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Pastoralism and Forest Conservation in Ghana's Forestry Sector

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Abstract

Forest conservation is vital for maintaining biodiversity, ecosystem stability, sustainable livelihoods, and supporting Sustainable Development Goals (SDGs) 13 and 15. However, increasing pastoralist activities within forest reserves threatens forest resource conservation and management efforts. This study examined forest officials' and cattle herders' perceptions of the drivers of pastoralists' cattle movement into forest reserves, and the perceived effects of pastoralism on forest resource conservation and management in Ghana. Data were collected from 119 forest officials and 8 cattle herders using semi-structured questionnaires and interview guides and analyzed using descriptive and inferential statistics in RStudio version 2025. Results show that cattle movement into forest reserves was mainly driven by the availability of abundant high-quality forage (85.7%), limited grazing land outside protected areas (79.8%), availability of water resources (75.6%), and weak enforcement of grazing regulations (73.9%). Perceptions of grazing effects differed between officials and herders; officials generally viewed pastoralism as harmful to forest ecosystems, whereas some herders considered livestock manure beneficial to soil fertility under controlled grazing. Damaging tree seedlings and saplings, soil compaction, habitat destruction, water pollution, and increased risk of forest degradation were the most reported effects on forest resources conservation. Additionally, increased budgetary expenditure (21%), conflicts between officials and herders (16.8%), and delayed staff attention to other duties (14.2%) were the most prioritized effects of pastoralism on forest management authorities' activities. However, significant differences existed among all the study districts in officials' perceptions of these effects ($p < 0.05$), except effects such as the creation of psychological stress among staff, damage to institutional reputation with international donors, and loss of livelihood assets among forest officials ($p > 0.05$). These findings underscore the need for the Forestry Commission to

strengthen monitoring and surveillance systems while enhancing collaboration with district assemblies, traditional authorities, and security agencies. Such coordinated efforts would improve the enforcement of forest protection regulations and contribute to reducing illegal grazing activities within forest reserves.

Keywords

Cattle Grazing, Cattle Herders, Forest Reserve, Forest Resources Conservation, Forest Officials, Pastoralism

1. Introduction

Pastoralism is a widespread livelihood system practiced across various regions in the world, providing sustenance to millions of people (Reid et al, 2014; Sloat et al., 2018; Manzano et al., 2021). It plays a crucial role in food security, poverty reduction, economic stability, and cultural heritage (Manzano et al., 2021), thereby contributing to the achievement of United Nations Sustainable Development Goals (SDGs), particularly SDG 1 (No poverty), and SDG 2 (Zero hunger) (United Nations, 2015). However, pastoralist activities have increasingly intersected with environmental conservation challenges, particularly in forested landscapes (Lucatello et al., 2020). The encroachment of grazing activities into protected areas has raised concerns about biodiversity loss, deforestation, and land degradation (Davies et al., 2010; Niamir-Fuller & Huber-Sannwald, 2020). While some farmers argue that pastoralism can contribute to ecosystem balancing through controlled grazing, the absence of proper management often leads to unsustainable resource exploitation (Odadi et al., 2017).

In Africa, pastoralism is a dominant livelihood system, especially in arid and semi-arid regions where livestock rearing remains a primary economic activity (Gatdet et al., 2024). Pastoralist communities often migrate seasonally in search of water and grazing pastures. This practice has historically ensured livestock survival (McGuirk & Nunn, 2024). However, increasing population pressure, climate change, and land-use conflicts have escalated tensions between pastoralists and conservationists (Kuusaana & Bukari, 2015; Tamou et al., 2018; Niamir-Fuller & Huber-Sannwald, 2020). The competition over land resources has led to deforestation, degradation of protected areas, and a decline in biodiversity, raising concerns about sustainable forest management (Reid et al., 2014; Davies et al., 2020).

Sub-Saharan Africa hosts a significant portion of the continent's pastoralist population (Krätli & Toulmin, 2020; Brobbey et al., 2023). The region has witnessed intensified conflicts between pastoralists, farmers, and conservation authorities due to land scarcity and environmental degradation (Houessou et al., 2019). These conflicts undermine peaceful coexistence and inclusive governance, thereby affecting SDG 16 (Peace, Justice and Strong Institutions).

Overgrazing in protected forests is a growing issue, with pastoralists seeking alternative grazing areas due to climate-induced droughts and restricted access to

traditional rangelands (Brobbey et al., 2023). Weak institutional frameworks and inadequate land management policies have further exacerbated these challenges, hindering effective conservation efforts (Kuusaana & Bukari, 2015; Timpong-Jones et al., 2023). Despite efforts to regulate grazing practices, enforcement remains a challenge, leading to continued encroachment into forest reserves (Reid et al., 2014).

In Ghana, pastoralism is primarily practiced by transhumant herders, notably the Fulani, who migrate with their cattle in search of pasture and water (Bayala et al., 2023; Ampadu & Yang, 2024). In recent years, the movement of cattle into forested areas has increasingly become contentious due to its significant implications for forest conservation and land-use governance (Kuusaana & Bukari 2015; Agyemang 2017). The encroachment of cattle grazing into Ghana's forests has contributed to deforestation, soil erosion, and biodiversity loss, thereby threatening sustainable ecosystem management (Kuusaana & Bukari, 2015) and undermining the attainment of SDG 13 (Climate Action) and SDG 15 (Life on Land). These environmental pressures have also intensified conflicts between pastoralists and local farmers, leading to growing socio-economic and security challenges for communities and forest management authorities (Agana et al., 2018; Turner, 2019; Davies et al., 2020).

