



# SOCIO-ECONOMIC FACTORS INFLUENCING THE ADOPTION OF LIVESTOCK INSURANCE IN NYAGATARE DISTRICT, RWANDA

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## ABSTRACT

The livestock sector remains a source of livelihood in Rwanda. Particularly "dairy" is a profitable and one of the best investment sectors that can work properly in the rural areas of Rwanda due to its benefits not only as income from milk production but also as a way of providing food and nutrition security, supporting crop production through manure, and creating employment. Though the sector is faced with many risks, they include flooding and windstorms, lightning, internal and external injuries, illnesses and diseases of a terminal nature, and epidemics, to mention a few. A livestock insurance scheme is one of the new concepts used to improve risk management practices in Rwanda. However, factors influencing the adoption of livestock insurance among dairy farmers remain unknown in Rwanda. The purpose of this study was to examine the socioeconomic factors that influence the adoption of livestock insurance among dairy farmers in the Nyagatare district of Rwanda. Data were collected from 345 sampled respondents, and a logit model using STATA 13 was used to analyze the socio-economic factors influencing the adoption of livestock insurance among dairy farmers. The logit model revealed that education level, access to credit, and knowledge of livestock insurance were significant variables that positively influenced the probability of adoption of livestock insurance at the 1% level of significance, whereas farming experience and distance to town were significant variables that negatively influenced the probability of adoption of livestock insurance at the 5% and 10% levels of significance, respectively. Government and insurance companies should improve their marketing strategies. During the marketing process, the government and insurance companies should take the education level and farming experience of dairy farmers into account.

Government and insurance companies should also encourage and empower farmers' access to credit facilities.

**Key words:** *livestock insurance, socio-economic factors.*

## **1. Introduction**

Global warming and its associated variables have an impact on water availability, food availability, and health in the livestock sub-sector (Herrero et al., 2021). Climate-related risks have dramatically increased, leading to the decline of large numbers of livestock, which mainly affect nomadic herder communities, especially in African nations (Jensen & Barrett, 2017; Kunow, 2016). This lowers income for poor households in these countries, where farming is the main industry (Gebrekidan et al., 2019).

Fortunately, insurance products are a profitable and intriguing technology for dealing with climate-related risks faced by vulnerable households (Mude et al., 2010). The insurance product began in Germany in 1909 with the establishment of a compensation fund to insure livestock. Since then, livestock insurance schemes have advanced, and nowadays there are so many types of schemes in most developed countries, although they remain in their preliminary phases in emerging regions (Kaweesi, 2005).

In Rwanda, agriculture is the most important sector in the country's economy, accounting for 26% of the country's GDP, employing 66% of the population, and earning USD 444.8 million in exports (MINAGRI 2021; NISR 2021). The livestock sub-sector, particularly "dairy," is a profitable and one of the best investment sectors that can work properly in the rural areas of Rwanda due to its benefits not only as income from milk production but also as a way of providing food and nutrition security, support for crop production through manure, and employment creation (Rutamu, 2008). However, the dairy industry is facing climate change risks on both the production and marketing fronts (IFAD, 2016). Temperature and precipitation variations are the main determinants of climate and weather-related disasters that hinder

Rwandans and the country's economy (GoR, 2020). Floods, windstorms, droughts, extreme temperatures, and landslides have significantly increased, resulting in loss of livestock and damage to infrastructure, to name a few (MIDIMAR, 2015). In response to the numerous economic challenges, Rwanda has established risk management strategies in the agricultural sector, including insurance (GoR, 2018; GoR, 2020).

The Rwandan government has identified an insurance scheme in its national agriculture policy, primarily in Policy Action 3.52: states develop and implement crop and livestock insurance strategy by 2018-2019 (GoR, 2018). Rwanda has also considered insurance products in its updated NDC 2020 under the Paris Agreement, which states "expand crop and livestock insurance" (GoR, 2020).

