A MULTIVARIATE LOGISTIC ANALYSIS ON FACTORS AFFECTING THE MARKET PARTICIPATION OF SMALLHOLDER INDIGENOUS GOAT FARMERS IN MAKUYA VILLAGE OF THE HAMAKUYA COMMUNITY, MUTALE LOCAL MUNICIPALITY, LIMPOPO PROVINCE

Samuel GEORGE THEWELI [1]

Jenny POTSISO MOKHAUKHAU [2*]

Rudzani NENGOVHELA [3]

1 University of Limpopo, Faculty of Science and Agriculture, Department of Agricultural Economics and Animal Production, School of Agricultural and Environmental Sciences, theweligeorge@gmail.com

*2 University of Limpopo, Faculty of Science and Agriculture, Department of Agricultural Economics and Animal Production, School of Agricultural and Environmental Sciences, jenmkha@gmail.com, *Correspondent Author*

3 University of Limpopo, Faculty of Science and Agriculture, Department of Agricultural Economics and Animal Production, School of Agricultural and Environmental Sciences, nengovhelarudzani90@gmail.com

Abstract

Livestock farming, particularly indigenous goat farming, is essential for rural economies, providing food and income. The demand for goat products is growing, encompassing meat, milk, fibers, and skins. Nevertheless, there's limited participation by farmers in formal markets, with most transactions happening privately. The study examined 45 smallholder indigenous goat farmers in Makuya Village, located in the Mutale Local Municipality, Limpopo Province. Data analysis included descriptive statistics and a multivariate logistic model to explore factors influencing market participation. The findings highlighted the diverse community, with a notable presence of male smallholder goat farmers. Several factors affecting market participation were identified, including the age of the farmer, the number of goats owned, distance to the market, and the source of agricultural information. This research offers valuable insights for policymakers and stakeholders, supporting sustainable goat farming and enhanced market engagement in rural areas.

1. Introduction

Livestock farming is an important part of many rural economies for the integral asset, nutrition, tradition, and generation of income for many poor households. According to the Southern African Development Community (SADC) (2022), livestock also plays a crucial role as a valuable natural asset in the Southern African Region. In addition, more than 60% of the total land area in the region is well-suited for livestock farming, making a substantial contribution to ensuring food security throughout the SADC region (SADC) (2022). Furthermore, goats play a crucial role in securing both food and economic sustenance for small-scale farmers in rural regions across the globe (Monau, 2020).

Most households practice the rearing of goats for meat, milk, and other purposes (Tesfaye and Tamir, 2015; Mataveia et al., 2023). Monau, (2020) noted that female farmers perform a crucial role in fostering economic independence within households through their involvement in goat rearing. Male farmers are responsible for the marketing of goats and decide on the usage of the income generated from the selling of the goat (Tsvuura, 2020).

The prominence of indigenous goats is significant, given their adaptive characteristics that align with climate resilience and require minimal maintenance (Monau, 2020; Nair et al., 2021). Improving the sustainable use and development of native goat breeds faces challenges due to insufficient focus on farmer-

centric technology advancement, accurate breed characterization and poor management (Marius et al., 2020). Monau (2020) highlighted that it is essential to establish strong connections between market needs and agricultural production, implement effective local and nationwide farming regulations, initiate local community-based breeding initiatives, foster global joint research efforts, and ensure ongoing government support. Hence, according to NAMC (2005), there are many types of indigenous goat breeds in South Africa that are said to be resistant to disease. However, these goat breeds are for several purposes such as milk, meat, fiber, skin and wool, and not marketed for income generation (Sayer, 2010).

In less urbanized regions of developing nations, goats play a crucial role in sustaining communities, a contribution often overlooked when assessing them in comparison to sheep and cattle (Monteiro et al., 2017). Notably intelligent, agile, and independent, goats exhibit a remarkable resilience to diseases, surpassing that of other ruminant species (Monteiro et al., 2017). Goats were among the first animals to be domesticated. However, due to their remarkable ability to thrive in challenging environmental conditions and adapt to various diets, these animals have consistently been regarded as valuable due to their high productivity and easy manageability (Weaver, 2020; Giger-Reverdin et al., 2020). Additionally, goats do not pose a competition with humans for food resources and can thrive on cost-effective feeds.

