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Assessing the Role of Smallholder Livestock Farmers on Rural Household Food Security: Experiences from Raymond Mhlaba Local Municipality, Eastern Cape Province, South Africa

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ABSTRACT

The smallholder farming sector is crucial in South Africa, serving as a key source of food security and income for numerous rural households. However, in many other African countries, livestock production is a common farming practice that most farmers engage in for various reasons, such as to improve their food security status and well-being. Despite this, certain regions in South Africa witness inefficiencies in smallholder agriculture's ability to alleviate food insecurity, leading some households to engage in off-farm activities to supplement their income. Rural communities grapple with persistent challenges such as unemployment, food insecurity, insufficient income, and limited access to resources and information. This paper aims to assess the role of smallholder livestock farmers on rural household food security, focusing on the Raymond Mhlaba Local Municipality in the Eastern Cape Province of South Africa. The study utilised a cross-sectional survey design with 120 livestock farmers obtained through a random sampling method. Statistical Package for Social Sciences (SPSS) software version 22 was used for analysis, employing descriptive statistics. Additionally, a binary logistic regression model was applied to assess the factors influencing food security by

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smallholder farmers. The study's findings affirm the profitability of smallholder livestock farming and its positive contribution to household food security. Notably, the results reveal that most farmers engage in cattle farming, followed by goat and sheep production. In light of these findings, the study recommends implementing extension services, farmer-based training, and awareness campaigns to enhance rural households' food security and overall livelihoods. Such initiatives are crucial for addressing the existing challenges and fostering sustainable improvements in smallholder farming communities.

Keywords: Smallholder Farming, Livestock, Rural Household, Food Security.

1. INTRODUCTION

In many developing countries, many rural households grapple with food insecurity and poverty due to insufficient food production (Galhena, Freed, & Maredia, 2013). This presents an opportunity for farmers to play a more active role in agriculture to augment food production for rural communities. Addressing this challenge necessitates farmers to explore innovative approaches to boost food production and alleviate food insecurity. To achieve this goal, smallholder agriculture remains a crucial factor in shaping the livelihoods of many rural families in emerging economies, contributing up to 50% of family income in certain countries and enhancing food security (Samuel, 2019; Jayne *et al*., 2003). The role of smallholder agriculture in the South African economy is particularly noteworthy, as it significantly contributes to nutritional security and employment in rural areas (DAFF, 2016; Adam & Hassan, 2015). This sector presents viable avenues for generating local income for rural households and is an alternative solution to fight against food insecurity and poverty (Mdiya & Mdoda, 2021).

Existing literature indicates that approximately 80% of smallholder farms globally focus on producing food for local income generation and household consumption, thereby contributing to alleviating food insecurity and poverty (IFAD & UNEP, 2013). However, smallholder agriculture in South Africa is a pivotal pillar for agricultural development (African Smallholder Farmers Group (ASFG), 2013). Despite their numerous efforts to enhance yields, most farmers encounter difficult challenges, preventing their ability to scale up food production for commercial purposes. These challenges encompass narrow profit margins resulting from labour costs, the imposition of minimum wages for farm workers, and a lack of capital for

expanding land size and overall production. Prior research underscores that smallholder farming in rural areas often yields meagre net farm incomes, significantly impacting farmers and impeding their capacity to effectively address food insecurity and generate local income (Mdiya & Mdoda, 2021).

According to Adam and Hassan (2015), small-scale farmers in many developing countries frequently grapple with a lack of financial resources, including limited access to credits and loans, rendering their farms less profitable due to the challenges of meeting stringent requirements for loan and credit applications. Against this backdrop, this study aims to scrutinise the impact of smallholder livestock farmers on food security within rural households in the Raymond Mhlaba Local Municipality.

