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Assessment of Crop Damage and Agropastoralist Attitudes Towards Crop Raiders in the Frontier Area of Gambella National Park, Western Ethiopia: Implications for Human Wildlife Conflict Mitigation

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ABSTRACT

Crop damage by wild animal impacts people's livelihood in Ethiopia. This study aimed to assess the incidence of crop damage and agropastoralist attitude towards crop raiders in the frontier area of Gambella National Park, Western Ethiopia, from September 2017 to May 2018 using semi-structured questionnaire. Warthog (26.6%), anubis baboon (25.5%), grivet monkey (21.9%), bushpig (10.4%) and porcupine (15.6%) were identified as crop pest responsible for damage of sesame (22.7%), maize (21.7%), rice (21.1%), green gram (14.8%) sweet potato (11.3%) and sorghum (8.5%). Cohen's omega tests revealed small values for all crop raiders, indicating uniform damage across villages, except bushpigs, which exhibited inconsistent crop damage with a medium effect size (ω=0.324). Among crops, sesame damage was significant with a large effect size (ω=0.561) showing its inconsistence across villages. Despite some informants' lack of response (36.19%) to questions about ways to mitigate crop loss due to wildlife damage, suggestions for eradicating (28.57%) and reducing (17.62%) or relocating (17.62%) were made with medium effect size (ω=0.314) exhibiting its inconsistency across villages. The study reported prevailing significant negative attitude (70.0%) towards crop raiders with large effect size (ω=0.789) revealing its variations among villages. The Potential for Conflict Index$_2$ analysis revealed no consensus among attitudinal segments on accepting crop damage by wild animals. Skewed responses for all crop raiders revealed the prevalence of negative attitudes regardless of actual damage extent. Regression model revealed factors such as age and education influenced native people's attitudes necessitating sustainable and culturally sensitive conservation strategies to mitigate human-wildlife conflicts.

Keywords: Agropastoralist, Attitude, Crop damage, Disparity, Gambella National Park, and Potential for Conflict Index$_2$.

INTRODUCTION

Competition between humans and wildlife for living space frequently leads to human-wildlife conflict in many countries irrespective of their level of development (Hoffman, 2011; Bibi et al., 2013). Currently the issue of conflict between humans and wildlife is prevalent in various parts of the world as the needs of wildlife and human increasingly overlap (Lamarque et al., 2009). Human-wildlife conflicts occur when wild animals cause harm to crop, livestock, humans, and property, resulting in detrimental consequences (Bibi et al., 2013), often occuring near wildlife protected areas (Karanth et al., 2012). Hence, such conflict is rapidly becoming one of the critical menaces to the existence of numerous wildlife species, posing ever-growing obstacles to conservation endeavors (Madden, 2008). Crop cultivation in Africa plays a crucial role in ensuring food security for people and as a feed source for livestock. Nevertheless, agricultural crop

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productivity faces challenges due to drought and significant crop damage caused by wild animals (Dixon, 2005). Such crop damage often results in a negative perception of wildlife in community and impedes conservation initiatives (Mohammed et al., 2017). In Ethiopia, occurrences of crop destruction resulting from a diverse range of species are on the rise (Nibret et al., 2017; Goudar et al., 2017; Sebsibe & Yihune, 2018; Kifle, 2021; Merkebu & Yazezew, 2021; Ibrahim et al., 2023).

Ethiopia possesses a diversified ecosystem, hosting rare endemic species mainly confined to its various protected areas (Yalden, & Largen, 1992). Crop destruction caused by various wild animals differs in type and extent across Ethiopia (Alemu et al., 2017; Goudar et al., 2017; Kifle, 2021; Merkebu & Yazezew, 2021; Ibrahim et al., 2023). Conflict manifestation in terms of crop damage was reported where warthogs, anubis baboons, grivet monkeys, bushpigs and porcupines are common. Incidents of crop damage caused by anubis baboon, warthogs, common mole rats, porcupines, grey duikers, mountain nyala, and bohor reedbucks were reported around Bale Mountains National Park (Sebsibe & Yihune, 2018). According to residents living in the Choke Mountains, anubis baboon, bushpig, and porcupine have been recognized as the major crop pests (Nibret et al. 2017). Buffalo, vervet monkey, and warthog were identified as the primary wild animals causing damage to crop around Chebera Churchura National Park (Datiko & Bekele, 2013). Moreover, in Senkelle Swayne's Hartebeest Sanctuary, warthogs were specifically recognized as notorious pest (Kumssa & Bekele, 2013). Primates such as grivet monkeys in Zegie Peninsula area (Gebeyehu & Bekele, 2009), Bale monkey in the Oromia and Southern Nations regions (Mekonnen et al., 2012), gelada, anubis baboon, and grivet monkey in Yegof National Forest Priority Area (Mohammed et al., 2017; Goudar et al., 2017) and hamadryas baboons in Borena-Sayint National Park (Ibrahim et al., 2023) were reported as major problematic animals that damage crops.

