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Forest conservation practices: Insights of local communities near wildlife-protected areas in Ghana

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Abstract

Effective forest conservation relies on active community participation; however, local communities in Ghana are often excluded from policy development. This study explored community perspectives on forest conservation by identifying practices that local inhabitants believed could help preserve the forests in two wildlife-protected areas within the forest-savannah transition zone of Ghana: Boabeng-Fiema Monkey Sanctuary (BFMS) and Kogyae Strict Nature Reserve (KSNR). A cross-sectional survey involving 300 respondents was conducted using semi-structured questionnaires to gather insights into locally suggested conservation practices. A Multinomial Logistic Regression (MLR) model was employed to assess whether the socio-demographic variables such as age, sex, educational level, occupation and residential status influenced these perspectives. Wildfire prevention was the most emphasised conservation strategy in BFMS (38.6 %), while respondents in KSNR (37.2 %) emphasised increased staffing for effective forest monitoring. Socio-demographic variables had no statistically significant influence ($p > 0.05$) on respondents' perspectives. The findings highlight the importance of integrating local knowledge and community-driven conservation approaches for effective forest management. Strengthening participatory strategies can enhance conservation outcomes and contribute to the achievement of Sustainable Development Goals 13 (Climate Action) and 15 (Life on Land), which focus on biodiversity conservation and ecosystem resilience.

Keywords: biodiversity conservation, forest-savannah transition zone, sustainable forest management

1 Introduction

Communities surrounding protected areas (PAs) hold diverse perspectives on forest conservation practices shaped by interaction with their natural environment (Sobeng *et al.*, 2023). These perspectives influence their engagement in conservation efforts, including selective logging, the establishment of sacred grooves, agroforestry practices and other locally practised forest management techniques (Constant & Taylor, 2020; Kofi Sarfo-Adu *et al.*, 2022). Developed through lived experiences and continuous adaptation to environmental changes, these practices contribute significantly to the sustainable use and protection of forest resources (De-

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hghani Pour *et al*., 2023). However, despite their key role, local communities are often excluded from formal conservation decision-making, which undermines the effectiveness of sustainable forest management (SFM) and limits the integration of community-driven conservation approaches (Sobeng *et al*., 2023).

SFM is not only an environmental priority but also a global necessity, particularly in this era of utilising nature-based solutions for climate change mitigation and adaptation. SFM contributes to biodiversity conservation, carbon sequestration, ecosystem stability and sustainable livelihoods. However, deforestation and forest degradation continue to threaten protected areas in Ghana, including Boabeng-Fiema Monkey Sanctuary (BFMS) and Kogyae Strict Nature Reserve (KSNR), despite their ecological significance (Janssen *et al*., 2018; Afriyie *et al*., 2021a; Amankwah *et al*., 2021). Studies indicate a decline in forest cover and carbon stocks in these areas due to anthropogenic activities. For instance, Janssen *et al*. (2018) reported a doubling of the deforestation rate in KSNR from 1.7 % yr^{-1} to 5.4 % yr^{-1} between 1984 and 2015. Singh *et al*. (2022) documented the near-total clearance of dry forests in KSNR, while Amankwah *et al*. (2021, 2024) reported a 242-hectare decline in BFMS's closed forest between 1992 and 2018 and a loss of 40,236 Mg C in BFMS and 272,109 Mg C in KSNR from 1992 to 2024. These findings highlight the urgent need for improved protection and management strategies in these reserves.