2. METHODOLOGY

2.1. Study Area and Research Design

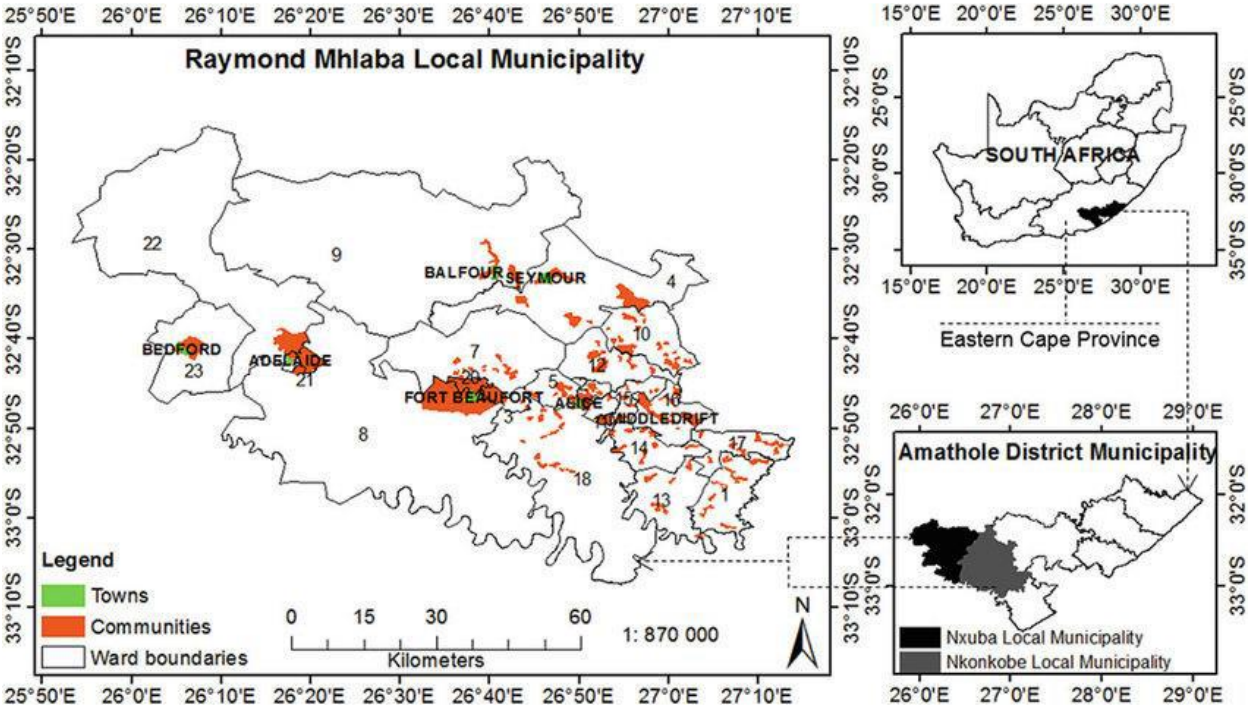

FIGURE 1: Location of Raymond Mhlaba Local Municipality (Source: Chari, 2018)

The research was carried out in the Gaga location of the Raymond Mhlaba Local Municipality in the Eastern Cape, South Africa (refer to Figure 1). Raymond Mhlaba, formerly known as Nkonkobe, is the largest local municipality in the Amathole District, encompassing a vast area of 6,357 km2. It comprises 41,022 households, with 65.3% of the population falling between

15 and 64 years of age and a dependency ratio 53.2 (Municipalities of South Africa, 2021). Gaga specifically has a population of 558 residing in 170 households within an area of 0.84 km2 (StatsSA, 2011a, 2011b, 2011c). The entire population of Raymond Mhlaba Local Municipality is 159,516, with 92.7% being of Black African descent (ECSECC, 2017). Females comprise 51.8% of the population, and 43.1% are youths aged between 15 and 34. The poverty rate in the municipality is 64.7%, and the unemployment rate stands at 46.7%, with 43.8% having completed some secondary schooling (ECSECC, 2017). Despite these challenges, Raymond Mhlaba has the highest human development index in the Amathole District Municipality. The municipality's GDP is R5.2 billion (2016 levels), constituting 18.6% of the total for the Amathole District Municipality. Notably, the agricultural sector contributes 8.5% to Raymond Mhlaba's GDP, amounting to R400 million—the highest in the Amathole District—following community services, trade, and finance (ECSECC, 2017).

The selection of the study location within the municipality was based on the prevalence of numerous livestock farmers, a well-defined communal area for grazing and browsing, and the predominant reliance of most farmers on livelihoods derived from both livestock and crop farming (Mujuru *et al*., 2022; Mdiya *et al*., 2020). The study adopted a cross-sectional design to investigate the specified aspects.

2.2. Data Collection and Sampling Size

The research employed primary data gathered through a survey methodology. A meticulously crafted structured questionnaire served as the primary tool to facilitate data collection. Both qualitative and quantitative approaches were incorporated, and a combination of purposive and random sampling methods was applied to select participants. The chosen study site was the Gaga location within the Raymond Mhlaba Local Municipality, a selection made with specific intent. From this designated area, a sample size of 120 livestock farmers was randomly chosen, ensuring that only individuals actively engaged in livestock farming were included in the study.

