



Farm Characteristics and Willingness to Pay for Livestock Insurance among Cattle Farmers in Tanga Region, Tanzania

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Article History

Received: 20.04.2026

Revised: 30.08.2026

Accepted: 19.09.2026

Published: 29.09.2026

Keywords

Cattle

Farmers

Livestock insurance

Risk management

How to cite:

Bigeni, A., & Mmari, F. (2026). Farm Characteristics and Willingness to Pay for Livestock Insurance among Cattle Farmers in Tanga Region, Tanzania. *Research Journal of Business and Finance*, 5(2), 98-112.

Abstract

This study examined the association between farm characteristics and cattle farmers' willingness to pay (WTP) for livestock insurance in Tanga Region, Tanzania. Guided by the Theory of Planned Behaviour (TPB), the study adopted a pragmatist philosophy and a cross-sectional explanatory mixed-methods design. Of the 385 targeted respondents, 380 provided usable questionnaires, while qualitative evidence was obtained from 15 key informants. Quantitative data were analysed using descriptive statistics and a probit model, while qualitative data were analysed in NVivo 14 using Braun and Clarke's six-phase reflexive thematic analysis. The results showed that farm size, livestock breed diversity, and farm income were positively and statistically significantly associated with WTP. Farm size was positively associated with WTP ($\beta = 0.072$, $p = 0.004$), livestock breed diversity was positively associated with WTP ($\beta = 0.194$, $p = 0.029$), and farm income was positively associated with WTP ($\beta = 0.00091$, $p = 0.001$). Qualitative findings further indicated that livestock losses, diseases, drought, theft, veterinary costs, livestock value, and dependence on livestock income contribute to farmers' perceived need for financial protection. The integration of quantitative and qualitative findings suggests that farm characteristics are important correlates of farmers' willingness to pay for livestock insurance, particularly through differences in livestock ownership, economic exposure, and the potential consequences of livestock losses. The study recommends the development of risk-sensitive and scalable livestock insurance products, differentiated coverage according to livestock value and risk profiles, and stronger integration of livestock insurance with livestock-risk-management and extension services. The findings provide empirical evidence for policymakers, insurers, and livestock-sector stakeholders seeking to improve the relevance and accessibility of livestock insurance schemes among cattle farmers in Tanzania.

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Introduction

Globally, livestock is an important productive asset and source of food, income, savings, and livelihood security for rural households. However, livestock production faces risks such as drought, disease, injury, theft, and other shocks that can cause significant economic losses (Ahmed et al., 2019). Livestock insurance provides a risk-management mechanism for protecting farmers against specified losses, with conventional and index-based schemes implemented in different developing regions



(Greatrex et al., 2015). Despite its potential, participation among smallholder farmers remains uneven because the value and affordability of insurance may depend on livestock-asset value, household economic circumstances, and the suitability of insurance products to local production systems (Nshakira-Rukundo et al., 2021).

In Africa, the case for livestock insurance is particularly strong because pastoralists and smallholder livestock farmers face recurrent climate and production shocks while livestock frequently functions as a store of wealth and a source of household security. Index-based livestock insurance has been implemented in countries such as Kenya and Ethiopia, but African evidence shows that uptake is influenced by product quality, affordability, information, trust, delivery arrangements and farmers' own production circumstances (Nshakira-Rukundo et al., 2021; Takahashi et al., 2020). Studies from Kenya and South Africa further show that cattle breed, animal value, income, farm resources and exposure to climatic risks influence farmers' willingness to participate in livestock insurance arrangements (Otieno et al., 2006; Oduniyi et al., 2020). These findings indicate that farm characteristics are not merely descriptive attributes; they affect the economic value exposed to loss and the incentives for formal risk-transfer.

In Tanzania, livestock remains important to rural livelihoods, but cattle production is affected by disease, climatic stress, and other shocks. Evidence from smallholder dairy systems shows substantial variation in farmers' valuation of cattle traits such as milk yield, fertility, feed requirements, and disease resistance, demonstrating that livestock assets differ in both productive value and risk characteristics (Chawala et al., 2019). Evidence from Tanga and Iringa further indicates that cattle mortality, particularly among young stock, is associated with animal-health risks, with tick-borne diseases accounting for a substantial proportion of reported deaths (Swai et al., 2010; Laizer et al., 2024). Moreover, John (2023), studying dairy-cattle farmers in Mara Region, found that land size, total livestock owned, and household income were positively associated with willingness to pay for cattle insurance. These findings provide a basis for examining farm size, livestock characteristics, and farm-derived financial capacity as factors associated with farmers' willingness to pay for livestock insurance in Tanzania.

Tanga Region provides a relevant setting for examining farm-level correlates of willingness to participate because cattle farmers operate under heterogeneous landholding, breed, management and risk conditions. The study data show substantial variation in farm size, livestock breed diversity and perceived disease or hazard risk, while the probit model identifies farm size, livestock breed diversity and farm income as the three farm-level explanatory variables. This approach responds to the limited Tanzania-specific evidence on how farm scale, livestock-asset composition and farm-derived income jointly relate to stated willingness to participate for livestock insurance (John, 2023; Nshakira-Rukundo et al., 2021).

