Evaluation of the Performance of the Small Ruminant Industry in Mandera County, Kenya

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Abstract

Small ruminant production is a key component of pastoral livelihoods and food security in Mandera County, Kenya. This study investigated disease occurrence, veterinary delivery, climate impacts, market integration, and value chain constraints affecting Mandera County's small ruminant industry to fill a gap in integrated evidence. Using a mixed-methods cross-sectional design, researchers combined structured surveys of 370 pastoralist households across six sub-counties, six focus group discussions, six key informant interviews with veterinary and extension officers, and a review of 2022–2024 climate records. Regression analysis, Pearson correlation, one-way ANOVA and thematic analysis were applied. Reported disease occurrence was high, with 68.1% of respondents reporting PPR in goat herds and 71.9% in sheep flocks, while 41.9% reported CCPP occurrence in goats. Veterinary service access was limited, with only 31.9% of pastoralists reporting regular access, due to geographical barriers (60.8% living beyond 15 km) and financial constraints (81.9% reporting services as unaffordable). Climate variability impacts were substantial, with 89.0% of respondents reporting changes, particularly increased drought frequency (67.0%) and unpredictable rainfall (45.0%), leading to reduced herd sizes (72.0%) and high mortality (40.0%). Market integration was constrained by dominant local market channels (65.1%), information asymmetries and limited value addition (72.0%). Regression analysis accounted for 79.4% of the variation in small ruminant industry performance ($R^2 = 0.794$, Adjusted $R^2 = 0.780$, $p < 0.001$), identifying drought frequency ($\beta = -0.387$, $p < 0.001$), reported PPR occurrence ($\beta = -0.245$, $p < 0.001$) and market access ($\beta = 0.275$, $p < 0.001$) as the strongest predictors. Disease burden, inadequate veterinary services, climate stress and market integration constraints are significantly associated with reduced industry performance in Mandera County. The study recommends establishing community-based animal health worker systems, implementing climate-resilient feeding strategies and developing pastoralist cooperatives for improved market integration.

Keywords*: Mandera County, Small ruminants, Disease occurrence, ASALs, Market access*

1.0 Introduction

Africa's arid and semi-arid lands (ASALs) constitute over 40% of the continent's landmass (Homewood et al., 2012). In Kenya, ASAL regions cover about 89% of the country's total land area supporting extensive pastoral production systems (Akuja & Kandagor, 2024). Small ruminants, comprising sheep and goats, are particularly suited to these environments due to their adaptability to harsh climates and ability to utilize scarce vegetation (Wodajo et al., 2020). In Mandera County, located in northeastern Kenya along the borders of Ethiopia and Somalia, pastoralism accounts for 84% of household incomes, making small ruminant production central to local livelihood and food security (MoALF, 2017). Despite their importance, small ruminant systems in ASAL regions face persistent constraints that suppress productivity. Recurrent droughts lead to severe pasture and water shortages, resulting in substantial herd losses (Ndiritu & Gichuki, 2025). Disease challenges including Peste des Petits Ruminants (PPR), Contagious Caprine Pleuropneumonia (CCPP) and helminthiasis further reduce productivity, particularly where veterinary services are inadequate (Kimeli et al., 2025). In addition, weak market systems and inefficient value chains limit commercialization and pastoral income generation (Chelanga et al., 2022).

Although these constraints are widely recognized, existing studies in East Africa have largely examined individual factors in isolation without assessing their combined effects on small ruminant system performance (Armson et al., 2021). Consequently, there is limited integrated quantitative evidence on how disease burden, veterinary service access, climate variability and perceived market integration jointly influence small ruminant industry performance in Mandera County. This evidence gap constrains the development of coordinated system-wide interventions. This study therefore evaluated small ruminant industry performance in Mandera County by examining reported disease occurrence, veterinary service delivery, climate variability and market access and value chain constraints, with the aim of generating integrated evidence to inform targeted interventions in Mandera and comparable ASAL contexts.

