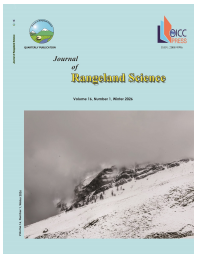

J. Rangeland Sci. 2026; 16(1) : 88-95

Journal of Rangeland Science (JRS)

https://doi.org/10.57647/jrs-2026-1601.08

Knowledge to Practice in Rangeland Management and Livestock Health Among Nomadic Pastoralists in Fars Province, Iran

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Original Research

Received:
23 Aug 2024
Revised:
15 Apr 2025
Accepted:
22 Jun 2025
Published online:
31 March 2026
Published in Issue:
31 March 2026

Abstract:

Nomadic pastoralists play a vital role in managing and sustaining the range livestock production, yet their traditional knowledge often faces challenges amid environmental degradation and climate change. Despite their experience, a gap persists between what they know and what they can effectively practice. Understanding this gap is crucial for designing sustainable interventions. This study examined the knowledge and practices of nomadic pastoralists in Fars Province, Iran, focusing on rangeland management and livestock health, and how these factors influence livestock production. A stratified random sample of 248 nomadic household heads was surveyed using the validated questionnaires. Index reliability was confirmed (Cronbach's alpha: 0.702–0.827; composite reliability > 0.7). Findings revealed a significant knowledge-practice disparity: the average scores for rangeland management knowledge and practice were 0.83 and 0.31 (out of 2), respectively while scores for livestock health were higher, 1.65 for knowledge and 1.49 for practice. Structural equation modeling showed that livestock health practices had a strong positive impact on production ($\beta = 0.329$, $p < 0.01$), whereas current rangeland management practices negatively affected it ($\beta = -0.322$, $p < 0.01$). These results highlight pastoralists' difficulties in applying sustainable rangeland practices, likely due to climate pressures and limited institutional support. The study emphasizes the need for practical training and policy support to bridge the knowledge-practice gap and to enhance resilience in arid pastoral systems.

Keywords: Pastoralism, Nomads; Rangeland management; Livestock production

Cite this article: Abedi Sarvestani A., & Shahraki M., (2026). "Knowledge to practice in rangeland management and livestock health among nomadic pastoralists in Fars Province, Iran." *Journal of Rangeland Science*, *16*(1), 88-95. https://doi.org/10.57647/jrs-2026-1601.08

1. Introduction

Nomadic pastoralism is an essential practice for cultural preservation and maintaining ecological balance in arid regions (Hobbs et al., 2014; Koocheki & Gliessman, 2005). However, these traditional systems face increasing threats from environmental and climatic changes, including rising temperatures, prolonged droughts, and erratic rainfall, which severely affect forage and water availability (Tugjamba et al., 2023).These communities also grapple with challenges from overgrazing, land-use changes, and limited access to modern veterinary services and sustainable management techniques, all of which degrade rangelands, reduce biodiversity, and endanger livestock and ecosystems (Seid et al., 2016). This research aims to identify key areas for support and intervention by assessing current rangeland management and livestock health practices. The ultimate goal is to inform policies that empower nomadic communities to adapt, maintain their traditions, and ensure the sustainable use of rangeland resources for future generations.

The relationship between rangelands and human communities has evolved over centuries, fostering stability and mutual adaptation (Psyllos et al., 2022). In Iran, rangelands are vital for livestock production and the preservation of cultural heritage and traditional lifestyles. Livestock production on rangelands is not merely an economic activity; it embodies a way of life

steeped in cultural norms, beliefs, social values, and practices related to animal husbandry (Davies et al., 2010; Tamou et al., 2018). Pastoralists' accumulated knowledge shapes their approach to rangeland management and local natural resource policies (Fernandez-Gimenez, 2000). Through centuries of interaction with rangelands, pastoralists have refined their understanding of ecosystems, which is fundamental to conserving resources and preventing degradation (Kahumba & Tefera, 2023).