Research Objective

To determine the association between farm characteristics, particularly farm size, livestock breed diversity, and farm income, and willingness to pay for livestock insurance among cattle farmers in Tanga Region, Tanzania.

Hypothesis

H1: Farm size is positively and statistically significantly associated with cattle farmers' willingness to pay for livestock insurance in Tanga Region, Tanzania.

H2: Livestock breed diversity is positively and statistically significantly associated with cattle farmers' willingness to pay for livestock insurance in Tanga Region, Tanzania.



H3: Farm income is positively and statistically significantly associated with cattle farmers' willingness to pay for livestock insurance in Tanga Region, Tanzania.

Literature Review

Theoretical Review

The study is anchored in the Theory of Planned Behaviour (TPB), developed by Ajzen (1985) and formally elaborated by Ajzen (1991). TPB explains deliberate behaviour through behavioural intention, which is shaped by attitude toward the behaviour, subjective norms and perceived behavioural control. Attitude reflects whether a person evaluates an action favourably or unfavourably; subjective norms concern perceived social expectations; and perceived behavioural control concerns the perceived ease or difficulty of performing the action given available resources and constraints (Ajzen, 1991). WTP for livestock insurance is therefore appropriately viewed as both an economic and behavioural intention because a farmer must evaluate the usefulness of insurance, consider the views and experiences of relevant social actors, and judge whether premium payment and access to the product are feasible.

TPB has increasingly been applied to agricultural and insurance-related decisions because such decisions involve uncertainty, expectations about future benefits and constraints on farmers' ability to act. Mathithibane and Chummun (2022), examining weather-index insurance in South Africa, integrated behavioural and socioeconomic factors in explaining farmers' WTP intentions. Cabeza-Ramírez et al. (2024) similarly applied an extended TPB perspective to farmers' intention to adopt drought insurance and demonstrated the relevance of attitudes, social influence and perceived control in insurance-related decision-making. These applications support the use of TPB in the present study because livestock insurance requires farmers to convert perceptions of risk and protection into an intention to commit scarce financial resources.

Within TPB, farm characteristics are treated as background or contextual factors. Farm size, livestock breed diversity and farm income can shape the beliefs from which attitudes and perceived behavioural control are formed. A farmer with larger or more valuable livestock investments may expect greater financial consequences from disease, drought or mortality and may therefore evaluate insurance more favourably. Likewise, higher farm income may increase perceived behavioural control by improving the farmer's capacity to meet premium obligations. This interpretation is consistent with Ajzen's (1991) proposition that background conditions influence intention through behavioural, normative and control beliefs, and with livestock insurance evidence linking farm assets, livestock characteristics and economic capacity with insurance decisions (Devkota et al., 2021; Melketo et al., 2025).

The subjective-norm pathway remains relevant even though the farm variables are most directly related to attitude and perceived behavioural control. Farmers interpret the value and risk of their livestock partly through interactions with fellow farmers, cooperative leaders, extension officers and insurance providers. Evidence from agricultural-insurance research shows that information, social learning, institutional credibility and delivery mechanisms can shape participation alongside farm resources (Nshakira-Rukundo et al., 2021). Thus, two farmers with similar farm assets may form different insurance intentions depending on the social and institutional environment through which those assets and risks are interpreted.

This study therefore uses the Theory of Planned Behaviour (TPB) as an interpretive framework rather than estimating attitude, subjective norms, and perceived behavioural control as separate regressors. The empirical model estimates observable farm characteristics, while the qualitative evidence provides contextual interpretation of farmers' willingness to pay for livestock insurance. Accordingly,

TPB is used to guide the interpretation of farmers' reported perceptions, experiences, and decision-making regarding livestock insurance, rather than to establish or statistically estimate behavioural pathways. This approach allows the mixed-methods findings to provide a contextual understanding of the association between farm characteristics and willingness to pay without implying that TPB constructs were directly measured or causally tested.