A major barrier to combating deforestation in Ghana has been the exclusion of local communities from policy formulation, planning and implementation of forest management strategies (Adusei & Dunyah, 2016). Research studies conducted in BFMS and KSNR show the limited involvement of local communities in conservation efforts, often due to weak communication, lack of collaboration, and imposed policies that do not integrate community perspectives (Jachmann, 2008; Oduro *et al*., 2012; Ayivor & Ntiamoa-Baidu, 2015; Oduro-Ofori *et al*., 2015; Afriyie *et al*., 2021a; Afriyie *et al*., 2021b). For instance, Ayivor & Ntiamoa-Baidu (2015) noted that strained communication between management and local communities in KSNR has created conflicts. Oduro-Ofori *et al*. (2015) reported that weak enforcement of resource laws and policy imposition without community participation has increased illegal activities such as agricultural encroachment in KSNR. Furthermore, poor community relations, inadequate staff, and insufficient research and resource inventories in the protected areas (Afriyie *et al*., 2021a; Afriyie *et al*., 2021b), have influenced the degree of these pressures. Ghana's 2012 Wildlife and Forest Policy advocates for collaborative forest management, recognising the role of local communities in conservation and the potential socio-economic and ecological benefits of inclusive governance (Ministry of Lands and Natural Resources, 2012). While previous studies have recommended collaborative approaches in PAs (Adusei & Dunyah, 2016; Husseini *et al*., 2020; Sobeng *et al*., 2023) few have assessed the forest conservation practices from the perspectives of local communities in BFMS and KSNR.

This study sought to bridge the gap by assessing the forest conservation practices from the perspective of the local communities in KSNR and BFMS and investigating how socio-demographic factors influence community knowledge of forest conservation using a semi-structured questionnaire. By providing empirical evidence on local conservation efforts, the study contributes to policy recommendations for participatory forest management, thereby promoting sustainable forest management and contributing to Sustainable Development Goals (SDGs) 2 (Zero Hunger), 11 (Sustainable Cities and Communities), 13 (Climate Action), and 15 (Life on Land).

2 Method and materials

2.1 Study area

BFMS and KSNR are Wildlife Protected Areas (WPA) located in the forest-savannah transition zone of Ghana. These areas have dry semi-deciduous vegetation serving as important wildlife habitats and are under the management of the Wildlife Division of the Ghana Forestry Commission (Fig. 1). BFMS covers an area of 535 ha and is situated in longitudes 1°41'10" to 1°42'15" W and latitudes 7°41'30" to 7°43'33" N, in the Kintampo Forest District of the Bono East Region (Amankwah *et al*., 2021). The sanctuary experiences an annual rainfall of 800-1200 mm on average and has a mean annual temperature of 26 °C (Eshun & Tonto, 2014). The elevation of BFMS is approximately 360 m a.s.l. In addition to being an important protected area, BFMS is a national ecotourism site and provides a home to the critically endangered Colobus vellorosus monkey, which is endemic to West Africa and listed on the International Union for Conservation of Nature (IUCN) Red List.

KSNR on the other hand is located in the Sekyere Mampong Forest District of the Ashanti region and spans an area of 33,000 ha. Its coordinates are 7°08' to 7°21' N and 0°59' to 1°14' W, with an annual range from 1200 to 1300 mm. The reserve has an annual temperature of 25 °C (Janssen *et al*., 2018; Ibrahim *et al*., 2020; Afriyie *et al*., 2021b). Surrounding communities include Domeabra, Sankasase, Njaya and Congo Nkwanta. The elevation of KSNR is relatively

flat with an average altitude of 180 m a.s.l. The nature reserve is classified as an IUCN 1a strict nature reserve, meaning that visits are permitted solely for research purposes. Human access and use are strictly monitored to preserve and protect the ecological, geological and geomorphological features of the reserve (Ayivor & Ntiamoa-Baidu, 2015).

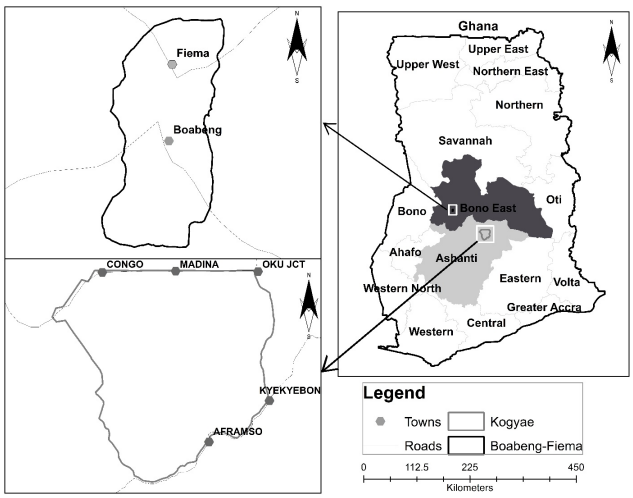

Fig. 1: *Map of the study area showing Boabeng-Fiema Monkey Sanctuary (BFMS) and Kogyae Strict Nature Reserve (KSNR), both wildlife-protected areas (WPAs) located in the forest-savannah transition zone of Ghana.*