Despite the critical role of rangelands in supporting pastoral livelihoods, there is a significant gap in empirical research focused on the management practices of nomadic pastoralists in Iran, particularly in Fars Province. This gap hampers effective policy-making and resource management. This is while pastoralists are eager to revitalize rangelands, they often lack access to the necessary information for effective management (Aderinoye-Abdulwahab et al., 2024). Key determinants of pastoralists' knowledge such as age, education level, and experience in livestock production highlight the urgent need for targeted educational programs to enhance their management capabilities.

Studies have shown that improving management practices can enhance resource utilization and promote sustainable outcomes. However, economic constraints may limit the application of knowledge in practice among pastoralists (Knapp & Fernandez-Gimenez, 2009). Field research on pastoralists' rangeland management knowledge emphasizes the integration of indigenous knowledge with scientific approaches to enhance sustainable practices. Studies from Iran (Behmanesh et al., 2015), (Kahumba & Tefera, 2023), Australia (Waudby et al., 2012), and Ethiopia (Hassan et al., 2018) reveal that pastoralists possess valuable traditional insights into rangeland degradation, biodiversity, and resource utilization. These findings advocate for collaborative management strategies that leverage local ecological knowledge, ultimately improving ecosystem health and supporting pastoralist livelihoods. By combining local expertise with scientific assessments, researchers highlight the potential for more effective and sustainable rangeland management. Regarding pastoralists' animal health knowledge, field research has revealed valuable insights into their perceptions and practices about livestock diseases. Studies in Ethiopia (Amenu et al., 2017) and Kenya (Onono et al., 2019) for assessing pastoralists' understanding of animal health issues including udder health and zoonotic diseases indicated that while pastoralists possess significant knowledge about various diseases, gaps remain, particularly concerning zoonotic risks. Additionally, research highlighted the influence of age and experience on knowledge levels, emphasizing the importance of integrating local expertise with veterinary interventions. Overall, these studies underscore the potential for tailored educational strategies to enhance animal health management in pastoralist communities.

It is therefore essential to assess both the level of knowledge that pastoralists possess regarding sustainable rangeland management and animal health, and the degree to which they implement this knowledge in practice (Mahdavi et al., 2023). Such assessments enable the integration of effective management strategies and the development of actionable insights to guide policy and practice in rangeland management. This study contributes meaningfully to the ongoing discourse on sustainable land stewardship. By examining the knowledge-practice gap, it offers a transferable model for applying effective management approaches in similar arid and semi-arid regions. Understanding the impact of pastoral knowledge and behaviors on both rangeland and livestock management can clarify the critical links between animal health and rangeland conditions. Strategic utilization of natural resources, when aligned with sound management practices, can enhance livestock performance, product quality, and biodiversity conservation, ultimately contributing to economic and social sustainability.

This study aims to assess the knowledge and practices of nomadic pastoralists in Fars Province, Iran, with regard to sustainable rangeland management and livestock health. By identifying discrepancies between what pastoralists know and what they actually practice, the research intends to generate evidence-based insights that can inform the tailored educational initiatives and policy reforms. The ultimate goal is to support the improved livestock productivity and the adoption of sustainable natural resource management within these vulnerable communities. The study addresses the following key questions:

- What is the level of knowledge held by nomadic pastoralists about sustainable rangeland management and livestock health?
- To what extent is this knowledge translated into actual practice?
- How do the knowledge and practices of nomadic pastoralists regarding sustainable rangeland management and livestock health affect livestock production, as revealed through structural equation modeling?