In 2019, the Rwandan government launched the National Agricultural Insurance System (NAIS) in collaboration with three insurance companies: Radiant, PRIME, and SONARWA. NAIS assists farmers in mitigating risks and losses caused by unexpected natural disasters, pests, and diseases that affect their livestock and crops (MINAGRI, 2021). Further, it facilitates farmers' access to financial services, for instance, credits (MINAGRI, 2021). The government's subsidies cover 40% and farmers pay 60% of premium costs. The priority was given to dairy cows and productive pork and chicken for livestock insurance. In the case of dairy cows, product is available for crossbred and high-yield exotic cattle notes by Radiant. Among the risks covered are flooding and windstorms, lightning, internal and external injuries, snake bites, terminal illnesses, diseases, and epidemics (MINAGRI, 2021). The scheme began in a few regions, including Nyagatare district, and has since been expanded throughout the country (MINAGRI, 2021).

According to the World Bank Group Report 2022, Rwanda's insurance sector is still in its early stages of development, with limited exposure in various sectors such as agriculture. According to one report, less than 2% of Rwandans use micro-insurance, of which agricultural insurance is a subcategory. The same report also says that coverage in terms of crops and locations is low (World Bank Group, 2022). Few studies on insurance products have previously been conducted, particularly on the factors influencing crop insurance adoption. Previous findings within Rwanda showed that factors like the insurance premium farmers pay, a higher level of education, land

tenure, and group membership have a positive effect, while the size of the farm has a negative effect on farmers' decisions to pay for crop insurance (Ngango et al., 2022). However, no specific research was done in Rwanda to assess the socio-economic factors impacting dairy farmers' uptake of livestock insurance. Thus, the purpose of this study was to examine the socioeconomic factors that influence the adoption of livestock insurance among dairy farmers in the Nyagatare district of Rwanda.

## 2. Methodology

### 2.1. Study area, sampling, and data collection

Nyagatare district is one of the seven districts comprising the Eastern Province of Rwanda. Nyagatare is bounded to the north by Uganda, Tanzania to the east, Gatsibo to the south, and Gicumbi to the west. Nyagatare is the country's largest district, covering 1,741 square kilometers and located at an elevation of 1° 18' 52.4 S and 30° 22' 20.7 E. The majority of households in this area raise cattle such as ankole cattle, exotic cattle, and cross-bred cattle mainly for milk production (ILRI, 2009). As a result, this district was purposively sampled as a study area. Yamane's (1973) formula was applied to determine the sample.

$$n = \frac{N}{1+N(e)^2} \tag{1}$$

Where;

$n$  : Sample size

$N$  : Population size

$e$  : error

Therefore;