Problem statement

Sheep and goat production is a critical livelihood source for pastoral communities in Mandera County, yet the industry faces persistent productivity and profitability challenges. Evidence from Kenya's arid and semi-arid lands demonstrates substantial losses associated with animal health, veterinary service limitations, climate variability and market inefficiencies. Outbreaks of Peste des Petits Ruminants in Turkana County caused estimated economic losses of US$19.1 million, of which approximately 88% resulted from sheep and goat mortality (Kihu et al., 2015). Animal health challenges are further compounded by limited access to formal veterinary services, with 87.76% of pastoral households relying on drug stockists while only 12.24% accessed government veterinary officers (Onono et al., 2013). Climate variability continues to threaten livestock production through recurrent droughts that reduce pasture and water availability, while substantial differences in flock profitability have been reported, with high-performing flocks generating more than twelve times the returns of low-performing flocks (Arnold et al., 2024). Despite this evidence, existing studies in Kenya's arid and semi-arid lands have largely examined these

constraints in isolation and in geographically specific contexts outside Mandera County. Consequently, limited understanding exists regarding the relative and combined influence of disease burden, veterinary service access, climate variability and market access and value chain constraints on small ruminant industry performance. Limited county-specific integrated quantitative assessments exist in Mandera County. This evidence gap undermines evidence-based prioritization of interventions and reduces the efficiency of resource allocation for improving livestock productivity and pastoral livelihoods. This study therefore addressed this gap through a county-specific integrated quantitative assessment of these determinants.

"The study concludes that Small ruminant production in Mandera County faces a complex and interacting set of constraints"

Objectives of the study

The main objective of the study was to evaluate the performance of the small ruminant industry in Mandera County, Kenya. Specific objectives were: (i) to determine the reported occurrence and impact of major small ruminant diseases and pastoralist-reported control measures; (ii) to assess access to and utilization of veterinary services among small ruminant pastoralists; (iii) to assess pastoralist-reported impacts of climate variability on small ruminant production; and (iv) to assess market integration, value chain constraints and pastoralist perceptions of profitability in the small ruminant sector.

2.0 Materials and Methods

Study Design and Area

This study employed a mixed-methods research design combining a cross-sectional survey with qualitative data collection methods. The study was conducted in Mandera County, covering all six sub-counties: Mandera East, Mandera North, Mandera West, Mandera South, Banisa and Lafey. Mandera County is situated in Northeastern Kenya, bordered by Ethiopia to the north and Somalia to the east, within a hot, dry and arid environmental characteristic of ASAL regions. Livestock production, especially small ruminants, is the primary source of livelihood for most households in the County.

Sample Size and Sampling

The study targeted small ruminant pastoralists, veterinary officers, community disease reporters and livestock traders across Mandera County. Based on an estimated 90,549 pastoralist households, derived from 125,763 total households (KNBS, 2019) of which 72% are engaged in pastoralism as the primary livelihood activity (Mandera CIDP, 2018), the required sample size was calculated as 384 using the Cochran (1977) formula ($Z = 1.96$, $p = 0.5$, $e = 0.05$), and rounded up to 400 to account for potential non-response. Proportional stratified random sampling was applied across all six sub-counties to ensure representative coverage. A total of 370 questionnaires were fully completed and returned, representing a response rate of 92.5% (Table 1).

Table 1

Sample distribution and response rate by sub-county

Sub-County	Sampled (n)	Completed (n)	Response Rate (%)
Mandera East	70	65	92.9
Mandera North	65	60	92.3
Mandera West	68	63	92.6
Mandera South	67	62	92.5
Banisa	65	60	92.3
Lafey	65	60	92.3
Total	**400**	**370**	**92.5**

Data Collection

Primary data were collected through four methods: (i) structured questionnaires administered to 370 pastoralist households, (ii) Key Informant Interview (KII) conducted with 6 veterinary officers and livestock extension agents, (iii) Focus Group Discussions (FGDs) with six groups of 8 -12 participants each and (iv) retrospective data review of climate data (2022-2024). Questionnaires were pre-tested with 38 respondents (10% pilot sample size), translated into Somali language by trained enumerators and administered through personal interviews to address literacy challenges.

