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Original Research Article

Livestock Insurance Adoption in Rural Nepal: A Behavioral Analysis

Bharat Singh Thapa[1*], Rachana Bhandari[2], Durga Datt Pathak[3]

[1] Lecturer, Central Department of Management, Tribhuvan University, Nepal
[2] MBA Graduate, School of Management, Tribhuvan University, Nepal
[3] Lecturer, Shanker Dev Campus, Tribhuvan University, Kathmandu, Nepal

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Correspondence

Bharat Singh Thapa
Lecturer, Central Department of Management, Tribhuvan University, Nepal
Email: bharatthapa89@gmail.com

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Abstract

Purpose: This study explores the behavioral and contextual factors influencing the adoption of livestock insurance in rural Nepal, drawing on the integrative frameworks of the Theory of Planned Behavior (TPB) and the Theory of Reasoned Action (TRA).

Design/methodology/approach: A cross-sectional survey was conducted among 300 farmers in Tinpatan Rural Municipality, Sindhuli. Logistic regression was used to assess adoption likelihood, and Smart PLS-SEM validated the model and structural relationships.

Findings: The study found that social, economic, regulatory, and occupational factors significantly influence the adoption of livestock insurance among rural farmers in Nepal. Economic factors had the strongest effect, followed by social factors, regulatory factors, and occupational factors. These results suggest that higher income, awareness, access to subsidies, community influence, transparent policies, and institutional trust all contribute positively to adoption.

Conclusion: Increasing awareness, simplifying procedures, enhancing policy transparency, and strengthening institutional support are crucial strategies for promoting livestock insurance uptake among rural farmers.

Implications: The findings provide insights for policymakers, insurers, and development agencies to design farmer-centric insurance schemes. Tailored awareness campaigns, streamlined claim processes, and stronger local support mechanisms can make livestock insurance more inclusive.

Originality/Value: This study integrates behavioral theories with socio-economic determinants, addressing a critical gap overlooked in studies focused mainly on developed economies.

JFL Classification: G22, Q12, Q14, D81, O13

Introduction

Insurance is a risk management tool that allows individuals or organizations to transfer the risk of financial loss to an insurance company in exchange for a premium, offering protection against specified risks (Black & Skipper, 2000; Vaughan & Vaughan, 2003). Livestock insurance, a branch of insurance, serves as an essential risk management tool that helps farmers safeguard against potential financial losses arising from livestock diseases, deaths, or accidents. By offering a reliable safety net, it enhances the resilience of farming households and promotes the stability of agricultural livelihoods. Livestock insurance helps in mitigating risks and provides a safety net for farmers. In developing countries, where agriculture is a primary source of livelihood and farmers often operate under high vulnerability to climate, disease, and market shocks, livestock insurance plays a critical role in fostering economic resilience and reducing poverty through improved risk-sharing mechanisms (Xie et al., 2024). Although livestock insurance is gaining global relevance as a risk management instrument, its adoption rates exhibit considerable variation across countries (Guan et al., 2024). These disparities are shaped by diverse geographic, socio-economic, and cultural contexts, reflecting both the adaptive potential and the limitations of current insurance models.

Despite its vital role in reducing agricultural production risks (Turvey, 2018) and supporting agricultural development (Akter et al., 2017), limited adoption of agriculture insurance remains a concern for both policymakers and researchers. Previous studies identified a range of issues influencing farmers' low insurance uptake, including social, financial, occupational, and regulatory factors among others (Greatrex et al., 2015; Nshakira-Rukundo et al., 2021; Marr et al., 2016; Masara & Dube, 2017; Vyas et al., 2021). For instance, Macionis (2015) claimed that social factors, including social constructs and community trust in organizations, play a significant role in shaping perceptions and behaviors regarding insurance adoption. Social norms, beliefs, access to information, and social networks can either encourage or discourage the perceived need and appeal of livestock insurance products. Additionally, livestock insurance adoption in developing countries is hindered by factors such as a lack of tailored insurance products, limited awareness, complex regulatory provisions, and poor rural infrastructure (Khan et al., 2024).

In Nepal, livestock insurance is critical for protecting rural livelihoods and safeguarding agricultural GDP (MoALD, 2022). Livestock farming in Nepal has grown steadily, with the annual growth rate of the livestock population rising from 0.73% to 1.23% over the past two decades (Upadhyay et al., 2017). Despite this growth, livestock farmers remain highly vulnerable due to limited access to health services, veterinary support, and technical guidance (Adhikari & Bidari, 2018). The sector currently accounts for over 75% of Nepal's agricultural insurance market (Nepal Insurance Authority [NIA], 2024), with generous subsidies allowing farmers to pay only 5% of the insured value in premiums, and coverage providing up to 90% compensation for losses. However, actual uptake of livestock insurance remains strikingly low, reflecting poor adoption despite favorable policy measures. Globally, livestock insurance is recognized as a vital risk management tool, especially in developing countries exposed to climate risks and animal health threats (Food and Agriculture Organization [FAO], 2018). Yet in Nepal, challenges such as low awareness, administrative complexity, and skepticism toward the claims process continue to deter participation. Studies further indicate that insured farmers are generally better informed about subsidy provisions than uninsured ones, revealing a critical knowledge gap (Serchen et al., 2025).

This situation highlights the need for a focused investigation into the factors influencing farmers' decisions regarding livestock insurance adoption in Nepal. While previous studies point to issues such as cooperative membership, breed type, income instability, and accessibility to insurance services (Acharya et al., 2024; Devkota et al., 2021; Mishra & Singh, 2024; Subedi & Kattel, 2022), a systematic understanding of these variables and other important socio-economic determinants of livestock insurance adoption within Nepal's context remains limited. This study, therefore, aims to examine the determinants affecting the adoption of livestock insurance, using adoption status as the dependent variable. Major predictors include socioeconomic characteristics (such as income, education, and farm size), knowledge of insurance schemes, prior experience, and risk perception. By exploring these relationships, the research intends to uncover critical drivers and barriers to insurance adoption, ultimately guiding more targeted policy interventions and awareness strategies to strengthen resilience in Nepal's livestock sector.

Literature Review and Hypothesis Development

Livestock insurance is a contractual arrangement that transfers the financial risk of livestock mortality, morbidity, or productivity loss to an insurer in exchange for a premium (Mahul & Stutley, 2010). It aims to indemnify livestock owners against financial losses arising from death, disease, injury, drought, or other environmental hazards. Livestock insurance can be structured as indemnity-based, where compensation is provided after a loss, or index-based, where payouts are triggered by environmental indicators crossing a predefined threshold (Barnett & Mahul, 2008).