The goat population is expanding, regardless of lack of support for its development due to environmental degradation as compared to the sheep population which has been facing a decline from the late 1990s. Such has driven the goat demand to increase over the years for meat because of its health reasons, milk for products such as cheese, fibres for mohair and goatskins for making products such as car seats and gloves (NAMC, 2005; Sati and Singh, 2010).

With the surge in human population and the growing demand for goats, a notable obstacle emerged: a limited number of farmers engaged in the market. The prevailing approach involved individual, private sales of goats rather than dealing with retailers or wholesalers. The methods employed for selling these goats and their marketing are contingent on the initiative of the producers. Additionally, goats were often slaughtered for various purposes, including religious, traditional, and ceremonial events (Dube, 2022). Traditional healers also use goats for their rituals, this increases goat demand as there is no specific goat for ritual purposes (DAFF, 2012).

The study by Khowa et al. (2023) indicated that goats played a role in generating income for households by providing both cash and meat in diverse sociocultural settings, such as weddings, funerals, and festive gatherings like Easter and Christmas. This income was used to cover various household expenses, including food, school fees, and medical and cultural consultations (Khowa et al., 2023). Goats are primarily marketed alive for cultural and religious events, and historically, they have functioned as a source of immediate cash and a buffer against economic and agricultural challenges (Zewdie & Welday 2015). Nevertheless, changes in the meat industry and the growing emphasis on consumer health are gradually facilitating the entry of goats into the formal market. Goat meat is now accessible in select retail establishments in Eastern Cape, Gauteng, and a limited number of outlets in KZN (DAFF, 2015).

Goat farming has been a prominent agricultural sector in South Africa and various African regions since the 19th century. Many believe that the goat population has grown alongside the human population (Ntshangase, 2021). One of the main reasons for the increasing prevalence of goat farming in Africa is its accessibility in terms of investment, making it an attractive option for South African farmers to combat food insecurity due to its high demand in informal markets. Interestingly, despite its importance, goat farming is often associated with lower economic status. This perception is due to the sector's informal nature, characterized by a lack of industry organization, limited value addition, and a reliance on traditional distribution channels. Most farmers choose not to sell their goats through abattoirs, as these primarily cater to consumers driven by cultural and traditional beliefs (Ntshangase, 2021).

As stated by Modiba in 2022, communal goats play a vital role in improving the well-being of underprivileged communities in developing nations. These goats make significant contributions to ensuring access to food within households and help mitigate fluctuations in seasonal food availability. Because of their ability to graze on a variety of plants, endure harsh arid conditions, and reproduce quickly, goats are better adapted to thrive in challenging environments compared to other ruminants. Despite the potential for goats to bring about positive changes in the lives of goat farmers, their utilization remains limited in many communities. There is an urgent need to formulate strategies that encourage the sustainable development of this valuable resource while simultaneously improving rural livelihoods, and achieving this goal can be facilitated through active participation in the market.

In South Africa, goat marketing is notably limited and informal, a situation worsened by the minimal involvement of goat farmers

in formal markets (Morales-Jerrett et al., 2020). The low engagement in markets is influenced by several factors, including the predominantly rural location of goat farmers. In most areas of the country, indigenous goats rely on natural forage under extensive conditions year-round, with no nutritional supplements provided during the dry winter season (Ntshangase, 2021). Chipasha et al., (2017) accords that the lack of market information hinders farmers from getting up-to-date information which might enable them to increase production. Therefore, this study seeks to answer the following research questions: *"What is the demographic information of smallholder goat farmers in Makuya village"* and *"What are the factors affecting the market participation of smallholder goat farmers in Makuya village".*

2. Methodology

The HaMakuya community comprises approximately 5,000 residents, and within this community, Makuya village is home to a population of 1,179 individuals (Smith, 2011; Makonese and Bradnum, 2017). These statistics offer a clearer perspective on the population distribution within our study area.

Moreover, households in the study area engage in agricultural activities, including livestock and vegetable production. These households cultivate vegetables and raise livestock, such as chickens and goats, both for consumption and as a means of income generation (Makonese and Bradnum, 2017). To enhance the comprehensibility of our research, the study intends to elaborate on these agricultural practices particularly on goat production, shedding more light on the roles they play in the livelihoods of the community members.