Addressing the challenge of crop raiding within and around protected areas is of utmost importance in conservation efforts to mitigate conflicts and promote sustainable coexistence between people and wildlife (Karanth et al., 2012). It is imperative to understand the factors that influence both humans and the environment, especially in protected areas, to effectively address the issue of crop raiding. In southwestern part of Ethiopia, excessive exploitation of natural resources compels wild animals to engage in competition for limited resources (Mekonen, 2020). Until now, no endeavors have been made to evaluate the extent of the conflict between crop raiding animals and the local communities living in Abobo district, which is connected to Gambella National Park. Therefore, this research aimed to assess the incidences of crop damage and agropastoralist attitude towards crop raiders in the frontier area of Abobo district, in the Gambella region for future intervention plans.

MATERIALS AND METHODS

Description of the study area:

This study was carried out in Abobo district to assess the incidences of crop damage caused by crop raiders and to analyze attitudes of agropastoralists living with wild animals, particularly lions (Bauer & van Der Merwe, 2004), white eared kobs (IUCN SSC Antelope Specialist Group, 2016), and roan antelopes (IUCN SSC Antelope Specialist Group, 2017). Moreover, this study site is situated on the periphery of the Gambella National Park (Fig. 1). Hillman (1993) reported that the Gambella National Park is situated within latitude of 8°N and longitude of 34°15′E. The average temperature is 27° C – 33° C and the annual rainfall amount ranges from 900mm to 2200mm with an altitude of 1560 masl. This park is surrounded by nine administrative districts, namely Jikawo, Lare, Wantawo, Akobo, Gambella, Itang, Gog, Abobo, and Jor. This park was established in 1973 and spans an expansive area of 4,575 km2. In fact, it serves as a habitat for a wide array of wildlife, including 69 species of mammals, 327 species of birds, 7 species of reptiles, 493 species of plants, and 92 species of fish. Notably, the park is inhabited by various wild animals such as the white-eared kob (*Kobus kob*), Nile lechwe (*Kobus megaceros*), Africa elephants (*Loxodonta africana*), buffalos (*Syncerus caffer*), lions (*Panthera leo*), leopards (*Panthera pardus*), roan antelopes (*Hippotragus equinus*), giraffes (*Giraffa camelopardalis reticulate*), lelwel hartebeests (*Alcelaphus bucelaphus*), and tiangs (*Damaliscus lunatus*). As a result, encounters between humans and straying wild animals are common around Gambella National Park. Gambella, with a population of approximately 365,000, is predominantly inhabited by the Anuak and Nuer ethnic groups (Gebresenbet et al., 2018) along with Agyuwa, Nure, Majang, Komo and Opo. In the study area, various agricultural crops are grown, including sesame, maize, rice, green gram, sweet potato, and sorghum.

Method of data collection:

A preliminary assessment was conducted utilizing a semi-structured to ascertain the clarity of all questions, after which a final version was prepared for the purpose of sampling. The survey included a combination of open-ended and fixed-response questions (Goudar et al., 2017; Ibrahim et al., 2023). From September 2017 to May 2018, a study was conducted involving a sample of 210 agropastoralists living in villages (Kebeles in

Amharic language) of Abobo District. The villages, namely village7, villages8 and 9, villages11 and 12, village13, village14, and village17, were chosen due to their coexistence with wild animals, particularly lions, white-eared kobs, and roan antelope, and experiences with human-wildlife interactions. The occupations of the study participants consisted of agropastoralists, with 42.38% being dedicated agriculturists and 57.62% engaging in agropastoral activities. The study participants were included using the purposive sampling method (Mohammed et al., 2017; Goudar et al., 2017). Out of total respondents, 150 (71.43%) were males and 60 (28.57%) were females. A significant portion of the individuals providing information were illiterate or had received an informal education (72.86%). Some of them had completed primary