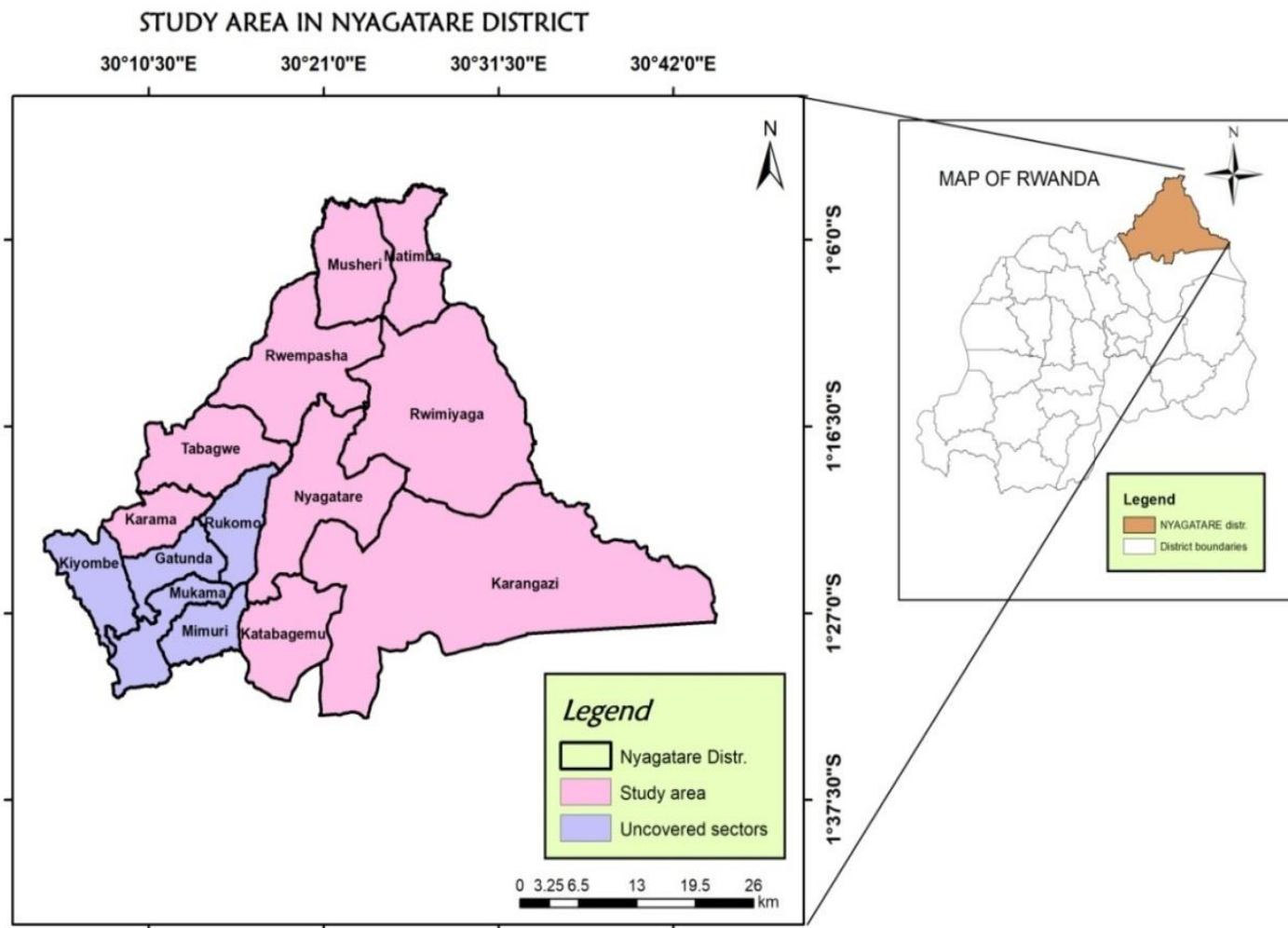
$$n = \frac{2465}{1 + 2465 (0.05)^2} = 345$$

Additional, based on the Yamane formula, to know how many respondents needed from each cooperative proportional sample size allocation was applied (see Appendix A). Yamane formula is as follows:

$$n_i = n \cdot \frac{N_i}{N} \quad (2)$$

Thus, a total of 345 respondents were sampled from 2,465 cooperative members registered in 15 dairy cooperatives (see Appendix A). Besides, in consultation with dairy cooperative leaders, a list of cooperative members was compiled. From the list of each cooperative, respondents were sampled using a simple random sampling technique. Data was collected in December 2022 through a household survey using a semi-structured questionnaire. Questionnaires were pre-tested before being distributed to all sampled respondents.

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**Figure 1.**map showing study areas

## 2.2. Analytical tools

Data obtained from the respondents were analyzed in STATA 13 using descriptive statistics and econometric model. Frequency, percentage, and mean were used to describe the characteristics of the sampled respondents. The logit model was used to analyze the socioeconomic factors that influence the adoption of the insurance in Nyagatare district. The value of "1" was assigned to adopters of livestock insurance, while 0 was assigned to non-adopters.