2.1. Data Collection and Analysis

The study used cross-sectional design to collect the data from smallholder goat farmers in HaMakuya village. The cross-sectional study design was chosen for observation as it enables researchers to assess both the outcomes and exposures in participants simultaneously (Setia, 2016). The study was designed to identify the demographic information of smallholder farmers and to analyse the factors that influence the market participation of smallholder farmers in Makuya village.

Data was collected from smallholder rural goat farmers in the Makuya village. A questionnaire was developed to capture the information related to the factors affecting the market participation of goat farmers. Due to the unknown number of goat farmers in the study area judgmental and snowball sampling techniques were employed to select 45 respondents. Data was collected on a face-to-face basis.

The collected data were analysed quantitatively, thus, descriptive analysis and multivariate logistic regression model. The multivariate logistic model was employed to test the relationship between the dependent and independent variables (Tesfaw and Fenta, 2021).

The multivariable logistic equation is given by: $log \frac{\pi_i}{1-\pi_i} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_n X_n + u_i$

Where $\pi(x) = P(X = x)$ is a binary independent variable Y with two categories which take the form 0 and 1 (0 = participate and 1=not participate). $X_1, X_2 X_3$ are the predictor variables in the multivariable model.

3. Results and Discussion

Table 1 presents the socio-economic characteristics of the respondents. A total of 45 smallholder goat farmers were considered for the study. Most of the surveyed respondents were male (67%) as compared to their female (33%) counterparts. Education levels vary, with a significant portion having completed secondary education (38%). In terms of farm income, the respondents were almost evenly split between those earning below and above R6000. Market participation was relatively high, with 78% of respondents actively participating. In addition, most respondents (91%) received extension services, indicating a strong connection to support systems. Finally, transportation is predominantly through personal ownership (60%). These findings suggest a diverse community with varying education levels, income sources, and active participation in agricultural and market activities. The high engagement with extension services implies receptiveness to external support, possibly indicative of a community eager to improve and optimize its agricultural practices.

Table 1. Socio-economic characteristics of the smallholder goat farmers

Variables	Frequencies / Percentages (%)
Gender	
Female	15 (33)
Male	30 (67)
Level of education	

Never went to school	4 (09)
Primary	14 (31)
Secondary	17 (38)
Tertiary	10 (22)
Farm income	
<R6000	23 (51)
>R6000	22 (49)
Market participation	
Participate	35 (78)
Not participate	10 (22)
Extension services	
Yes	41 (91)
No	4 (09)
Type of transport	
Own	27 (60)
Other	18 (40)

The descriptive results of the continuous variables are presented in Table 2. The age of respondents ranged from a minimum of 29 years to a maximum of 88 years, with an average age of 53 years. This suggests that most of the goat farmers in the study area are in their active stage but closer to retirement.

Table 2. Descriptive results of continuous variables

Variables	Minimum	Maximum	Mean	Standard Deviation
Age	29	88	53	13.441
Household size	3	12	7	2.580
Number of goats	14	38	23	6.077

Household size in the study varied in size, with the smallest having three members and the largest having 12, averaging seven (7) members per household. The large household size indicates the presence of household labour. Regarding the number of goats, the quantity ranged from 14 to 38, and the standard deviation was 6.077, as illustrated in the table above. The average number of goats a farmer is likely to have in the study area is 23 suggesting a goat opportunity to engage in market participation.

Table 3. Multivariate logistic results of the factors affecting the market participation of smallholder goat farmers.