2.2 Sampling technique and sample size

The Nkoranza North District, where BFMS is located, has a population of 56,468, while the Sekyere Central District, encompassing KSNR, has a population of 73,228 (Ghana Statistical Service, 2021). However, the target population for this study was not the entire district population, but rather the adult residents of the selected communities. Based on a reconnaissance survey and consultations with local leaders, including community elders and assembly members, the total adult population was estimated at approximately 1,600 individuals. To determine the appropriate sample size, Slovin's formula was employed. The minimum sample size required for accuracy in estimating proportions was computed by allowing a 5 % margin of error. Thus, the minimum sample size was computed to be 320 respondents. However, due to incomplete responses, data from 300 respondents were analysed.

The distribution of respondents was as follows; Boabeng (n=78), Fiema (n=72) in BFMS, and Congo Nkwata (n=40), Domeabra (n=49), Njaya (n=41) and Sankasaase (n=20) in KSNR. The selected communities were chosen based on their proximity to the reserves. The variation in sample distribution across communities was influenced by differences in population size, household availability and willingness of respondents to participate in the survey. Communities with larger populations had higher representation, while those with smaller populations contributed fewer respondents.

2.3 Data collection

Primary data was collected through (i) questionnaires administered through interviews and (ii) field observations. A semi-structured questionnaire tailored to the local context, comprising both open and closed-ended questions, was developed to gather data on respondents' socio-demographic characteristics and conservation practices related to forest conservation. Prior to the main survey, a pilot study was conducted with a small group to assess the questionnaires' applicability and address any potential misunderstandings. Research assistants from the Forestry Research Institute of Ghana (FORIG) were trained to assist in data collection. Questionnaires were administered through interviews conducted in the local dialect, Twi, with questions translated from English to accommodate respondents' educational and linguistic backgrounds.

The Wildlife Division of Ghana, under the Forestry Commission and the local authorities including chiefs and assembly committee, approved this study. The research team followed community entry procedures, including a formal introduction at the chiefs' palaces and consultation with assembly committee leaders. Announcements about the research activities were disseminated through local information centres within the towns. This collaborative approach ensured transparency, respect for local authority and community engagement.

Respondents were fully briefed on the research's purpose, scope and confidentiality measures before the interviews. They were informed that participation was voluntary, and they could withdraw at any point. To ensure a representative sample of the population, surveys were conducted at households, workplaces and town centres. Data collection schedules were adjusted to accommodate the community's farming activities with interviews conducted during late afternoons and weekends.

A systematic random sampling method was employed, with the local communities divided into clusters based on specific locations; Boabeng and Fiema in BFMS and Domeabra, Sankasase, Nyaja and Congo Nkwanta in KSNR. Starting points within each community were randomly selected and households were surveyed along predetermined routes using a fixed sampling interval of every third household (i.e., after sampling one household, the next household was skipped and the subsequent one was surveyed). The transects were spaced approximately 50 metres apart to ensure ad-

equate coverage of the community. For this study, a respondent is defined as an individual aged 18 years or older who resides in the selected communities and voluntarily agreed to participate in the survey. Respondents were selected randomly from the eligible population within each of the selected communities. It is important to note that no specific predefined protocols or selection criteria were applied to target respondents based on their knowledge or experience related to local forests or conservation practices. The study aimed to capture a broad spectrum of perspectives from community members, allowing for a general understanding of the communities' views on forest conservation practices.

2.4 Data analysis

The data collected from the questionnaires were cleaned, coded and analysed using Statistical Package for Social Sciences (SPSS). The software facilitated data management and computation of descriptive statistics to summarise the socio-demographic variables of respondents. Demographic variables such as sex, age, educational level, occupation and residential status were summarised in a table.