Numerous forest conservation initiatives, such as the implementation of national grazing policies and the intensification of monitoring in protected forest areas, have been introduced in Ghana to control and manage cattle grazing within the country's forest estates (Hansen, 2022; Bayala et al., 2023; Brobbey et al., 2023). However, the effectiveness of these interventions has been constrained by weak enforcement mechanisms, limited stakeholder collaboration, and inadequate policy implementation (Hansen, 2022). Although strategies such as the establishment of designated grazing areas and the enforcement of stricter forest protection laws have been introduced, their implementation has faced resistance and challenges due to socio-economic and logistical constraints associated with managing grazing activities in protected forestlands (Reid et al., 2014; Davies et al., 2020). Addressing these challenges, therefore, requires a balanced and integrated approach that supports pastoralist livelihoods while promoting sustainable forest management practices. Despite the growing body of literature on pastoralism and forest conservation, there remains a significant gap in understanding the specific drivers of cattle grazing in Ghana's forested areas and their long-term ecological consequences (Hansen, 2022; Bayala et al., 2023). Existing studies (Alhassan, 2017; Bukari, 2017; Amankwaa, 2019; Kyei-Poakwah, 2018; Kugbega & Aboagye, 2021; Otu & Sarfo, 2023; Derkyi & Gyamfi, 2025) have largely focused on the broader conflicts between pastoralists and local farmers, with limited attention given to the direct effects of cattle grazing on forest resources conservation and the activities of forest management authorities within many forest districts in Ghana. Additionally, while strategies to curb pastoralist activities in protected areas have been proposed, reasons for pastoralists' movement of cattle into forest reserves in

many forest districts of the country remain underexplored (Niamir-Fuller, 2016). This research seeks to bridge this gap by providing a comprehensive analysis of how forest officials and cattle herders perceive reasons for pastoralists' movement of cattle herds into forest areas, and analyzing their perceived effects of pastoralism on forest resources conservation and forest management authorities. Two questions emerged: 1) *How do forest officials and cattle herders perceive the factors driving pastoralists' movement of cattle into forest reserves in Ghana*? 2) *How do forest officials and cattle herders perceive the effects of pastoralism on forest resources conservation and the activities of forest management authorities in Ghana*?

Addressing this knowledge gap will contribute to evidence-based policy recommendations that balance pastoralist livelihoods while enhancing sustainable forest conservation, climate resilience, peaceful resources governance, and supporting the achievement of the Sustainable Development Goals, particularly SDGs 1, 2, 13, 15, and 16. The paper is structured into five sections. The first section provides the contextual background to the study, followed by the methodology, which describes the approaches used for data collection and analysis. The third section presents the results, while the fourth section discusses the findings. The final section concludes the paper and provides recommendations based on the study findings.

2. Materials and Methods

2.1. Study Area

The study was conducted in three (3) Forest Districts in Ghana, namely Sunyani, Offinso, and Juaso (see **Figure 1**). These Forest Districts form part of the country's High Forest Zones, and were selected due to increasing reports of cattle grazing activities occurring in the forest reserves.

The Sunyani Forest district falls within the dry semi-deciduous ecological zone and covers seven (7) local assemblies, including Wenchi, Sunyani East, Sunyani West, Berekum East, Banda, Asutifi North, and Tain Districts. The Forest District shares boundaries with Dorma Forest District in the west, Bachem and Techiman in the east, Bole and Kintanpo in the north, and Goaso in the south. The Sunyani Forest District manages seven (7) Forest Reserves covering a total area of 610.8 km^2. These reserves are Asukese, Amama, Yaya, Tain I, Tain II, Nsemere, and Sawsaw. These are classified under two management regimes: production (Asukese, Amama, Yaya) and protection (Tain I, Tain II). However, cattle grazing predominantly occurs in the Tain I, Tain II, Nsemere, Yaya, and Sawsaw Forest reserves (Key informant, Sunyani Forest District, 2025).

The forest district headquarters is at Sunyani within the Bono Region, and lies between latitudes 07˚20'N and longitude 02˚20'W, with an extreme seasonal variation in monthly rainfall of 63.12 mm. The most staple crops grown in the district include cabbage (*Brassica oleracea var. capitata*), garden eggs (*Solanum melongena*), carrots (*Daucas carota*), pepper (*Capsicum spp.*), tomatoes (*Solanum lycopersicum*), cashew (*Anacardium occidentale*), and cocoa (*Theobroma cacao*) (Ghana Statistical Service, 2021).