Variables	B	S. E	Wald	Sig
Constant	-14,222	8,453	2,831	0,092
Gender	2,608	1,745	2,233	0,135
Age of farmer	0,151*	0,080	3,625	0,057
Level of education	-2,403	1,577	2,322	0,128
Household size	0,190	0,265	0,512	0,474
Farm income	-0,427	1,807	0,056	0,813
Number of goats owned	0,441**	0,212	4,314	0,038
Distance to the market	-1,821*	1,009	3,260	0,071
Do you have other livestock	-2,111	1,912	1,220	0,269
Access to agricultural extension services	0,078	1,937	0,002	0,968
Type of transport	2,796	1,714	2,659	0,103
Source of agricultural information	-2,128**	1,025	4,310	0,038
Number of years in farming	-3,191	2,137	2,229	0,135
2 Log likelihood	27,033			

Model Chi-square	27,033
Model significance	,008
Cox & Snell R Square	,452
Nagelkerke R Square	,691

Table 3 presents the binary logistic variables on the factors affecting the market participation of goat farmers in Makuya Village of the Mutale Local Municipality. The results show that the binary logistic model is significant at less than 5% level. In addition, Nagelkerke R Square implies that 69.1% of the variance is explained by the independent variables. The significant variables, age of the farmer, number of goats, distance to the market and source of agricultural information are found to influence the dependent variable.

The age of the farmer is both positively and significantly correlated at a 10% level, suggesting that age is likely to have an impact on the market involvement of goat farmers in the study area. The findings indicate that the likelihood of smallholder farmers participating in the market may increase as they grow older. However, it's worth noting that Randela et al. (2008) and Hlatshwayo et al. (2021) argue that older farmers in many parts of South Africa tend to rely on traditional production methods, which could potentially hinder their market participation. Additionally, age represents a level of experience, which ultimately influences market participation (Ntshangase et al., 2021).

The number of goats owned also exhibits a positive and significant relationship with the market participation of goat farmers. Generally, larger flock sizes tend to generate higher income compared to smaller ones, which could incentivize farmers to participate more actively in the market (Zewdie et al., 2019).

The distance to the market plays a crucial role in the market involvement of smallholder goat farmers. A shorter distance to the market is likely to increase farmers' market participation. Conversely, farmers who live farther from the market might opt to sell their produce to nearby households (Namonje-Kapembwa et al., 2022).

The source of agricultural information is an important factor that influences the market participation of smallholder farmers. In this study, the variable representing the source of agricultural information is statistically significant but has a negative coefficient, indicating that this variable does not have a significant impact on the market participation of goat farmers in the study area. Nevertheless, sources of agricultural information

are essential in equipping farmers with the latest knowledge that could enhance their market participation. This lack of influence might be due to the reliance on traditional information sources like television and radio (Chen and Lu, 2020).

4. Conclusions

The study provided a comprehensive understanding of the demographic profile of smallholder goat farmers in Makuya Village, revealing a diverse community with varying education levels, income sources, and active participation in agricultural and market activities. Despite the informal and limited nature of goat farming in South Africa, the study found that a significant percentage (78%) of smallholder goat farmers in Makuya Village actively participate in the market. This suggests a robust engagement with the agricultural sector within the community. The multivariate logistic regression analysis identified several key factors influencing the market participation of smallholder goat farmers. These include the age of the farmer, the number of goats owned, distance to the market, and the source of agricultural information.

Contrary to some existing literature, the study found that as the age of smallholder farmers increases, there is a likelihood of increased market participation. This may be attributed to accumulated experience and a more favorable attitude toward market engagement. The number of goats owned positively influences market participation, with larger flock sizes encouraging farmers to participate in the market. This aligns with the economic incentive of larger flock sizes leading to higher income, motivating farmers to engage in market activities. The distance to the market emerged as a significant factor, indicating that a shorter distance increases market participation. In addition, farmers located closer to markets are more likely to participate, while those at a distance may resort to selling produce within the local community. The study highlighted the significance of the source of agricultural information, although the influence is negative. Furthermore, farmers may not rely on certain information sources for market participation, emphasizing the need to understand and utilize effective channels for disseminating market-related information.