Data Analysis

Quantitative data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics including frequencies, percentages, mean and standard deviations were computed. Multiple regression analysis, Pearson correlation analysis and one-way Analysis of Variance (ANOVA) with post-hoc Tukey HSD tests were performed to examine relationships among key variables. Reliability of the research instruments was assessed using Cronbach's Alpha. Qualitative data from FGDs and KII were analyzed using thematic analysis following Braun and Clarke's (2006) framework. Ethical approval was obtained from Kenya Methodist University Ethics Review Committee and informed consent was secured from all participants.

3.0 Results and Discussion

Reliability of Research Instruments

The Cronbach's Alpha test confirmed acceptable internal consistency across all constructs: Reported Disease Occurrence and Control (α = 0.842), Veterinary Service Access (α = 0.791), Climate Variability Impact (α = 0.813) and market integration and value chain (α = 0.768) with an aggregate coefficient of 0.824, exceeding the recommended threshold of 0.70 (Taber, 2018).

Socio-Demographic Characteristics

The study sample was predominantly male (80.0%), reflecting traditional pastoral cultural norms where men manage livestock. Most respondents (50.0%) were aged 36-50 years. Educational attainment was low, with 60.0% having no formal education and 30.0% attaining only primary education. The majority (90.0%) were married, 60.0% had household sizes of 6-10 members, and 90.0% reported more than five years of farming experience. Half of the respondents maintained medium-sized herds of 50-100 small ruminants.

Reported Disease Occurrence and Control Measures in Mandera County

Table 2

Reported Disease Occurrence and Control Measures (n = 370)

Variable	Response Category	Frequency	Percentage	Mean	Std. Deviation
Major Diseases Affecting Goats	PPR	252	68.1%	4.32	0.76
	CCPP	155	41.9%	3.89	0.82
	Helminths	130	35.1%	3.45	0.91
	SGP	104	28.1%	3.12	0.95
Major Diseases Affecting Sheep	PPR	266	71.9%	4.45	0.71
	Helminths	167	45.1%	3.78	0.85
	Enterotoxaemia	56	15.1%	2.89	1.02
Disease Impact on Productivity	High mortality (>20%)	222	60.0%	4.23	0.78
	Reduced growth rates	185	50.0%	3.95	0.83
	Poor reproduction	148	40.0%	3.67	0.89
	Weight loss	133	35.9%	3.45	0.92
Vaccination Access	Regular access	118	31.9%	3.12	1.05
	Occasional access	148	40.0%	2.89	1.12
	Rare access	74	20.0%	2.45	1.23
	No access	30	8.1%	1.89	1.34
Disease Control Methods	Vaccination	207	55.9%	3.78	0.86
	Traditional medicine	167	45.1%	3.45	0.94
	Veterinary drugs	148	40.0%	3.23	0.97
	Herd management	111	30.0%	2.95	1.03
Mortality Rates	<10%	74	20.0%	2.34	1.15
	10-20%	185	50.0%	3.12	0.98
	21-30%	89	24.1%	3.78	0.87
	>30%	22	5.9%	4.23	0.76

Peste des Petits Ruminants (PPR) emerged as the most devastating disease, reported in 68.1% of goat herds and 71.9% of sheep flocks with mean severity scores of 4.32 and 4.45 respectively. These findings align with Jones et al. (2016) who reported widespread PPR prevalence and high transmission rates in pastoral systems across the Horn of Africa, though prevalence in Mandera exceeds the 54.3% reported in neighboring Kwale County by Lugonzo et al. (2023) suggesting regional epidemiological variation. Contagious Caprine Pleuropneumonia (CCPP) followed as the second most commonly reported disease with 41.9% of respondents reporting its occurrence in goats, consistent with Yatoo et al. (2019) who identified northern Kenya as a CCPP hotspot. Helminth infections affected 35.1% of goats and 45.1% of sheep. The high mortality reported (60.0% with >20% herd mortality) is consistent with economic impact assessments by Aboah et al. (2024) estimating annual PPR-related losses exceeding USD 1.4 billion across Africa. Vaccination access was critically limited, with only 31.9% of respondents reporting regular access. The reliance on traditional medicine by 45.1% of pastoralists reflects the adaptive