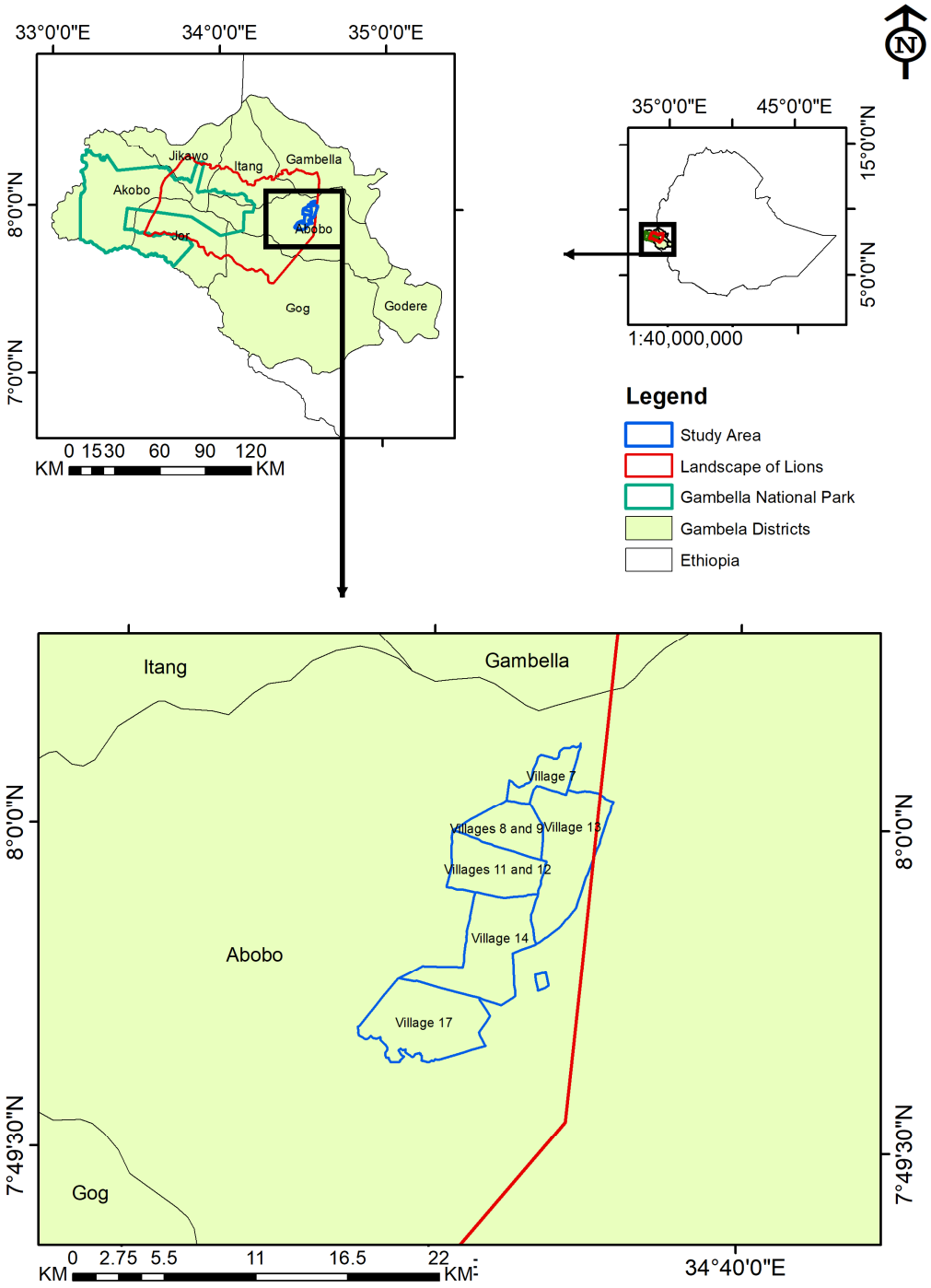

Fig 1: Location of Abobo district that associated with Gambella National Park

school education (23.33%), while few had received secondary education or higher (3.81%). Most of the informants identified as Christians (83.33%) while others were Muslims (16.67%); more were married (80.95%) than single (9.52%) and divorced (9.52%); and a majority were young adults (71.43%) compared to old adults (28.57%).