2.3. Analytical Framework

This research employed a quantitative approach, specifically utilising a binary logit regression model (BLRM) to scrutinise various factors influencing a household's food security status with livestock ownership. When the need arises to predict the presence or absence of a particular characteristic or outcome based on the values of a set of predictor variables, the BLRM is

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considered beneficial (Norusis, 2004). Comparable to a linear regression model, the BLRM is suitable for models with dichotomous dependent variables, aligning with the structure of the present study. The BLRM coefficients were utilised to estimate odds ratios for each independent variable in the model. As Norusis (2004) outlined, the link function employed in the BLRM elucidates the relationship between the dependent variable Z and the likelihood of the relevant event. The equation is shown below:

$$\pi_i = \frac{e^{Zi}}{1+e^{Zi}} = \frac{1}{1+e^{Zi}} = \frac{1}{1+e^{-Zi}} \quad (1)$$

or,

$$Z_i = log\left(\frac{\pi_i}{1-\pi_i}\right) \quad (2)$$

Where, π_i = probability of the i^{th} case; Z_i = value of the independent variable for the i^{th} case. The model assumes that Z is linearly related to the predictors. Thus,

$$Z_i = b_0 + b_1X_{i1} + b_2X_{i2} + \ldots + b_pX_{ip} \quad (3)$$

Where, X_{ij} = predictor for the j^{th} case; $b_j = j^{th}$ coefficient and p = number of predictors. Since Z is unobservable, the predictors are related to the probability of interest by substituting Z in Equation 1.

$$\pi_i = \frac{e^{Zi}}{1+e^{Zi}} = \frac{1}{1+e^{Zi}} = \frac{1}{1+e^{-(b_0 + b_1X_{i1} + b_2X_{i2} + \ldots + b_pX_{ip})}} \quad (4)$$

In the regression context, it is assumed that there is a set of predictor variables, $X_1, \ldots X_n$ that are related to Y and, therefore, provide additional information for predicting Y (Greene, 2003).

$$Logit\ (P_i) = ln\ (P_i/1 - P_i) = \alpha + \beta_1X_1 + \ldots + \beta_nX_n + u_i \quad (5)$$

Where, $ln\ (P_i/1 - P_i)$ = logit for households keeping livestock was measured as a binary variable with either 0 or 1 value. Specifically, zero (0) denotes households that are not food secure, and one (1) expresses food secure households. *(Yes or No); P_i = Yes; $1 - P_i$) = No*; β = coefficient; X_1 = covariates; u_i = error term.

When the variables are fitted into the model in Equation 5, the model is presented as:

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$$ln\ (P_i/1 - P_i) = \alpha + \beta_1 X_1 + \ldots \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \ldots\ldots \beta_n X_n + u_i \quad (6)$$

The estimated model was adapted from Tshikororo *et al*. (2020) and is specified as follows:

$$Y = \alpha + \beta_1 Age + \beta_2 Gender + \beta_3 Marital\ status + \beta_4 Household\ size + \beta_5 Educational\ level + \beta_6 Occupation\ of\ household\ head + \beta_7 Source\ of\ income + \beta_8 Farming\ experience + \beta_9 Type\ of\ livestock\ kept$$

$$+ \beta_{10} Access\ to\ extension + \beta_{11} Access\ to\ credit + \beta_{12} Distance\ to\ agricultural\ markets \quad (7)$$

This research employed a binary logistic regression model, incorporating twelve explanatory variables pertaining to household farmers' socio-economic and demographic attributes. A thorough literature review informed the selection of these explanatory or independent variables, and the specific variables chosen are outlined in Table 1.

TABLE 1: Description of Variables Used in the Study

Variable	Description	Measurement	Expected sign
Independent variables			
X_1	Gender of the farmer	1= male, 0 = Female	-
X_2	Age of the farmer	Actual years	-
X_3	Marital status of the farmer	Single=0,married=1, divorced=2, widowed=3	+
X_4	Family size of the farmer	1 = > 4, 0 = if less	+
X_5	Level of education by the farmer	primary=0, High school= 1, Tertiary=2	+
X_6	Household source of income by the farmer	social grants= 0, Farming sales=1,salary from employment=2	-
X_7	Farming years by the farmer	0-10 years=0, >10 years =1	+
X_8	Type of livestock kept	0= Cattle, 1= Sheep, 2= Goats	+

X_9	Distance to the agricultural marketing centre	1= 10 km, 0 = otherwise	-
X_{10}	Access to extension services by the farmer	1= access to extension agents, 0 = if not	+
X_{11}	Access to a financial institution by the farmer	1= access to finance, 0 = otherwise	-
X_{12}	Occupation by the household head	0 = part time farmer, 1= full time farmer, Employed=2	+

3. RESULTS AND DISCUSSIONS

This section provides the socio-economic characteristics of smallholder farmers in the study area. Table 2 below summarises the results.