In Nepal, crop and livestock insurance is voluntary, with ongoing revisions to policies, yet adoption remains low due to limited awareness, particularly in rural areas (Sapkota, 2024). The Crop and Livestock Insurance Directives 2013 introduced insurance based on production costs for crops and estimated value for livestock, poultry, and fisheries (Dahal et al., 2022; Pant et al., 2019). In 2022, the Agriculture, Livestock and Medicinal Herb Insurance Directives (NIA, 2022) replaced the earlier framework, broadening its scope to include medicinal herbs and guaranteeing insurance access for farmers in all regions. The new directive prioritizes robust livestock insurance, safeguarding against losses from diseases, accidents, or natural calamities, thus bolstering the sustainability of Nepal's agricultural sector. Currently, fourteen non-life insurance companies and three non-life micro insurance companies offer these services nationwide (NIA, 2024). The Crop and Livestock Subsidy Premium Insurance Directive 2070 (2014) requires farmers to pay a 5% premium, with the government subsidizing 75%, paid directly to insurers (Dhakal, 2019). Low awareness limits the adoption of livestock insurance, but a subsidy makes insurance attractive.

To develop the research framework for this study, this study combined the TRA and the TPB, as both offer valuable insights into the factors influencing farmers' adoption decisions. TPB explains how beliefs, attitudes, societal expectations, and perceived control shape behavioral intentions and actions (Ajzen, 1991). Similarly, TRA posits that an individual's intention to engage in a behavior is determined by their attitude toward the behavior and the subjective norms surrounding it (Fishbein & Ajzen, 1975). Both theories are instrumental in understanding the behavioral aspects behind livestock insurance adoption. According to TRA, a farmer's decision is primarily driven by their attitude toward insurance and the social pressures they perceive. TPB extends this understanding by incorporating perceived behavioral control; factors such as farming experience, herd size, and income, which affect the farmer's confidence in adopting insurance. Together, TRA and TPB provide a comprehensive perspective, helping insurance providers and policymakers design targeted interventions that address farmers' attitudes, social influences, and perceived barriers to adoption, ultimately promoting wider uptake of livestock insurance.

Social Factors and Adoption of Livestock Insurance

The adoption of livestock insurance among farmers is not merely a matter of economic cost-benefit analysis but is deeply embedded in a web of social influences, awareness levels, educational attainment, cultural orientation, demographic characteristics, and the structure of social networks.

These variables collectively shape farmers' cognitive frameworks and risk perceptions, thereby influencing their decisions to adopt or reject formal insurance mechanisms (Manyike et al., 2025; Akter et al., 2016; Jokhio et al., 2016).

Education and awareness function as foundational drivers that enhance comprehension of insurance schemes and reduce behavioral inertia. Multiple studies converge on the finding that formal education enhances an individual's capacity to interpret insurance contracts and assess their utility in mitigating risk (Akter et al., 2016; Babalola, 2014; Aditya et al., 2018). This is not only because education improves information processing but also because it raises general financial literacy, enabling more nuanced evaluations of insurance products. Awareness campaigns serve a complementary role by closing the information gap in contexts where formal education is limited. For instance, targeted awareness efforts and community sensitization programs have been empirically linked to significant improvements in uptake rates (Aditya et al., 2018; Manyike et al., 2025).

Furthermore, social capital in the form of farmer groups, cooperatives, and peer networks exerts a multiplier effect on insurance adoption through mechanisms of trust, observational learning, and information diffusion. Singh and Chandel (2019) emphasize the role of these networks in India, where participation in farmer cooperatives facilitates peer-based learning and reduces informational asymmetry. Similarly, Dercon et al. (2014) argue that community-level exposure to insurance benefits, whether through pilot programs or testimonies from early adopters, induces positive spillovers, reinforcing social learning effects and legitimizing the adoption of new financial instruments.

However, this socially embedded perspective must also account for the inertia imposed by cultural norms and traditional risk-sharing practices. In many agrarian societies, informal mechanisms such as reciprocal lending, communal labor sharing, and religious-based safety nets continue to dominate risk management strategies. These entrenched systems often generate skepticism toward formal insurance, viewing it as an alien and mistrusted alternative (Kebede et al., 2020). This cultural resistance has been documented in multiple contexts, including Ethiopia and Kenya, where farmers express reservations about replacing familiar systems with institutional mechanisms (Dercon et al., 2014).

Demographic variables introduce another layer of complexity. Age and household size, in particular, act as significant moderating factors in insurance behavior. Younger farmers, who are often more open to innovation and financial planning, exhibit higher adoption rates compared to older farmers with entrenched habits and greater risk aversion (Manyike et al., 2025; Babalola, 2014). At the same time, larger households, due to their heightened exposure to economic shocks, are more inclined to view insurance as a necessary buffer against livelihood disruption. Empirical evidence from Ethiopia supports this claim, suggesting a positive correlation between family size and willingness to pay for livestock insurance (Kebede et al., 2020).

Based on this evidence, the study hypothesizes:

H1: Social factors positively influence the adoption of livestock insurance.

Economic Factors and Adoption of Livestock Insurance

Economic variables significantly shape farmers' decisions regarding livestock insurance, but their effects are contingent on the interplay between affordability, risk exposure, and perceived value. Core factors, such as household income, herd size, and access to financial support, do not operate in isolation; rather, they interact to form economic thresholds that either enable or inhibit adoption (Chand et al., 2016; Kurniaty et al., 2021).

While income is often positively correlated with insurance uptake, its influence is nonlinear. Wealthier farmers have both the capacity and incentive to insure their livestock due to their higher exposure to economic losses (Barrett & Carter, 2013; Aidoo et al., 2014). However, this does not imply that low-income farmers lack demand; rather, their adoption is constrained by affordability, liquidity constraints, and competing financial priorities (Jokhio et al., 2016; Kurniaty et al., 2021). These constraints emphasize the structural inequities in access to insurance, wherein the very farmers who are most vulnerable to shocks are least able to afford protection, an issue that distorts the intended function of livestock insurance as a risk mitigation tool.

Herd size further reinforces this dynamic. Larger herds entail greater financial stakes, making insurance a rational investment for wealthier or commercially oriented farmers (Subedi & Kattel, 2021). Yet this also creates a systemic bias in insurance uptake, as smaller-scale subsistence farmers remain excluded from coverage despite facing significant livelihood risks. Index-based insurance products, particularly in developing economies, have been promoted as a cost-effective alternative to traditional models by minimizing moral hazard and transaction costs (Stoeffler et al., 2022). However, their uptake is also skewed toward farmers with better financial literacy and institutional trust, suggesting that product design alone cannot overcome broader economic and social barriers.

Subsidies and grants are often positioned as enablers, yet over-reliance on them introduces new limitations. Farmers may engage with insurance primarily for the subsidy rather than a genuine risk management strategy, undermining long-term sustainability and market penetration (Timsina et al., 2018; Kandel & Timilsina, 2018). Moreover, poor dissemination of subsidy information further weakens uptake, especially in marginalized regions (Jha & Singh, 2021). Thus, without strategic alignment between subsidy design, communication, and actual farmer needs, economic incentives may fail to produce sustained adoption.