Further, the interviews were carried out with the voluntary participation of individuals who had given their prior written consent. Before giving consent, they received a clear explanation from a researcher about the study's objectives, their right to decline participation in the questionnaire, and the confidentiality of their responses. Informants were selected based on specific inclusion criteria, including being at least 18 years old, having given written consent, being permanent residents of Abobo District, and having experienced crop damage by wild animals. Throughout the interview, the interviewer ensured the informant's isolation from other family members, thereby preventing any potential familial influence on the responses. As the preliminary assessment revealed instances of crop damage by wild animals, the final assessment focused on reporting crop damage by wild animals, identifying them through photographs, documenting the damage type, exploring preventive measures, and assessing respondents' attitudes towards crop raiders. To analyze individuals' attitude toward crop raiders, the feedback received regarding likes and dislike of various animals was classified into three categories: positive (response of supportive words), negative (response of disparaging phrases), or neutral (no response).

Data analysis:

Throughout the process of data collection, thorough checks were conducted to ensure the completeness, appropriateness, and accuracy of each response. Multiple response analysis (Ibrahim et al., 2023) and chi-square test of independence were used to analyze respondents' opinions on wild animal involvement in crop damage, preventive measures, and attitudes towards crop raiders in the R environment. Cramer's V, an effect size index (Cohen, 1988), was calculated using the 'lsr' package (Navarro, 2014) in the R environment and transformed into Cohen's omega (ω) using the specified formula (Cohen, 1988):

$$\omega = \phi^* \sqrt{(r - 1)}$$

where ϕ is Cramer's V; (r - 1) is the degree of freedom (r being the smallest dimension of the contingency table). Then Cohen's rule of thumb was applied to evaluate Cohen's omega values with values of 0.1, 0.3, and 0.5 considered as small, medium, and large effect sizes, respectively (Cohen, 1988).

Furthermore, participants were asked to rate their agreement or disagreement with wild animal involvement in crop damage, and their responses were analyzed to determine consensus or disparity. Additionally, the second generation of the Potential for Conflict Index$_2$ (PCI_2) was utilized to visually illustrate the variations in acceptance of crop damage among individuals who held positive or negative attitudes towards crop raiders. The PCI_2 helps to illustrate the extent of disparity between respondents within a specific group, assigning greater importance to extreme responses while disregarding neutral responses (Vaske et al., 2010; Vaske, 2017). PCI_2 values of 0 indicate total agreement or high consensus, no potential for conflict, when responses are 100%, and least agreement or low consensus, with greatest potential for conflict when responses are equally distributed between two extreme values. To establish statistical significance ($p \leq 0.05$), the observed PCI_2 values were compared to the critical value for a normal distribution, which was conducted using a value exceeding 1.96 (Vaske et al., 2010). The figure illustrates the PCI_2, with the location of bubble representing the average responses and the size of the bubble indicating the PCI_2 values. The position of the bubble in relation to the neutral point is believed to reflect skewed responses towards a crop raider (Vaske et al., 2010; Engel et al., 2017).,

The Multinomial Logistic Regression (MLR) model was used to predict respondents' attitudes towards crop raiders, using their social profile parameters as independent variables and their attitude as the dependent variable using 'nnet', 'DescTools' and 'lmtest' packages in the R environment. Besides, the independent variables were tested for multi-collinearity through the application of the Variance Inflation Factor (VIF) test. A VIF value of ≤3 was observed, signifying the lack of collinearity among the variables, and thus confirming their suitability for analysis (Zuur et al., 2010). The VIF ranged from 1.020 to 1.094 for sex, age, family size, marital status, religion, education, and occupation were incorporated, and non-significant variables ($p > 0.05$) were removed further to establish the minimal adequate model. Likelihood ratio tests were employed to assess the importance of each predictor variable. Then regression coefficient (B), Wald $\chi 2$ statistics, standard error (SE), and odds ratios (OR) were utilized to evaluate the comparative impacts of the reference category on the variables of interest.