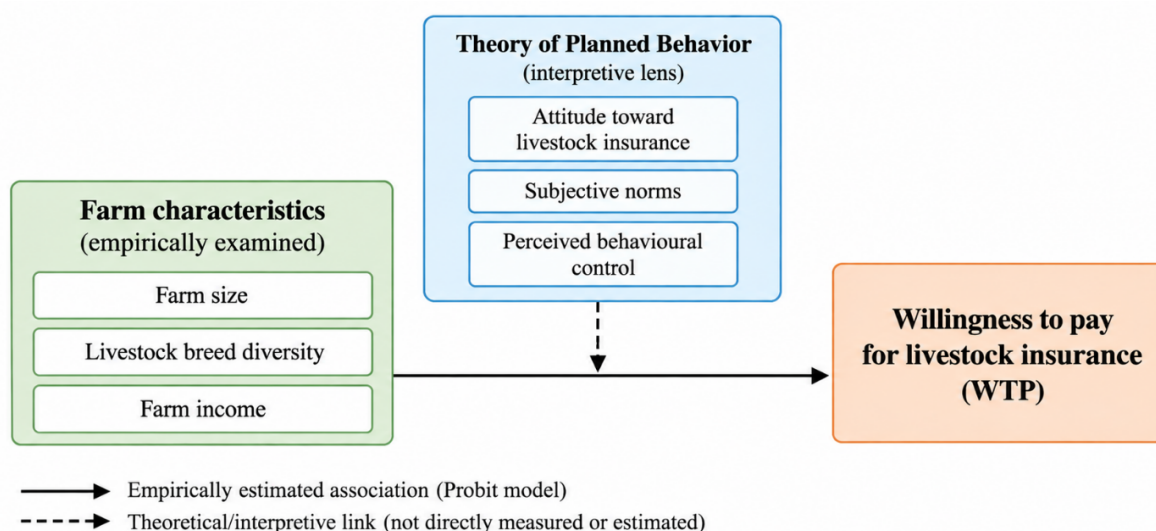


Figure 1. Conceptual framework of farm characteristics associated with willingness to pay for livestock insurance.

Empirical Review

Empirical research across different livestock production systems shows that farm characteristics influence insurance decisions, although the relevant variables and effect sizes differ across contexts. In Western Kenya, Otieno et al. (2006) found high stated interest in a hypothetical cattle insurance scheme and reported that WTP was related to income, cattle breed and the economic value of animals. The study demonstrates that livestock characteristics and asset value can affect demand for cattle insurance, not merely general household demographics.

Dong et al. (2020) examined willingness to pay for livestock husbandry insurance among grassland farms in Inner Mongolia, China. Their analysis showed that farm and livestock production characteristics were relevant to insurance demand, reinforcing the argument that the structure of the production enterprise affects how farmers value formal risk-transfer. Although the production system differs from Tanga, the study provides comparative evidence that livestock insurance decisions are embedded in farm-level economic and production conditions.

In Nepal, Devkota et al. (2021) analysed determinants of livestock insurance adoption and found that livestock and household characteristics contributed to adoption decisions. Acharya et al. (2024), also working with dairy farmers in Nepal, reported that the number of cattle, awareness and previous livestock-loss experience were important to WTP. The findings link the scale of livestock assets and experience of loss with farmers' valuation of insurance, thereby supporting the expectation that farm scale and risk exposure matter for WTP.



Oduniyi et al. (2020), studying index-based livestock insurance among farmers in North West South Africa, emphasised climate-related risks and socioeconomic and farm conditions in explaining WTP. Nshakira-Rukundo et al. (2021), synthesising agricultural-insurance evidence from 23 African countries, identified affordability, product design and quality, information, behavioural factors and government support as major determinants of uptake. Although their review covers agricultural-insurance more broadly, it shows that farm-level exposure and financial capacity operate alongside institutional conditions rather than independently of them.

In Ethiopia, Takahashi et al. (2020) used multi-year panel data to examine pastoralists' dynamic insurance-uptake decisions and demonstrated that livestock insurance participation changes over time as households learn and respond to their circumstances. More recently, Melketo et al. (2025) examined WTP for index-based livestock insurance in Dasenech District, South Omo, and found that land and livestock assets, previous livestock-loss experience and household characteristics were relevant to WTP.

Evidence from Tanzania remains comparatively limited. John (2023), studying improved dairy-cattle farming and livestock insurance in Mara Region, found positive associations between WTP and household income, total land size and total livestock owned, while farming risks such as theft and drought were also relevant to insurance demand. In addition, Chawala et al. (2019) found that Tanzanian smallholder dairy farmers attached different values to cattle traits including milk yield, fertility, feed requirements and disease resistance.

Overall, previous studies support the inclusion of farm size, livestock characteristics and farm-related income in livestock insurance analysis. Much of the available evidence examines herd size, cattle type, landholding, loss experience or general household income separately, and Tanzania-specific studies remain scarce. The present study extends this literature by jointly estimating farm size, livestock breed diversity and farm income within a probit model. It further integrates qualitative evidence to explain how asset exposure, production risk and farm cash-flow capacity shape WTP in Tanga Region.