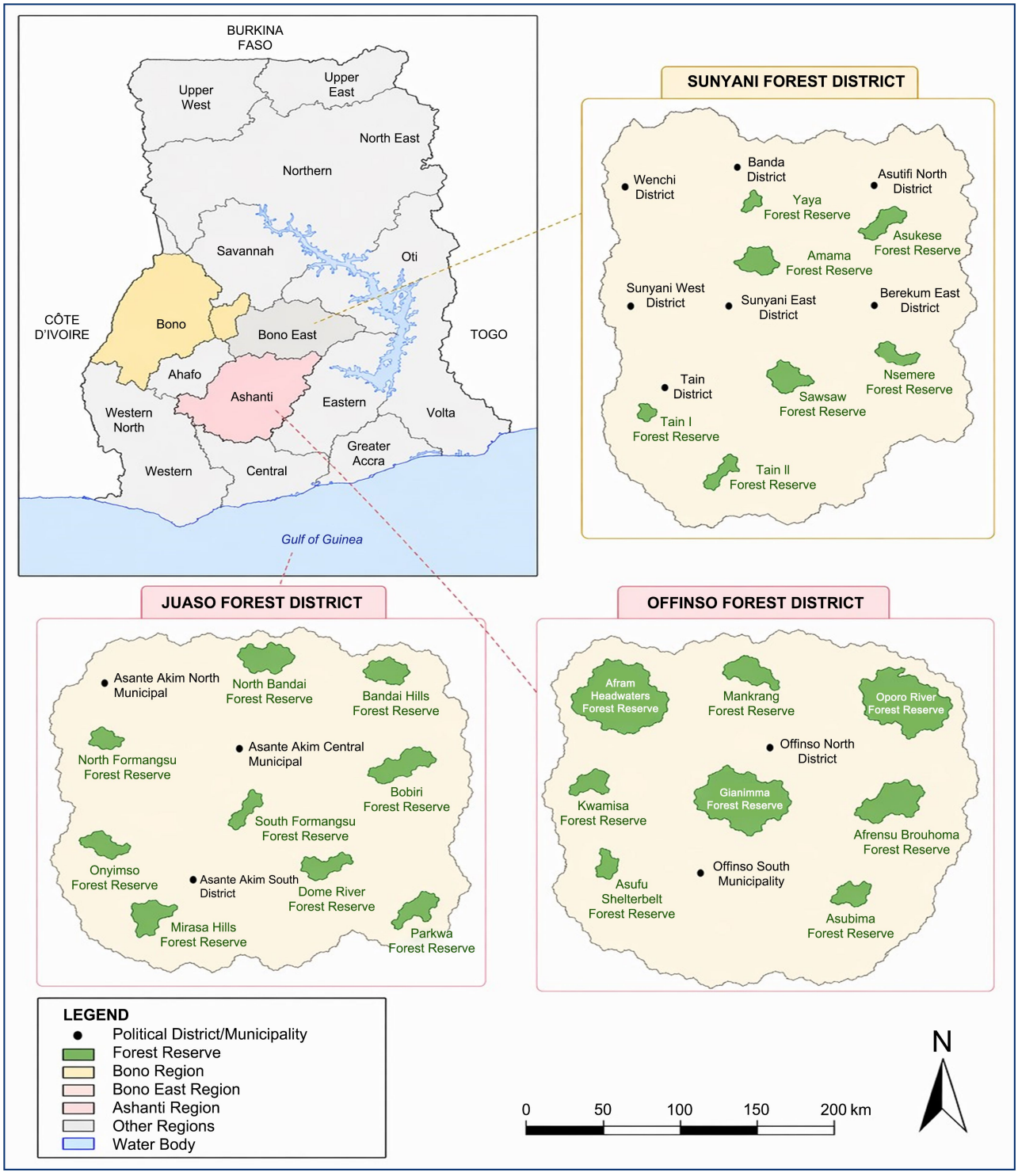

Figure 1. Map of the study area (Source: Mapping office Sunyani, Offinso, and Juaso forest districts).

The Offinso forest district (One of the study areas) falls within the dry Semi-deciduous ecological zone and covers two local assemblies, including Offinso South Municipality and Offinso North District, and shares boundaries with Nkoranza, Mampong, and Mankranso forest districts. The Offinso forest district man-

ages eight forest reserves covering a total area of 428.23 km^2. These forest reserves are the Oporo River, Afram headwaters, Mankrang, Gianimma, Afrensu Brouhoma, Kwamisa, Asufu shelterbelt, and Asubima. However, cattle grazing predominantly occurs in the Afram headwaters, Mankrang, and Kwamisa Forest reserves (Key informant, Offinso Forest District, 2025). The forest district headquarters is at Offinso within the Ashanti Region, and lies between latitudes 06˚95'N and 07˚15'N and longitudes 01˚35'W and 01˚50'W (Ghana Statistical Service, 2021). The most staple crops grown in the district include maize (*Zea mays*), cassava (*Manihot esculenta*), plantain (*Musa paradisiaca*), groundnut (*Arachis hypogaea*), cocoyam (*Xanthosoma sagittifolium*), rice (*Oryza sativa*), and cowpeas (*Vigna unguiculata*) (Ghana Statistical Service, 2021).

The Juaso forest district falls within both the dry semi-deciduous and the transitional ecological zones and covers three local assemblies, including Asante Akim North Municipal, Asante Akim South District, and Asante Akim Central Municipal. The forest district shares boundaries with the Mpraeso and Asante Bekwai Forest districts. The Juaso forest district manages nine forest reserves covering a total area of 534.45 km^2. These reserves are North Bandai, Bandai Hills, North Formangsu, South Formangsu, Onyimso, Dome River, Parkwa, Bobiri, and Mirasa Hills forest reserves. However, cattle grazing predominantly occurs in the Bandai Hills, Dome River, and North Bandai Forest reserves (Key informant, Juaso Forest District, 2025). The Juaso forest district headquarters is at Juaso within the Central Region, and lies between latitudes 6˚35'0'N and longitudes 1˚7'10'W (Ghana Statistical Service, 2021). The most staple crops grown in the district include cocoa (*Theobroma cacao*), coffee (*Coffea arabica*), oil palm (*Elaeis guineensis*), orange (*Citrus sinensis*), maize (*Zea mays*), cassava (*Manihot esculenta*), plantain (*Musa paradisiaca*), yam (*Dioscorea species*), cocoyam (*Xanthosoma sagittifolium*), rice (*Oryza sativa*), and vegetables (Ghana Statistical Service, 2021).

2.2. Research Design and Sampling Techniques

A cross-sectional research design was employed to collect primary data from the respondents regarding their views on cattle grazing activities within the forest reserves in the study areas. Cross-sectional studies provide data on a specific time point and help to establish the relationship between variables more easily (Levin, 2006).

The study also used a descriptive research design to obtain first-hand information from the primary data, providing an in-depth understanding of why pastoralists move their cattle into forest reserves. It also explores how cattle herders and forest officials perceived the effects of grazing on forest resource conservation and on the activities of the management authorities within these areas.

Yin (2003) reported that a descriptive research design describes a phenomenon or an intervention and details real-life situations. A total of one hundred and nineteen (119) forest officials and eight (8) cattle herders participated in the study (**Ta-**

ble 1). The forest officials were not sampled; rather, all available operational staff directly involved in forest management activities within the selected forest districts (Sunyani, Offinso, and Juaso) were included in the study. To be eligible, respondents had to be employees of the Forestry Commission working within the selected districts and have direct responsibilities for forest administration, protection, monitoring, law enforcement, or resource management. Their inclusion was justified by their institutional knowledge and practical experience regarding forest conservation and the management of cattle incursions into forest reserves.

Table 1. Selected respondents and their respective forest districts.

Forest District	Sex of selected forestry officials		Total n = 119	Cattle herders
	Male	Female		8*
Sunyani	37	8	45	
Offinso	27	9	36	
Juaso	31	7	38	
Total	**95**	**24**	**119**	

Source: The number of respondents selected from each Forest District was determined based on information provided by key informants in the selected districts.

The eight cattle herders were identified and recruited using snowball and convenience sampling techniques because no comprehensive sampling frame existed for this highly mobile population. Initial participants were identified through consultations with forest officials, community leaders, and key informants familiar with cattle grazing activities in the study areas, who subsequently assisted in identifying other eligible herders. To be included in the study, participants had to be actively engaged in cattle rearing, have experience with cattle movement within or around the selected forest districts, and be willing to share their experiences and perspectives on pastoral activities and interactions with forest management authorities.

The relatively small number of cattle herders reflects the practical challenges of accessing this highly mobile and difficult-to-reach population. Consequently, the unequal sample sizes between the forest officials and the cattle herders precluded direct quantitative comparisons between the two groups. Accordingly, the herders' accounts were treated as qualitative perspectives that complemented the quantitative findings from forest officials by providing contextual insights into pastoral practices and interactions with forest management authorities, rather than as evidence of group-level differences.

3. Data Collection and Analysis

The study employed a semi-structured questionnaire and interview guide to gather primary data from the forestry officials and cattle herders in February 2026,

respectively. The questionnaire centered on the forestry officials' socio-demographic characteristics, their perceived factors driving pastoralists' cattle movement into forest reserves, and the effects on forest management authorities' activities. The questions were coded in the KoboCollect[1] software application, thus enabling easy data collection and analysis.