2. Materials and Methods

This research was conducted using a survey method with a cluster random sampling technique in Fars province (Figure 1). Three nomadic tribes named Qashqai, Khamsa and Mamasani are settled in Fars province. The Qashqai tribe consists of 6 clans and 203 races, the Khamsa tribe consists of 5 clans and 125 races, and the Mamasani tribe consists of 4 clans and 24 races. The term 'races' refers to the various sub-groups within the clans that exhibit the various familial and cultural subgroups that together form a rich tapestry of traditions and practices, reflecting the tribe's complex history and social dynamics. The next step was to randomly select 10% of the races from each clan in each tribe. Thus,

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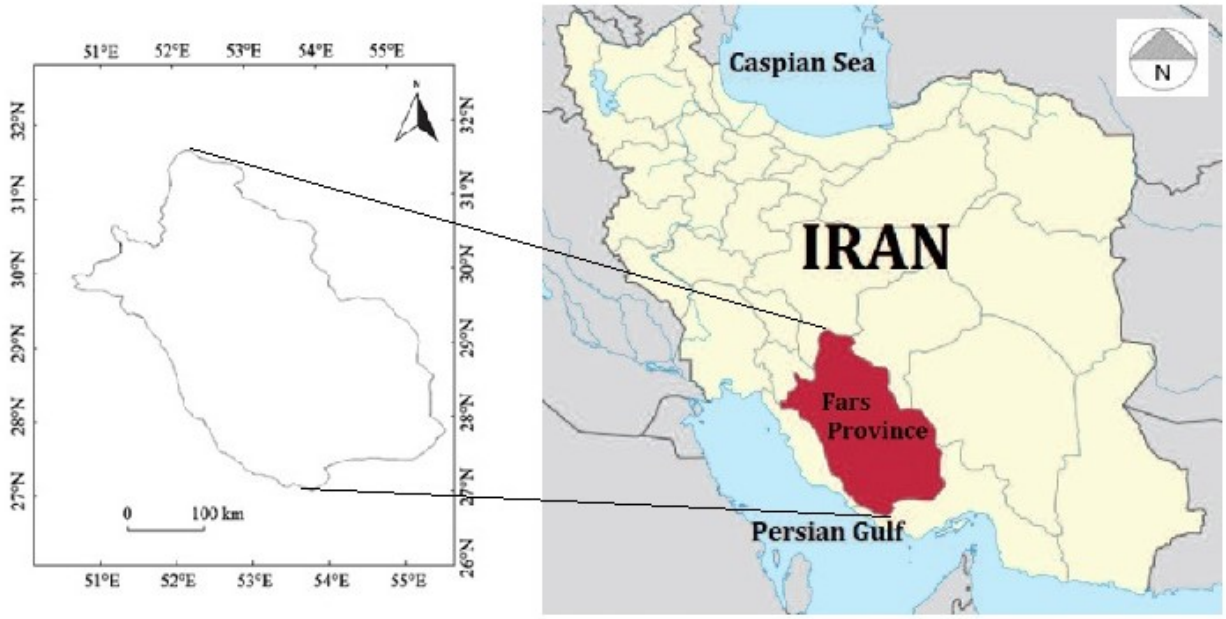

Figure 1. Geographical Coordinates of Fars Province in Iran

20 races of the Qashqai tribe, 12 races of the Khamsa tribe, and 3 races of the Mamasani tribe were randomly selected (Table 1). Then, 7 nomadic households within each race were randomly selected. Thus, in this study, 245 households from 35 nomadic races constituted the research sample. The data collection instrument was a questionnaire. The main variables of the research included knowledge and practice of rangeland management, livestock health, and changes in livestock production in the last five years. To measure the knowledge of rangeland management, 9 key items were used (on a three-point Likert scale: I know, I somewhat know, I don't know). Rangeland management practice was assessed using the same 9 key items (on a three-point Likert scale: I have done, I have done somewhat, I have not done). Livestock health knowledge was measured with 7 key items (on the same three-point Likert scale). Practice of livestock health was assessed with the same 7 key items (also on the same three-point Likert scale) (Table 4).