According to Gujariti (1995), the model is as follows:

$$\ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U_i \quad (3)$$

- $P_i$  : Probability of having livestock insurance
- $1 - p_i$  : Probability of not having livestock insurance
- $\beta_0$  : Constant term,
- $\beta_i$  : Regression coefficient,
- $u_i$  : Disturbance term
- $X_i$  : Independent variable,

Thus, independent variables were defined below;

- $X_1$  : Age
- $X_2$  : Education status
- $X_3$  : Farm size
- $X_4$  : Farming experience
- $X_5$  : Farmer Income
- $X_6$  : Distance to town
- $X_7$  : Access to credits
- $X_8$  : Knowledge of livestock insurance

**Table 1. Definition of variables and expected signs**

Variables	Definition	Hypothesized sign
Age	Categorical age 1=21-30, 2=31-40, 3=40>	+
Education level	0=Nonformaleducation,1=primary,2=secondary, 3=Tertiary	+/-
Access to credits	1=Yes, 0=NO	+
Knowledge of LI	1=0-25%, 2=26-50%, 3=51-100%	+
Farm size	Total number of hectares	+
Farming Experience	Years of cattle farming experience	-
Income	Income of dairy farmer per month ( in Frws)	+/-
Distance to the town	distance to the town in walking minutes	-

Table 1 presents the definition and hypothesized sign of each variable used in this study. Age is expected to have a positive influence on the adoption of livestock insurance. Chand et al. (2016) found a positive relationship between age and the adoption of livestock insurance. Farm size is also expected to have a positive influence on dairy farmers' decisions to adopt livestock insurance. Osipenko et al. (2015) reported a positive relationship between farm size and agricultural insurance. Additionally, their study illustrated that larger farm sizes tend to have an advantage in the adoption of innovations due to economies of scale. Education level is expected to have a positive or negative sign. Higher education raises awareness and reflects a greater comprehension of the possible dangers, mostly in the absence of livestock insurance (Chand et al., 2016). On the other hand, Bullock et al. (1994) found a negative association between education and farmers' willingness to take risk. Income is expected to have a positive or negative sign. Nahvi et al. (2014) reported a positive association between income and crop insurance in Iran. On the contrary, Chand et al. (2016) found that income has a negative influence on the adoption of livestock insurance in India. The higher the income from livestock, the more likely insurance adoption is (Chizari et al., 2003). Farming experience is expected to be a negative sign. Experience in livestock farming decreased the probability of purchasing livestock insurance (Mohammed & Ortmann, 2005; Chand et al., 2016). Access to credit is another essential factor that influenced the adoption of insurance products. It is expected to have a positive sign. Amare et al. (2019) reported that access to credit facilitates farming households in boosting their financial ability to pay insurance premiums. Sami (2017) also reported that higher access to credit by farmers led to higher involvement in agriculture insurance. The distance to town is expected to have a negative sign. Birinci and Tumar (2006) found that distance from a village to a larger town had a negative effect on farmers' knowledge of agricultural insurance in Turkey. Knowledge of livestock insurance is expected to have a positive sign. Musonda (2012) reported that a farmer with sufficient knowledge of insurance is expected to be more likely to adopt insurance because he or she understands the benefits and drawbacks and is thus better able to use this information to his or her advantage.



### **3. Results and discussion**

#### **3.1 descriptive statistics**

The results of the descriptive statistics presented in Appendices B and C. Appendix B indicated that 99% of the sampled dairy farmers were male and only 1% were female. 55% of sampled dairy farmers were above 40 years of age and 45% were between 21 to 40 years of age. About 76% of sampled dairy farmers had no formal education, 14% had secondary education, 6% had primary education, and only 5% had completed tertiary education. About 79% of sampled dairy farmers did not have access to credit, and only 21% did. Appendix B showed that 89% of the sampled dairy farmers had knowledge of livestock insurance in the range of 0–50%, and only 11% had better knowledge of insurance in the range of 51–100%.

Further, Appendix C results indicated that the average farm size of sampled dairy farmers was 10.4 ha and the average number of farming experiences was 28.67 years. The average of the income from milk production per month and the distance to the town in walking minutes were 25,4501 Rwandan francs and 46 minutes, respectively.