Methodology

Research Design and Study Area

The study adopted a pragmatist philosophy and a cross-sectional explanatory mixed-methods design. Quantitative analysis examined associations between farm characteristics and willingness to pay (WTP) for livestock insurance, while qualitative interviews provided institutional perspectives on livestock risks and insurance decisions. The study was conducted in Korogwe, Muheza, Pangani, and Mkinga districts of Tanga Region, using a sampling frame of 5,016 programme-linked cattle-farming households identified from Kopa Ng'ombe Lipa Ng'ombe programme and district records. The programme provided selected farmers with cattle in exchange for returning the first female calf and supplying milk for a specified period, with the study's sampling frame comprising 5,016 registered beneficiaries who were actively keeping cattle. The target sample comprised Korogwe (102), Muheza (96), Pangani (84) and Mkinga (103), of which 101, 95, 82 and 102 usable questionnaires were obtained, respectively, giving a total of 380 respondents. Cochran's (1977) formula produced an initial sample of 385 respondents, retained as a conservative target despite a finite population correction yielding approximately 357; 380 questionnaires provided usable observations, while five were incomplete or excluded. The study purposively selected 15 institutional key informants: 10 National Insurance Corporation (NIC) staff and 5 livestock cooperative leaders. Because farmers were not interviewed, the qualitative findings reflect institutional perspectives rather than direct evidence of farmers' perceptions or preferences.



3.2 Data collection methods and procedures

Quantitative data were collected using a structured questionnaire administered to cattle farmers. Trained research assistants administered Swahili translated structured questionnaires through face-to-face interviews, following standardised consent, explanation and response-recording procedures. The questionnaire was pretested before the main data collection to ensure clarity and relevance.

Measurement of Variables

The dependent variable was operationalised as farmers' willingness to participate in livestock insurance, coded as 1 for respondents who indicated willingness to purchase or participate in livestock insurance and 0 for those who were unwilling. Because the questionnaire did not elicit a maximum monetary amount that respondents were willing to pay for a specified insurance product, premium, coverage period, or sum insured, the measure represents willingness to participate rather than monetary willingness to pay. Accordingly, the interpretation of the dependent variable and related findings is restricted to farmers' willingness to participate in livestock insurance. The independent variables were farm size, livestock breed diversity, and farm income. Farm size was measured using the farm size categories reported in the questionnaire, while livestock breed diversity captured the reported diversity of cattle breeds kept by respondents. Farm income was measured using the monetary income derived from farming activities, expressed in Tanzanian Shillings (TZS). The mean and standard deviations are reported in the descriptive statistics to ensure that the estimated coefficient can be appropriately interpreted.

Validity and Reliability

The questionnaire was developed in accordance with the study objectives, conceptual framework, and relevant empirical literature. Before the main survey, the instrument was subjected to expert review and pre-testing to assess the clarity, relevance, sequencing, and adequacy of the items. The pre-test was also used to identify ambiguous questions and ensure that the wording and administration procedures were appropriate for the livestock-farming context (Creswell & Creswell, 2018; Saunders et al., 2019). These procedures strengthened the content and face validity of the instrument by ensuring that the questions adequately reflected the concepts examined in the study.

Reliability assessment was applied only where appropriate to the structure of the measures. Cronbach's alpha is commonly used to assess the internal consistency of multi-item scales, with a coefficient of approximately 0.70 or above generally considered acceptable in applied social-science research, subject to the number and characteristics of the items (Nunnally & Bernstein, 1994; Tavakol & Dennick, 2011). In this study, farm size, livestock breed diversity, and farm income were operationalised as single-item variables. Consequently, Cronbach's alpha was not calculated for these variables because internal consistency cannot be assessed for a single-item measure. Their measurement quality was instead supported through clear operational definitions, expert review, pre-testing, and standardised coding and administration procedures.

Reliability and validity were therefore treated as related but distinct aspects of measurement quality. While reliability concerns the consistency of a measurement, validity concerns the extent to which the instrument adequately represents the concept being measured. Accordingly, the absence of Cronbach's alpha for the single-item farm-characteristic variables does not indicate a lack of methodological rigour; rather, it reflects the nature of their operationalisation. The study therefore relied on appropriate validity procedures and transparent measurement definitions for these variables, while reserving internal consistency assessment for any multi-item constructs where such an assessment was methodologically applicable.



Quantitative Analysis and Model Specification

Quantitative data were analysed using STATA 13. Descriptive statistics were used to summarise respondents' characteristics and study variables, while probit regression was applied because the dependent variable was binary. The model examined the association between farm characteristics and cattle farmers' willingness to participate in livestock insurance (Wooldridge, 2020).

The model was specified as $P(Y_i = 1 | X_i) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)$, where (Y_i) represents willingness to participate, (Φ) is the cumulative standard normal distribution, (β_0) is the intercept, and (X_i) represents the explanatory variables, including farm size, livestock breed diversity, farm income, and other control variables included in the final model. Categorical variables were coded using appropriate dummy variables and reference categories. Since the study used a cross-sectional design, the findings were interpreted as statistical associations rather than causal effects.

Model Diagnostics

Model adequacy was assessed using diagnostics appropriate to a binary-response model. Multicollinearity was examined using VIF and tolerance; specification was assessed using the link test; overall fit was assessed using the likelihood-ratio chi-square, McFadden Pseudo R^2 and log-likelihood. The Probit model was statistically significant overall ($p < 0.001$), indicating that the explanatory variables were jointly associated with willingness to participate in livestock insurance. Model specification was further assessed using the link test, which provided no evidence of substantial specification error (link test, $p = 0.428$).