Changes in livestock production over the past five years were measured using five key items (three items for average production of milk, meat, and wool per livestock, one item for herd birth rate, and one item for profitability of livestock production) on a five-point Likert scale: significantly decreased, decreased, no change, increased, significantly increased. All items were developed through a review of scientific literature, interviews with experts from the General Directorate of Natural Resources and Watershed Management in Fars Province, and consultations with experienced nomadic pastoralists. The face validity of the questionnaire was confirmed by experts. Reliability was also tested by conducting a pilot study among nomads. The questionnaires were completed through personal interviews with the heads of nomadic households. A total of 248 questionnaires were completed using this method. It should be noted that all methods employed in this study were conducted in accordance with relevant ethical guidelines and regulations of survey research involving human participants. Although the study did not involve experimental protocols requiring institutional approval, we confirm that our research protocols were reviewed and approved by the Gorgan University of Agricultural Sciences and Natural Resources. Informed consent was obtained from all participants, ensuring their voluntary participation in the survey.

Statistical calculations in this study were performed using SPSS25 software and also, Smart PLS3 software to assess the relationships between knowledge and practice of rangeland management and livestock health on livestock production and to extract a model based on the Structural Equation Modeling (SEM) method. To examine the relationship between latent and observable variables, factor loadings were first obtained for each item. Considering the acceptable threshold of 0.5 and above for factor loadings, the values for factor loadings were confirmed for all items. In the Partial Least Squares (PLS) approach, before testing hypotheses, it is necessary to fit measurement models by evaluating Average Variance Extracted (AVE) and reliability coefficients (Hair et al., 2021). The validity of the questionnaire was confirmed by the opinions of experts in rangeland management and experts of Nomads Affairs Organization in Fars Province, Iran, and also by the criterion of AVE with a minimum value of 0.5. To determine the reliability of the measurement tool, two criteria, Cronbach's alpha coefficient and Composite Reliability (CR), were calculated with a value higher than 0.7 considered acceptable (Kilic, 2016; Peterson & Kim, 2013)(Table 2).

https://doi.org/10.57647/jrs-2026-1601.08

Table 1. Names of nomadic tribes, clans and selected races for study

Tribes	Clans	Races
Qashqai	Kashkooli Bozorg	Arekhloo, Gashtasbi, Bigdeli, Dizjani, Ghouri
	Kashkooli Koochak	Lak
	Amaleh	Safikhani, Golzaneh, Namadi, Gorkani, Tayyebi
	Farsimadan	Qara Mirshamloo, Tavabe
	Dareh Shoori	Kheiratloo, Charbenje Bozorg, Janbazloo, Qaraqani, Osmanloo
	Shesh Boluki	Kuhi, Duqzaloo
Khamseh	Inanlu	Bayat, Dindarloo
	Baseri	Labumusi, Ali Shah Qoli
	Baharloo	Safikhani, Salemani
	Arab Jabareh and Shibani	Yuzbashi, Labardani, Mirkhi, Abdolyousefi
	Nafar	Kordshuli, Sanjarloo
Mamasani	Javid	Ahmad Harouni
	Doshmanziyari	Kaleh Siyahi
	Bakesh	Amaleh Ale Amiri
	Rostam	Bahmanyari

Table 2. Validity and reliability of research indices

Indices	Number of Items	Cronbach's Alpha Coefficient	Composite Reliability	Average Variance Extracted
Rangeland management knowledge	9	0.796	0.834	0.590
Rangeland management practice	7	0.779	0.801	0.515
Livestock health knowledge	9	0.827	0.879	0.569
Livestock health practice	7	0.702	0.807	0.538
Livestock production	5	0.821	0.863	0.583

3. Results

3.1 Participant characteristics

As shown in the results, 37.9% of the respondents were in the 40-50 age group, which was the most common age group, with a mean age of 57.50 years and a range of 22 to 81 years. More than half of the nomadic pastoralists (53.6%) were illiterate, and less than one percent had an associate degree. The average household size was 7, with 37.1% belonging to families with 7 to 9 members. On average, each nomadic pastoralist family had 224 livestock (sheep and goats), with a minimum and maximum of 20 and 800, respectively (Table 3).