Based on this evidence, the study hypothesizes:

H2: Economic factors have a positive influence on the adoption of livestock insurance.

Occupational Factors and Adoption of Livestock Insurance

Occupational dynamics, such as engagement with extension services, organizational affiliation, and farming experience, significantly influence livestock insurance adoption, not as isolated inputs but through their cumulative impact on information access, trust, and perceived need for external risk mitigation (Nabikolo et al., 2012; Mishra & Singh, 2024). Extension services operate as crucial intermediaries between insurance providers and farmers, particularly in regions where formal financial literacy is limited. Evidence consistently shows that farmers with regular access to

extension services are more likely to adopt livestock insurance due to increased exposure to technical knowledge and awareness about available schemes (Kandel & Timilsina, 2018; Mishra & Singh, 2024). However, the quality and frequency of these interactions, not mere access, determine the actual influence on decision-making. Extension agents serve not only as conveyors of information but also as trust brokers, which is essential given farmers' skepticism toward unfamiliar financial products.

Similarly, membership in cooperatives or farmer organizations strengthens adoption behavior by embedding farmers in structured social networks that facilitate knowledge-sharing and peer validation. Studies in both Nepal and India confirm that cooperatives play a central role in disseminating insurance information and simplifying enrollment logistics (Acharya et al., 2024; Singh & Chandel, 2019). These institutions reduce individual transaction costs and build collective confidence in formal mechanisms. Notably, Acharya et al. (2024) found that 93% of surveyed dairy farmers in Nepal were cooperative members and relied on these networks for insurance-related decisions, highlighting the systemic role of organizational affiliation in shaping adoption outcomes.

Farming experience, however, reveals a counterintuitive trend. While one might expect experienced farmers to be early adopters due to accumulated knowledge, empirical findings suggest the opposite. More experienced livestock rearers often prefer traditional risk management strategies and display lower uptake of formal insurance (Chand et al., 2016; Akinola, 2014; Singh & Chandel, 2019). This inverse relationship indicates that experiential knowledge can create a sense of self-sufficiency, reducing perceived need for formalized protection. Such farmers may also have stronger informal safety nets or more diversified income streams, further lowering their incentive to engage with insurance. Based on this evidence, the study hypothesizes:

H3: Occupational factors positively influence the adoption of livestock insurance.

Regulatory Factors and the Adoption of Livestock Insurance

Regulatory factors play a significant role in the adoption of livestock insurance, particularly through constraints, transparency issues, and trust in providers. These elements are crucial in shaping farmers' perceptions and their willingness to engage with insurance products, which, in turn, affects their resilience against risks. Effective regulatory frameworks are essential to fostering trust and transparency in the insurance market. Poor claim settlement practices and opaque processes discourage farmers from interacting with insurance companies. If farmers perceive insurance plans as clear and well-structured, they are more likely to enroll. Studies by Linhoff et al. (2022) and Waithaka (2024) have shown that open policy frameworks can significantly increase insurance uptake. Similarly, Mahul and Stutley (2010) highlighted that collaboration between private insurers and governments in Pakistan helps expand the reach of livestock insurance programs while reducing administrative bottlenecks.

Moreover, transparency in insurance products is vital for building trust among clients. Linhoff et al. (2022) found that farmers in Northern Kenya preferred receiving regular updates on index readings, emphasizing the importance of clear communication in enhancing both trust and the adoption of insurance products. When clients are well-informed about the processes and criteria governing their coverage, they are more likely to engage with insurance services. In contrast, a lack of transparency can lead to misunderstandings regarding policy coverage and claims, which may discourage potential participants. Farmers may feel uncertain about the support they would receive in times of need, further hindering the uptake of insurance schemes (Waithaka, 2024). Based on this evidence, the study hypothesizes:

H4: Regulatory factors increase the likelihood of adopting livestock insurance.

Based on this theoretical foundation and empirical evidence, a hypothesized conceptual model has been developed:

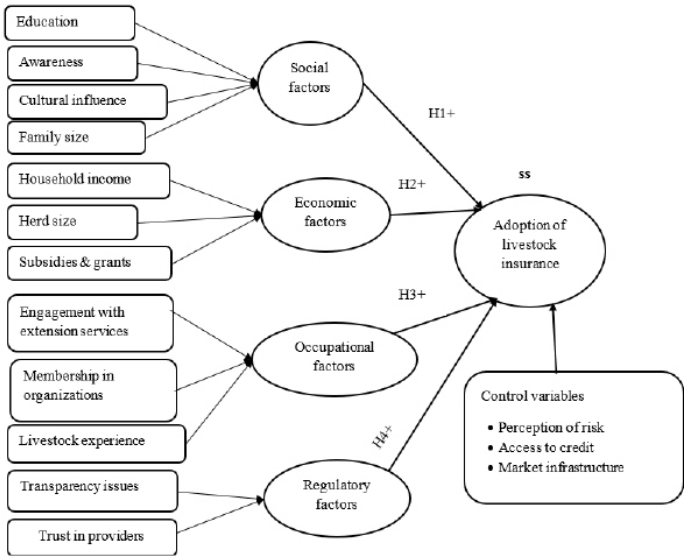

Figure 1: Research Model

Methods

This study follows a descriptive and explanatory research design. Firstly, the study assesses the status of livestock insurance adoption among farmers. Secondly, it employs logistic regression and structural equation model (SEM) to examine the effect of social, economic, occupational, and regulatory factors on the adoption of livestock insurance in Tinpatan village. Tinpatan Rural Municipality of Sindhuli district was selected as the field for this study, where livestock farming plays a vital role in the local economy. Moreover, this Municipality offers an appropriate research foundation due to its strong dependence on livestock farming, agro-ecological diversity, and active development interventions through mixed farming systems. According to the National Census Survey (2021), Tinpatan Rural municipality comprises 34,889 population and 7,918 households; out of these, 13,675 individuals (approximately 37.5%) are engaged in agriculture and livestock farming.

Approximately 2,965 households in Tinpatan village are actively engaged in livestock farming. These households formed the sampling frame for the survey. The minimum required sample size was calculated using equation (1).

$$\text{Sample size (n)} = \frac{N.\ Z^2.\ p.\ (1-p)}{e^2.\ (N-1) + Z^2.\ p.\ (1-p)} \quad \text{.....(1)}$$

Where, total population of active farmers (N) = 2,965, Z=1.96 (for 95% confidence level), *P*= 0.5, p=0.5 (maximum variability), and **e** = 0.05 (5% margin of error).