Recognizing the influence of age on market participation, tailored interventions and support programs should be designed to address the unique needs and challenges faced by both younger and older

smallholder farmers. Encouraging and supporting farmers to increase their flock sizes could contribute to higher income generation and increased market participation. This may involve targeted breeding programs, access to veterinary services, and financial incentives. Initiatives aimed at reducing the distance to markets could enhance overall market participation. Infrastructure development, transportation support, and market aggregation strategies can play a crucial role in this regard. While the study found a negative influence of the source of agricultural information on market participation, efforts should be made to diversify and strengthen information dissemination channels. Incorporating modern communication tools and ensuring accessibility to relevant information can empower farmers for market engagement. Implementing community-based training programs focused on market-oriented farming practices, business skills, and market trends can empower smallholder goat farmers to make informed decisions and actively participate in formal markets. Policymakers should consider the findings of this study in formulating and adjusting policies related to goat farming. Addressing the identified factors can contribute to the development of a more inclusive and vibrant goat farming sector in Makuya Village and similar communities. Hence, gaining insights into the factors affecting how smallholder goat farmers engage in the market is crucial for promoting long-term, environmentally friendly farming methods, enhancing the well-being of rural populations, and bolstering food security in rural areas.

References

1. Chen, Y., & Lu, Y. (2020). Factors influencing the information needs and information access channels of farmers: An empirical study in Guangdong, China. Journal of Information Science, 46(1), 3-22. https://doi.org/10.1177/0165551518819970

2. Chipasha, H., Ariyawardana, A., & Mortlock, M. Y. (2017). Smallholder goat farmers' market participation in Choma District, Zambia. African Journal of Food, Agriculture, Nutrition and Development, 17(1), 11691-11708. https://doi.org/10.18697/ajfand.77.16175

3. Department of Agriculture, Forestry and Fisheries (DAFF). (2012). A Profile of the South African Goat Market Value Chain. Website: online at http://www.nda.agric.za/docs/AMCP/Goat2012.pdf

4. Department of Agriculture, Forestry and Fisheries. (2015). A profile of the South African goat market value chain. Website: online at http://www.nda.agric.za

5. Dube, E. (2022). The etymology of naming November as Mbudzi ("goat [s]") and collateral sacredness. Nomina Africana: Journal of African Onomastics, 36(1), 47-57.

6. Giger-Reverdin, S., Domange, C., Broudiscou, L. P., Sauvant, D., & Berthelot, V. (2020). Rumen function in goats, an example of adaptive capacity. The Journal of dairy research, 87(1), 45–51. https://doi.org/10.1017/S0022029920000060

7. Hlatshwayo, S. I., Ngidi, M., Ojo, T., Modi, A. T., Mabhaudhi, T., & Slotow, R. (2021). A typology of the level of market participation among smallholder farmers in South Africa: Limpopo and Mpumalanga Provinces. Sustainability, 13(14), 7699. https://doi.org/10.3390/su13147699

8. Khowa, A. A., Tsvuura, Z., Slotow, R., & Kraai, M. (2023). The utilisation of domestic goats in rural and peri-urban areas of KwaZulu-Natal, South Africa. Tropical Animal Health and Production, 55(3), 204.

9. Makonese, T., & Bradnum, C. (2017). Public participation in technological innovation: The case of the Tshulu stove development programme. Journal of Energy in Southern Africa, 28(1), 13-24. http://dx.doi.org/10.17159/2413-3051/2017/v28i1a1379

10. Marius, L. N., Shipandeni, M. N. T., & Togarepi, C. (2020). Review on the status of goat production, marketing, challenges and opportunities in Namibia. Tropical animal health and production, 53(1), 30. https://doi.org/10.1007/s11250-020-02468-3

11. Mataveia, A.G., Visser, C., & Sitoe, A. (2023). Smallholder Goat Production in Southern Africa: A Review. IntechOpen. doi: 10.5772/intechopen.97792.

12. Modiba, M. (2020). Agricultural commercialisation through innovation platforms: A case for goat production (Master's thesis, Faculty of Commerce). University of Cape, western Cape province.