3.2 Knowledge and practice of rangeland management and livestock health

The results indicate that the knowledge of nomadic pastoralists in "making rainwater collection pits in rangeland" and "sowing seeds in rangelands" was higher than other key activities of rangeland management. In addition, their knowledge in "administering antiparasitic drugs to livestock" and "vaccinating livestock" was higher compared to other key livestock health activities. In contrast, the lowest level of knowledge in rangeland management was related to "bunch planting in the rangeland," and in livestock health, it was related to "culling livestock infected with rabies or plague" (Table 4). In practice, in terms of key activities related to rangeland management, the results show that "making rainwater collection pits in rangeland" and "bunch planting in the rangeland" were the most and least practiced by nomadic pastoralists, respectively. From this perspective, "vaccinating livestock" and "isolating sick livestock" were the most and least important livestock health activities practiced by pastoralists, respectively (Table 5).

For further analysis, the scores of the rangeland management knowledge index and the rangeland management practice index (each with 9 items), as well as the livestock health knowledge index and the livestock health practice index (each with 7 items), were calculated by summing the scores of their respective items. It is worth mentioning that the response range for items related to rangeland management and livestock health knowledge includes "I don't know" (with a score of 0), "know to some extent" (with a score of 1), and "I know" (with a score of 2). The response range for items related to rangeland management and livestock health practices includes "not done" (with a score of 0), "done to some extent" (with a score of 1), and "done" (with a score of 2). Therefore, the scores for the rangeland management knowledge and practice index range from 0 to 18. The scores for the livestock health knowledge index and practice index range from 0 to 14. Data analysis showed that the average score for the rangeland management knowledge index and the practice index is 7.46 and 2.83, respectively. Also, the average scores for the livestock health knowledge index and the practice index are 11.57

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Table 3. Characteristics of the studied nomadic pastoralists

Variables	Mean	Min	Max	Groups	Frequency	Percentage
Age (years)	57.50	22	81	< 40	42	16.9
				40-50	94	37.9
				51-60	57	23
				> 60	51	20.6
				No response	4	1.6
Education level	0.91	0.0	5	Illiterate (0)	133	53.6
				Reading and writing (1)	49	19.8
				Elementary school (2)	30	12.1
				Secondary school (3)	20	8.1
				High school (4)	11	4.4
				Associate degree (5)	2	0.8
				No response	3	1.2
Household size	6.95	2	18	< 4	32	12.9
				4-6	86	34.7
				7-9	92	37.1
				> 9	34	13.7
				No response	4	1.6
Number of livestock	224.3	20	800	< 100	25	10.1
				100-200	75	30.2
				201-300	103	41.5
				301-400	33	13.3
				> 400	12	4.8

and 10.44, respectively. For a more thorough examination and comparison of the rangeland management and livestock health indices, the average scores of each of the indices mentioned were divided by the number of items in that index. In this way, the scores of the indices are all within the range of 0 to 2, allowing for comparison. The results of this analysis showed that the average scores for the rangeland management knowledge index and practice index were 0.83 and 0.31, respectively. In addition, the average scores for the livestock health knowledge index and practice index are 1.65 and 1.49, respectively. These results indicate that the studied nomadic pastoralists have a low level of knowledge and practice in rangeland management. However, they have a medium to high level of knowledge and action regarding livestock health. Nevertheless, their actions in terms of livestock health and rangeland management are lower than their knowledge (Figure 2).

3.3 Impact of rangeland management and livestock health on livestock production

The results obtained from testing the hypotheses and analyzing the path model indicate that rangeland management knowledge has a positive and significant impact on the level of rangeland management practice at a 99% confidence level. On the other hand, rangeland management practice has a negative impact on changes in livestock production in the last five years, leading to a decrease in production (Table 6). The level of pastoralists' knowledge of livestock health had a direct and positive impact on livestock health practice. Increased livestock health practices have resulted in increased livestock production (Figure 3).