To assess the factors influencing pastoralists' movement of cattle into forest reserves, the forest officials were first asked to identify the factors they perceived as contributing to cattle movement into forested areas. From the factors identified, respondents were then requested to select the factor(s) they considered to be the most influential drivers of cattle movement into forest reserves.

The respondents' perceptions of the effects of pastoralism on forest resource conservation were assessed using a five-point Likert scale based on a set of identified effects derived from the literature and preliminary field observations. Respondents were asked to indicate their level of agreement with each statement using the following response anchors: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Higher scores indicated stronger agreement that pastoralism influenced forest resource conservation outcomes.

Regarding the perceived effects of pastoralism on the activities of forest management authorities were assessed using a multiple-response format. A list of potential effects was provided, and respondents were allowed to select multiple effects that they perceived as most significant. The selected effects were subsequently ranked based on their frequency of occurrence among respondents. For all questionnaire items, respondents were given the option to provide a response only where they had relevant knowledge or experience. Missing responses were treated as missing values and excluded from the analysis of the specific item rather than being replaced or assumed as a particular response category.

The interview was designed as an open-ended question to elicit detailed and informative responses from the cattle herders regarding their reasons for moving cattle to forested areas, as well as their perceptions of the effects of cattle grazing on forest resources conservation and forest management authorities. Follow-up questions were allowed for further probing and clarification of specific points raised by the cattle herders. All interviews were conducted via telephone conversation because it was challenging to access the cattle herders in person. Responses from the interview were recorded through note-taking and audio recordings on mobile phones, and the recordings were subsequently transcribed for data analysis. Before the data collection, a pilot study was conducted to check for any errors or ambiguities in the semi-structured questions and the interview guide; this helped to ensure the validity and reliability of the research instruments.

Furthermore, the One-Sample Wilcoxon Signed-Rank was employed to determine whether the officials' ratings of the effects of cattle grazing on forest resources conservation differed significantly (that is, either higher or lower) from

[1]https://support.kobotoolbox.org/kobocollect-android.html.tionnaires assessed on 31st January, 2026.

the neutral benchmark value (hypothesized median = 3.00). This helped to identify the most significant and the least significant effects perceived by the forest officials. The rationale for this non-parametric test was due to the ordinal nature of the study data and the lack of its normal distribution. P-values were used to assess whether the observed perceptions were statistically different from neutrality, and effect sizes (r) were included to evaluate the magnitude of these differences.

The qualitative data from the interviews (note-taking and audio recordings) were transcribed verbatim into textual data and analyzed using thematic content analysis, backed with respondent quotes. Kawulich (2004) explains transcription data as reading and re-reading transcripts and identifying differences and similarities.

The transcripts were initially reviewed to identify relevant statements and assign preliminary codes representing key ideas related to pastoral practices, cattle movement, forest conservation, and interactions with forest management authorities. Similar codes were subsequently grouped into broader categories, from which major themes and sub-themes were developed. The coding process and emerging themes were reviewed by all authors against the original transcripts to ensure they accurately reflected participants' experiences and perspectives.

This process enhanced consistency, ensured alignment with the study objectives, minimized individual bias, and improved the reliability of the findings. Where differences in interpretation arose, the authors discussed the issues until consensus was reached on the final themes. Representative quotations were selected based on their relevance, clarity, and ability to capture recurring or particularly insightful perspectives expressed by participants. These quotations were presented alongside the thematic findings to support and illustrate the interpretation of the qualitative results.

4. Ethical Considerations and Limitations of the Study

Due to the sensitive nature of the study, the researchers strictly observed ethical issues such as confidentiality, anonymity, and informed consent. Ethical approval was sought from the forestry officials and the cattle herders. The respondents' consent was obtained, and their right to voluntary participation was respected. The participants' confidentiality was ensured by removing all identifying information, such as names and phone numbers, from the questionnaires, and all secondary sources of information were acknowledged in the in-text and reference list.

In the context of limitations, the study was confined to settler cattle herders, with notable gender disparity among respondents. However, these limitations did not affect the quality of the data collected but are acknowledged to guide future research. The absence of herdswomen made it difficult to achieve gender balance among herders; consequently, only male herders were engaged in the study, consistent with Manu et al. (2014) and Adisa (2012), who note that cattle herding is

predominantly male-dominated. Another limitation is the substantial difference in sample size between forest officials and cattle herders. Consequently, the study does not support direct quantitative comparisons or statistical inferences between the two groups. Instead, the herders' accounts are presented as qualitative perspectives that complement the quantitative findings from forest officials and provide contextual insights into pastoralists' experiences and perceptions. Future studies should seek to include a larger and more representative sample of cattle herders to enable more robust comparative analyses.

Similarly, no nomadic cattle herders were available during the period of data collection, resulting in the inclusion of only settler herders. This limitation is also noted for future research consideration. In addition, the study was conducted within selected forest districts in the High Forest Zones; therefore, the findings may be more representative of these specific districts and may not be fully generalisable to other ecological zones, such as the Savannah Forest Zones. Nevertheless, the insights generated may still provide useful implications for forest districts in other regions with similar conditions.

5. Results

5.1. Socio-Demographic Characteristics of the Respondents

Table 2 depicts the socio-demographic characteristics of the study respondents. The majority (79.8%) of the forest officials were males, and 20.2% were females. Most respondents (33.6%) were within the age range of 40 - 49 years, and 46.2% had attained a Bachelor's degree educational qualifications. Concerning the rank and years of service of the forest officials, the majority (86.5%) were Frontline staff (that is, Range Managers and Forest Guards), while 29.4% had worked within the Forestry Commission for 11 - 15 years.

Table 2. Socio-demographic characteristics of the respondents.

