

Research Article



How Can Livestock Insurance Adoption be Increased? Empirical Evidence from Indonesia

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Abstract | The Cattle Business Insurance Program (AUTS) is a vital risk management tool aimed at protecting Indonesian farmers from livestock-related losses. However, its adoption rate remains low. This study compares the characteristics of adopters and non-adopters of AUTS and identifies key factors influencing adoption decisions. Data were collected from 200 cattle farmers in Yogyakarta Province through structured interviews and analyzed using chi-square tests and Binary Logistic Regression (BLR). Significant differences were found between adopters and non-adopters in terms of age, family size, education, credit access, extension contacts, knowledge of livestock insurance, herd size, and farming experience. BLR results show that AUTS adoption is positively influenced by education ($\text{Exp}^B = 1.207$, $p < 0.01$), extension contacts ($\text{Exp}^B = 3.613$, $p < 0.01$), knowledge of livestock insurance ($\text{Exp}^B = 6.100$, $p < 0.01$), and herd size ($\text{Exp}^B = 2.362$, $p < 0.05$), while age ($\text{Exp}^B = 0.959$, $p < 0.05$) and farming experience ($\text{Exp}^B = 0.947$, $p < 0.01$) have negative effects. These findings underscore the importance of strengthening extension services and prioritizing knowledge-based outreach to encourage wider adoption among cattle farmers.

Keywords | Adoption, Cattle business insurance program (AUTS), Cattle farmers, Extension services, Logistic regression

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INTRODUCTION

Livestock plays a significant role in rural livelihoods and the economies of developing countries (Herrero *et al.*, 2013). Across all provinces in Indonesia, most rural residents keep at least one type of livestock (Smith *et al.*, 2024), with cattle being one of the most commonly raised commodities by rural farmers (Agus and Widi, 2018). For instance, in the Yogyakarta Special Region, the cattle

population reached 322,576 head in 2022 before declining to 230,067 head in 2023, largely due to a foot-and-mouth disease outbreak (BPS DIY, 2023; DPKP DIY, 2023). Gunungkidul Regency consistently recorded the highest cattle population in the province, underscoring the economic and social importance of cattle farming to rural households.

Although livestock farming plays a significant role in rural

communities, it remains highly susceptible to business losses. Previous research has documented economic damages in livestock enterprises caused by disease outbreaks (Jemberu *et al.*, 2014; Rasmussen *et al.*, 2024), natural disasters (Chapagain and Raizada, 2017), and livestock theft (Khoabane and Black, 2012). While the causes of loss may differ, all such events present significant disruptions to farmers' livelihood.

To protect farmers from the risk of business losses, the Indonesian Ministry of Agriculture has developed livestock insurance through the Cattle Business Insurance Program (AUTS). The scheme covers losses caused by calving-related deaths, diseases, accidents, and theft (Directorate General of Agricultural Infrastructure and Facilities, 2022). However, its implementation remains limited. According to the Association of Southeast Asian Nations (ASEAN) Guideline on Agricultural Insurance Implementation, the penetration rate of livestock insurance in Indonesia is still much lower than that of food crop insurance (Stutley, 2022). As of 2022, only 67,436 cattle were insured under AUTS, well below the government's annual target of 120,000 cattle, and significantly disproportionate considering Indonesia has over 4.5 million livestock farmers (Directorate General of Agricultural Infrastructure and Facilities, 2022). In contrast, food crop insurance reached a coverage rate of 13.2%, while livestock insurance covered less than 1.5% of the eligible population (Stutley, 2022).

The low penetration of livestock insurance in Indonesia indicates that farmer adoption remains limited (Devkota *et al.*, 2021). While this does not necessarily imply program failure, it highlights potential shortcomings in implementation, such as limited outreach, unclear benefit communication, and challenges in aligning program incentives with farmer needs. Additionally, concerns have been raised about the sustainability of the program, where claim payouts exceed the premiums collected (Stutley, 2022). These issues are part of a wider national challenge, not limited to specific regions.