#### **3.2 Socio-economic factors influence the adoption of livestock insurance in Nyagatare district.**

Table 2 presents the results of the logit model analysis for the socio-economic factors influencing the adoption of livestock insurance among dairy farmers. The validity of the estimated model was confirmed by using the Hosmer-Lemeshow goodness-of-fit test, where the result showed that the p value of the chi-square for Hosmer-Lemeshow was 0.9980. The result of the logit model in Table 3 below indicated that education level, access to credit, and knowledge of livestock insurance were significant variables at the 1% level of significant, farming experience was significant at the 5% level of significant, and distance to town was a significant variable at the 10% level of significant.

**Table 4. Logit model results**

Variables	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Age	0.633	.809	0.78	0.434	-.953	2.219	
Education level	1.28	.335	3.82	0.000	.623	1.937	***
Farm size	-0.034	.05	-0.68	0.494	-.132	.064	
Farming experience	-0.097	.04	-2.45	0.014	-.175	-.019	**
Farm income	1.10e-06	0	0.54	0.588	-2.88e-06	5.08e-06	
Access to credit	2.384	.683	3.49	0.000	1.045	3.722	***
Distance to town	-0.022	.011	-1.92	0.054	-.044	.0004035	*
Knowledge of LI	2.054	.652	3.15	0.002	.776	3.332	***
Constant	-7.408	2.304	-3.21	0.001	-11.924	-2.892	***
Mean dependent var		0.133	SD dependent var			0.340	
Pseudo r-squared		0.715	Number of obs			345	
Chi-square		193.771	Prob> chi2			0.000	
Akaike crit. (AIC)		95.174	Bayesian crit. (BIC)			129.766	
Hosmer-Lemeshow chi2(8)		1.58	Prob> chi2			0.9914	

**Source:** Field Survey Data, 2022 Note: \*\*\*, \*\*, \* Significant at 1%, 5%, and 10 % levels, respectively.

The summary of the results of logit model from Table 5 was expressed as:

$$Z = -7.408 + 0.633X_1 + 1.28X_2 + -0.034X_3 + -0.097X_4 + 1.10e^{06}X_5 + 2.384X_6 + -0.022X_7 + 2.054X_8$$

The results of the logit model presented in Table 2 indicated that education level has a significant positive coefficient. This signified that an increase in the level of education among dairy farmers increased the adoption of livestock insurance. This result supports the view of Mohammed and Ortman's (2005) study, which reported a significant positive association between education level and adoption of livestock insurance. Quality education raises awareness and reflects a better understanding of future risks (Chand et al., 2016). According to Smith and Watts (2009) and De Angelis (2013), farmers with higher education levels were more willing to participate in insurance programs.

Access to credit is positively associated with the adoption of livestock insurance. This suggested that greater access to credit would lead to greater adoption of livestock insurance. Amare et al. (2019) also found that access to credit has positively affected the adoption of an insurance program in Ethiopia.

Knowledge of livestock insurance has a positive, statistically significant coefficient. This indicated that as the level of knowledge about livestock insurance increased, the adoption of livestock insurance also increased among dairy farmers. Musonda (2012) found that a farmer who has adequate knowledge of insurance is more likely to adopt insurance because he understands both its advantages and disadvantages. The more details a household has about insurance, the more likely adoption is (Mohammed & Ortmann, 2005).

The results of the logit model also indicated that farming experience has a negative significant coefficient. This indicated that with an increase in farming experience, the adoption of livestock insurance decreased among the dairy farmers in the Nyagatare district of Rwanda. Experience in livestock farming decreased the probability of purchasing livestock insurance (Chand et al., 2016). In this study, the older farmers with high levels of experience in farming had not yet adopted the insurance. According to a study conducted by Mohammed and Ortmann (2005), farmers with these unique characteristics may perhaps have sufficient knowledge to deal with risks without insurance.

A distance to town is another variable that has a negative significant coefficient. This implied that with the increase in distance to town, the adoption of insurance would decrease among dairy farmers. Birinci and Tumar (2006) reported that when distance increases, it negatively affects the number of farmers who have knowledge of insurance.