Variable	Category	Frequency (n = 119)	Percent (%)
Gender	Male	95	79.8
	Female	24	20.2
Age in years	20 - 29	20	16.8
	30 - 39	35	29.4
	40 - 49	40	33.6
	50+	24	20.2
Educational Level	Diploma/Certificate	42	35.3
	Bachelor's Degree	55	46.2
	Postgraduate Degree	22	18.5

Continued

Operational Rank	Senior Managers (Regional and District Managers)	5	4.2
	Middle managers (Assistant District Managers and Human Resources Managers)	11	9.2
	Frontline Staff (Range Managers and Forest Guards)	103	86.5
Years of Service	0 - 5 years	25	21.0
	6 - 10 years	30	25.2
	11 - 15 years	35	29.4
	16+ years	29	24.4

5.2. Respondents Perceived Factors Influencing Pastoralists' Movement of Cattle into Forest Reserves

The results revealed diverse factors influencing pastoralists' movement of cattle into forest reserves. The most widely reported factors were availability of abundant and high-quality forage within forest reserve (85.7%), limited access to grazing lands outside protected areas (79.8%), accessibility of water resources within forest reserve (75.6%), and weak enforcement of grazing land use regulations (73.9%). The desire for cattle herders to avoid conflicts with other pastoralists and community members (58.8%), and destruction of community grazing lands for farming activities (54.6%) were reported as the least factors.

The Chi-square test indicated a statistically significant association between officials' years of service and their perceptions of drivers such as the availability of abundant high-quality forage within forest reserves, limited access to pasture lands in off-reserve areas, accessibility of water within forest reserves, weak enforcement of grazing and land-use regulations, and the lack of designated cattle corridors ($p < 0.05$). The results suggest that officials' years of service are associated with their perceptions of these drivers of pastoralists' movement into forest reserves.

However, the Cramér's V values ranged from 0.188 to 0.266, indicating weak to moderate associations between years of service and these perceptions. This implies that although a statistically significant relationship exists, the strength of the association is relatively limited (see Table 3).

Interviews with the cattle herders revealed that scarcity of pasture and water sources is among the major factors influencing the movement of cattle into the forest reserves. According to the herders, forest reserves provide abundant foliage, reliable water sources, and shade, which contribute to better feeding and survival of their cattle.

Table 3. Forest Officials' perceptions of factors driving pastoralists' movement of cattle into forest reserves.

Factors	Total Frequency (n)	Total (%)	Respondents' Years of Service		χ^2	p	V
			0 - 10 years (n)	11+ years (n)			
1) Availability of abundant and high-quality forage within the forest reserve	102	85.7	42	60	4.21	0.040*	0.188
2) Limited access to grazing lands outside protected areas	95	79.8	38	57	5.84	0.016*	0.222
3) Accessibility of water resources within the forest reserve	90	75.6	36	54	5.12	0.024*	0.208
4) Weak enforcement of grazing land use regulations	88	73.9	30	58	8.42	0.004*	0.266
5) Lack of designated cattle corridors	82	68.9	28	54	7.85	0.005*	0.257
6) Forest cover serves as shade/shelter for cattle	85	71.4	38	47	1.42	0.233	0.109
7) Climatic variability and prolonged drought	78	65.5	32	46	3.22	0.072	0.165
8) Infestations of pests on off-reserve grazing lands (grasses)	62	52.1	28	34	1.14	0.285	0.098
9) Herders desire to avoid conflicts with other pastoralists and community members	70	58.8	28	42	1.10	0.295	0.096
10) Destruction of community grazing lands for farming activities	65	54.6	25	40	2.14	0.143	0.134

Note. *$p < 0.005$ = Significant; $p > 0.005$ = Insignificant; χ^2 = Chi-Square test statistic; p = Probability value; V = Cramer's V.

As one of the herders stated, "*In the olden times, our cattle used to feed on grasses along roadsides in nearby communities, while others also provided feed for them at home. We did not send our cattle for grazing in the forest reserves until recently, when feed become scare, and it became difficult to obtain enough pasture for them. In the forest reserves, foliage and water are abundant, and the vegetation also provides shade and shelter, so I believed that taking the cattle there would help them obtain enough feed*" (Interview with cattle herder, Offinso Forest District, 2026).

Another herder added, "*When our cattle graze on the forest vegetation, they grow well, because some of the plants in the forest are very nutritious. Sometimes when the cattle are taken to the nearby communities for grazing and proper care is not taken, they may feed on farmers' crops, creating conflicts between farmers and us*" (Interview with cattle herder, Sunyani Forest District, 2026).

Another herder from Juaso Forest District also added that some herders unknowingly graze cattle in forest reserves due to local guidance and limited knowledge about reserve boundaries. "*For me, it was not my intention to allow my cattle to graze in the forest reserve. When I brought my cattle from my hometown, I was directed to see some community leaders to help me find a grazing area. After paying some amount of money* (*GH₵* 5000.00) *equivalent to $*446 *as a toking, they asked me to meet a herder who had lived in the community for a long time to show me the place for grazing. The herder later took me into the forest reserve, although I did not know it was a forest reserve*" (Interview with cattle herder, Juaso Forest District, 2026).

5.3. Respondents Perceived Effects of Pastoralism on Forest Resources Conservation

The study revealed several perceived effects of pastoralism on forest resource conservation as reported by forest officials. The Wilcoxon Signed-Rank Test results indicated that most of the observed effects differed significantly from the neutral benchmark (hypothesized median = 3.00), suggesting that pastoralism is generally perceived to have notable effects on forest resources conservation.

Among the effects, damage to tree seedlings and saplings recorded the strongest effect size (Mdn = 5.00, $p = 0.001$, r = 0.754), indicating a strong perceived effects on forest regeneration. This was followed by soil compaction resulting from trampling (Mdn = 5.00, $p = 0.001$, r = 0.682), which also showed a strong effect. Destruction of natural habitats for plants and animals similarly demonstrated a statistically significant strong effect (Mdn = 4.00, $p = 0.001$, r = 0.598). However, the reduction in seed dispersal (Mdn = 3.00, $p = 0.155$, r = 0.130) and introduction of wildlife diseases (Mdn = 3.00, $p = 0.262$, r = 0.103) were not statistically significant and exhibited weak effect sizes, indicating that these effects were less strongly perceived by forest officials (as shown in **Table 4**).

According to the cattle herders interviewed, they believed that although cattle graze within forest reserves, the grazing activities do not cause extensive destruction to forest resources. Some herders indicated that the most likely resources to be affected are plant species and water bodies within the reserves. Other cattle herders also argued that cattle dung contributes to improving soil fertility in the grazing areas.

Like one of the cattle herders indicated, "*Even though my cattle had grazed in the forest reserve before, they did not cause any extensive destruction to the forest resources, because they were sent there once*" (Interview with cattle herder, Sunyani Forest District, 2026).