4. Discussion

This study reveals a significant knowledge-practice gap among nomadic pastoralists, a disparity that might be attributed to critical factors such as drought and climate change (Tugjamba et al., 2023). These conditions restrict resource availability, compelling pastoralists to prioritize immediate survival over sustainable practices. Economic constraints further impede the translation of knowledge into action, as financial limitations prevent investment in essential resources for effective management (Wane et al., 2020). Adding to these challenges is limited access to updated information and support systems (Abdulkadr, 2019). These multifaceted barriers, including limited access to resources and modern technologies, economic pressures prioritizing immediate needs over long-term sustainability, and the absence of supportive policies that recognize and integrate traditional ecological knowledge into rangeland management, contribute to a substantial knowledge-practice gap, thus hindering the achievement of sustainable rangeland management and livestock health outcomes.

The findings indicate that while pastoralists possess above-average knowledge in livestock health, this contrasts sharply with their performance in rangeland management, underscoring the critical need for knowledge transfer and practical application of sustainable practices. This may be because livestock health offers more immediate and tangible benefits, while rangeland management is more complex, long-term, and constrained

Table 4. Knowledge items in rangeland management and livestock health

Indices	Items	Knowledge Level (%)				Mean*	SD	Rank
		Know	Know to Some extent	Don't know	No response			
Rangeland Management	Making rainwater collection pits in rangeland	58.9	26.6	9.7	4.8	1.52	0.68	1
	Sowing seeds in the rangeland	48.8	25.0	21.4	4.8	1.29	0.81	2
	Rangeland enclosure	39.9	33.1	22.6	4.4	1.18	0.79	3
	Creating furrows for rainwater collection in the rangeland	38.3	26.6	30.2	4.8	10.8	0.85	4
	Determining the appropriate livestock number for rangeland	20.2	25.4	49.6	4.8	0.69	0.80	5
	Rotational grazing in the rangeland	22.6	21.8	52	3.6	0.68	0.83	6
	Observing livestock entry and exit times to rangeland	12.9	19.0	63.3	4.8	0.47	0.72	7
	Shrub planting in the rangeland	10.5	10.9	73.4	5.2	0.34	0.67	8
	Bunch planting in the rangeland	8.1	6.5	80.6	4.8	0.24	0.59	9
Livestock Health	Administering antiparasitic drugs to livestock	89.9	3.6	1.2	5.2	1.95	0.29	1
	Vaccinating livestock	91.1	2.0	2	4.8	1.94	0.32	2
	Tick bath (washing livestock with anti-tick medication)	91.1	2.4	2	4.4	1.93	0.33	3
	Isolating sick livestock	89.5	4.0	1.6	4.8	1.92	0.32	4
	Establishing hygienic drinking troughs for livestock	84.3	6.5	4.4	4.8	1.84	0.48	5
	Quarantining livestock	78.2	10.1	7.3	4.4	1.74	0.59	6
	Culling livestock infected with rabies or plague	9.3	5.6	79.8	5.2	0.26	0.62	7

*Range: 0-2

Table 5. Practice items in rangeland management and livestock health

Indices	Items	Extent of action (%)				Mean*	SD	Rank
		Have done	done to some extent	Have not done	No response			
Rangeland Management	Making rainwater collection pits in rangeland	18.1	38.3	38.7	4.8	0.78	0.74	1
	Sowing seeds in the rangeland	13.3	20.2	61.7	4.8	0.49	0.73	2
	Rangeland enclosure	11.7	18.5	64.5	5.2	0.44	0.70	3
	Creating furrows for rainwater collection in the rangeland	6	25.4	63.7	4.8	0.39	0.61	4
	Observing livestock entry and exit times to rangeland	5.2	14.9	74.6	5.2	0.27	0.56	5
	Determining appropriate livestock number for rangeland	3.2	16.9	74.2	5.6	0.25	0.51	6
	Rotational grazing in the rangeland	3.6	8.5	81.9	6	0.17	0.47	7
	Shrub planting in the rangeland	1.6	2	91.1	5.2	0.06	0.29	8
	Bunch planting in the rangeland	1.6	0.4	92.7	5.2	0.04	0.27	9
Livestock Health	Vaccinating livestock	88.3	4	2.4	5.2	1.91	0.37	1
	Isolating sick livestock	84.7	8.1	2	5.2	1.87	0.39	2
	Administering antiparasitic drugs to livestock	79.4	10.5	4.4	5.6	1.79	0.51	3
	Tick bath (washing livestock with anti-tick medication)	70.2	21.8	2.4	5.6	1.72	0.51	4
	Quarantining livestock	69.4	10.1	14.9	5.6	1.58	0.75	5
	Establishing hygienic drinking troughs for livestock	64.9	11.7	18.1	5.2	1.49	0.80	6
	Culling livestock infected with rabies or plague	1.2	3.6	89.9	5.2	0.06	0.29	7