Using these values, the required sample size was determined to be 278. However, data were collected from 300 respondents (households) to increase robustness. A proportional stratified random sampling technique was used to ensure that the sample accurately reflected the diversity of the farming population across all 11 wards of Tinpatan Rural Municipality. First, the total number of livestock farmers in each ward was identified. A permission from the Chief District Officer (CDO) was obtained to collect survey data from the targeted households. Subsequently, a list of all farmers from each of the 11 wards of the Tinpatan municipality office was also prepared. Using the list of all farmers, investigators assigned a unique identification code to each individual. A randomization function in Excel was then used to generate random numbers. Based on these numbers, the sample size for each ward was determined proportionally to the total number of farmers in that ward, ensuring fair and representative sampling. This approach allowed the study to capture a broad range of experiences, farm sizes, and socio-economic backgrounds, enhancing the reliability and generalizability of the findings. The survey data were collected using a structured questionnaire administered by the researcher to the selected respondents to ensure clarity and completeness of responses. Data collection from the selected households was carried out between 5th November 2024 and 20th December 2024. The adoption of livestock insurance is a dependent variable and is a binary defining the farmers who had purchased livestock insurance were assigned a value of 1 (Yes), while those who had not were assigned a value of 0 (No). Therefore, the binary logistic regression model, which is commonly used to analyze categorical dependent variables (Hosmer et al., 2013), has been used in this study.

To examine the determinants of livestock insurance adoption, this study utilized standardized research instruments adapted from established literature. These instruments were employed to measure both observed variables for logistic regression and latent constructs for SEM. Table 1 presents the constructs, corresponding variables, measurement formats, and sources of reference.

The collected data were initially analyzed using logistic regression to determine the likelihood of respondents adopting livestock insurance. Additionally, Partial Least Squares Structural Equation Modeling (PLS-SEM)was employed to confirm the results, for which items representing the constructs were developed by incorporating first-order variables. However, since it was unclear whether these items should be modeled as reflective or formative, Confirmatory Tetrad Analysis (CTA) was conducted to confirm their nature. The model's validity was further verified through assessments of convergent and discriminant validity. While both logistic regression and SEM examine the factors influencing insurance adoption, they serve distinct purposes and offer different analytical perspectives. Logistic regression primarily estimates the probability of adoption based on independent variables such as income, cooperative membership, and policy perception. It produces odds ratios, which facilitate the interpretation of the relative influence of each predictor. However, logistic regression is limited to analyzing only direct relationships and cannot account for unobserved latent variables or indirect effects. In contrast, SEM enables the exploration of both direct and indirect relationships while incorporating latent constructs that may influence adoption indirectly. Thus, SEM provides a more comprehensive and in-depth understanding of the factors shaping farmers' decisions regarding livestock insurance adoption.

Table 1: Measurement Constructs, Variables, and Sources

Construct	Variables	Measured		References
		For Logistic regression	For SEM	
Social factors (SF)	Education	• No formal education • Primary education • Secondary education • Vocational Training • Higher education	Five items were measured on a 5-point Likert scale	Devkota et al. (2021); Foladizada et al. (2017)
	Awareness	Yes/No		Devkota et al. (2021)
	Cultural influence	Yes/No		Kebede et al. (2020)
	Family size	Number of members		Kebede et al. (2020)
Economic factors (EF)	Household income	Livestock-related income in %	Five items measured on a 5-point Likert scale	Kandel and Timilsina (2018)
	Herd size	Number of animals		Kurniaty et al. (2021)
	Subsidies & grants	Yes/No		Kandel and Timilsina (2018)
Occupational factors (OF)	Engagement with extension services	Yes/No	Five items measured on a 5-point Likert scale	Mishra and Singh (2024)
	Membership in organizations	Yes/No		Mishra and Singh (2024)
	Livestock experience	Number of years involved in livestock farming		Singh and Chandel (2019)
Regulatory factors (RF)	Transparency issues	Yes/No	Five items measured on a 5-point Likert scale	Waithaka (2024)
	Trust in providers	Yes/No		Mishra and Singh (2024)
Adoption of livestock insurance (DV)		Yes/No	Four items, 5-point Likert scale	Devkota et al. (2021); Foladizada et al. (2017)

Results and Analysis

Demographic Profile

Table 2 provides an overview of respondents' demographic and socioeconomic characteristics, including age distribution, household size, gender balance, income sources, and education levels. It also highlights how information about livestock insurance is obtained and the overall adoption rate.

The findings suggest that older and middle-aged individuals are more engaged in livestock-related activities, larger households may face greater financial responsibilities, and education levels may impact the understanding of financial products, such as insurance. Additionally, personal networks and agricultural officers play a crucial role in disseminating information, while adoption of livestock insurance is influenced by factors such as awareness, affordability, and perceived benefits.

Table 2: Demographic Characteristics of Respondents

Statements with criteria		Frequency	Percentage (%)
Age	Less than 20	11	3.7
	20-30	52	17.3
	30-50	150	50.0
	50 and above	87	29.0
Size of household	1	1	0.3
	2	12	4.0
	3	62	20.7
	4	80	26.7
	5	145	48.3
Gender	Male	144	48.0
	Female	156	52.0
Percentage of income comes from livestock activities	Less than 25%	227	75.7
	25%-50%	63	21.0
	50%-75%	9	3.0
	Above 75%	1	0.3
Level of education	No formal education	72	24.0
	Primary education	68	22.7
	Secondary education	107	35.7
	Vocational Training	1	0.3
	Higher education	52	17.3
Primary source of information about livestock insurance	Unfamiliar with it	38	12.7
	Extension officers	102	34.0
	Media	1	0.3
	Friends	129	43.0
	Others	30	10.0
Adoption of Livestock Insurance	Yes	150	50.0
	No	150	50.0

Note. From Survey Data (2024)

Logistic Regression Analysis without Control Factors

Table 3 presents the detailed results of the logistic regression analysis, excluding control variables. The Omnibus Tests of Model Coefficients ($\chi^2 = 80.999$, df = 12, $p < 0.001$) indicate that at least one of the independent variables significantly influences the adoption of livestock insurance. The Hosmer and Lemeshow test confirm that the model fits the data adequately. In terms of predictive performance, the model demonstrates a sensitivity (true positive rate) of 78.7%, correctly predicting 118 out of 150 cases of livestock insurance adoption. Its specificity (true negative rate) is 65.3%, accurately classifying 98 out of 150 non-adopters. Thus, the model achieves an accuracy of 72%, reflecting reasonable predictive capability. Furthermore, Table 3 highlights the effects of social, economic, occupational, and regulatory factors on farmers' willingness to adopt livestock insurance. Demographic variables such as farmers' age, household size, and gender show no significant influence on adoption. However, the percentage of income derived from livestock activities has a statistically significant negative effect (odds ratio Exp(B) = 0.449), suggesting that as dependence on livestock income increases, the likelihood of adopting insurance decreases. The highest level of education is marginally significant, indicating a potential negative influence on adoption.