Another cattle herder added, "*If we stop our cattle from grazing in the forest reserve, many of them will starve to death because there is limited pasture available for grazing. Due to that, we try to ensure that they do not destroy the forest resources. Therefore, I believe that the effects of the cattle grazing on forest resources are minimal*". (Interview with cattle herder, Offinso Forest District, 2026).

However, one of the cattle herders cited that grazing within forest reserves has negative effects. *"Personally, I do not think it is good* to take *cattle into the forest reserve for grazing. I have witnessed that in the areas where cattle frequently graze, young tree species, especially saplings, do not grow well, and the soil becomes compacted. But what can I do? I have no other place to take them, and I cannot wait for the Nomadic to send their cattle there for pasturing while we settler herders stay away."* (Interview with cattle herder, Juaso Forest District, 2026).

Table 4. Forestry officials' perceived effects of pastoralism on forest resources conservation.

Effects	Median (Mdn)	Mean	Test-value	Z	*p*-value	r	Decision/ interpretation
1) Browsing damages seedlings and saplings	5.00	4.45	3	−8.22	0.001	0.754	Very strong
2) Trampling brings about soil compaction	5.00	4.32	3	−7.44	0.001	0.682	Strong
3) Overgrazing destroys the natural habitats for plants and animals	4.00	4.18	3	−6.52	0.001	0.598	Strong
4) Cattle drinking from water sources leads to water pollution	4.00	4.12	3	−6.14	0.001	0.563	Strong
5) Reduces canopy cover and causes microclimate changes, and increases the risk of forest degradation	4.00	4.05	3	−5.72	0.001	0.524	Strong
6) Overgrazing accelerates topsoil erosion	4.00	4.10	3	−5.98	0.001	0.548	Strong
7) Grazing alters the composition and structure of the forest ecosystem	4.00	4.02	3	−5.34	0.001	0.490	Moderate
8) Decline in Non-Timber Forest Products	4.00	3.98	3	−5.12	0.001	0.469	Moderate
9) Disrupts soil microfauna such as worms and microbes	4.00	3.85	3	−4.42	0.001	0.405	Moderate
10) Grazing promotes the regeneration of invasive plant species	4.00	3.80	3	−4.05	0.001	0.371	Moderate
11) Increases the risk of wildfires	4.00	3.72	3	−2.88	0.004	0.264	Weak
12) Interrupts the phenological cycles of trees	4.00	3.55	3	−1.82	0.069*	0.167	Very weak (insignificant)
13) Leads to a reduction in seed dispersal	3.00	3.48	3	−1.42	0.155*	0.130	Very weak (insignificant)
14) Livestock introduces wildlife diseases	3.00	3.35	3	−1.12	0.262*	0.103	Very weak (insignificant)

Note. $p < 0.05$ =Significant; *$p > 0.05$ = Insignificant; Test Value = Neutral Benchmark; Z = Z test statistic; p = Probability value; Mdn= Median; r = Effect Size (strength of impacts).

5.4. Respondents' Perceived Effects of Pastoralism on Forest Management Authorities' Activities

The study identified several perceived effects of pastoralism on forest management authorities in the study districts. The most frequently reported effects by the forest officials were increased budgetary expenditures for the forest districts (21%), followed by conflicts between forest officials and cattle herders (16.8%), and delays in staff attention to other field and office duties (14.2%). The least reported effects were damage to institutional reputation, with international donors accounting for 3.4% of the responses, and loss of livelihood assets among forest officials (2.5%) (as shown in Table 5). However, the Chi-square results revealed statistically significant differences in all the responses across the three forest districts for all the identified effects ($p < 0.05$), except effects such as the creation of psychological stress among staff, damage to institutional reputation with international donors, and loss of livelihood assets among forest officials ($p > 0.05$). This suggests that although pastoralism is generally perceived to negatively affect forest management operations, some effects are observed differently across all the study districts.

Interviews with cattle herders revealed that conflicts sometimes arise between herders and forest officials due to the killing of cattle found grazing within forest reserves.

According to the cattle herders, the cattle are their primary source of livelihood; therefore, any loss of cattle negatively affects their economic survival and contributes to tension between them and forest officials. Some herders expressed resentment toward forest officials, arguing that compensation mechanisms should be considered instead of killing the animals.

According to one of the cattle herders from Offinso Forest District;

"*When the forest officials kill our cattle, we lose our livelihood, so we don't want to be associated or relate to them closely. I believe that instead of killing them, they could have let us compensate for the damage cost*" (Interview with cattle herder, Offinso Forest District, 2026).

Another respondent from the Juaso Forest District acknowledged that forest officials are also affected by the situation because of the efforts they make to control cattle grazing in forest reserves.

"*I believe that the forest officials are also affected because they try to prevent our cattle from grazing on the forest land. They often patrol in the forest reserve to arrest us, and sometimes they hardly get enough rest.*" (Interview with cattle herder, Juaso Forest District, 2026).

However, a cattle herder from the Sunyani Forest District mentioned that… "*The herders suffer more from the conflicts than the forest officials. The forest officials don't lose much because their cattle are not killed, and they are not arrested. We, the herders, suffer most because our cattle are killed, and we are arrested and prosecuted. When we see the Forest Guards in the forest, we run away because we are afraid of being arrested, and even the running itself feels like punishment*".

Table 5. Forestry officials' perceived effects of pastoralism on forest management authorities' activities.

Effects	Name of Forest District (N = 119)			Total n (%)	DF	p-value
	Sunyani n (%)	Offinso n (%)	Juaso n (%)			
1) Increased budgetary expenditures for forest districts	9 (7.6)	5 (4.2)	11 (9.2)	25 (21.0)	4	
2) Creates conflicts between forest officials and herders	8 (6.7)	7 (5.9)	5 (4.2)	20 (16.8)	4	
3) Delays in staff attention to other fields and office duties due to patrols	7 (5.9)	6 (5.0)	4 (3.4)	17 (14.2)	4	
4) Requires additional resources (financial, physical, and human resources) to support the restoration of degraded grazing areas.	5 (4.2)	4 (3.4)	6 (5.0)	15 (12.6)	4	0.00
5) Requires additional time resolving conflicts	6 (5.0)	3 (2.5)	2 (1.7)	11 (9.2)	4	
6) Causes insecurity among forest officials	3 (2.5)	4 (3.4)	3 (2.5)	10 (8.4)	4	
7) Leads to reallocation of staff from other forest districts to support grazing management	2 (1.7)	1 (0.8)	5 (4.2)	8 (6.7)	4	
8) Creates psychological stress among staff	2 (1.7)	3 (2.5)	1 (0.8)	6 (5.0)	4	0.340*
9) Damages to institutional reputation with international donors	2 (1.7)	1 (0.8)	1 (0.8)	4 (3.4)	4	0.061*
10) Leads to loss of livelihood assets among forest officials	1 (0.8)	2 (1.7)	0 (0.0)	3 (2.5)	4	0.178*
	45 (37.8)	**36 (30.2)**	**38 (31.9)**	**119 (100)**		

Note. $p < 0.05$ = Significant; *$p > 0.05$ = Insignificant.