13. Monau, P., Raphaka, K., Zvinorova-Chimboza, P., & Gondwe, T. (2020). Sustainable utilization of indigenous goats in Southern Africa. Diversity, 12(1), 20. https://doi.org/10.3390/d12010020

14. Monteiro, A., Costa, J. M., & Lima, M. J. (2017). Goat system productions: Advantages and disadvantages to the animal, environment and

farmer. Goat science, 351-366.
https://doi.org/10.5772/intechopen.70002

15. Morales-Jerrett, E., Mancilla-Leytón, J. M., Delgado-Pertíñez, M., & Mena, Y. (2020). The contribution of traditional meat goat farming systems to human wellbeing and its importance for the sustainability of this livestock subsector. Sustainability, 12(3), 1181. https://doi.org/10.3390/su12031181

16. Nair, M. R., Sejian, V., Silpa, M. V., Fonsêca, V. F. C., de Melo Costa, C. C., Devaraj, G., Krishnan, M. Bagath, P. O. Nameer & Bhatta, R. (2021). Goat as the ideal climate-resilient animal model in tropical environment: revisiting advantages over other livestock species. International Journal of Biometeorology, 65, 2229-2240. https://doi.org/10.1007/s00484-021-02179-w

17. Namonje-Kapembwa, T., Chiwawa, H., & Sitko, N. (2022). Analysis of goat production and marketing among smallholder farmers Zambia. Small Ruminant Research, 208, 106620. https://doi.org/10.1016/j.smallrumres.2022.106620

18. National Agricultural Marketing Council (NAMC). (2005). Report on the investigation into the potential for the South African goat industry. website: online at http://www.old.dalrrd.gov.za/docs/AAPS/NAMC1.pdf

19. Ntshangase, Z. M., Sanelise, T., Moyo, B., Misery, S., & Van Niekerk, J. (2021). Factors Affecting Household Goat Farmers' Market Participation and the Extent of Commercialization. In Goat Science-Environment, Health and Economy. IntechOpen.

20. Ntshangase, Z. M., Sanelise, T., Moyo, B., Misery, S., & Van Niekerk, J. (2021). Factors Affecting Household Goat Farmers' Market Participation and the Extent of Commercialization. In Goat Science-Environment, Health and Economy. IntechOpen. https://doi.org/10.5772/intechopen.97233

21. Randela, R., Alemu, Z. G., & Groenewald, J. A. (2008). Factors enhancing market participation by small-scale cotton farmers. Agrekon, 47(4), 451-469. doi: 10.1080/03031853.2008.9523810.

22. Sati, V. P., & Singh, R. B. (2010). Prospects of sustainable livestock farming in the Uttarakhand Himalaya, India. Journal of Livestock Science, 1(1), 9-16.

23. Sayer, M. (2010). Storey's Guide to Raising Meat Goats: Managing, Breeding, Marketing. website: online at

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3049417/

24. Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. Indian journal of dermatology, 61(3), 261.https://doi.org/10.4103%2F0019-5154.182410.

25. Smith, A. (2011). Ha-Makuya. Website: Online at https://census2011.adrianfrith.com/place/965057

26. Southern African Development Community (SADC). (2022). Livestock Production. Website: online at https://www.sadc.int/pillars/livestock-production

27. Tesfaw, L. M., & Fenta, H. M. (2021). Multivariate logistic regression analysis on the association between anthropometric indicators of under-five children in Nigeria: NDHS 2018. BMC pediatrics, 21(1), 1-13. https://doi.org/10.1186/s12887-021-02657-5

28. Tesfaye, A., & Tamir, B. (2015). Assessment of goat production and marketing practices, constraints and opportunities in Yabello District of Borana Zone, Southern Ethiopia. International Journal of Innovative Research and Development, 4(11), 2278-0211.

29. Tsvuura, S. M. (2020). A gendered analysis on the role and potential of goat production to improve income and food security in semi-arid areas of South Africa (Doctoral dissertation). University of Kwa-Zulu Natal, Durnan, South Africa.

30. Weaver, S. (2020). The Goat: A Natural and Cultural History. Princeton: Princeton University Press. https://doi.org/10.1515/9780691208527

31. Zewdie, B. & Welday, K. (2015). Reproductive Performance and Breeding Strategies for Genetic Improvement of Goat in Ethiopia: A Review. Greener Journal of Agricultural Sciences, 5(1):023-033. http://doi.org/10.15580/GJAS.2015.1.080614317

32. Zewdie, B., Urge, M., Tadesse, Y., & Gizaw, S. (2019). Factors Affecting Arab Goat Flock Dynamics in Western Lowlands of Ethiopia. Open Journal of Animal Sciences, 9(03), 305. https://doi.org/10.4236/ojas.2019.93026