Respondents' perspectives on forest conservation practices were captured through an open-ended question: "What practices do you think can help preserve the forest in your area?" The responses were grouped into thematic categories – such as wildfire prevention, staffing of forest protection units, community engagement, reforestation, alternative livelihoods and enforcement of forest laws – based on a qualitative coding framework developed during data review. Each conservation theme was then converted into a categorical variable with multiple outcomes (e.g., 1 = wildfire prevention, 2 = staffing of forest protection units, 3 = community engagement, etc), which were used as the dependent variables for analysis.

Since respondents could mention multiple conservation practices, each theme was treated as a separate outcome. Multinomial logistic regression (MLR) was conducted for each conservation practice to assess whether socio-demographic variables influenced the likelihood of a respondent mentioning each specific conservation practice.

The general form of the MLR model used is:

$$\log\left(\frac{P(Y_i = k)}{P(Y_i = 0)}\right) = \beta_0^k + \beta_1^k \text{Age}_i + \beta_2^k \text{Sex}_i + \beta_3^k \text{Education}_i + \beta_4^k \text{Residential Status}_i + \varepsilon_k$$

Where: Y_i is the categorical variable indicating the specific conservation practice mentioned by respondent i.
$P(Y_i = k)$ is the probability that respondent i. mentioned conservation practice k.
$P(Y_i = 0)$ is the reference category, representing respondents who did not mention any practice.
β_0^k is the intercept for category k.
$\beta_1^k, \ldots, \beta_4^k$ are the coefficients for the socio-demographic predictors (age, sex, education and residential status) for conservation practice k. ε_k is the error term for each.

Separate models were estimated for each conservation theme (e.g., wildfire prevention, staffing, education). Statistical significance was assessed at a 95 % confidence level ($p < 0.05$) and results were interpreted accordingly to identify demographic predictors of conservation practices.

3 Results

The socio-demographic profiles of respondents (Table 1) indicate that both BFMS and KSNR are characterised by predominantly older, male populations. Notably, BFMS has a higher proportion of formally educated individuals and indigenes, whereas KSNR features a larger share of settlers and a greater reliance on farming.

Table 1: *Socio-demographic characteristics of respondents from Boabeng-Fiema Monkey Sanctuary (BFMS) and Kogyae Strict Nature Reserve (KSNR).*

Characteristics	*BFMS (%)*	*KSNR (%)*
Sex		
Male	64	72
Female	36	28
Age		
20–30	27	26
31–40	19	23
41–50	17	19
50 upwards	36	31
Educational level		
Not educated	17	35
Primary school	15	11
Junior high/middle school	47	27
Senior high school	10	20
Tertiary level	11	7
Occupation		
Farmer	61	79
Trader	7	2
Salaried employee	4	5
Student	7	1
Unemployed	3	3
Others	17	9
Residential status		
Indigene	92	44
Settler	8	56

Table 2: *Perspectives of forest conservation practices from the local communities near the Boabeng-Fiema Monkey Sanctuary (BFMS) and the Kogyae Strict Nature Reserve (KSNR).*

Conservation practices	*BFMS (%)*	*KSNR (%)*
Implementation of wildfire preventive measures	38.6	6.5
Staffing up the forest protection unit	1.8	37.2
Educating the populace about the importance of the forest	7.1	11.8
Enforcement of forest legislation	19	16.3
Prohibiting illegal felling of trees	7.1	
Regulating hunting activities		3.8
Enforcement of penalties for forest law violators	3.5	2.7
Engagement of the community in forest conservation programmes	4.4	13.3
Replanting indigenous tree species	9.3	
Intensifying management		4.6
Introduction of an alternative source of livelihood	2.2	
Others	7	3.8

Community perspectives on forest conservation (Table 2) differ between the sites. BFMS favours proactive and ecologically restorative measures, such as wildfire prevention and replanting native species, while KSNR emphasises institutional actions, including enhanced forest protection units and improved public education. Additionally, the multinomial logistic regression analysis (Table 3) reveals that none of the examined socio-demographic variables (education, age, sex, residential status) serve as statistically significant predictors of forest conservation knowledge.