strategies pastoralists employ under limited veterinary service access, consistent with Nwafor (2022).The significant correlation between limited vaccination access and high PPR prevalence supports the integrated approach advocated by FAO and OIE (2015) for coordinated disease control and service delivery in pastoral systems.

Veterinary Service Delivery

Access to veterinary services remained constrained. Distance was the primary barrier: only 15.1% of respondents lived within 5 km of service points, while 40.0% faced distances of 16-30 km and 20.8% exceeded 30 km. Financial constraints compounded these barriers, with 81.9% of respondents considering services unaffordable. Only 24.1% of respondents received monthly veterinary services. Extension services were the least available service type (30.0%), indicating a critical gap in knowledge transfer. These findings align with Omondi et al. (2021) who documented similar service gaps in Kenya's ASAL regions, though access in Mandera appears lower than the 38.0% reported in comparable Ethiopian pastoral regions (Gizaw et al., 2021). The severity of distance constraints aligns with the findings of Ilukor (2017), which demonstrate that transaction costs significantly limit access to veterinary and healthcare services in remote areas.

Climate Variability Effects on Small Ruminant Production

Table 3

Climate Variability Impacts and Adoption Strategies (n = 370)

Variable	Response Category	Frequency	Percentage	Mean	Std. Deviation
Climate Change Perception	Noticed changes	329	89.0%	4.23	0.76
	No changes noticed	41	11.0%	1.89	1.12
Observed Changes	Increased drought frequency	248	67.0%	4.12	0.79
	Unpredictable rainfall	166	45.0%	3.78	0.86
	Extreme temperatures	111	30.0%	3.45	0.92
	Other changes	85	23.0%	3.12	1.04
Climate Impact Severity	Severe impact	222	60.0%	4.23	0.78
	Moderate impact	111	30.0%	3.45	0.89
	Mild impact	30	8.1%	2.67	1.15
	No impact	7	1.9%	1.89	1.34
Production Impacts	Reduced herd size	266	72.0%	4.12	0.81
	Poor body condition	222	60.0%	3.89	0.84
	Low reproduction rates	185	50.0%	3.67	0.88
	High mortality	148	40.0%	3.45	0.93
Coping Strategies	Seasonal migration	266	72.0%	4.23	0.76
	Supplementary feeding	166	45.0%	3.78	0.85
	Feed conservation	104	28.0%	3.34	0.94
	Income diversification	111	30.0%	3.12	1.02
	Early livestock sales	74	20.0%	2.89	1.08
Rainfall Pattern Changes	Decreased amounts	259	70.0%	4.05	0.82
	Erratic distribution	222	60.0%	3.78	0.87
	Delayed onset	185	50.0%	3.56	0.91

	Early cessation	148	40.0%	3.34	0.95
Temperature Changes	Increased maximum temperatures	207	56.0%	3.89	0.84
	Higher night temperatures	148	40.0%	3.56	0.90
	Longer hot seasons	111	30.0%	3.23	0.96
	Heat stress episodes	89	24.0%	3.01	1.03

Climate change perceptions were high among respondents (89.0%), with strong consensus indicated by a mean score of 4.23 and low standard deviation (0.76). Increased drought frequency was the primary concern (67.0%), consistent with findings from northern Kenya documenting heightened vulnerability to recurrent droughts and climate variability (Ojango et al., 2023). Key production impacts included reduced herd sizes (72.0%), poor body condition (60.0%), low reproduction rates (50.0%) and high mortality (40.0%), corroborating evidence that climate-induced heat stress, water scarcity and pasture degradation significantly reduce small ruminant industry performance in pastoral systems (Ngongolo & Gayo, 2025). Retrospective meteorological records confirmed these perceptions, showing a declining trend in long-rains season rainfall from 191 mm in 2022 to 174 mm in 2024, alongside a rise in maximum temperatures to 37.3°C in 2024 (Figures 1 and 2). Seasonal migration remained the dominant coping strategy (72.0%), reflecting the adaptive value of mobile pastoralism (Opiyo et al., 2015), while limited adoption of feed conservation (28.0%) and income diversification (30.0%) indicates persistent technological and institutional barriers (Akall, 2021).