This study builds its theoretical framework by synthesizing findings from prior research on agricultural and livestock insurance adoption. Numerous studies have shown that farmer characteristics such as age, education, herd size, credit access, and experience significantly influence the likelihood of adopting insurance schemes (Aidoo *et al.*, 2014; Amare *et al.*, 2019; Chand *et al.*, 2016; Mohammed and Ortmann, 2005; Subedi and Kattel, 2021). These variables are often used as proxies for decision-making capacity, resource access, and risk perception. While these studies may not always explicitly adopt a theoretical model, their patterns are conceptually consistent with Rogers' Diffusion of Innovations theory, which emphasizes that adoption is shaped by individual traits, exposure to

information, and the perceived value of an innovation (Rogers *et al.*, 2014). Empirical studies in Indonesia echo this framework. For example, Paly (2024) found that age, farming experience, and interaction with extension officers significantly influenced insurance adoption in Gowa Regency. Likewise, Riana *et al.* (2020) observed that attitudes, social norms, and the degree of dependence on livestock farming shaped adoption decisions in Bungaya, South Sulawesi. These insights reinforce the relevance of socio-economic, informational, and contextual factors in explaining livestock insurance adoption among Indonesian smallholder farmers.

Despite these valuable contributions, existing studies have been limited to specific districts these studies did not include comparative analysis between adopters and non-adopters, specifically in Yogyakarta, Indonesia. Therefore, this study aims to fill that gap by analyzing the differences in characteristics between farmers who adopt and those who do not adopt livestock insurance and identifying the key factors influencing adoption among cattle farmers in the Yogyakarta Special Region. The findings are expected to inform more targeted and effective policy strategies, particularly in enhancing extension services, improving communication approaches, and designing adoption incentives that are better aligned with farmers socio-economic profiles.

MATERIALS AND METHODS

The study was conducted in Yogyakarta Province, focusing on four districts: Sleman, Bantul, Gunungkidul, and Kulonprogo. These districts were purposively selected because they are among the few areas in Indonesia where the Cattle Business Insurance Program (AUTS) has been actively implemented (Sulaiman, 2018). Their inclusion allows for the observation of both adopters and non-adopters within regions where insurance services are available and accessible, thus providing a relevant context for analysing adoption behaviour.

Primary data collection was carried out from October to December 2023. A convenience sampling technique was used to select farmers who were accessible and willing to participate (Sugiyono, 2014). From a list of farmer groups that had adopted and not adopted livestock insurance, 100 respondents were drawn from each group, resulting in a total of 200 cattle farmers. While this approach enabled efficient data collection, it also introduces a limitation in terms of representativeness. Convenience sampling does not guarantee equal selection probability across the target population and may result in selection bias. Therefore, while the findings provide useful insights into livestock insurance adoption in Yogyakarta, they should be interpreted with caution when generalizing to broader farming populations.

The questionnaire was developed based on prior literature related to livestock insurance adoption and the official guidelines of the Cattle Business Insurance Program (AUTS) issued by the Ministry of Agriculture (Directorate General of Agricultural Infrastructure and Facilities, 2022). To ensure content validity, the instrument was reviewed by two academic experts in agricultural economics and one practitioner from the Yogyakarta Provincial Agricultural and Food Security Office. Their feedback was used to refine item wording, improve clarity, and ensure alignment with the study's objectives. The final questionnaire consisted of structured, close-ended questions covering farmer characteristics, livestock business profiles, and knowledge related to livestock insurance. Knowledge of livestock insurance was assessed using a series of true/false statements that measured farmers' factual understanding of the cattle business insurance program (AUTS). The items covered key aspects of the program, including premium costs, maximum herd eligibility, covered risks (e.g., disease, theft), claim conditions, compensation rules, and participation criteria.