6. Discussion

6.1. Respondents Perceived Factors Driving Pastoralists' Movement of Cattle into Forest Reserve

Pastoralism activities have increasingly intersected with environmental conservation challenges, particularly in forested landscapes (Lucatello et al., 2020). Previous studies have identified multiple ecological, economic, and sociopolitical factors that influence pastoralists' movement of cattle herds into forestland areas. The decline in availability of pasture due to climate change, the desire to search for water and fodder, especially during the dry season (Little, 2015; Houessou et al., 2019), and government land policies that restrict pastoralist access to traditional grazing lands (Gatdet et al., 2024) influence pastoralists' movement of cattle herds into forestland areas.

Similarly, this current paper found that pastoralists' movement into forest re-

serves is largely driven by the availability of abundant and high-quality forage, limited access to grazing lands outside protected areas, availability of water resources within forest reserves, and weak enforcement of grazing land use regulations.

This suggests that the existing forest policies and regulations in Ghana are not adequately addressing the underlying drivers of cattle movement into forest reserves. Continued dependence on forest reserves for grazing may increase pressure on forest ecosystems, leading to degradation and resource-use conflicts. The findings correspond to Turner's (2019) assertion that land-use governance frameworks in Ghana are not sufficiently responsive to the structural and ecological drivers of pastoral mobility, such as pasture scarcity, water availability, and land-use pressures. Likewise, Fratkin (2001) cited that pastoral systems are highly sensitive to environmental stress and land conversion, and that without providing viable alternative grazing options, conservation-oriented policies alone are insufficient to deter livestock movement into ecologically protected areas. The findings, therefore, highlight the need for integrated and participatory policies that combine effective enforcement with sustainable grazing management, pasture development, water provision, and conflict resolution strategies. The results suggest that officials' years of service significantly influence their perceptions of the factors driving pastoralists' movement of cattle into forest reserves ($p < 0.05$). However, the magnitude of this influence is relatively limited. This implies that work experience influences how forestry officials perceive the causes of cattle grazing within forest reserves. This suggests that while work experience contributes to shaping perceptions, it is not a dominant explanatory factor. This implies that differences in how forestry officials interpret pastoralist activities are only partly explained by how long they have worked in the institution. Other factors, such as educational background, specific training in forest management, institutional role, and direct field exposure, may also influence the officials' views. This finding contrasts with Lund (2006), who posited that institutional experience shapes how institutions interpret and respond to natural resource governance issues. Similarly, the findings of Ostrom (2005), who posited that individuals' decision-making and perceptions in resource governance are influenced not only by experience but also by institutional arrangements, incentives, and rules-in-use within organizations.

6.2. Respondents Perceived Effects of Pastoralism on Forest Resources Conservation and Forest Management Authorities' Activities

The results of this study provide valuable insights into how forest officials and cattle herders perceive the effects of pastoralist cattle movement into forest reserves on forest resource conservation and activities of forest management authorities. The findings are significant for policymakers to develop targeted interventions that address the root causes of cattle grazing in forest reserves while supporting effective forest management. Some scholars (see Little, 2015; Haq et al.,

2021) have reported that pastoralism adversely impacts forest conservation and presents institutional challenges. Kuusaana and Bukari (2015) and Agyemang's (2017) studies in Ghana revealed that the movement of cattle into forested areas has increasingly become a point of contention, with significant implications for forest conservation and land-use governance.

Not surprisingly, this current study identified that pastoralist cattle movement into forest reserves poses a major threat to forest resources conservation and the effective functioning of forest management authorities in the study districts. The significant effects perceived effects by the forest officials, particularly damage to tree seedlings and saplings, soil compaction resulting from trampling, and destruction of natural habitats for plants and animals, suggest that continuous cattle grazing within forest reserves may undermine forest regeneration, biodiversity conservation, and ecosystem stability. The destruction of seedlings and saplings indicates that pastoral activities interfere with natural forest regeneration and afforestation efforts. This finding could be attributed to uncontrolled grazing and browsing by cattle within forest reserves. Similar findings were reported by Bufford and Gaoue (2015), who found that livestock grazing negatively affected tree seedling survival and regeneration in savanna ecosystems. Likewise, Elgar et al. (2014) observed that grazing activities create barriers to seedling regeneration and forest restoration on tropical pasture lands.

The strong perceived effect of soil compaction resulting from trampling implies that pastoral activities may reduce soil porosity, water infiltration, and nutrient cycling, thereby affecting vegetation growth and overall forest productivity. This may be explained by the repeated movement of cattle herds across forest soils. Krzic et al. (2006) similarly found that cattle grazing significantly increased soil compaction and negatively affected vegetation development on forest lands.

The finding that destruction of natural habitats for plants and animals was strongly perceived implies that pastoralism contributes to habitat degradation and biodiversity loss within forest reserves. This may result from overgrazing, trampling, and vegetation clearing associated with cattle movement. Dayamba et al. (2011) similarly reported that grazing pressure negatively affected vegetation regeneration and ecosystem recovery in savanna woodlands. The findings of this study are consistent with previous studies of Geist and Lambin (2002), who identified that cattle grazing in forest reserves contributes to deforestation and biodiversity loss due to overgrazing and trampling of vegetation. The non-significant findings regarding reduction in seed dispersal and introduction of wildlife diseases imply that forest officials did not strongly perceive these effects as immediate threats compared to direct physical impacts such as trampling and browsing. This could be because these ecological processes are less visible or less frequently monitored within the forest reserves.

The findings imply that the pastoralist cattle movement into forest reserves affects forest management authorities, creating operational and financial pressure on forest management institutions. The findings of this study are consistent with

previous studies (Vedeld et al., 2012; Homewood et al., 2012) that reported that pastoralism and illegal grazing activities often create management and governance challenges for conservation institutions. The results show that increased budgetary expenditures for the forest districts, conflicts between forest officials and cattle herders, and delays in staff attention to other field and office duties were the most reported significant effects of pastoralism on forest management authorities.