TABLE 2: Summary of Socio-Economic Characteristics of Smallholder Farmers

Variables	**Percentage (%)**
Age	
38-68	89
Youth	11
Gender	
Male	72
Female	28
Marital status	
Married	51
Not married	49
Education level	
Primary school	20
Secondary school	48
Tertiary	32
Occupation	
Fulltime farmer	57

Parttime farmer	26
Employed	17
Access to extension	
Yes	42
No	58
Access to credit	
Yes	45
No	55

Table 2 presents data from a survey focusing on the demographic and socio-economic characteristics of smallholder farmers engaged in livestock farming. The findings reveal that 72% of these farmers were male-headed households, contrasting with the 28% headed by females. This aligns with Hoang *et al*.'s (2021) discovery that more than two-thirds of household heads were male, differing from Mdiya and Mdoda (2021), who reported 68% female-headed households and 32% male-headed.

Most farmers were 38-68 years old, with only 11% categorised as youth (<35 years). Additionally, 51% of farmers were married, while 49% were not, consistent with Mdoda *et al*.'s (2022) findings indicating that 64% were married. Notably, 57% of household heads were full-time farmers, 26% were part-time, and only 17% were employed, aligning with Mdoda *et al*.'s (2022) observation that most were engaged in full-time farming. Educational attainment varied, with 48% completing secondary school, 32% achieving tertiary education, and 20% completing primary school. Moreover, 45% of farmers received social grants, 30% derived income from livestock sales, and 25% earned salaries. Access to credit was limited for 55% of farmers, in agreement with previous studies highlighting the restricted credit access among South African smallholder farmers (Khapayi *et al*., 2016; Van Schalkwyk *et al*., 2012). Extension services were inaccessible to 58% of farmers, consistent with studies by Kruger and Gilles (2014) and Aliber and Hall (2012) highlighting the poor access to such services among South African smallholder farmers.

Livestock farming is predominantly centred around cattle at 43%, followed by sheep at 35%, and goats at 28%. Additionally, 60% of farmers travel more than 10 kilometres to reach agricultural markets. Household sizes vary from two to eight members, and farming experience

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spans seven to thirty years. These comprehensive findings provide valuable insights into the diverse characteristics of smallholder livestock farmers in the surveyed area.

The outcomes presented in Table 3 illustrate that cattle are the primary livestock kept by smallholder farmers in the study area. Furthermore, the rationale behind livestock rearing is attributed to its significant role as a source of income to support their families, cultural considerations, and perceived ease of management. These findings align with Imana's (2016) study, which identified livestock keeping as a key means to provide household sustenance and meet educational expenses. However, they diverge from a study by Mdiya *et al*. (2023), which reported that 86% of households predominantly raise sheep, compared to 58% and 18% for goats and cattle, respectively. Lastly, the study suggests that farmers with livestock are more likely to achieve food security than their counterparts.

TABLE 3: Type of Livestock Kept

Type of livestock kept	Frequency	Percentage (%)
Cattle	52	43
Sheep	42	35
Goats	26	22
Total	120	100

3.1. Factors Influencing Food Security by Livestock Smallholder Farmers

The assessment for multicollinearity among independent variables utilised the Variance Inflation Factor (VIF), revealing a value of 3.4, below the conventional threshold of 10, indicating no significant correlation among variables. The Pseudo R2 highlights that 53% of the variations in the probability of adopting modern farm technology were explained by the dependent variables in the Logit regression. The likelihood ratio Chi-square, registering a value of 64.82 with a p-value of 0.000, underscores the statistical significance of the employed model. Findings from a binary logistic regression model unveiled that age, marital status, educational level, farming experience, access to credit, and distance to agricultural markets emerged as the key variables significantly influencing the food security of smallholder livestock farmers in the study area, as delineated in Table 4.