Qualitative Analysis and Mixed-Methods Integration

The qualitative component consisted of 15 interviews with five livestock cooperative leaders and 10 National Insurance Corporation (NIC) staff. The interviews were analysed using thematic analysis, following the approach of Braun and Clarke (2021), with NVivo 14 used to organise and manage the data. The 15 transcripts initially generated 152 inductive codes, which were subsequently organised into eight higher-order themes. The analysis focused on major themes related to livestock risks, risk-management practices, insurance awareness, insurance participation, operational challenges, and barriers to insurance adoption. Particular attention was given to livestock disease, drought, theft, mortality, veterinary costs, and the importance of livestock to household livelihoods. The qualitative findings were used to provide institutional perspectives that complemented the quantitative results. Since the qualitative participants were not the cattle farmers included in the survey, the findings were not used as direct evidence of farmers' perceptions or behaviour. The study therefore interpreted the qualitative results as contextual institutional information supporting the understanding of the quantitative findings.

Results and Discussion

Results

Respondent Characteristics

Respondents averaged 51.34 years (range: 26–76), were predominantly male (67%), mainly had primary education (46.8%), and mostly lived in households of five or more members (71%).



Table 1: Descriptive Farm Characteristics

Farm-characteristic	Response option	Frequency (n)	Percentage (%)	Mean (SD)
Farm size	1–10 acres	160	42.1	2.00 (1.04)
	11–20 acres	106	27.9	
	21–30 acres	68	17.9	
	More than 30 acres	46	12.1	
Livestock breed diversity	Low	130	34.2	1.92 (0.77)
	Medium	152	40.0	
	High	98	25.8	
Management practice	Traditional	144	37.9	1.89 (0.80)
	Modern	133	35.0	
	Mixed	103	27.1	
Risk of disease/hazard	Very low	38	10.0	3.35 (1.26)
	Low	57	15.0	
	Moderate	95	25.0	
	High	114	30.0	
	Very high	76	20.0	
Monthly farm income	Less than TZS 100,000	54	14.2	2.59 (0.99)
	TZS 100,000–300,000	132	34.7	
	TZS 300,001–500,000	108	28.4	
	More than TZS 500,000	86	22.6	

Source: Field Survey, March 2026.

The descriptive results show substantial heterogeneity in farm conditions. The largest group of respondents (42.1%) operated farms of 1–10 acres, while only 12.1% operated more than 30 acres, indicating that the sample was dominated by relatively small and medium farm holdings. This pattern is consistent with John (2023), who found that total land size was positively associated with WTP for cattle insurance in Mara Region, Tanzania, and with Melketo et al. (2025), who reported that land and livestock assets were associated with WTP for index-based livestock insurance in Ethiopia. The Tanga distribution therefore suggests that many respondents operate at a scale where both vulnerabilities to shocks and affordability constraints may be important, while a smaller group has larger asset exposure that may strengthen the economic rationale for insurance.

Livestock breed diversity was mainly medium (40.0%), followed by low (34.2%) and high (25.8%). This finding shows that the surveyed cattle farmers managed heterogeneous livestock portfolios rather than a uniform breed structure. Otieno et al. (2006) found that cattle breed and the economic value of animals influenced WTP for cattle insurance in Kenya, while Chawala et al. (2019) showed that Tanzanian dairy farmers place different economic values on cattle traits such as milk yield, fertility and disease resistance.

Management practices were distributed across traditional (37.9%), modern (35.0%) and mixed (27.1%) systems. This diversity indicates that farmers differ in production intensity, husbandry practices and likely interaction with formal livestock services. The pattern provides useful context for interpreting insurance demand. Devkota et al. (2021) and Dong et al. (2020) similarly show that livestock production characteristics and farm circumstances form part of the environment in which insurance adoption and WTP decisions are made.

Perceived disease and hazard risk varied considerably among the respondents. Half of the farmers (50.0%) reported high or very high levels of risk, comprising 30.0% who rated the risk as high and 20.0% who rated it as very high, while 25.0% reported moderate risk. The remaining respondents reported low (15.0%) or very low (10.0%) risk. These findings indicate that livestock-related risks were an important concern among the surveyed farmers and provide useful contextual information for



understanding the potential relevance of livestock insurance. Previous studies have similarly highlighted disease, climatic shocks, theft, and previous livestock losses as important considerations in livestock insurance decisions (Oduniyi et al., 2020; Acharya et al., 2024; John, 2023).

Of the 380 respondents, 274 (72.1%) indicated that they were willing to participate in livestock insurance, while 106 (27.9%) indicated that they were unwilling. This binary outcome formed the dependent variable used in the probit analysis. The subsequent analysis therefore examined whether farm size, livestock breed diversity and farm income were statistically associated with the probability of a respondent reporting willingness to participate.