The increased budgetary expenditure suggests that additional resources are required for patrols, monitoring, and enforcement activities, while conflicts between forest officials and cattle herders indicate challenges in land-use management and enforcement of forest regulations. Vedeld et al. (2012) found that conflicts between local resource users and conservation authorities increase management costs and reduce institutional effectiveness in protected areas. Similarly, Homewood et al. (2012) observed that competition over land and grazing resources frequently generates tensions between pastoralists and conservation agencies in East Africa. Delays in staff attention to other duties also suggest that pastoralism diverts officials from routine forest management activities, thereby affecting institutional efficiency.

The significant differences observed across the three forest districts for most of the identified effects on forest resource conservation, and forest management authorities activities imply that the effects of pastoralism vary according to local environmental and management conditions. These differences could be attributed to variations in grazing intensity, cattle population, enforcement capacity, and the level of interaction between pastoralists and forest officials within the different districts.

The findings indicate that stakeholders may interpret the environmental implications of pastoralism differently based on their experiences, institutional roles, and interactions with forest landscapes. Forest officials emphasized the potential negative consequences of uncontrolled cattle grazing, particularly its implications for forest resource conservation and management. However, the cattle herders highlighted their perceptions that grazing activities may not always result in extensive environmental degradation and that cattle dung can contribute to soil fertility through nutrient recycling and soil enrichment.

The current study results are consistent with other study identified that pastoralism significantly impacts forest conservation and management positively and adversely. For an instant, while Reid et al. (2008) observed that unmanaged grazing activities negatively affected habitats and wildlife populations in semi-arid ecosystems, Augustine and McNaughton (2006) argued that moderate and well-managed grazing may enhance nutrient cycling and support ecosystem productivity in some environments.

7. Conclusion and Policy Recommendations

Pastoralism is a widespread livelihood system practiced across various regions of the world, providing sustenance for millions of people. In Ghana, pastoralism is

mainly practiced by transhumant herders, particularly the Fulani, who migrate with their cattle in search of pasture and water. However, the movement of cattle into forest reserves has increasingly become a major concern, with significant implications for forest conservation and land-use governance. This study examined forest officials' and herders' perceptions of the factors driving pastoralists' movement of cattle into forest reserves and analyzed their perceived effects of pastoralism on forest resource conservation and forest management authorities' activities in Ghana.

The findings revealed that pastoralist cattle movement into forest reserves is largely driven by ecological and socio-economic pressures, including availability of abundant and high-quality forage, limited access to grazing lands outside protected areas, availability of water resources within forest reserves, and weak enforcement of grazing land use regulations. These findings suggest that the growing dependence on forest reserves for grazing is not merely the result of non-compliance with forest regulations, but also reflects broader structural challenges such as pasture scarcity, environmental stress, and limited livelihood alternatives for pastoral communities. The study further established that pastoralism poses significant threats to forest resource conservation and forest management operations. The major perceived effects identified include damage to tree seedlings and saplings, soil compaction, habitat destruction, biodiversity loss, and increased risks of forest degradation. In addition to these perceived ecological effects, pastoralism also imposes financial, administrative, and operational burdens on forest management authorities through increased budgetary expenditure, conflicts between forest officials and cattle herders, and delays in staff attention to other field and office duties.

Although pastoralism was generally perceived to have negative effects on forest resource conservation and the activities of forest management authorities, the findings indicate that perceptions of these effects varied across districts depending on local environmental conditions, grazing intensity, institutional capacity, and the nature of interactions between pastoralists and forest authorities.

The study also identified diverse perspectives regarding the effects of cattle grazing within forest reserves. Whiles, forest officials highlighted concerns about the potential negative impacts of uncontrolled grazing on forest ecosystems, particularly its implications for forest resource conservation and management, some pastoralists believed that livestock manure contributes positively to soil fertility and ecosystem productivity under moderate grazing conditions.

The study concludes that uncontrolled cattle grazing within forest reserves threatens ecological sustainability and complicates effective forest governance in Ghana. Thus, efforts to prevent, manage, and minimize pastoralists' movement of cattle into forest reserves should focus on the following recommendations:

1) Policymakers should strengthen existing forest and environmental regulations by incorporating participatory approaches that involve pastoralists, local communities, traditional authorities, and conservation agencies in decision-mak-

ing processes.

2) Policies aimed at addressing pastoralism should integrate conflict prevention and resolution mechanisms to minimize tensions between forest officials and cattle herders. Compensation and alternative dispute resolution mechanisms should also be considered in situations involving the killing of cattle to reduce hostility and improve cooperation between herders and conservation authorities.

3) A call for the Forestry Commission to strengthen monitoring and surveillance systems while enhancing collaboration with district assemblies, traditional authorities, and security agencies. Such coordinated efforts would improve the enforcement of forest protection regulations and contribute to reducing illegal grazing activities within forest reserves.

4) The Ministry of Food and Agriculture should support the establishment of sustainable pasture systems, ranching schemes, improved fodder production technologies, and dry-season feed preservation methods to reduce uncontrolled cattle movement and seasonal grazing pressures within forest reserves.

5) Comparative studies involving both forest officials and pastoralist communities should be conducted to better understand differences in perceptions regarding the effects of pastoralism on forest resource conservation and forest management authorities, and to identify sustainable livestock production systems that can reduce conflicts between pastoralism and forest conservation objectives.

6) This study was limited to the perspectives of forest officials and cattle herders. Future studies should incorporate the views of other key stakeholders, including District Assemblies, forest fringe communities, traditional and opinion leaders, and community volunteer groups, to provide a more comprehensive understanding of the factors driving pastoralism in forest reserves and its implications for forest resource conservation and management.

7) Future studies should examine the long-term ecological effects of cattle grazing on forest regeneration, biodiversity, and soil properties within forest reserves, while also using geospatial and remote sensing techniques to assess the extent and spatial patterns of grazing-related forest degradation across different ecological zones in Ghana.

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Availability of Data

The data supporting this study's findings will be made available at the request of the corresponding author.

Author Contributions

All authors contributed to the conceptualization, drafting, and review of the man-

uscript. EG FA and DDK conceptualized the study. EG developed the research design, methodology, and prepared the original draft of the manuscript, while FA and DDK reviewed and revised the draft.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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