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TABLE 4: Estimated Results on the Factors Influencing Food Security by Smallholder Farmers

Variables	Odds Ration	Std. Error	P> |z|
Age	.088	.042	0.038**
Gender	-.593	.942	0.529
Marital status	1.622	.857	0.059*
Household size	-.124	.158	0.434
Education level	1.343	.670	0.045**
Occupation	.469	.602	0.436
Source of income	.684	.605	0.258
Farming experience	2.909	.949	0.002***
Type of Livestock kept	.437	.566	0.403
Access to Extension	.222	.807	0.783
Access to Credit	3.718	1.337	0.005***
Distance to the agricultural market	-2.020	.911	0.027**
_cons	6.610	3.039	0.030**
Number of obs = 120 LR chi2(13) = 64.82 Prob > chi2 = 0.0000 Pseudo R2 = 0.5397			

*, **, *** denote the statistical significance at 10%, 5%, and 1% levels respectively

3.2. Overall Discussions

This section provides a concise discussion of the explanatory variables that significantly impacted the food security of smallholder livestock farmers in the study area.

The findings reveal that age has a statistically significant and positive impact on food security among smallholder livestock farmers at a 10% significance level. This implies that a one-year increase in age is associated with a corresponding 0.088 increase in food security. These results suggest that household heads, with each additional year of age, are more likely to achieve food security compared to younger counterparts or are more inclined to engage in livestock keeping for food security. This aligns with the observations of Opiyo (2016), who noted that older

individuals have a longer history of practising livestock keeping than their younger counterparts.

Marital status was identified as statistically significant at a 10% level, with a positive coefficient of 1.622. This indicates that married smallholder farmers are 1.622 times more likely to achieve food security than their unmarried counterparts. These findings resonate with Atube *et al*.'s (2021) study, which reported that most (over 82%) household heads were married.

Regarding educational level, the results indicate a positive and statistically significant coefficient at a 5% level. This suggests that each additional year of schooling is associated with a 1.343 times increase in food security. This implies a direct relationship between food security and the duration of formal education. These findings are consistent with the observations of Nontu and Taruvinga (2021), who suggested that years spent in school enhance the likelihood of households engaging in farming.

Farming experience demonstrates a positive coefficient with statistical significance at a 1% level. This indicates that a one-year increment in farming experience corresponds to a 2.009% rise in food security. This suggests that a heightened level of expertise in livestock farming is linked to an increased likelihood of achieving food security. These findings support the notion that farming experience can shape food security. Schilling *et al*. (2018) emphasised shifts in livestock reliance as pastoral households increasingly engage in the market economy, resulting in higher livestock sales.

The findings reveal that access to credit significantly influences the food security of smallholder livestock farmers at a 1% level, with a positive coefficient of 3.781. This implies that for every unit increase in the access to credit variable, the odds of a farmer being food secure are 3.718 times higher than their counterparts. Access to credit is posited to mitigate financial constraints, allowing farmers to procure food for their families. These results align with prior studies indicating that access to credit has a positive and significant impact on the food security of smallholder farmers (Saguye, 2016; Tessema *et al*., 2018).

Additionally, the results highlight that distance to agricultural markets adversely affects food security. A one-unit increase in distance (in kilometres) is associated with a -2.020 impact on

food security, with a 5% level of statistical significance. This implies that greater distance to agricultural markets is linked to increased food insecurity.

4. CONCLUSION AND RECOMMENDATIONS

Rural households face numerous challenges, including unemployment, food insecurity, insufficient income, and limited access to resources and information. Addressing these issues, this study delves into the role played by smallholder livestock farmers in enhancing food security within the Eastern Cape Province. Based on a sample of one hundred and twenty livestock smallholder farmers, the investigation highlights a predominance of male farmers. Many of these farmers are married and have completed secondary school education. Despite these demographics, the study underscores persistent challenges, such as limited access to extension services and credit among regional farmers. The livestock composition in the study area reveals that cattle are the primary livestock kept by farmers, followed by sheep, surpassing other types of livestock. The majority of farmers fall within an average age of 63 years. Employing a binary logistic regression model, the study explores the impact of smallholder livestock farmers on rural household food security. The model results indicate that the age, marital status, education level, and access to credit of livestock smallholder farmers exhibit positive and significant effects at various levels.

The study's outcomes affirm the profitability of smallholder livestock farming and its positive contribution to household food security. Moreover, the findings highlight the prevalent practice of cattle farming, followed by goat and sheep production. To address the identified challenges and improve rural households' food security and livelihoods, the study recommends providing extension services, farmer-focused training, and awareness campaigns on farming practices. Additionally, the study advocates for implementing agricultural policies to raise awareness and enhance access to extension services among livestock farmers, thereby fostering food security in rural households.

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