4 Discussion

4.1 Socio-demographic characteristics of respondents

The study found a gender imbalance among respondents, with more males than females in both communities, reflecting broader socio-cultural factors. Traditional gender roles, particularly household responsibilities, often limit women's engagement in public and economic affairs in rural Ghana, potentially affecting their participation in forest conservation and decision-making (Bermúdez Figueroa *et al*, 2023). The age distribution showed a predominance of individuals above 50 years, with a notable presence of respondents aged 20-30. This pattern aligns with cultural norms where older individuals, often household heads, are more likely to engage in interviews (Randall & Coast, 2016). However, the study did not assess younger adults explicitly, limiting conclusions about the overall age composition of the community.

Educational levels varied between the study sites, with KSNR having a higher proportion of uneducated respondents compared to BFMS. Most respondents in both areas attained Junior High School education, with the lower educational levels in KSNR corroborating previous findings on educational challenges in the region (Oduro-Ofori *et al*, 2015).

Farming was the dominant occupation, illustrating a strong dependence on forest resources. This aligns with the forest-savannah transition zone's role as an agricultural hub in sub-Saharan Africa (Staver *et al*, 2011). Farming was previously identified as the primary occupation in KSNR (Ayivor *et al*, 2020), reinforcing its central role in local livelihoods. Crop cultivation varied between sites, with maize, yam, rice, and cassava in BFMS, while yam and groundnut dominated KSNR. Agricultural practices, particularly slash-and-burn methods, contribute to deforestation and degradation. Livestock rearing and palm wine tapping were also observed.

A key socioeconomic distinction was the indigenous-settler divide between the sites. Most respondents in BFMS were indigenes, whereas KSNR was largely composed of settlers who migrated over two decades ago in search of arable land. This pattern, as noted by Oduro-Ofori *et al* (2015), has implications for land tenure, community dynamics, and forest resource sustainability.

4.2 Forest conservation practices from local communities' perspective

The study highlights the significance of forest conservation practices as perceived by local communities near wildlife-protected areas. In BFMS, wildfire prevention was a top priority, whereas in KSNR, respondents stressed the need for more personnel to enhance forest protection (Awotwi *et al*, 2018; Amankwah *et al*, 2021). Staffing shortages in KSNR, with deteriorating former staff quarters and no replacements after retirements, mirror longstanding concerns (Ayivor & Ntiamoa-Baidu, 2015; Oduro-Ofori *et al*, 2015). However, official reserve management data on staffing adequacy was unavailable.

KSNR respondents reported threats from external hunters, signifying weakened local enforcement and the need for community-driven monitoring systems. Fieldwork confirmed evidence of illegal hunting, with fires set to drive wildlife out, often leading to uncontrolled forest fires (Afriyie *et al*, 2021a; Janssen *et al*, 2018). These anthropogenic activities accelerate biodiversity loss and soil fertil-

Table 3: *Multinomial Logistic Regression (MLR) results of socio-demographic variables influencing forest conservation perspectives near the Boabeng-Fiema Monkey Sanctuary (BFMS) and the Kogyae Strict Nature Reserve (KSNR).*

	BFMS				*KSNR*			
	Coefficient	*Std. err.*	*t*	*P>t*	*Coefficient*	*Std. err.*	*t*	*P>t*
Education (not educated)								
Primary school	−0.27	0.26	−1.01	0.31	−0.09	0.21	−0.41	0.68
Junior high/middle school	−0.20	0.22	−0.93	0.35	0.23	0.17	1.34	0.18
Senior high school	0.11	0.31	0.37	0.72	0.22	0.20	1.08	0.28
Tertiary level	0.08	0.30	0.28	0.78	0.49	0.28	1.73	0.09
Age (20–30)								
31–40	0.17	0.22	0.76	0.45	0.16	0.20	0.84	0.40
41–50	0.22	0.27	0.83	0.41	0.15	0.22	0.67	0.50
50 upwards	0.00	0.24	0.01	0.99	−0.24	0.21	−1.14	0.26
Sex (Male)								
Female	0.05	0.15	0.31	0.76	−0.19	0.16	−1.22	0.22
Residential Status (native)								
Settler	−0.25	0.27	−0.92	0.36	−0.09	0.13	−0.69	0.49

ity decline. While there are regulations prohibiting poaching and charcoal production (Janssen *et al*, 2018), respondents in KSNR voiced concerns about damage from unsupervised cattle grazing.