Table 2: Probit Results for Farm Characteristics

Variable	Coefficient (β)	Std. Error	z	p-value	Sig.
Constant	-1.874	0.608	-3.08	0.002	**
Farm Size (FS)	0.072	0.025	2.88	0.004	**
Livestock Breed Diversity (LBD)	0.194	0.089	2.18	0.029	*
Farm Income (FI), per TZS 100,000	0.091	0.027	3.37	0.001	***

Source: Field Survey, March 2026.

*Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.*

The Probit results show that farm size, livestock breed diversity, and farm income were all positively and statistically significantly associated with farmers' willingness to participate in livestock insurance. Farm size had a positive coefficient ($\beta = 0.072$, $p = 0.004$), indicating a positive association between farm size and the probability of insurance participation. Livestock breed diversity was also positively associated with participation ($\beta = 0.194$, $p = 0.029$), while farm income showed also a positive and statistically significant association ($\beta = 0.091$, $p = 0.001$).

The findings provide support for the individual hypotheses that farm size, livestock breed diversity, and farm income are positively associated with willingness to participate in livestock insurance. They are broadly consistent with previous studies showing that farm assets, livestock characteristics, and household economic conditions are relevant to livestock insurance decisions (Devkota et al., 2021; Acharya et al., 2024; Melketo et al., 2025). However, the findings represent statistical associations rather than causal effects because the study used a cross-sectional observational design. Accordingly, the variables should be described as **associated factors** rather than determinants or causal influences.

Table 3: Model Diagnostics and Goodness-of-Fit

Diagnostic	Result
Mean VIF	2.51
Maximum VIF / minimum tolerance	3.12 / 0.3205
Link test (_hatsq)	$p = 0.428$
Null log-likelihood	-224.94
Likelihood-ratio test	$LR \chi^2(8) = 192.39$; $p < 0.001$
McFadden Pseudo R^2	0.4276
Full-model log-likelihood	-128.75

Source: Field Survey, March 2026.

The multicollinearity assessment indicated no serious linear dependence among the explanatory variables, with a mean VIF of 2.51, a maximum VIF of 3.12, and a minimum tolerance of 0.3205. These values are below the commonly used VIF threshold of 10 and above the tolerance threshold of 0.10,



suggesting that multicollinearity among the included explanatory variables was not a major concern (Gujarati & Porter, 2009). However, VIF assesses linear dependence among the included regressors only and does not address omitted variables, measurement error, endogeneity, or sample-selection problems.

The link test produced an insignificant squared prediction term ($\hat{\rho}^2$, $p = 0.428$), providing no evidence of the particular specification error detected by that test. The likelihood-ratio test was statistically significant, indicating that the estimated model provided a better fit than the intercept-only model.

Qualitative Findings

Risk exposure and livestock vulnerability. Key informants described livestock disease, drought, water and pasture shortages, theft, mortality and rising veterinary costs as recurrent threats to cattle-farming households. These risks can cause sudden losses of productive assets and income, increasing the perceived value of a mechanism that can transfer part of the financial consequences of loss. This qualitative evidence provides the risk context within which farm size and livestock breed diversity become relevant to WTP. For instance, one cooperative leader explained:

"In the past year, many members lost cattle because of diseases and poor pasture caused by drought. Feed prices also increased, making it difficult for small farmers to maintain healthy animals" (COOPL1).

Another informant reported:

"Our members struggled with water shortages and lack of pasture during the dry season... Some calves also died because farmers could not afford enough feed supplements" (COOPL3).

Farm scale and livestock characteristics. Key informants from NIC and livestock cooperatives perceived that the scale and composition of cattle holdings were relevant considerations in livestock insurance decisions because farmers with larger or more diverse herds may face different production risks and protection needs. These perspectives provide contextual information for interpreting the positive associations observed for farm size and livestock breed diversity in the probit model. An NIC staff member stated:

"Farmers who previously suffered heavy losses are usually more willing to join the insurance. Some say they cannot risk losing cattle again without support" (NICW02).

Another explained:

"Most farmers become interested after experiencing losses themselves or hearing stories from others... Premium cost is still a sensitive issue in many villages" (NICW06).

Farm income and capacity to pay. Key informants also emphasised affordability and irregular cash-flow as practical constraints. Farmers may recognise the value of insurance but still be unable to pay premiums when income is low or seasonal. Conversely, stronger farm income can increase the ability to allocate resources to formal risk protection. This qualitative mechanism is consistent with the positive and significant farm income coefficient. For example, a cooperative leader stated:

"I would prefer insurance with affordable premiums because many farmers here have unstable incomes... If compensation takes too long, farmers may lose trust in the product" (COOPL1).

Similarly, an NIC representative observed:

"...the product must remain affordable if smallholder farmers are expected to participate consistently" (NICW04).



Risk-management practices and insurance complementarity. Respondents used a range of existing risk-management strategies, while qualitative themes also highlighted their limitations under severe shocks. Insurance should therefore be understood as a complement to, rather than a substitute for, animal-health management, veterinary services, record keeping and other preventive measures. This is important because insurance demand can be strengthened when farmers perceive both the probability of loss and the value of the asset at risk. For example; one cooperative leader explained:

"We encouraged members to vaccinate their animals and contribute to emergency support funds within the cooperative. Some farmers also started keeping smaller herds so they could manage feeding costs better" (COOPL1).