RESULTS

Assessment of crop damage by crop raiders:

The level of crop damage by wild animals is summarized in Table 1. In the study area, the analysis of multiple responses indicated that

Table 1: Response of informants on human wildlife conflict with reference to crop raider and crop damage

Attribute		Villages with number of respondents faced crop damage						Overall (n=210)	χ^2	df	p	*V*	ω	Effect size
		V7 (n = 31)	V8/9 (n = 19)	V11/12 (n = 53)	V13 (n=45)	V14 (n = 36)	V17 (n = 26)							
Crop raiders*	Warthog	21	13	33	33	25	18	143 (26.6)	1.446	5	0.919	0.083	0.186	Small
	Anubis baboon	19	12	33	31	24	18	137 (25.5)	0.935	5	0.968	0.067	0.150	Small
	Grivet monkey	19	11	29	25	18	16	118 (21.9)	1.267	5	0.938	0.078	0.174	Small
	Bushpig	9	5	16	9	10	7	56 (10.4)	4.432	5	0.489	0.145	0.324	Medium
	Porcupine	11	10	23	18	10	12	84 (15.6)	1.472	5	0.925	0.084	0.188	Small
Name of the crop damaged by crop raider*	Sesame	21	13	38	21	29	20	142 (22.7)	13.210	5	0.022	0.251	0.561	Large
	Maize	23	19	32	30	22	16	136 (21.7)	2.167	5	0.826	0.102	0.228	Small
	Rice	21	13	34	29	18	17	132 (21.1)	3.260	5	0.658	0.125	0.280	Small
	Green gram	10	7	25	23	18	10	93 (14.8)	4.106	5	0.534	0.140	0.313	Medium
	Sweet potato	10	7	18	17	12	7	71 (11.3)	4.432	5	0.489	0.068	0.152	Small
	Sorghum	7	4	11	14	9	8	53 (8.5)	2.102	5	0.845	0.100	0.224	Small
Preventive measures to prevent crop loss	No response/ Do not know	13	21	17	16	13	9	76 (36.19)	20.74	3	0.000	0.181	0.314	Medium
	Relocate to other area	5	8	10	8	6	5	37 (17.62)						
	Reduce their presence	5	8	11	8	6	4	37 (17.62)						
	Eradicate them completely	8	13	15	13	11	8	60 (28.57)						
Attitude	Positive	3	2	5	5	2	3	20 (9.5)	130.83	2	0.000	0.558	0.789	Large
	Negative	23	11	37	30	27	19	147 (70.0)						
	Neutral	5	6	11	10	7	4	43 (20.5)						

V = Villages; n = Number of informants; * = Parameters analyzed by multiple response analysis; Values mentioned in parentheses are percentage values; $\chi 2$ =Pearson Chi-Square value; df = Degree of freedom; p = Significant at 0.05; V = Cramer's V effect size index; ω = Cohen's omega.

warthogs (26.6%) were the most reported crop raiders. The effect size associated with this damage was classified as small. On the other hand, bushpigs (10.4%) were the least mentioned crop raider. The effect size attributed to bushpig damage was classified as medium. However, the anubis baboon (25.5%), grivet monkey (21.9%), and porcupine (15.6%) were identified as other crop raiders with the effect size relatively small. The chi-square test of independence indicated that there were no significant variations among respondents from different villages in terms of crop damage by crop raiders. Sesame was the most frequently cited crop damage by the crop raiders ($\chi2 = 13.210$, df = 5, p = 0.022) with an effect size of large ($\omega = 0.561$). Maize and rice ware reported as the second and third most frequently affected crop by the informants, with a small impact size observed in both crops. However, green gram, sweet potato and sorghum were damaged occasionally with small effect size. In fact, many of the respondents did not know (36.19%) of any measures to prevent the crop loss due to wild animals. However, the most recommended solutions to prevent crop damage was to eradicate them completely from area (28.57%) followed by minimizing the number of crop raiders (17.62%) and relocating them to the other areas (17.62%). Respondents differed significantly ($\chi2 = 20.74$, df = 3, p = 0.000) in the usage of preventive measures with an effect size of medium ($\omega = 0.314$). In fact, most respondents had a negative attitude (70.0%) followed by neutral (20.5%) and positive attitudes (9.5%). The informants attitude showed statistical significance ($\chi2 = 130.83$, df = 2, p = 0.000) with an effect size of large ($\omega = 0.789$).