Slash-and-burn agriculture was prevalent in both sites, exacerbated by population growth, shorter fallow periods, and climate stress (Daniel Tang & Yap, 2020; Afriyie *et al*, 2021b; Amankwah *et al*, 2021). While rooted in traditional farming, its increasing unsustainability demands intervention that integrates local knowledge and adaptability.

The community's recognition of weak law enforcement presents an opportunity for policy action. While legal frameworks exist, effective regulation requires participatory enforcement. Community members emphasised their role in addressing illegal activities and expressed the need for stronger forest management (Boafo, 2013). Additionally, education was identified as a crucial conservation tool, suggesting room for improvement in fostering long-term forest protection awareness (Dehghani Pour *et al*, 2023).

Finally, 9.3 % of BFMS respondents advocated for restoring degraded forests using indigenous species, citing their ecological benefits (Djagbletey *et al*, 2021). Incorporating community perspectives into reforestation efforts can improve both ecological outcomes and local engagement.

4.3 Socio-demographic influence on forest conservation knowledge

The Multinomial Logistic Regression (MLR) analysis revealed that socio-demographic factors – education level, age, sex, and residential status – did not significantly affect respondents' perspectives on forest conservation in BFMS or KSNR. This contrasts studies in Central Alps (Zoderer *et al*., 2016) and South-Central Ethiopia (Tamene *et al*., 2024) where these variables influenced conservation knowledge and engagement.

The absence of a significant effect suggests a shared baseline conservation awareness among these communities, likely shaped by traditional ecological knowledge passed down through generations (Sinthumule & Mashau, 2020; Cebrián-Piqueras *et al*, 2020). Oduro-Ofori *et al* (2015) emphasised the role of local knowledge in forest conservation in KSNR, while Attuquayefio & Gyampoh (2010) documented indigenous knowledge's positive impact on wildlife conservation in BFMS. Direct reliance on forest resources and participation in conservation efforts foster a communal stewardship mindset, potentially outweighing individual socio-demographic influences. This study underscores the importance of cultural context and community-driven governance in shaping conservation perspectives.

4.4 Implications of the findings on biodiversity conservation

The lack of correlation between education level and conservation practices in BFMS and KSNR suggests that formal education is not the primary driver of conservation knowledge in these communities. Zoderer *et al*. (2016) and Tamene *et al*. (2024) reported a positive link between education and biodiversity conservation for Central Alps and South-Central Ethiopia, respectively, but this research highlights the importance of traditional ecological knowledge and cultural ties to forests (Oduro-Ofori *et al*, 2015).

These findings suggest that conservation efforts should integrate local knowledge systems rather than rely solely on

formal education (Dehghani Pour *et al*, 2023). A key area of application is mitigating slash-and-burn farming, which contributes to deforestation and soil degradation (Tang & Yap, 2020). Conservation strategies should promote sustainable agricultural techniques, such as agroforestry or no-burn methods, that align with both environmental goals and local farming traditions. By bridging indigenous knowledge with modern conservation strategies, biodiversity conservation initiatives can become more effective and culturally attuned.

5 Conclusion

This study underscores the importance of integrating local perspectives with scientific research to enhance forest conservation in BFMS and KSNR. While socio-demographic factors did not significantly influence conservation views, the findings highlight the need for inclusive strategies that engage all community members. Strengthening forest management through increased staffing, law enforcement, and participatory conservation initiatives is crucial for sustainability. Future research should explore community participation in decision-making and conservation actions. By aligning local knowledge with effective policies, BFMS and KSNR can achieve more sustainable forest management outcomes.

Conflict of interest

The authors declare that they have no known financial or interpersonal conflicts that would have appeared to have an impact on the research presented in this study.

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