The obtained data were analyzed using STATA version 19, employing chi-square test and binary logistic regression (BLR). Based on the work of Chand *et al.* (2016), the chi-square test is adopted to illustrate the differences in characteristics between adopters and non-adopters. Additionally, BLR is employed to identify the factors influencing the adoption of livestock insurance. BLR is an analysis used when the dependent variable is binary or dichotomous (Hosmer *et al.*, 2013). BLR model formula as follows (Nahayo *et al.*, 2017).

$$\frac{P_i}{1 - P_i} = \frac{Prob(Y_i = 1)}{Prob(Y_i = 0)} = e^{\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki}}$$

Where, P_i is the probability that Y_i takes the value 1 (adoption); $1 - P_i$ is the probability that Y_i is 0 (no adoption); e is an exponential constant. By taking the natural logarithm of both sides of the equation, we obtain:

$$\ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + \epsilon_i$$

Where, L_i stands for logit model, which is linear in X_i as well as in β ; subscript i denotes the i th observation in the sample; P is the probability of the outcome; β_0 is the intercept term; $\beta_1 + \beta_2 + \dots + \beta_k$ are the coefficients associated with each independent variable $X_1, X_2, \dots, X_k$. To support the regression analysis, Table 1 provides an overview of all variables included in the model, along with their definitions and how they were measured during data collection.

ETHICAL CONSIDERATIONS

This study received an official research permit from Universitas Gadjah Mada and obtained permission from the relevant agricultural offices in each of the four districts where the research was conducted. Prior to interviews, all respondents were informed about the objectives of the study, assured of the confidentiality of their responses, and told that their participation was entirely voluntary. Verbal informed consent was obtained from each participant. As the study involved no medical procedures, animal testing, or sensitive personal data, ethical clearance from an institutional review board was not required under prevailing university and regional regulations. Nonetheless, the research was reviewed for ethical compliance by the academic supervisors and relevant administrative authorities at Universitas Gadjah Mada.

Table 1: Definition of variable and type of measurement.

Variable Name	Definition	Type of Measurement
Dependent variable		
Adoption status	Adoption status of livestock insurance	Nominal (1= Adopter, 0= non-Adopter)
Independent variables		
Age	Age of farmer in years	Ratio
Family Size	Number of family members	Ratio
Education	Education of farmers in years of schooling	Ratio
Credit Access	Utilization of credit access	Nominal (1= Yes, 0= No)
Extension contacts	Frequency of contact with agricultural extension services in the last 12 months	Nominal (1= Often, 0= Rarely)
Knowledge	Knowledge of livestock insurance	Nominal (1= Good, 0= Not good yet)
Herd size	Total livestock holding	Ratio
Farming Experience	Years length of raising livestock	Ratio
Income	Income from livestock in the last 12 months	Ratio

SOCIOECONOMIC PROFILE OF CATTLE FARMERS

The analysis begins by describing the overall profile of cattle farmers who participated in the study. As shown in Table 2, the respondents vary across several socio-economic characteristics, including age, family size, education, credit access, extension contacts, knowledge of livestock insurance, herd size, farming experience, and income. These characteristics help provide a clearer picture of the farming communities involved and set the stage for understanding the factors that influence adoption decisions.

Table 2: Farmer characteristics.

Variables	Category	Fre- quency	Percent- age
Age	15-65	166	83
	>65	34	17
Family size	1-2	32	16
	3-4	128	64
	>4	40	20
Education	Not educated	4	2
	Elementary school	76	38
	Middle school	73	36.5
	Senior high school	46	23
	Diploma/bachelor	1	0.5
Credit access	Yes	101	50.5
	No	99	49.5
Extension contacts	Often	145	74.5
	Rarely	55	25.5
Knowledge of live- stock insurance	Good	88	44
	Not good yet	112	56
Herd size	1-3	183	91.5
	4-10	15	7.5
	>10	2	1
Farming experience	1-10	38	19
	>10	162	81
Income ^a	Less than RMW	158	79
	Over than RMW	42	21

^a RMW = Regional Minimum Wages.

DIFFERENCES BETWEEN ADOPTERS AND NON-ADOPTERS

When comparing adopters versus non-adopters, clear patterns emerge. The results (Table 3) show that both groups differ significantly in several key aspects namely age, family size, education, credit access, extension contacts, knowledge of livestock insurance, herd size, and farming experience. Income, however, does not appear to differ significantly between the two groups.