An NIC representative added:

"We combined insurance awareness with vaccination campaigns so farmers could see the connection between livestock health and financial protection" (NICW07).

Table 5: Integration of Quantitative and Qualitative Findings

Quantitative finding	Qualitative/institutional context
Farm size: $\beta = 0.072$, $p = 0.004$	Informants associated larger livestock operations with greater productive assets, financial exposure and protection needs.
Livestock breed diversity: $\beta = 0.194$, $p = 0.029$	Informants indicated that breeds differ in value, productivity, management requirements and consequences of loss.
Farm income: $\beta = 0.00091$, $p = 0.001$	Informants identified premium affordability and irregular cash-flow as important considerations affecting insurance participation.
Disease/hazard risk: 50% reported high or very high risk (<i>descriptive; not modelled</i>)	Informants identified disease, drought, theft, mortality, pasture and water shortages, and veterinary costs as recurring livestock-related concerns.

The integration of the findings indicates that farm size, livestock breed diversity, and farm income were positively and statistically significantly associated with willingness to participate in livestock insurance. Qualitatively, the scale and value of livestock assets, exposure to disease and environmental shocks, livelihood dependence and the ability to pay premiums explain why these variables matter. In TPB terms, farm conditions may be regarded as background factors that could influence attitudes toward the expected value of insurance and perceived behavioural control over the ability to purchase it. They provided institutional context concerning livestock risks, insurance affordability, and conditions surrounding insurance participation.

Discussion of findings

Farm size was positively and statistically significantly associated with willingness to participate in livestock insurance in the Tanga model ($\beta = 0.072$, $p = 0.004$). This finding is broadly consistent with Melketo et al. (2025), who reported that land and livestock assets were relevant to willingness to participate in index-based livestock insurance in Ethiopia. Contextual evidence from Tanzania is also provided by John (2023), who reported a positive association between total land size and WTP for cattle insurance among dairy farmers in Mara Region. Although John (2023) provides a useful local comparison, it is treated as supplementary rather than primary empirical evidence. The present finding nevertheless contributes to the Tanzania-specific evidence by showing that farm size is statistically associated with willingness to participate in livestock insurance. Given that 42.1% of respondents operated farms of 1–10 acres, followed by progressively smaller proportions in the larger farm size categories, the positive coefficient indicates that respondents with larger farm sizes had a higher predicted propensity to participate in livestock insurance.



The qualitative findings explained the farm size relationship and are consistent with previous livestock-risk research. Key informants identified disease, drought, water and pasture shortages, theft, mortality and veterinary costs as important threats to livestock production. Otieno et al. (2006) similarly framed cattle insurance in Kenya around the risk of losing economically valuable animals to disease, while Acharya et al. (2024) found previous livestock-loss experience relevant to WTP among dairy farmers in Nepal. Thus, the positive association between farm size and willingness to participate in livestock insurance may be interpreted in the context of economic exposure. As the scale of livestock production increases, the potential financial consequences of livestock-related shocks may also increase, which may strengthen the perceived relevance of formal risk-transfer mechanisms.

Livestock breed diversity was also positively and statistically significantly associated with WTP ($\beta = 0.194$, $p = 0.029$). This result is related to Chawala et al. (2019), who demonstrated that Tanzanian smallholder dairy farmers assign different values to cattle traits such as milk yield, fertility, feed requirements and disease resistance.

Descriptively, 40% of respondents reported medium breed diversity and 25.8% reported high diversity, indicating that a substantial proportion managed more than a uniform livestock profile. Chawala et al. (2019) provides relevant context by showing that Tanzanian smallholder dairy farmers assign different values to cattle traits such as milk yield, fertility, feed requirements, and disease resistance.

The positive and statistically significant association between breed diversity and willingness to participate in livestock insurance is broadly consistent with Chawala et al. (2019) and, with more limited evidential weight, John (2023). This finding suggests that differences in breed composition are relevant to farmers' stated willingness to pay for livestock insurance. It indicates that farmers with more diverse cattle holdings exhibited a higher latent propensity to report WTP, holding the other variables in the model constant.

Farm income had a positive and statistically significant association with WTP ($\beta = 0.00091$, $p = 0.001$). This is consistent with John (2023), who found household income positively associated with WTP for cattle insurance in Tanzania, and with the broader African review by Nshakira-Rukundo et al. (2021), which identifies affordability and liquidity constraints as persistent determinants of agricultural-insurance uptake. Melketo et al. (2025) likewise show that household economic circumstances matter for livestock insurance WTP.