*Range: 0-2

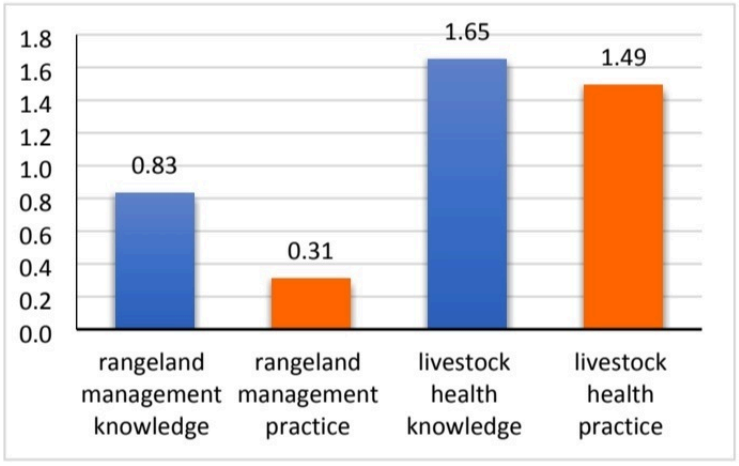

Figure 2. Indices of knowledge and practice of rangeland management and livestock health

Table 6. Path analysis of rangeland and livestock health on livestock production

Relationships / Paths	Path coefficient	t-values*	Direction of relationship	Result
Rangeland management knowledge / Rangeland management practice	0.581**	14.97	Positive	Accepted
Livestock health knowledge / Livestock health practice	0.775**	12.97	Positive	Accepted
Rangeland management practice / Livestock production	-0.322**	9.67	Negative	Accepted
Livestock health practice / Livestock production	0.329**	3.35	Positive	Accepted

* t > 1.96 Significant at 0.05, t > 2.58 Significant at 0.01; ** Significant at the 99% confidence level

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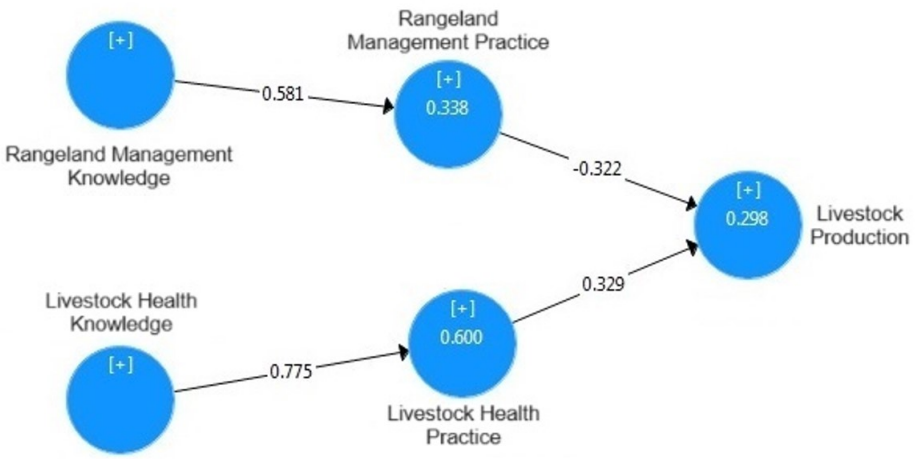