Figure 1

Seasonal rainfall trends in Mandera County (2022–2024)

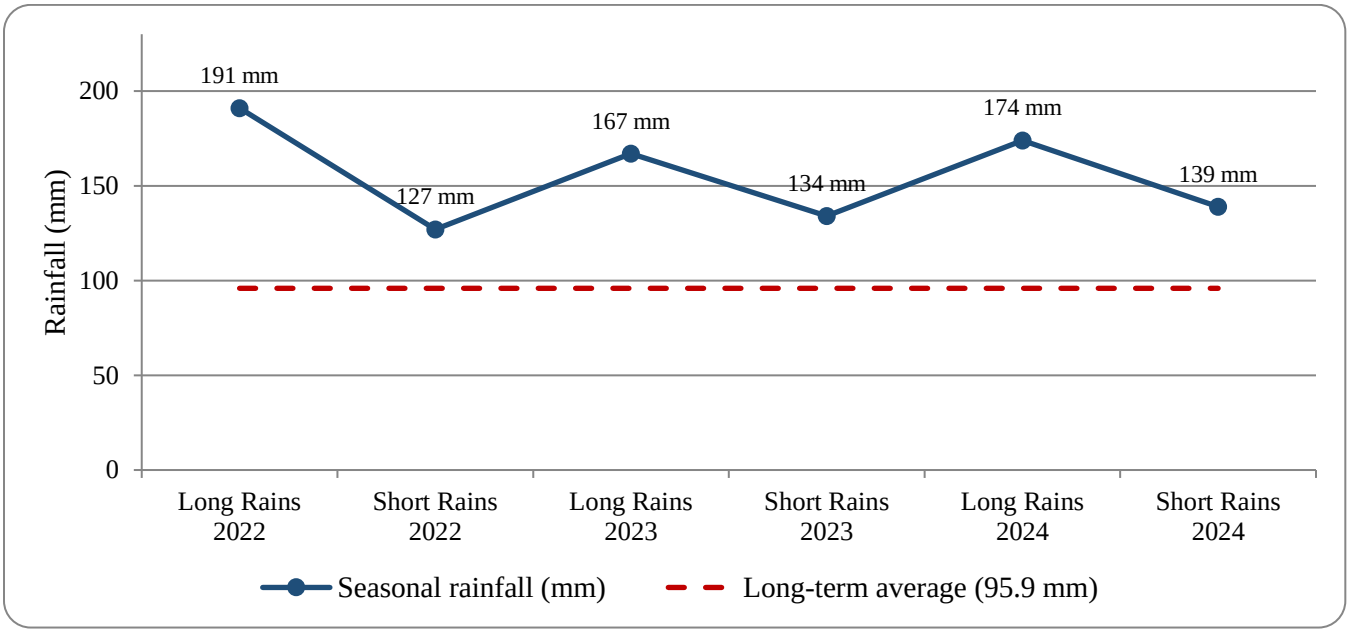
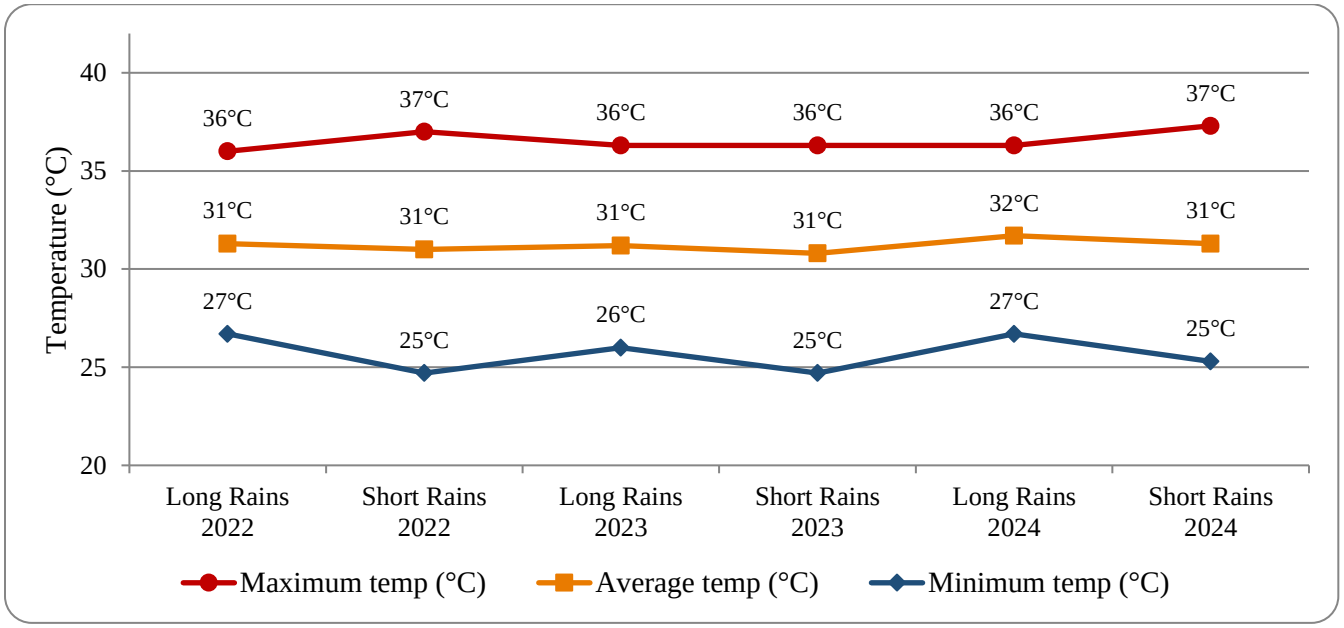