#### **4. Conclusion and Recommendations**

The livestock sub-sector remains a source of livelihood for dairy farmers in Nyagatare district. Besides, this sector is the foundation of development for the Rwandan economy as well as providing opportunities for private investment. However, the livestock sector is mainly vulnerable to unpredictable natural disasters, diseases to mention few. Livestock insurance is one of the insurance schemes designed to help farmers mitigate risks and losses in the agricultural sector in Rwanda. The purpose of this study was to examine the socioeconomic factors that influence the adoption of livestock insurance among dairy farmers in the Nyagatare district of Rwanda. The result of the logit model indicated that education level, access to credit, and

knowledge of livestock insurance were significant variables that positively influenced the probability of adoption of livestock insurance at the 1% level of significance, whereas farming experience and distance to town were significant variables that negatively influenced the probability of adoption of livestock insurance at the 5% and 10% levels of significance, respectively.

Government and insurance companies should improve their marketing strategies. During the marketing process, government and insurance companies should also take the education level and farming experience of dairy farmers into account. This could enhance the understanding and attractiveness of insurance in Nyagatare district. Research also highlights the importance of access to credit; this study recommends the government and insurance companies encourage and empower farmers' access to credit facilities. Further research should be undertaken to assess the socioeconomic profiles of non-cooperative farmers. Moreover, studies should be conducted to evaluate the impact of environmental and institutional factors on the adoption of livestock insurance.

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**Appendix A:** Cooperative members in Nyagatare district and selected respondents

S/N	Sector	Cooperative/ MCC	Number of cooperative members	Sample size
1	Rwimiyaga	Kirebe	275	$\frac{275 \times 345}{2465} = 38$
2	Matimba	Matwoki	114	$\frac{114 \times 345}{2465} = 16$
3	Musheri	Zirahumuje	205	$\frac{205 \times 345}{2465} = 29$
4	Tabagwe	Muvumba	89	$\frac{89 \times 345}{2465} = 12$
5	Nyagatare	Nyagatare	172	$\frac{172 \times 345}{2465} = 24$
6	Karangazi	Rwabiharamba	397	$\frac{397 \times 345}{2465} = 56$
7	Rwempasha	BCRK	170	$\frac{170 \times 345}{2465} = 24$
8	Rwimiyaga	Isangano	273	$\frac{273 \times 345}{2465} = 38$
9	Nyagatare	Abashumbabeza	70	$\frac{70 \times 345}{2465} = 10$
10	Karangazi	Terimberemworozi	125	$\frac{125 \times 345}{2465} = 17$
11	Katabagemu	KAFCO	84	$\frac{84 \times 345}{2465} = 12$
12	Karangazi	KAMDAMACO	177	$\frac{177 \times 345}{2465} = 25$
13	Karangazi	Abarwanashyaka	104	$\frac{104 \times 345}{2465} = 15$
14	Karama	HOK	60	$\frac{60 \times 345}{2465} = 8$
15	Rwimiyaga	BNRT	150	$\frac{150 \times 345}{2465} = 21$
<b>Total</b>			<b>2,465</b>	<b>345</b>

Appendix B: Distribution of sampled respondents by categorical variables

Variables	Category	Frequency	%
Gender	Female	2	0.52
	Male	343	99.42
	Total	345	100
Age	21-30	9	2.61
	31-40	145	42.03
	>40	191	55.36
	Total	345	100
Education level	Non –education	261	75.65
	Primary	20	5.80
	Secondary	47	13.62
	Tertiary	17	4.93
	Total	345	100
Access to credits	No	272	78.84
	Yes	73	21.16
	Total	345	100
Knowledge of LI	0-25%	20	5.8
	26-50%	288	83.48
	51-100%	37	10.72
	Total	345	100

**Source:** Field Survey Data, 2022.

Appendix C: Distribution of sampled respondents by continuous variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Farm size	345	10.475	7.464	3	38
Farming experience	345	28.67	13.808	2	65
Income	345	254501.45	193225.47	30000	1000000
Distance to town	345	45.997	31.125	1	190

**Source:** Field Survey Data, 2022