Figure 3. The model of influence of knowledge and practice of rangeland and livestock health on livestock production

by external factors, even if the knowledge exists. The Structural Equation Modeling (SEM) analysis demonstrates a positive and significant relationship between knowledge of rangeland management and the performance of nomadic pastoralists in this area. This supports existing literature, such as the work by (Kahumba & Tefera, 2023), which emphasizes that the increased knowledge leads to the improved management strategies. However, the unexpected inverse relationship between rangeland management practices and livestock production raises important questions. It suggests that while pastoralists engage in management activities, environmental challenges—such as drought, climate change and soil erosion—may hinder their effectiveness, ultimately affecting livestock production negatively. This finding aligns with broader research indicating that adverse environmental conditions can undermine sustainable practices (Mburu et al., 2023).

The implications of this study extend beyond local contexts, connecting to global challenges such as climate change and resource scarcity. As nomadic pastoralists face increasing pressures from environmental degradation, the need for effective knowledge transfer becomes paramount. Educational programs tailored to the unique circumstances of pastoralists, utilizing accessible language and practical training, are essential for enhancing their management capabilities. Furthermore, government support in the form of financial incentives and resources can facilitate rangeland restoration efforts, addressing the economic vulnerabilities faced by such communities.

While this study provides valuable insights, it is important to acknowledge its limitations. The cross-sectional nature of the data restricts the ability to draw definitive causal conclusions. Future research should adopt longitudinal designs to better understand the dynamics of knowledge application over time. Additionally, potential confounding factors, such as socio-economic conditions and climate variability, should be considered in future studies to provide a more comprehensive understanding of the challenges faced by pastoralists.

The role of sustainable practices in biodiversity conservation cannot be overstated. Effective rangeland management not only enhances livestock productivity but also contributes to the preservation of the biodiversity they support. Integrating traditional knowledge with modern management practices can lead to more resilient rangeland management, as demonstrated in case studies from other regions where such approaches have been successfully implemented (Moameri et al., 2016; Singh et al., 2020). For instance, the integration of indigenous practices with modern techniques in East Africa has shown promising results in improving both livestock health and rangeland sustainability.

5. Conclusion

To enhance practical solutions for sustainable rangeland management, this research underscores the urgent need for targeted educational initiatives and policy support to bridge the knowledge-practice gap among nomadic pastoralists. Key recommendations include developing tailored educational programs that integrate traditional knowledge with scientific approaches, implementing demonstration projects within pastoralist communities to showcase successful practices such as rainwater harvesting, seed sowing, and livestock vaccination, and improving access to essential resources such as tools and veterinary services. Additionally, fostering community engagement in decision-making processes will encourage ownership of sustainable practices, while establishing the monitoring and feedback systems can help track the outcomes of management efforts. Furthermore, a call to action is necessary for stakeholders to prioritize the integration of traditional knowledge with modern practices, ensuring the resilience of pastoral systems in the face of ongoing environmental challenges. Government policies should incentivize sustainable practices and support the financial needs of pastoralists, enabling

https://doi.org/10.57647/jrs-2026-1601.08

them to invest in both rangeland restoration and livestock health improvements. By addressing these critical areas, we can pave the way for a more sustainable future for nomadic pastoralists and the rangelands they depend on. To gain a deeper understanding of the factors contributing to the knowledge-practice gap among nomadic pastoralists, future research should employ qualitative methods to explore pastoralists' experiences and perceptions regarding environmental, economic, and informational dynamics. This comprehensive approach will not only enhance livestock productivity but also contribute to sustainable resource management in arid regions, conserve biodiversity, and promote sustainable rangeland restoration.

Authors contributions
All the authors have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript.
Availability of data and materials
The current study did not use or generate any datasets.
Conflict of interests
The authors have no competing interests to declare that are relevant to the content of this article.
Declaration of Funding
his research did not receive any specific funding.

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