Most farmers in the sample were between 15 and 65 years old, placing them within the productive age group. Within this group, 91% of adopters were in the productive age range, compared to 75% of non-adopters. This implies that older, non-productive-age farmers may be less likely to adopt livestock insurance. In terms of family size, the majority of farmers (64%) had three to four household members, with 69% of adopters and 59% of non-adopters falling into this category. Although the chi-square test indicates a statistically significant difference, the proportions suggest that medium-sized households are common among both groups. This implies that while family size may play a role in shaping labor availability or economic responsibilities within the household, it does not appear to be a primary determinant in the decision to adopt livestock insurance (Amare *et al.*, 2019; Subedi and Kattel, 2021).

Regarding education, 38% of all respondents had completed elementary school. Interestingly, a higher proportion of adopters (49%) had attained only elementary-level education compared to non-adopters (29%). This finding suggests that even farmers with relatively limited formal education can adopt livestock insurance, possibly due to the influence of informal learning, peer networks, or extension services. In the regional context, this pattern aligns with broader national statistics indicating that most smallholder farmers in Indonesia, including those in Yogyakarta, possess low to moderate levels of formal education. According to Ministry of Agriculture (2023), a significant proportion of agricultural workers in Yogyakarta have completed only primary or junior secondary education. In terms of credit access, 50.5% of respondents reported no access to credit services. Among non-adopters, 61% lacked credit access, compared to 40% of adopters. While access to credit appears associated with adoption, it does not emerge as a decisive barrier.

Looking at extension contacts, 74.5% of farmers reported attending extension sessions regularly. Notably, 82% of adopters engaged with extension services compared to 63% of non-adopters. This difference suggests that regular interaction with extension agents plays a critical role in facilitating livestock insurance adoption. Beyond merely serving as a communication channel, extension services often function as trusted sources of technical information, policy updates, and program eligibility requirements (Qui *et al.*, 2021). Farmers may attend these sessions to gain new knowledge, secure access to government programs or subsidies, and strengthen relationships with local agricultural authorities. In resource-constrained settings like rural Yogyakarta, such motivations are especially relevant, as information asymmetry and institutional trust often shape farmers' decisions. The trust built through consistent extension engagement can reduce uncertainty about unfamiliar instruments such as livestock insurance.

Table 3: Difference between adopter and non-adopter livestock insurance.

Variables	Category	Adopter	Non-adopter	χ^2	Sig.
Age	15-65	91	75	9.072***	0.003
	>65	9	25		
Family size	1-2	10	22	5.381*	0.068
	3-4	69	59		
	>4	21	19		
Education	Not educated	0	4	22.013***	0.000
	Elementary school	49	27		
	Middle school	38	35		
	Senior high school	12	34		
	Diploma/bachelor	1	0		
Credit access	Yes	60	39	8.821***	0.003
	No	40	61		
Extension contacts	Often	82	63	9.053***	0.003
	Rarely	18	37		
Knowledge of livestock insurance	Good	65	23	35.795***	0.000
	Not good yet	35	77		
Herd size	1-3	87	96	5.843*	0.054
	4-10	12	3		
	>10	1	1		
Farming experience	1-10	24	14	3.249*	0.071
	>10	76	86		
Income ^a	Less than RMW	75	83	1.929	0.165
	Over than RMW	25	17		

*Significant at 10% level, **Significant at 5% level, and *** Significant at 1% level. ^aRMW = Regional Minimum Wages.

Table 4: Binary logistic regression results.

Variables	B	S.E.	Wald	Df	Sig.	Exp ^B
Age	-0.042	0.021	4.217	1	0.040**	0.959
Family size	0.153	0.165	0.868	1	0.352	1.166
Education	0.189	0.084	4.986	1	0.026**	1.207
Credit access	0.250	0.397	0.394	1	0.530	1.283
Extension contacts	1.284	0.447	8.248	1	0.004***	3.613
Knowledge of live-stock insurance	1.808	0.402	20.239	1	0.000***	6.100
Herd size	0.859	0.227	14.381	1	0.000***	2.362
Farming experience	-0.054	0.024	5.205	1	0.023**	0.947
Income	0.000	0.000	0.032	1	0.859	1.000
Constant	-2.853	1.676	2.897	1	0.089	0.058
Chi ² (9) = 96.136						
Prob > Chi ² = 0.00						
Pseudo R ² = 0.616						

*Significant at 10% level, **Significant at 5% level, and *** Significant at 1% level. B: unstandardized regression coefficients, Exp^B: odds ratio.