Figure 2

Seasonal temperature trends in Mandera County (2022–2024)



Market Access, Value Chain Constraints and Pastoralist Perceptions of Profitability

Table 4

Market Access, Value Chain Constraints and Pastoralist Perceptions of Profitability (n = 370)

Variable	Response Category	Frequency	Percentage	Mean	Std. Deviation
Market Channels	Local market	241	65.1%	4.12	0.79
	Through middlemen	93	25.1%	3.45	0.92
	Direct to butcheries	30	8.1%	2.89	1.08
	Export	6	1.6%	2.34	1.23
Price Range (Sheep)	3000-5000 Ksh	148	40.0%	3.45	0.91
	6000-8000 Ksh	185	50.0%	3.78	0.85
	>11000 Ksh	37	10.0%	4.23	0.76
Price Range (Goats)	4000-7000 Ksh	111	30.0%	3.34	0.94
	8000-10000 Ksh	222	60.0%	3.89	0.83
	>11000 Ksh	37	10.0%	4.12	0.79
Market Barriers	Low market prices	155	41.9%	4.05	0.82
	Lack of market information	130	35.1%	3.78	0.87
	Poor road infrastructure	111	30.0%	3.56	0.90
	High transportation costs	89	24.1%	3.34	0.94
	Middlemen issues	74	20.0%	3.12	0.98
Market Integration	Well integrated	56	15.1%	3.89	0.84
	Moderately integrated	148	40.0%	3.45	0.89
	Poorly integrated	133	35.9%	2.89	0.95
	Not integrated	33	8.9%	2.23	1.12