The qualitative findings reinforce the farm income result by showing that affordability and irregular cash-flow can prevent farmers from translating a favourable view of insurance into premium payment. This interpretation is consistent with Nshakira-Rukundo et al. (2021), who identify affordability as a major barrier to insurance-uptake in Africa, and with Oduniyi et al. (2020), whose South African evidence places financial and farm circumstances within the WTP decision. Within TPB, the farm income finding is most closely linked to perceived behavioural control since farmers may regard insurance as useful but still feel unable to purchase it when farm cash flows are inadequate or poorly timed relative to premium obligations (Ajzen, 1991; Mathithibane & Chummun, 2022).

As for descriptive results, half of respondents rated disease or other hazards as high or very high, while management systems were distributed across traditional, modern and mixed practices. This pattern resembles evidence from Oduniyi et al. (2020), where climate-related risks motivated interest in index-based livestock insurance, and from Acharya et al. (2024), where prior livestock losses were relevant to WTP. In this study, risk perception and management practice provide contextual evidence and their role is therefore to help explain why farm assets and farm income may acquire greater insurance relevance under conditions of substantial perceived risk.



Overall, the farm characteristics objective is supported by convergent quantitative and qualitative evidence. Farm size, livestock breed diversity and farm income were all positively associated with WTP, while interviews emphasised livestock value, production risk, livelihood dependence and affordability. This convergence is consistent with the literature showing that insurance decisions reflect both the value exposed to loss and the resources available to finance protection (Otieno et al., 2006; Devkota et al., 2021; Nshakira-Rukundo et al., 2021; Melketo et al., 2025).

Conclusion

The study concludes that farm size, livestock breed diversity, and farm income were positively and statistically significantly associated with cattle farmers' willingness to participate in livestock insurance in Tanga Region. Descriptive results also showed variation in management practices and perceived disease or hazard risk, while institutional interviews identified livestock losses, disease, drought, theft, veterinary costs, and affordability as contextual concerns. Because the design was cross-sectional and TPB constructs were not directly measured, the findings indicate associations and possible contextual explanations rather than causal effects or tested behavioural pathways.

Farm characteristics are an important component of cattle farmers' willingness to pay for livestock insurance in Tanga Region. Farmers differ substantially in farm scale, livestock breed composition, production risks and farm-derived financial capacity, and these differences shape both the economic value exposed to loss and the feasibility of purchasing formal protection. The mixed-methods evidence shows that demand for livestock insurance cannot be understood solely as a response to risk; it also reflects the farmer's asset structure, livelihood dependence and ability to meet premium obligations.

Further, farm characteristics should be interpreted within a broader behavioural and institutional setting. Larger or more heterogeneous livestock investments can strengthen the perceived benefit of insurance, while stronger farm income can improve the perceived ability to pay. Qualitative evidence explains why these farm conditions become salient in insurance decisions.

The study contributes Tanzania-specific evidence that livestock insurance design should recognise heterogeneity among cattle farmers rather than treating them as a uniform market. Products that reflect differences in farm scale, livestock value, risk profile and cash-flow capacity are more likely to correspond with farmers' actual production circumstances. Because the study is cross-sectional and measures stated WTP, the findings establish associations and behavioural intentions rather than causal effects or confirmed future insurance purchases.

Insurance providers should develop farm-responsive livestock insurance products that reflect differences in farm size, livestock value and breed characteristics. Insurance providers should consider developing coverage and payment arrangements that are accessible to farmers with different farm sizes and income levels. Flexible payment arrangements, such as instalments or seasonal payment schedules, may also be considered to accommodate variations in farmers' cash-flow patterns. However, these recommendations should be regarded as areas for further product development rather than direct empirical conclusions from this study, since the study did not measure premium levels, price sensitivity, specific insurance product attributes, or farmers' preferences for different payment arrangements.

Government livestock authorities, insurers, extension officers and cooperatives should integrate livestock insurance with broader farm risk-management practices, including vaccination, veterinary care, livestock identification and record keeping. Strengthening these practices and farm documentation would support more accurate risk assessment and livestock valuation, facilitate claims



verification, and enable insurers to design products that better reflect farmers' actual farm characteristics and protection needs.

Acknowledgements

The researcher extends sincere appreciation to the staff of the National Insurance Corporation (NIC) and Cooperative Society Offices who participated in the study and provided valuable information. Special appreciation is extended to the Tanga Regional Administrative Secretary (RAS) and relevant district authorities for granting administrative permission and facilitating access to the study areas. The researcher also acknowledges the cooperation of the cattle farmers and key informants who participated in the study. Appreciation is further extended to the academic supervisors, reviewers, and other individuals whose guidance, constructive comments, and support contributed to the completion and improvement of this research.

Ethical considerations

Research permission was obtained from The Open University of Tanzania before data collection, followed by administrative authorisation from the relevant local government authorities in Tanga Region. Before participation, respondents were informed about the purpose and objectives of the study and how the information collected would be used. Participation was voluntary, and respondents were informed of their freedom to participate or decline. To protect confidentiality and anonymity, respondents' names and other identifying information were excluded from the questionnaires and research reporting.

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