When it comes to knowledge of livestock insurance, 56% of farmers lacked sufficient understanding of the program. Notably, 77% of non-adopters reported poor knowledge,

compared to just 35% of adopters. This points to a strong link between awareness and adoption behavior.

Herd size also varied between groups. Most farmers (91.5%) owned one to three cattle, but this was more common among non-adopters (96%) than adopters (87%), indicating that farmers with smaller herds may be less likely to adopt insurance. Farming experience followed a similar pattern. Overall, 81% of respondents had more than 10 years of experience. Among non-adopters, this figure was higher (86%) compared to adopters (76%), suggesting that more experienced farmers may rely on existing risk management strategies rather than formal insurance.

LOGISTIC REGRESSION RESULTS AND INTERPRETATION

The findings from the binary logistic regression (BLR) analysis presented in Table 4 demonstrate that all socioeconomic characteristic variables significantly affect the adoption of livestock insurance simultaneously. The column labeled “B” in Table 4 shows the unstandardized regression coefficients, which indicate the direction (positive or negative) and magnitude of each variable’s effect on the likelihood of livestock insurance adoption. This study found that factors such as age, education, herd size, farming experience, extension contact, and

knowledge of livestock insurance significantly influence farmers' decisions to adopt insurance. On the other hand, family size, income, and credit access do not show a significant effect on livestock insurance adoption.

In the logistic regression analysis, the values of Exp^B are interpreted as odds ratios. An odds ratio greater than 1 indicates an increase in the likelihood of livestock insurance adoption with a one-unit increase in the variable, while a value less than 1 indicates a decrease in likelihood. For example, an Exp^B of 1.20 suggests a 20% increase in odds, whereas an Exp^B of 0.95 implies a 5% decrease. For large odds ratios (e.g., $\text{Exp}^B > 2$), interpretation is presented as "times more likely" for clarity.

DETERMINANTS OF ADOPTION

Farmers' age has a negative and significant influence ($\text{Exp}^B = 0.959$). This means that with each additional year of age, the odds of adopting livestock insurance decrease by approximately 4.1%. These findings align with [Aidoo et al. \(2014\)](#) and [Amare et al. \(2019\)](#), who also reported a negative relationship between age and agricultural insurance adoption. [Singh and Hlophe \(2017\)](#) further explain that older farmers may rely more heavily on personal experience, especially if they rarely encounter major losses, making them less likely to seek formal insurance as a risk mitigation tool.

Farming experience also has a negative and significant influence ($\text{Exp}^B = 0.947$). This implies that for each additional year of experience in livestock farming, the odds of adopting livestock insurance decrease by around 5.3%. This result supports findings by [Mohammed and Ortmann \(2005\)](#), who found that more experienced farmers often develop their own risk management strategies and may be less inclined to rely on formal insurance. [Chand et al. \(2016\)](#) similarly observed that extensive farming experience may reduce the perceived need for external protection mechanisms.

Education level shows a positive and significant influence on adoption ($\text{Exp}^B = 1.207$). Each additional year of formal education increases the odds of adopting livestock insurance by approximately 20.7%. This is consistent with the findings of [Chand et al. \(2016\)](#) and [Mohammed and Ortmann \(2005\)](#), who reported that higher education levels improve farmers' awareness and understanding of risks, making them more likely to engage with formal insurance systems.

Extension contact has a strong and positive effect ($\text{Exp}^B = 3.613$). Farmers who frequently interact with extension officers are 3.6 times more likely to adopt livestock insurance compared to those with limited contact. This reinforces the role of agricultural extension in facilitating

information access, as noted by [Timsina and Tiwari \(2024\)](#) and [Akintude \(2015\)](#), who emphasized the value of regular contact in building trust and knowledge related to livestock risk management.