Perceived Profitability	Highly profitable	74	20.0%	4.12	0.79
	Moderately profitable	185	50.0%	3.67	0.86
	Marginally profitable	89	24.1%	3.12	0.93
	Not profitable	22	5.9%	2.45	1.08
Value Addition	No value addition	266	72.0%	2.34	1.18
	Basic processing	74	20.0%	3.12	1.04
	Moderate value addition	22	5.9%	3.67	0.92
	Significant value addition	8	2.1%	4.23	0.76

Market channels were dominated by local markets (65.1%), with limited participation in export markets (1.6%), reflecting the geographical and infrastructural barriers documented by Aklilu and Catley (2009). Low market prices were the primary constraint (41.9%), followed by lack of market information (35.1%), consistent with Barrett (2008) in East African pastoral systems. Only 15.1% of respondents were well-integrated into markets, while 72.0% reported no value addition activities. Price ranges showed moderate returns: 50.0% of sheep sold in the Ksh 6,000–8,000 bracket and 60.0% of goats in the Ksh 8,000–10,000 range, with only 10.0% achieving premium prices above Ksh 11,000. Pastoralists' perceptions of profitability were mixed, with 70.0% reporting highly or moderately profitable enterprises and 30.0% reporting marginal or no profitability, reflecting the structural market constraints and value chain inefficiencies identified by Negassa et al. (2013).

Inferential Analysis

The multiple regression model explained 79.4% of the variance in small ruminant performance (R^2 = 0.794, Adjusted R^2 = 0.780, F-change $p < 0.001$), indicating a strong model fit.

Table 5

Multiple Regression Coefficients for Small Ruminant Performance Prediction

Variable	B	SE	β	t	Sig.	95% CI
Constant	1.234	0.187	—	6.598	0.000	0.867 to 1.601
Drought frequency	-0.456	0.067	-0.387	-6.806	0.000	-0.588 to -0.324
Rainfall variability	-0.342	0.056	-0.289	-6.107	0.000	-0.452 to -0.232
Reported PPR occurrence	-0.289	0.048	-0.245	-6.021	0.000	-0.383 to -0.195
Reported CCPP occurrence	-0.198	0.042	-0.168	-4.714	0.000	-0.280 to -0.116
Market access	0.324	0.061	0.275	5.311	0.000	0.204 to 0.444
Veterinary access	0.312	0.058	0.265	5.379	0.000	0.198 to 0.426
Price stability	0.267	0.055	0.226	4.855	0.000	0.159 to 0.375
Extension services	0.234	0.051	0.198	4.588	0.000	0.134 to 0.334

R^2 = 0.794, Adjusted R^2 = 0.780, F-change $p < 0.001$.

Environmental factors showed the strongest negative effects, with drought frequency ($\beta = -0.387$, $p < 0.001$) and rainfall variability ($\beta = -0.289$, $p < 0.001$) substantially reducing performance. Reported disease occurrence also demonstrated significant negative impacts, particularly reported PPR occurrence ($\beta = -0.245$, $p < 0.001$) and reported CCPP occurrence ($\beta = -0.168$, $p < 0.001$). Among positive predictors, market access ($\beta = 0.275$, $p < 0.001$) and veterinary access ($\beta = 0.265$, $p < 0.001$) were the strongest contributors to industry performance.

The 95% confidence intervals confirmed the precision and reliability of all coefficient estimates. ANOVA results confirmed significant industry performance differences across veterinary access levels ($F(3,366) = 28.456$, $p < 0.001$, $\eta^2 = 0.189$), market integration levels ($F(3,366) = 22.167$, $p < 0.001$, $\eta^2 = 0.154$) and climate adaptation groups ($F(2,367) = 35.234$, $p < 0.001$, $\eta^2 = 0.162$). Pearson correlations revealed strong relationships between industry performance and mortality ($r = -0.723$), reported disease occurrence ($r = -0.634$), market returns ($r = 0.645$) and veterinary access ($r = 0.612$), all significant at $p < 0.01$

Qualitative Analysis

Thematic analysis of focus group discussions and key informant interviews identified four key themes relating to small ruminant production constraints and adaptive strategies in Mandera County.