Table 3: Logistic Regression Analysis Without Control Factors

Variables	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age group	0.20	0.19	1.10	1	0.29	1.22	0.84	1.76
Size of household			3.67	4	0.45			
Household size = 1	-21.17	40192.97	0.00	1	1.00	0.00	0.00	0.00
Household size = 2	0.25	0.70	0.13	1	0.72	1.29	0.32	5.11
Household size = 3	0.08	0.36	0.04	1	0.84	1.08	0.53	2.20
Household size = 4	0.61	0.33	3.44	1	0.06	1.84	0.97	3.49
Gender	0.26	0.27	0.88	1	0.35	1.29	0.76	2.21
Percentage of income from livestock activities	-0.80	0.29	7.83	1	0.01	0.45	0.26	0.79
Education	-0.19	0.11	3.40	1	0.07	0.83	0.67	1.01
Social factors	-0.02	0.04	0.29	1	0.59	0.98	0.90	1.06
Economic factors	-0.06	0.04	1.69	1	0.19	0.95	0.87	1.03
Regulatory factors	-0.14	0.05	9.42	1	0.00	0.87	0.80	0.95
Occupational factors	-0.09	0.04	4.72	1	0.03	0.91	0.84	0.99
Constant	6.81	1.52	20.01	1	0.00	909.58		
Omnibus Tests of Model Coefficients	(χ^2 = 80.999, df = 12, p < 0.001)							
Model Summary -2 Log Likelihood: 334.889a; Cox & Snell R Square: 0.237; Nagelkerke R Square: 0.315								
Hosmer and Lemeshow Test	(χ^2 = 8.503, df = 8, p > 0.05) Classification with 0.5 cut-off value							

Observed			Predicted		
			Adoption of Livestock Insurance		Percentage Correct
			Yes	No	
Step 1	ALI	Yes	118	32	78.7
		No	52	98	65.3
	Overall Percentage				72

Note. Researcher's Calculation

Moreover, regulatory factors (β = -0.137, p < 0.01) and occupational factors (β = -0.093, p < 0.05) exhibit statistically significant negative effects, implying that stricter regulations and occupational constraints reduce the likelihood of adoption. Other economic and social factors do not show significant impacts. Thus, the findings suggest that livestock insurance adoption is notably influenced by occupational factors, regulatory barriers, and livestock income dependence, while other economic and demographic factors play a limited role when control variables are not included.

Logistic Regression Analysis with Control Factors

In this logistic model, control variables such as risk perception, access to credit, and market infrastructure were introduced to assess whether the observed relationships remain robust when accounting for other demographic factors. This approach increases the robustness of the results by separating the true effects of significant independent variables on the adoption of livestock insurance.

Table 4 presents the logistic regression results with the inclusion of control variables. The Omnibus Tests of Model Coefficients show that the overall model is statistically significant, indicating that the likelihood of adopting livestock insurance is significantly influenced by at least one predictor. The model also demonstrates reasonable explanatory power, as reflected by the Nagelkerke R^2 value of 0.323 and the Cox & Snell R^2 value of 0.243. In terms of predictive performance, the model correctly identifies 118 out of 150 adopters, yielding a sensitivity (true positive rate) of 78.7%. Additionally, it accurately classifies 101 out of 150 non-adopters, achieving a specificity (true negative rate) of 67.3%, thus effectively distinguishing between adopters and non-adopters.

Furthermore, Table 4 highlights the effects of social, economic, occupational, and regulatory factors on the willingness to adopt livestock insurance, while accounting for control variables such as risk perception, credit availability, and market infrastructure. The results show that the control variables do not have a statistically

significant impact on insurance adoption, suggesting that while these factors may conceptually influence adoption, they are not decisive in this model. Similarly, demographic variables, i.e., gender, age, and household size, also do not significantly affect adoption decisions.

Table 4: Logistic Regression Analysis with Control Factors

Variables	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age group	0.20	0.19	1.1	1	0.29	1.22	0.84	1.76
Size of household			3.67	4	0.45			
Household size = 1	-21.17	40192.97	0	1	1.00	0.00	0.00	0.00
Household size = 2	0.25	0.7	0.13	1	0.72	1.29	0.32	5.11
Household size = 3	0.08	0.36	0.04	1	0.84	1.08	0.53	2.20
Household size = 4	0.61	0.33	3.44	1	0.06	1.84	0.97	3.49
Gender	0.26	0.27	0.88	1	0.35	1.29	0.76	2.21
Percentage of income from livestock activities	-0.8	0.29	7.83	1	0.01	0.45	0.26	0.79
Education	-0.19	0.11	3.4	1	0.07	0.83	0.67	1.01
Social factors	-0.02	0.04	0.12	1	0.73	0.99	0.90	1.07
Economic factors	-0.04	0.04	0.82	1	0.37	0.96	0.88	1.05
Regulatory factors	-0.13	0.05	7.80	1	0.01	0.88	0.81	0.96
Occupational factors	-0.08	0.05	2.84	1	0.09	0.93	0.85	1.01
Control factors	-0.06	0.04	2.28	1	0.13	0.94	0.87	1.02
Constant	7.07	1.55	20.69	1	0.00	1174.91		
Omnibus Tests of Model Coefficients	(χ^2 = 83.322, df = 13, p < 0.001)							
Model Summary -2 Log Likelihood: 332.567a; Cox & Snell R Square: 0.243; Nagelkerke R Square: 0.323								
Hosmer and Lemeshow Test	(χ^2 = 3.045, df = 8, p > 0.05) Classification with 0.5 cut-off value							

Observed			Predicted		
			Adoption of Livestock Insurance		Percentage Correct
			Yes	No	
Step 1	ALI	Yes	118	32	78.7
		No	49	101	67.3
	Overall Percentage				73

Note. Researcher Calculation

However, a significant negative relationship is observed between livestock income, occupational factors, regulatory factors, and insurance adoption. Farmers who derive a greater proportion of their income from livestock are less likely to adopt insurance, possibly because they prefer self-financed risk management strategies. Additionally, the marginal significance of education (β = -0.188, p = 0.075) suggests that more educated farmers may choose alternative risk mitigation approaches. Thus, the findings emphasize the importance of occupational and regulatory dynamics in shaping livestock insurance adoption, even when control variables are considered.

Measurement Model

The study identified four latent constructs, social, economic, occupational, and regulatory, each measured by a set of corresponding indicators (as illustrated in Figure 1). However, given the absence of an established theory specifying whether these constructs should be modeled as reflective or formative, the study applied CTA to determine the appropriate measurement model specification.