Knowledge of livestock insurance has the largest effect size in the model ($\text{Exp}^B = 6.100$). Farmers with good knowledge of livestock insurance are 6.1 times more likely to adopt it than those with limited understanding. This confirms previous findings by [Timsina and Tiwari \(2024\)](#) and [Singh and Hlophe \(2017\)](#), who highlighted that informed farmers are more confident in the insurance system and more likely to see its benefits, thereby increasing adoption likelihood.

Herd size is also positively and significantly associated with adoption ($\text{Exp}^B = 2.362$). Farmers with larger herds are 2.36 times more likely to adopt livestock insurance than those with fewer animals. This supports research by [Subedi and Kattel \(2021\)](#) and [Akintude \(2015\)](#), which shows that greater herd size correlates with increased risk exposure, encouraging farmers to seek protection through insurance.

Based on the results, farmers who do not participate in livestock insurance tend to have limited knowledge about the program and infrequent contact with agricultural extension workers. In contrast, those with better awareness and regular interaction with extension services are more likely to adopt livestock insurance. This suggests that efforts to increase adoption should focus on strengthening extension services and improving farmers' understanding of insurance ([Zhang and Wu, 2025](#)). However, in regions like Yogyakarta, these efforts must also account for the local socio-cultural context. Many smallholder farmers hold deeply rooted beliefs that livestock losses are part of divine will or destiny, fostering a sense of acceptance rather than urgency to mitigate risk. While such values may support emotional resilience, they can also reduce the perceived relevance of formal financial tools like insurance. Addressing these cultural barriers requires not only technical explanations but also empathetic and culturally sensitive communication strategies that respectfully align with farmers' worldviews.

Beyond conventional methods, implementation strategies can also leverage digital platforms ([Ike, 2024](#)) such as mobile applications, SMS reminders, or social media campaigns to provide timely and accessible information. Collaborating with private insurance providers can enhance service delivery, diversify insurance products, and streamline claims processing. Additionally, offering financial incentives, such as premium subsidies or bundling insurance with other agricultural services, may increase participation, especially among smallholder farmers ([Zhang and Wu, 2025](#)). A coordinated, multi-

stakeholder approach can help make livestock insurance more appealing, accessible, and sustainable in the long term.

CONCLUSION

This study revealed significant differences between adopters and non-adopters of livestock insurance in terms of age, family size, education, credit access, extension contacts, knowledge of livestock insurance, herd size, and farming experience. Adoption decisions were significantly influenced by age, education level, herd size, experience, extension contact, and familiarity with livestock insurance. These findings underscore the importance of strengthening extension services and prioritizing knowledge-based outreach to encourage wider adoption among cattle farmers. Although the study provides valuable insights into adoption drivers, the use of convenience sampling may limit the generalizability of the results. Therefore, findings should be interpreted with caution when applied to broader populations. Future research using probability-based sampling is recommended to enhance the representativeness and applicability of the conclusions.

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NOVELTY STATEMENT

Despite the growing relevance of livestock insurance in managing agricultural risks, especially under the AUTS program in Indonesia, empirical research on the adoption of livestock insurance among Indonesian farmers remains scarce. Previous studies have predominantly focused on crop insurance or the general impacts of agricultural risks, with limited exploration of livestock-specific insurance adoption drivers. This study contributes new insights by specifically analyzing the differences in farmer characteristics between adopters and non-adopters of livestock insurance and identifying key factors influencing adoption decisions. By addressing this research gap, the study provides evidence-based recommendations to improve policy design and promote wider adoption of livestock insurance in Indonesia.

AUTHOR'S CONTRIBUTION

AS: Contributed to the conceptualization, methodology, data collection, statistical analysis, and writing of the original manuscript.

ARSP, TAK, and SA: Involved in the conceptualization, methodology, and manuscript review.

MYS, ATA and MHZ: Contributed to the data collection, English translation, statistical analysis, and manuscript review and revision.

ARSP: Provided supervision, manuscript review, and final revision.

GENERATIVE AI AND AI-ASSISTED TECHNOLOGY STATEMENT

The authors declare that no Genrative AI was used in the creation of this manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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