i. *Disease Management and Veterinary Service Challenges* – PPR was identified as the most devastating disease, with reported mortality rates of 60–90% among young stock, consistent with documented impacts in African pastoral systems (Mantip et al., 2019). Limited veterinary access constrained timely diagnosis and treatment, leading pastoralists to rely on ethnoveterinary practices considered ineffective against highly contagious viral diseases. Reduced mobility and shrinking grazing corridors further facilitated disease transmission (Homewood et al., 2012).

ii. *Climate Variability and Adaptation Strategies* – Participants reported increasingly erratic rainfall, prolonged dry spells and reduced seasonal predictability, consistent with climate trends in arid and semi-arid regions (Mohammed & Scholz, 2017). Herd mobility and distress sales were common adaptive strategies but were constrained by limited grazing access and limitations of indigenous climate knowledge systems in responding to increasingly erratic climatic conditions (Kom et al., 2023).

iii. *Market Access and Value Chain Constraints* – Market systems were characterized by information asymmetry, broker dominance and limited producer bargaining power. Poor road infrastructure increased transport costs and reduced livestock value, consistent with challenges in pastoral value chains across sub-Saharan Africa (Ayza et al., 2025). Value addition was constrained by inadequate infrastructure and skills, while gender disparities limited women's market participation and income control (Njuki & Sanginga, 2013).

iv. *Institutional Support, Policy Gaps and Community Resilience* – Weak extension services, poorly timed interventions and limited policy implementation reduced program effectiveness. Despite these gaps, strong community-based resilience mechanisms were evident, including livestock sharing, livelihood diversification and integration of traditional and modern knowledge systems, consistent with evidence on the role of social capital in pastoral resilience (Homewood et al., 2012).

Summary of the findings

The study revealed significant constraints in small ruminant production in Mandera County. Reported disease occurrence was high, with 68.1% of respondents reporting PPR in goat herds and 71.9% in sheep flocks, while 41.9% reported CCPP occurrence in goats; notably, 60.0% of pastoralists reported herd mortality above 20%.

Veterinary access was limited, with only 31.9% of pastoralists reporting regular access, 81.9% citing high service costs and 60.8% living more than 15 km from service points. Climate variability was widely reported (89.0%), with 67.0% noting increased drought frequency and 45.0% reporting rainfall variability, resulting in reduced herd size (72.0%) and high mortality (40.0%). In addition, market integration remained low, with only 15.1% of pastoralists participating in formal markets.

4.0 Conclusion

Small ruminant production in Mandera County faces a complex and interacting set of constraints spanning disease burden, veterinary service access, climate variability and market integration, which collectively accounted for 79.4% of the observed variation in industry performance. These findings demonstrate that no single constraint operates in isolation, as disease impacts are amplified by inadequate veterinary access, climate shocks compound market vulnerabilities and weak institutional support undermine pastoralists' capacity to adapt. Addressing these challenges requires integrated, evidence-based and county-specific interventions that simultaneously target animal health systems, climate resilience and market development to sustainably improve small ruminant industry performance and pastoral livelihoods in Mandera County and comparable ASAL contexts.

5.0 Recommendations

Based on the study findings, Mandera County Government and development partners should strengthen and expand Community-Based Animal Health Worker (CAHW) networks and deploy mobile veterinary units to improve disease surveillance, reporting, vaccination coverage and access to animal health services, particularly for PPR and CCPP in remote pastoral areas. Extension services should promote climate-resilient livestock production through fodder conservation, drought-tolerant forage production and water harvesting technologies to reduce climate-related livestock losses. In addition, county and national governments should support pastoral cooperatives, improve market infrastructure, promote value addition and invest in mobile-based market information systems to enhance market participation and household income while ensuring gender-inclusive interventions that strengthen women's access to livestock market opportunities and benefits. Effective implementation of livestock development policies should be prioritized through increased veterinary financing, infrastructure development and coordinated multi-sector interventions.

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