Disparity among people's attitudes for crop damage by crop raiders:

In light of the observed small to medium effect sizes across different crop raiders and the prevailing negative attitudes expressed by respondents towards these raiders, the degree of potential for conflict or consensus or disparity for crop damage by each crop raider among positive and negative attitudes was analyzed by using PCI_2 with the results presented in Fig. 2. The analysis indicated low consensus or high disparity within people's positive and negative attitudes towards crop damage caused by different raiders. Specifically, notable low consensus or high disparity were observed for warthog (positive attitude $PCI_2 = 0.64$; negative attitude $PCI_2 = 0.94$; d = 2.13), anubis baboon (positive attitude $PCI_2 = 0.84$; negative attitude $PCI_2 = 0.93$; d = 0.82), grivet monkey (positive attitude $PCI_2 = 0.84$; negative attitude $PCI_2 = 1.00$; d = 1.50), bushpig (positive attitude $PCI_2 = 0.87$; negative attitude $PCI_2 = 0.98$; d = 1.12) and porcupine (positive attitude $PCI_2 = 0.64$; negative attitude $PCI_2 = 0.90$; d = 1.73). Disparity among negative attitudes was greater compared to positive attitudes towards all crop raiders, and this disparity statistically significant, particularly in the case of warthogs (PCI_2 difference test [d] ≥ 1.96, $p \leq 0.05$) among all crop raiders. Besides, the PCI_2 score in different

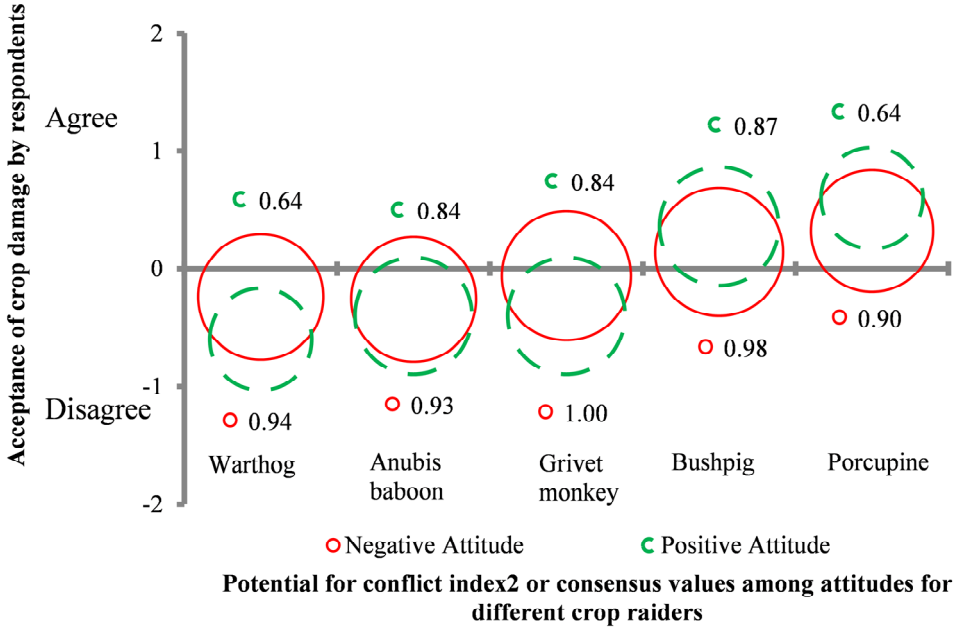

Fig. 2: Potential for conflict index$_2$ (Bubble size) or consensus or disparity values among attitudes for crop damage by crop raiders

attitudinal segments ranged from 0.64 to 1.00 on a scale of 0 to 1, indicating low consensus or high disparity among respondents within attitudes regarding crop damage by crop raiders. The bubble positions of both attitudinal segments were associated to the neutral point, suggesting skewed responses towards crop damage.

Factors influencing the attitude of local people:

The parameter estimates of explanatory variables used to predict respondents' attitudes toward crop raiders in the Multinomial Linear Regression (MLR) model are presented in Table 2. This model revealed that age and education contributed to respondents' attitudes toward crop raiders. The overall effect was statistically significant (Cox and Snell $r^2 = 0.171$, Nagelkerke $r^2 = 0.215$, McFadden $r^2 = 0.118$, Likelihood Ratio $r^2 = 39.453$, df = 18, p = 0.002). