a step ahead in improving the farming system, which leads to increasing efficiency, productivity, income, and well-being. Surya *et al*. (2021) assert that technological innovation influences productivity enhancement. Diverse improvements are introduced to farmers to enhance the quality of their farms, including feed innovation, waste management, reproduction, and animal healthcare (Muatip *et al*., 2024). Innovations in manure processing are anticipated to assist farmers in achieving zero-waste farming, which is presently the primary issue in livestock development initiatives. Silage innovation, preserving forage through fermentation, can prevent feed scarcity during the dry season, alleviating the need for farmers to source fodder from far locations. Artificial insemination may enhance the genetic quality of Jabres cattle. Vaccination innovation seeks to avert the infection of livestock by lethal diseases. Those innovations serve as a foundational framework for farmers to develop their livestock farming.

Farmers must take multiple steps to implement or adopt innovations. The phases of innovation adoption include awareness, interest, evaluation, trial, and adoption. The study of innovation adoption theory is particularly intriguing for Jabres cattle producers, as traditional farming practices remain popular in Jabres cattle farming (Vanclay and Lawrence, 1994; Dissanayake *et al*., 2022). Previously, Guntoro *et al*. (2016) studied innovation adoption, focusing on goat farmers in the DI Yogyakarta region and the characteristics of farmers that affect the adoption of innovations. In addition, Takanjanji and Kaka (2022) researched pig farmers in the East Nusa Tenggara region regarding the impact of farmer characteristics on the adoption of insemination technology. The study by Pambudy (2018) utilizing the PLS-SEM method with the Likert scale questionnaire mentioned that farmers entrepreneurial characteristics could increase the adoption of innovation in Madura that consists of knowledge, persuasion, implementation, and confirmation.

Previous research about adoption innovation reported only the final results and did not mention the stages of adoption innovation that the farmers were in. This study explores the final result of adoption innovation and observes its process stage-by-stage. The stage of adoption innovation is essential to describe because it is the psychological phase the farmers face before they decide to adopt or decline an innovation. This study also provides the most adopted innovation and the constraints that farmers face when adopting innovation. The policymaker needs to establish the most fit extension program. Our research distinguishes itself from prior studies by examining the circumstances of Jabres cattle farmers at a specific phase in the innovation adoption cycle, aiming to offer more refined advice to stakeholders for decision-making. This research employed a group theory methodology since the Jabres cattle farmers in the Brebes Regency are predominantly affiliated with the farmer group. Farmer groups serve as a learning source, production unit, and cooperation (Falo, 2016). The existence of organizations facilitates farmers' adoption of innovations. Farmers who have been members of farmer groups for an extended period generally possess superior access to information and innovations than those who have recently joined. This research is essential to ascertain the acceptance of innovations among Jabres cattle farmers and the supporting elements involved. Based on the explanation above, This study aims to analyze the

factors influencing innovation adoption among Jabres cattle farmers, focusing on demographic characteristics and length of group participation as member as key variables.

Materials and Methods

Location and time

The study used a survey method to discover farmers' adoption of innovation and explain the determining factor. The research location was determined purposively in the Bantarkawung subdistrict, Brebes Regency, Indonesia, as the Jabres cattle development and breeding centre (-7.208433055982429, 108.91296165082922). The villages were selected through purposive sampling, specifically targeting villages with the active cattle groups that focus in Jabres cattle breeding, including Pangebatan, Pengarasan, Kebandungan, and Karangpari. The research was conducted during May-June 2024.

Data collection

The respondents were determined using the Slovin formula with a 10% margin of error, yielding 131 respondents. The selection method employed was purposive sampling, targeting active members of the Jabres cattle farmers group with the criteria of being active in a group activity for the last two months and joining an extension program held by the government to improve group knowledge, skill, and attitude. Data were collected through observation and face-to-face interviews utilizing structured questionnaires. The variables in this study included age (years) (X1), education level (years) (X2), farming experience (years) (X3), duration of membership (year) (X4), and the innovation adoption process (%) (Y). The observed innovations in this study were artificial insemination, forage silage making, solid organic fertilizer processing, and livestock vaccination. Based on information from The Agency of Animal Husbandry and Health, Brebes Regency, those four innovations were selected as the latest and most important extension programs. There were 5 steps in the innovation adoption process, and every step the farmers applied was valued by 20%. The collected data were analysed using qualitative descriptive analysis to summarize farmer characteristics and multiple linear regression to determine factors influencing farmers' adoption of innovation using the SPSS application.

Results and Discussion

Jabres cattle farmers characteristic

A Jabres cattle farmer is a farmer who is directly engaged in the care and growth of Jabres cattle. Jabres cattle have remarkable tolerance to the hot weather of Bantarkawung subdistrict, Brebes Regency. The respondents of this research are active members of the farmer group (131 farmers) from the villages of Karangpari, Kebandungan, Pengarasan, and Pangebatan. The characteristics of Jabres cattle farmers in Bantarkawung subdistrict encompass educational level, age, duration of farming experience, and duration of joining the farmer group which are presented in Table 1.

Table 1: *Respondents characteristic.*

Farmer profile	Amount (person)	Percentage (%)
Educational level		
Unschooled/not graduated	17	13
Elementary	86	65.6
Junior high school	20	15.3
Senior high school	3	2.3
Undergraduate	5	3.8
Age		
Productive (15-64 years)	119	90.8
Non-Productive (≥64 years)	12	9.2
Duration of farming		
1-10 years	40	30.5
11-20 years	41	31.3
≥20 years	50	38.2
Duration of joining the group		
<10 years	38	29
≥10 years	93	71

Table 1 indicates that 78% of Jabres cattle farmers possess a low level of education. As many as 13% of farmers did not attend or graduate, while 65% graduated from an elementary school. The low educational attainment among Jabres cattle farmers is attributed to parental guidance that emphasises livestock farming above formal education. The level of education is crucial for self-development and significantly impacts an individual's thinking. Gusti *et al.* (2021) assert that farmers with higher educational attainment exhibit a superior attitude to those with lower education levels. In addition, Muatip *et al.* (2019) stated that a farmer's capacity to comprehend new information or knowledge significantly depends on the farmer's education level.

The average age of Jabres cattle farmers is 52.44 years old and ninety per cent of Jabres cattle farmers are within the productive age (15 to 64 years), while 9% are beyond this productive period. Interviews conducted reveal that farmers of non-productive age continue to raise cattle to occupy their leisure time. The age of farmers can influence their performance and enthusiasm in running their farming. Prasetya and Putro (2019) assert that the age of farmers influences work productivity since those who have surpassed the productive age have diminished energy and physical strength. Farmers of productive age seem more receptive to information on innovation than their non-productive counterparts. Mulyawati *et al.* (2016) noted that younger farmers typically exhibit more incredible passion and a quest for knowledge, leading them to accept innovations despite limited agricultural experience rapidly.

The average value of Jabres cattle farmers' farming experience is 21.30 years. Most cattle farmers have engaged in farming for an extended period, with some exceeding 20 years, perhaps due to their initiation into breeding at a young age. The longer the farmer's tenure, the more experience and knowledge they have regarding business development. Hidayah *et al.* (2019) assert that increased farming experience correlates with higher technology adoption; and Kurnia *et al.* (2019) noted that prolonged framing makes farmers more receptive to the knowledge provided by extension agents, facilitating a shift in their customary maintenance practices.

The duration of farmers group membership is 11.67 years. As many as 71% of Jabres cattle farmers have participated in groups for over a decade. The duration of farmers' membership in the group was due to their adherence to government recommendations to join an organisation focused on the preservation and sustainability of Jabres cattle genetics. Kaumbata *et al.* (2021) stated one of the objectives of farmers group formation is to conserve local livestock in rural regions. Farmers who have participated in groups for an extended period typically find it simpler to adopt innovations, as they have acquired substantial knowledge and information from extension workers inside the group. Adawiyah and Mulyani (2017) assert that communication within farmer groups, encompassing information access, collective learning, collaboration, and discussion, is highly valued by farmers since it is perceived to enhance productivity and bring substantial benefits.

Innovation adoption process of jabres cattle farmers

The innovation adoption process refers to farmer groups' actions to embrace the latest technologies. Farmers who recognise innovations will subsequently want to learn about them and embrace the latest advancements. Lamarang *et al.* (2017) describe the innovation adoption process as a sequence experienced by farmers, leading to behavioural changes through various stages: technology introduction, attention, assessment and evaluation, trial, and innovation adoption.

Table 2 illustrates the phases of innovation adoption by farmers for artificial insemination, forage silage making, solid organic fertiliser processing, and livestock vaccination for Jabres cattle in the Brebes Regency. The adoption rate of artificial insemination innovations among Jabres cattle farmers is significant, with 66% having adopted the practice and 64% maintaining it. The primary motivation for most farmers to persist with the artificial insemination method is its high success rate in enhancing genetic quality. Jabres cattle is the most favoured breed for this practice among Jabres cattle farmers. Pasino *et al.* (2020) assert that artificial insemination is a technology used to enhance cattle quality and genetic superiority. According to Razak *et al.* (2021), the success rate of pregnancy through artificial insemination is higher than that of natural mating.

Table 2: *Stages of innovation adoption.*

Innovation	Stages						
	Awareness (%)	Interest (%)	Evaluation (%)	Trial (%)	Adoption (%)	Continuing (%)	Discontinuing (and)
Artificial insemination	100	100	100	100	66.41	64.12	35.87
Silage	100	100	100	74.80	51.90	-	100
Solid organic fertiliser	100	100	100	66.41	56.48	23.66	76.33
Vaccination	100	100	100	100	100	100	-
Average						46.94	53.05

Table 3: *Problems in the continuation and discontinuation stages of innovation adoption.*

Innovation	Problems					
	1	2	3	4	5	6
Artificial insemination	-	100%	-	-	-	66.41%
Silage	3.81%	35.11%	94.65%	99.23%	51.90%	23.66%
Solid organic fertiliser	29%	35.11%	30.53%	54.19%	34.35%	27.48%
Vaccination	-	-	-	-	-	-
Average	8.2%	42.55%	31.29%	38.35%	21.56%	29.38%

Notes: 1= complex technology; 2= implementation cost; 3= hard-obtained supporting materials; 4= long manufacturing time; 5= infrastructure materials; 6= insufficient performance/mentoring of extension workers.

Table 4: *Assumption classic test.*

Classic Assumption	Test	Value/ probability	Result
Normality	Jarque-Bera	0.1173	Normal distribution
Heteroscedasticity	Harvey	0.0914	Homocedasticity
Multicolinearity	VIF		
Age	VIF	1.089556	<10
Educational level	VIF	1.031404	<10
Farming experience	VIF	1.218993	<10
Duration of membership	VIF	1.156245	<10

Approximately 36% of farmers discontinued using artificial insemination, reportedly due to a preference for natural mating, as they can directly know the quality of the male cattle. The farmers prefer natural mating because some have encountered trauma from unsuccessful animal births resulting from insufficient knowledge and experience with artificial insemination. This finding supports research by Campuzano *et al.* (2023), who stated that societal issues, including farmers' lack of knowledge, epistemic closure, unrecognised challenges, educational attainment, unskilled labour, and disinterested markets, hinder the optimal implementation of innovative systems.

Table 3 describes farmers' difficulties in implementing artificial insemination technology, specifically financial limitations and insufficient support from extension officers. Support from extension officers may result in farmers possessing sufficient information, leading to a lack of awareness regarding the significance of enhancing the Jabres cattle population through artificial insemination technology and the appropriate conditions for successful artificial insemination. Then, the growth of Jabres cattle should be maintained to satisfy meat consumption demands in Indonesia. The study's results aligned with Setiana's *et al.* (2020) statement that farmers' economic factors significantly influenced artificial insemination adoption due to the cost farmers needed to pay for the service. Repeated breeding, the risk that could occur because of artificial insemination failure, could increase the farming cost and reproduction time efficiency (Musriati *et al.*, 2024).

Silage-making was introduced to the farmer group members. Still, the adoption rate among farmers was merely 52%, and none of the farmers sustained the innovation until the completion of this research. This study revealed that farmers discontinued silage-making adoption due to the perception that natural supplies for animal feed were enough and plentiful, coupled with the lengthy process of silage production, which required around 14 days for completion. Handajani (2014) states that silage undergoes fermentation for 14 days in a sealed container. Acquiring materials and infrastructure for silage feed is challenging due to a need for suppliers or vendors catering to farmers' requirements.

Organic fertiliser comprises organic components, such as vegetable and cattle waste and other leftover living organisms (Juliani *et al.*, 2017). Jabres cattle farmers who continued to adopt the solid organic fertiliser innovation were 24%. Most Jabres cattle farmers stopped using solid organic fertiliser due to social considerations, which caused them to distribute it

without compensation, thus diminishing sales profits. Kluvankova *et al.* (2021) assert that social innovation in rural regions might be obstructed by prevailing social norms, which may oppose social change and restrict the participation of local stakeholders, ultimately influencing the implementation and sustainability of innovations.

Table 3 indicates that the primary issues contributing to the limited adoption of solid organic fertiliser innovations among Jabres cattle farmers are the long preparation duration and costs. Fitri *et al.* (2021) state that solid organic fertiliser is produced during a composting period of three weeks. The work-intensive method might elevate costs and manpower demands, which may not align with the benefits gained, resulting in decreased enthusiasm among farmers for solid organic fertiliser improvements.

The adoption rate of vaccine innovation among Jabres cattle farmers in Bantarkawung Subdistrict is very significant, as all respondents had adopted and maintained vaccination practices up to the time of this research. This study revealed that all farmers continued to adopt vaccinations due to the government programme that provides vaccines for free and follows farmers' needs. Navarro-Valverde *et al.* (2022) assert that governmental support is crucial for effectively adopting innovations in rural regions, promoting business establishment, job development, and partnerships with educational institutions to enhance project results.

To sum up, farmers have fully adopted vaccination stages (100%), whereas there has been no continued adoption of silage making (0%), with difficulty in obtaining materials (94.65%) and long manufacturing time (99.23%) as their main problems. Regarding the adoption of artificial insemination, 64.12% remained whilst discontinuing since it required high cost (100%); solid fertiliser adoption reached 76.33%, with long manufacturing time (54.19%) standing as farmers' main problem. The average percentage of farmers who discontinued adopting innovations (53.5%) exceeded that of those who continued adoption (46.94%).

Multiple linear regression test

The classical assumption test comprises a series of evaluations conducted in regression analysis to verify that the model meets the fundamental assumptions necessary for generating correct parameter estimates. It comprises the normality, Harvey model heteroscedasticity, and multicollinearity tests. The traditional assumption test is conducted before hypothesis testing to determine the econometric validity of the regression model equation (Purba *et al.*, 2021). Classical assumption testing involves assessing normality, multicollinearity, heteroscedasticity, and autocorrelation (Table 4).

The normality test evaluates whether confounding or residual variables in the regression model adhere to a normal distribution (Sholihah *et al.*, 2023). The null hypothesis of the Jarque-Bera test posits that the data adheres to a normal distribution. The Jarque-Bera test statistic adheres to the chi-square distribution with two degrees of freedom (df = 2). According to the chi-square distribution with 2 degrees of freedom, the conventional critical threshold for the p-value is 0.05, indicating that if the p-value is less than 0.05, the null hypothesis is rejected, or the data does not conform to a normal distribution. If the p-value exceeds or exceeds 0.05, the null hypothesis is accepted, indicating that the data adheres to a normal distribution. The table indicates a p-value of 0.117277, suggesting that the data adheres to a normal distribution.

An effective regression model shows homoskedasticity, indicating the absence of heteroskedasticity. When the variance is unequal, it is referred to as heteroscedasticity. The heteroscedasticity test is conducted on the regression model to assess the variance inequality of residuals across observations (Juliandi et al., 2014). The Harvey test involves regressing the absolute value of the residuals against the independent variables (Ghozali, 2018). The criterion for decision-making is that if the p-value ≥ 0.05, then H0 is rejected, indicating the absence of a heteroscedasticity issue. If the p-value is less than or equal to 0.05, then the null hypothesis (H0) is rejected, indicating the presence of a heteroscedasticity issue. The test results in the table indicate a value of 0.0914, signifying the absence of heteroscedasticity or homoscedasticity issues.

Results of the multicollinearity test can be derived by examining the Variance Inflation Factor (VIF). A regression model uses the Variance Inflation Factor (VIF) to identify multicollinearity among independent variables (Ghozali, 2016). As outlined by Ghozali (2016), the criteria for determining multicollinearity indicate that if the VIF value is

less than 10 or the Tolerance value exceeds 0.01, multicollinearity is deemed absent. Multicollinearity is indicated if the VIF value exceeds 10 or the Tolerance value is less than 0.01. Multicollinearity develops when the correlation coefficient of each independent variable exceeds 0.8. If the correlation coefficient of each independent variable is less than 0.8, then multicollinearity is absent. The table's results indicate no significant evidence of multicollinearity, as all variables exhibit a Centred VIF below 10. The findings of this study's multiple linear regression model adhere to the traditional assumption criteria.

Adopting contemporary innovations is essential for advancing and developing businesses, particularly animal livestock. The adoption of innovations can be affected by farmers' characteristics (Rogers, 2003). The independent variables are age, group membership duration, educational level, and farming experience. At the same time, the innovation adoption process serves as the dependent variable, which will be analysed using multiple linear regression equations alongside various tests, including the F test, the coefficient of determination (R^2) test, and the t-test.

Table 5 presents the F test, the coefficient of determination (R^2) test, and the t-test. The F test seeks to determine if the independent factors collectively or simultaneously impact the dependent variable (Darma, 2021). Decision-making criteria Ho is accepted if significance > 0.05 (no effect), Ho is rejected if Significance <0.05 (effect). The F-test results in Table 5 indicate a value of 0, signifying that the age variable, duration of farmers' group membership, educational level, and duration of farming collectively influence the innovation adoption variable.

Determination analysis quantifies the extent to which variable X influences variable Y. This study quantifies the simultaneous impact of independent variables on the dependent variable (Mardiatmoko, 2020). The R-square test results indicate a value of 0.2691, signifying that the independent variable accounts for 26.91% of the variance in the dependent variable. The remaining 73.09% is attributable to external variables not considered in this study. The results demonstrate that the R-square value is comparatively low. Other studies regarding innovation adoption empolyed R-square test possessing low value were Suvedi *et al.* (2017) and Kumar *et al.* (2020) conducted in Nepal. The low R-square value suggests that the findings of this investigation indicate possibility. Considering additional variables, such as extension services, satisfaction with extension officers, and the provision of production assistance, may alter the R-square test results.

The t-test seeks to determine if the independent variable influences the dependent variable, either partially or individually (Darma, 2021). A t-value of less than 0.05 indicates a substantial influence of one independent variable on the dependent variable. A t-value greater than 0.05 indicates the absence of a significant effect of the independent variable on the dependent variable. The t-test results in the table indicate that the variable representing the duration farmers participate in the group (-0.121270) shows a negative effect. In contrast, the duration of breeding (0.002890) significantly influences the innovation adoption process.

Table 5: *F test, coefficient of determination (R2) test, and t-test.*

F test				
F-Statistic	11.59839			
Probability	0.00	Results	Significant	
R-Square				
R-Square	0.2691			
Adjusted R-Square	0.2459			
Variable	**coefficients**	**Std. Error**	**t-Statistic**	**Prob.**
LN Age	0.023332	0.034358	0.679102	0.4983
LN Education	0.013337	0.010714	1.244794	0.2155
LN farming experience	0.002890	0.011284	0.256144	0.7983
LN duration of membership	-0.121270	0.019034	-6.371069	0.000*
C	4,529,098	0.140379	32.26326	0.000

*Notes: * = independent variable has a significant effect.*

Multiple linear equations are one of the statistical models that analyse the relationship between the dependent variable, namely the innovation adoption process, and the independent variables consisting of age, length of time the farmer has been in the group, education level, and length of farming. Multiple linear equations provide the dependent variable a linear function of the independent variables that influence it. Padilah and Adam (2019) assert that multiple linear regression is a technique employed to examine the association between a single dependent variable and two or more independent variables. The regression equation is derived from the coefficient values presented in Table 5.

$$Y= 4{,}529{,}098 - 0.023332\,X1 + 0.013337\,X2 + 0.002890\,X3 - 0.121270\,X4$$

The probability score of the age variable (X1) in Table 5 is 0.4983, indicating that the age variable (X1) does not significantly influence the innovation adoption process. Younger farmers are believed to be slower in adopting innovation due to their inclination to adhere to familial or communal traditions and teachings. The impact of extension officers in motivating young farmers remains limited due to the extensive work areas, coupled with challenging transportation access, which limits their ability to facilitate the innovation adoption process. This finding is in line with the study conducted by Camara *et al.* (2019) that emphasise that social factors, such as familial or communal customs, may obstruct the adoption of innovations by young farmers.

The variable level of education (X2) has a p-value of 0.2155, indicating that it does not significantly influence the innovation adoption process. It is hypothesised that farmers with low educational levels depend more on experiential knowledge and adhere primarily to the guidance of the group leader, needing a profound comprehension of innovative information. The insufficient literacy skills among Jabres cattle farmers came from their predominantly poor educational levels (78.6% of the farmers graduated from elementary schools and unschooled) affecting their ability to assess and comprehend new information, particularly in adopting innovations. This finding supports research conducted by Mutenje *et al.* (2020) who assert that an insufficient educational level affects farmers' decision-making, negatively affecting livestock technology adoption. Education enhances farmers' capacity in decision-making and affects their preferences for technology investments.

The variable of duration farming (X3) shows no significant impact on the innovation adoption process, as indicated by the probability value in Table 5, suggesting that the longer the farmer's duration, the lower the innovation adoption level. This situation occurred because most Jabres cattle farmers intend to run their animal farming for social and long time investment reasons instead of primary income. Livestock ownership indicates individuals' social class; the animals are liquid assets that can be sold when the farmers need substantial funds. These reasons are believed to be the significant factor in the low innovation adoption among Jabres cattle farmers. Another reason is the need for more government involvement in Jabres' cattle branding technique to enhance selling value. This finding is in line with research conducted by Masi *et al.* (2022), who elucidated that farmers' emphasis on savings may impede the adoption of innovations since perceptions of complexity and socio-economic aspects engender resistance towards implementing livestock technology, hence constraining farmers' desire to invest in innovation.

The variable of duration joining the group (X4) with a score of 0.000 shows a substantial influence on the variable of innovation adoption. Still, it has a negative coefficient (-0.1212), which suggests that the longer farmers join the group, the lower the degree of innovation adoption. This condition is attributed to the increasing inactivity of long-standing farmers within the group, who exhibit a greater affinity for traditional practices. The lack of assistance from extension workers may cause the group's function not to align with the group's objectives. In addition, the government also needs more support for extension workers, hindering group administrators from becoming self-help extension workers, which is essential for farmer groups to attain their objectives and positively influence the innovation adoption process. Ejem *et al.* (2023) articulated that the extension system is unsuccessful, primarily due to its one-way communication paradigm and insufficient support from extension workers, which impedes knowledge dissemination and delays innovation adoption.