Table 5: Confirmatory Tetrad Analysis (CTA) for Adoption of Livestock Insurance

Items of constructs	Original sample	Sample mean	Std. deviation	T statistics	P values	CI low	CI up	Construct
Adoption of Livestock Insurance (DV)								
1: DV1,DV2,DV3,DV4	-0.003	-0.003	0.016	0.196	0.845	-0.029	0.023	Reflective
2: DV1,DV2,DV4,DV3	0.003	0.003	0.015	0.191	0.849	-0.022	0.028	
Social factors (SF)								
1: SF1,SF2,SF3,SF4	0.026	0.025	0.027	0.945	0.345	-0.019	0.07	Reflective
2: SF1,SF2,SF4,SF3	-0.026	-0.025	0.032	0.794	0.427	-0.078	0.027	
4: SF1,SF2,SF3,SF5	0.04	0.04	0.028	1.431	0.152	-0.006	0.086	
6: SF1,SF3,SF5,SF2	-0.043	-0.043	0.028	1.556	0.12	-0.089	0.003	
10: SF1,SF3,SF4,SF5	0.012	0.012	0.028	0.446	0.656	-0.033	0.059	
Economic factors (EF)								
1: EF1,EF2,EF3,EF4	0.037	0.037	0.029	1.249	0.212	-0.032	0.105	Formative
2: EF1,EF2,EF4,EF3	0.077	0.077	0.028	2.772	0.006	0.013	0.143	
4: EF1,EF2,EF3,EF5	0.022	0.022	0.03	0.725	0.468	-0.048	0.093	
6: EF1,EF3,EF5,EF2	0.016	0.016	0.024	0.679	0.497	-0.04	0.073	
10: EF1,EF3,EF4,EF5	-0.011	-0.011	0.026	0.443	0.658	-0.071	0.048	
Occupational factors (OF)								
1: OF1,OF2,OF3,OF4	-0.045	-0.045	0.027	1.699	0.089	-0.09	-0.002	Formative
2: OF1,OF2,OF4,OF3	-0.035	-0.035	0.025	1.407	0.159	-0.077	0.005	
4: OF1,OF2,OF3,OF5	-0.008	-0.008	0.028	0.298	0.765	-0.054	0.037	
6: OF1,OF3,OF5,OF2	0.006	0.006	0.029	0.199	0.842	-0.042	0.053	
10: OF1,OF3,OF4,OF5	-0.055	-0.055	0.026	2.154	0.031	-0.097	-0.013	
Regulatory factors (RF)								
1: RF1,RF2,RF3,RF4	0.045	0.044	0.028	1.585	0.113	-0.001	0.093	Reflective
2: RF1,RF2,RF4,RF3	0.019	0.018	0.03	0.619	0.536	-0.031	0.068	
4: RF1,RF2,RF3,RF5	-0.01	-0.009	0.025	0.393	0.694	-0.05	0.03	
6: RF1,RF3,RF5,RF2	-0.014	-0.014	0.028	0.481	0.63	-0.06	0.033	
10: RF1,RF3,RF4,RF5	0.013	0.013	0.026	0.501	0.616	-0.03	0.055	

Note. Researcher's Calculation

The results, presented in Table 5, indicate that the social and regulatory constructs are reflective, as all their tetrads were statistically insignificant ($p > 0.05$), implying strong inter-item correlations and conceptual interchangeability among the indicators. Conversely, the economic and occupational constructs were classified as formative, with at least one statistically significant tetrad ($p < 0.05$) observed for each. This finding suggests that their indicators are distinct, non-interchangeable, and contribute uniquely to the definition of the respective constructs. Thus, CTA provided crucial guidance in accurately specifying the measurement models for our study.

In this study, the researcher incorporates both formative and reflective constructs. Reflective constructs, such as SF and RF, assume that their indicators are correlated because they reflect the same underlying latent variable. These constructs are analyzed using CFA, and their reliability and validity are assessed through Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE), ensuring internal consistency. In contrast, formative constructs, i.e., EF and OF, are defined by indicators that contribute uniquely to the construct rather than measuring a single latent concept. For these constructs, traditional reliability metrics like Cronbach's Alpha are not appropriate. Instead, CTA is used to validate their formative nature.

Table 6: Reliability and Convergent and Discriminant Validity

Constructs	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
DV	0.906	0.921	0.935	0.782
RF	0.911	0.929	0.934	0.74
SF	0.907	0.922	0.935	0.784
Panel A: Fornell-Larcker criterion				
Variables		DV	RF	SF
DV		0.885		
SF		0.617	0.886	
RF		0.653	0.566	0.86
Panel B: Heterotrait-monotrait ratio (HTMT)				
Variables		DV	RF	SF
DV				
RF		0.669		
SF		0.712	0.619	

Note. (DV = adoption of livestock insurance)

Table 6 presents the reliability and validity assessment of the constructs using Cronbach's Alpha, CR, and AVE. The Cronbach's Alpha values for DV, RF, and SF all exceed the minimum threshold of 0.7, indicating strong internal consistency and high reliability of the measurement items within each construct. Additionally, the composite reliability values (rho_a, & rho_c) are above 0.9 for all constructs, further confirming their excellent reliability. The AVE values for each construct are higher than the 0.5 benchmark, indicating that each construct captures more than half of the variance of its indicators, thereby establishing strong convergent validity.

In addition, Table 6 presents the assessment of discriminant validity using the Fornell-Larcker criterion and the HTMT ratio in panels A and B. According to the Fornell-Larcker criterion, the AVE, represented by the diagonal values, should exceed the corresponding off-diagonal inter-construct correlations in both rows and columns. This condition is met for all constructs. Furthermore, all HTMT values fall below the commonly accepted threshold of 0.85, which further supports discriminant validity. These results confirm that the constructs DV, RF, and SF are empirically distinct from one another.

For further validation, cross-loadings were also examined to ensure that each indicator loads more strongly on its associated construct than on any other construct. Ideally, each indicator should have a higher loading on its intended latent variable, with lower cross-loadings on unrelated constructs. If an indicator loads significantly onto multiple constructs, it may indicate measurement issues or construct overlap. Table A1 presents the results of cross-loading and multicollinearity. VIF measured multicollinearity. According to Hair et al. (2022), VIF values exceeding 5 can distort path coefficients and standard errors; therefore, EF1, OF1, RF1, SF1, and DV1 were eliminated to enhance construct validity, as their VIF score was greater than 5.

Structural Model

Table 7 presents the results of the relationship between predictors (EF, OF, RF, and SF) and the explained variables, where the predictors explain 58.6% of the variation in the adoption of livestock insurance. Based on Hair et al. (2022), this structural model has a moderate explanatory power because it ranges from 0.50 to 0.75. In addition, according to the results of f-square, which is used for effect size, the effect size is still in the small-to-medium range, even though EF has the biggest impact on the adoption of livestock insurance.

Additionally, path coefficients indicate that EF plays a crucial role in influencing adoption of livestock insurance ($\beta = 0.288$, $p<0.001$). This suggests that economic stability, which encompasses income levels, subsidies, and financial resources, has a major impact on the adoption of livestock insurance because respondents with greater financial security may be more inclined to invest in livestock insurance as a risk management strategy. Although OF exerts the least influence among all the predictors, it still has a significant positive effect ($\beta = 0.185$, $p< 0.01$). This indicates that elements such as professional experience, agricultural extension services, and vocational knowledge contribute to the adoption of livestock insurance. While these factors may support awareness and decision-making. The RF significantly affects adoption of livestock insurance ($\beta = 0.238$, $p<0.001$), emphasizing the importance of policy clarity, legal frameworks, and trust in the insurance system.

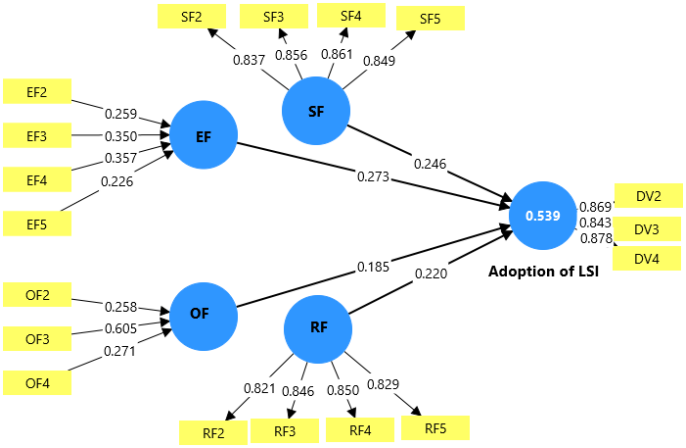

Figure 2: Results of PLS-SEM

A well-structured regulatory environment that ensures transparency and accessibility can reduce uncertainty and encourage adoption among livestock owners. Similarly, SF exerts the strongest influence on adoption of livestock insurance ($\beta = 0.273$, $p< 0.001$), highlighting the critical role of peer influence, community knowledge-sharing, and social norms in shaping adoption behavior. Farmers who receive positive feedback from peers or perceive livestock insurance as a socially accepted practice are more likely to participate in the system.

Table 7: Structural Relationships and Results of Hypothesis Testing

Hypothesis	Path coefficients	Original sample (β)	Standard deviation	t-value	p-values	f-square	Decision
H1	EF -> Adoption of livestock insurance	0.273	0.058	4.698	0.000	0.105	Supported
H2	OF -> Adoption of livestock insurance	0.185	0.057	3.237	0.001	0.045	Supported
H3	RF -> Adoption of livestock insurance	0.220	0.063	3.507	0.000	0.065	Supported
H4	SF -> Adoption of livestock insurance	0.246	0.068	3.604	0.000	0.073	Supported
R-square = 0.539				R-square adjusted = 0.533			

Discussions

This study comprehensively analyzes the factors influencing the adoption of livestock insurance using logistic regression and SEM approaches. Logistic regression identified only a few significant predictors, notably a negative effect of RF and livestock income on adoption, while SF and EF were not significant. SEM findings indicated that all four constructs, i.e., SF, EF, OF, and RF, significantly and positively influence livestock insurance adoption. Unlike logistic regression, SEM accounted for latent constructs and indirect effects, offering deeper insights into how different factors interact to shape farmers' decisions, suggesting it better fits our research context. Thus, SEM provided a more comprehensive and robust explanation of the factors driving livestock insurance adoption compared to logistic regression.

The positive relationship between education and the uptake of livestock insurance aligns with existing literature, which highlights the importance of financial literacy in enhancing risk management behaviors (Chantarat et al., 2012). Educated farmers are generally more aware of the potential value of insurance, which helps mitigate concerns about its costs, claims processes, and reliability. However, as noted by Devkota et al. (2021), formal education alone cannot address the information asymmetry that is prevalent in rural areas. Therefore, targeted information campaigns, especially those that include practical elements, real-world narratives from insured farmers, and outreach efforts from government programs, are crucial for bridging these gaps in knowledge and addressing hesitations around insurance uptake.

Moreover, the findings from this study provide further support for the research by Gine and Yang (2009), which demonstrated that training programs increase farmers' understanding of risk-reduction strategies. Despite this, Carter et al. (2017) highlight a persistent barrier among older farmers, who often refrain from engaging with financial education programs. This reluctance stems from limited access to training resources and a general unwillingness to adopt unfamiliar financial instruments. To overcome these barriers, policymakers could integrate insurance education into cooperative meetings, extension programs, and government-funded initiatives. Additionally, the development of mobile training modules and community-based workshops could provide an effective means of reaching a larger audience, especially among older or less literate farmers.

SF also plays a significant role in the adoption of livestock insurance, as farmers often rely on the experiences and advice of their peers when making financial decisions (Dercon et al., 2014; Akter et al., 2016; Aditya et al., 2018; Kebede et al., 2020). The role of social influence and community learning is crucial in shaping adoption behavior, and peer-to-peer education can help reduce skepticism and build trust around insurance products. Nevertheless, as Peng and Shen (2024) point out, misinformation remains a major barrier to adoption. Utilizing experienced farmers as community-based educators could help establish trust and counteract misleading information about insurance coverage and claims procedures.

Despite these efforts, cultural resistance to formal insurance products remains a challenge, particularly in rural communities where informal risk-sharing networks are deeply entrenched (Platteau & Abraham, 1987). These traditional networks are often perceived as more reliable and accessible than formal insurance schemes. To address this, Cole et al. (2013) suggest that financial literacy programs should incorporate elements of local risk-sharing practices. By framing insurance as a complementary tool to these traditional systems, rather than a replacement, it may be possible to reduce resistance and promote greater adoption. Policymakers should consider engaging local influencers, religious leaders, or cooperative heads to advocate for insurance products as a supplement to existing safety nets.

Economic stability is another key determinant of livestock insurance uptake, as supported by findings from Jokhio et al. (2016), Kurniaty et al. (2021), Subedi and Kattel (2021), and Stoeffler et al. (2022). Farmers with higher income levels and larger herd sizes are more likely to purchase insurance, as they are more aware of the financial risks associated with their livestock operations. Furthermore, studies by Kandel and Timilsina (2018) and Timsina et al. (2018) show that subsidies on insurance premiums can lead to increased adoption. However, long-term reliance on subsidies poses a risk of creating dependency on government support, which may not be sustainable. Therefore, it is essential for government stakeholders to gradually phase out subsidies while introducing flexible premium payment plans and microinsurance products that cater to the diverse financial capacities of farmers. This approach could help promote financial inclusion without fostering long-term dependence on subsidies.

Trust issues regarding insurance companies and concerns about the enforcement of claims processes remain significant barriers to insurance uptake, consistent with the findings of Waithaka (2024) and Linhoff et al. (2022). Increasing transparency regarding policy terms and encouraging timely claims processing can help alleviate skepticism and foster confidence in insurance products.

Further, expanding protections for policyholders, such as introducing heir protections or establishing an insurance ombudsman, could enhance trust and encourage greater uptake.

Finally, while experienced farmers may be less inclined to adopt formal insurance policies due to their reliance on traditional risk management practices, innovative marketing strategies could help shift this perception. As Singh and Chandel (2019) suggest, these farmers are often more comfortable using diversification strategies or emergency funds. To address this, insurance products should be marketed as complementary to, rather than a replacement for, traditional risk management tools. Real-world examples of insurance payouts, particularly those from farmers who have benefited from insurance, could also help mitigate hesitations. Furthermore, bundling insurance with other financial services such as credit or savings programs might incentivize uptake among more experienced farmers, who may value the broader financial security these packages offer.

Conclusion and Implications

This study provides compelling evidence that various factors significantly influence the adoption of livestock insurance, with social and economic variables emerging as the most impactful. Farmers who depend heavily on livestock income were found to be less likely to purchase insurance, potentially due to perceived costs or lack of understanding of the benefits. In contrast, farmers with access to subsidies and those who were better informed about the insurance market showed a higher likelihood of uptake. A particularly strong relationship was observed between farmer network engagement, trust in insurance providers, and the likelihood of adopting insurance. Peer influence, social networks, and the reputability of insurance providers emerged as key factors in overcoming skepticism and encouraging participation. However, more seasoned farmers exhibited reluctance, possibly due to their reliance on traditional risk-reduction strategies, such as diversification and informal risk-sharing mechanisms. Therefore, fostering a more common adoption of livestock insurance in Nepal requires a holistic approach that addresses the financial, informational, and social barriers to participation.

The insights from this study are invaluable for policymakers seeking to increase livestock insurance uptake in Nepal. To maximize adoption rates, it is essential to remove barriers to financial accessibility, such as high upfront premiums, and to improve the dissemination of information about insurance products. Government efforts should focus on simplifying policy structures, ensuring transparent and farmer-friendly claims processes, and introducing flexible payment models that cater to the diverse financial realities of farmers.

Policymakers should implement localized, community-based awareness programs by partnering with farmer cooperatives, livestock groups, and local governments. These campaigns should include practical demonstrations, testimonials from insured farmers, and simplified educational materials in local languages. Incorporating livestock insurance topics into regular community meetings and extension services by local government can institutionalize knowledge-sharing and improve trust. This approach may help bridge the information gap, reduce misconceptions, and increase adoption, especially among rural farmers.

Limitations and Further Research

Despite its rigorous methodological design and use of both logistic regression and SEM, this study is subject to several limitations. First, the research was confined to a single rural municipality, i.e., Tinpatan in Sindhuli, which may limit the generalizability of findings to other regions of Nepal with different socio-economic or agro-ecological contexts. Second, the study relied on cross-sectional survey data, restricting causal inference and failing to capture potential changes in insurance adoption behavior over time. Third, self-reported data from farmers could be influenced by recall bias or social desirability bias, potentially affecting the accuracy of responses. Fourth, while the study employed validated constructs from previous literature, the cultural and institutional specificity of Nepal may require further contextualization of some indicators. Lastly, the study excluded informal risk-sharing mechanisms and insurance alternatives, which might interact with formal livestock insurance adoption and provide a more holistic understanding of farmers' risk management behavior.

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Conflict of Interest

The Authors declare that there is no conflict of interest.

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Ethical Statement

This research did not require ethical approval as it does not involve any human or animal experiments.

Authors' Contribution and ORCID iDs

Bharat Singh Thapa: Conceptualization, Methodology, Data curation, Review and Editing, Validation, and Supervision.
: **https://orcid.org/0000-0002-9435-2490**

Rachana Bhandari: Visualization, Instrumentation, Data collection, Data analysis, Original Draft, Resources, and Investigation.
: https://orcid.org/0009-0005-3000-5552

Durga Datt Pathak: Data Analysis, Review and Editing, Methodology, Validation, and Software:
: https://orcid.org/0000-0003-4397-7375

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Annex

Table A1: Cross-Loading and Multicollinearity

	DV	EF	OF	RF	SF	VIF
DV2	0.869	0.484	0.478	0.542	0.542	1.933
DV3	0.843	0.476	0.444	0.431	0.49	1.825
DV4	0.878	0.561	0.534	0.506	0.527	1.955
EF2	0.479	0.813	0.44	0.35	0.364	1.955
EF3	0.501	0.851	0.415	0.435	0.424	1.928
EF4	0.518	0.88	0.446	0.43	0.422	2.227
EF5	0.46	0.782	0.41	0.345	0.353	1.807
OF2	0.465	0.415	0.825	0.367	0.461	2.095
OF3	0.528	0.463	0.937	0.43	0.527	1.912
OF4	0.456	0.456	0.809	0.384	0.448	1.951
RF2	0.466	0.39	0.408	0.821	0.472	1.882
RF3	0.459	0.34	0.36	0.846	0.446	2.113
RF4	0.516	0.469	0.39	0.85	0.486	2.032
RF5	0.473	0.381	0.379	0.829	0.473	1.912
SF2	0.503	0.388	0.451	0.475	0.837	2.022
SF3	0.515	0.377	0.493	0.468	0.856	2.192
SF4	0.544	0.442	0.481	0.464	0.861	2.201
SF5	0.485	0.403	0.48	0.508	0.849	2.199

Bios

Dr. Bharat Singh Thapa is a Lecturer at the Central Department of Management, Tribhuvan University, Nepal. He has been a visiting professor at the University of Padova, Italy, and serves on the Academic Board of its Joint International PhD Program in Human Rights, Society, and Multi-level Governance. His area of research include microfinance, financial inclusion, behavioral finance, and enterrepreneursip.

Email: bharatthapa89@gmail.com

Rachana Bhandari is an MBA graduate with a specialization in finance from the School of Management, Tribhuvan University. An emerging and aspiring research scholar, she is deeply interested in advancing knowledge in the fields of corporate finance and financial markets. Her academic journey reflects a strong commitment to analytical rigor and practical insight, positioning her to contribute meaningfully to scholarly and professional discourse.

Email: rachanabhandari2024@gmail.com

Durga Datta Pathak, a Lecturer at Shankar Dev Campus, Tribhuvan University, holds an M.Phil. in Finance (2020) with a gold medal and a 4 CGPA. His research focuses on behavioral finance, corporate finance, risk management, and development finance, with publications in Tribhuvan University and UGC Nepal journals.

Email: durga.pathak@sdc.tu.edu.np