The author also suspects that the Jabres cattle farmers

group is not performing its intended role because group extension activities focus more on technical innovation. Technical assistance without addressing the social aspects of the group can result in suboptimal group motivation and cooperation, and a lack of perceived group benefits. Farmers' groups play a crucial role as facilitators in providing production inputs and helping farmers access production inputs and agricultural tools, which can improve the efficiency and effectiveness of farming practices. Farmers' groups facilitate training and focus group discussions (FGDs), allowing farmers to share experiences and knowledge about new technologies. This enhanced function can encourage farmers' groups to promote comprehensive technology adoption further, from production to marketing (Arsyad *et al*. 2018). Another report by Maulu *et al*. (2021) states that farmers' groups are not only the object of extension activities but also serve as a means of managing training and information, whose members must support each other in implementing innovations.

As a summary of this subchapter, Jabres cattle farmers' age, education, farming experience, and duration of farmers' group membership, based on the F test, simultaneously influence innovation adoption. At the same time, the t-test result showed that only the duration of farmers' group membership significantly negatively influences the adoption of innovation. Several independent variables outside this study that can be predictors of the level of adoption of livestock innovations include livestock social networks (Fillippini *et al*., 2020), cultural factors, economic considerations (Llewellyn and Brown, 2020), and dispositional factors (Dessart *et al*., 2019). The government of Brebes Regency needs to create a strategy to engage old members of farmers' groups to adopt livestock farming innovation.

Conclusion

The findings indicated that most Jabres farmers possessed a low level of education, with 17 farmers having yet to attend school nor graduate (13%) and 86 farmers obtaining only an elementary education (65.6%) of the total respondents. The average age of Jabres cattle farmers fell within the productive age range of 15-64 years (90.83%). Jabres farmers have been farming for over 20 years (38.16%). As many as 71% percent of farmers have been members of the group for over ten years. The test results simultaneously stated that the variables of age, duration joined the farmer's group, education level, and duration of being farmers (farming experience) significantly affected the innovation adoption process. The analysis of the coefficient of determination (r2) yielded a result of 26.91%. The partial test results indicate that group membership duration negatively significance influences the innovation adoption process.

This study suggests that an intensive and consistent extension program for the Jabres Cattle group members is necessary to attract them to adopt and re-adopt the innovations. Financial and credit support from the government or other funding agencies is also needed to improve the farmers' motivation to adopt innovation among Jabres cattle farmers in the Brebes Regency.

This study provides limited information regarding the stage-by-stage innovation adoption process of Jabres cattle farmers, including its challenges and influencing factors. Further exploration of various innovations, disparities among livestock farmers, geographical areas, and additional independent variables are essential in future research to enhance innovation adoption among traditional rural farmers.

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Novelty Statement

The novelty of this study is the detailed quantification of each innovation adoption stage (Awareness, Interest, Evaluation, Trial, and Adoption), allowing for multiple linear regression analysis of the stages currently being faced by Jabres cattle farmers (a novelty compared to previous studies). Research on innovation adoption among Jabres cattle farmers has also been unprecedented, making this a novelty in innovation adoption research in the livestock sector.

Author's Contribution

Krismiwati Muatip, Alvin Ankhabit and Danang Nur Cahyo: Conceptualisation.
Krismiwati Muatip, Alvin Ankhabit, Danang Nur Cahyo and Mochamad Sugiarto: Methodology.

Krismiwati Muatip, Alvin Ankhabit, Danang Nur Cahyo, Lis Safitri and Dayu Lingga Lana: Investigation.
Krismiwati Muatip, Alvin Ankhabit, Lis Safitri and Dayu Lingga Lana: Validation.
Krismiwati Muatip, Alvin Ankhabit, Danang Nur Cahyo, Lis Safitri, Mochamad Sugiarto and Dayu Lingga Lana: Article preparation.
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Generative AI and AI-assisted technology statement

Generative AI and AI-assisted technologies were used only to assist in searching for relevant references. The authors are fully responsible for the selection, interpretation, and use of all sources cited in this manuscript

Conflict of interest

The authors have declared no conflict of interest.

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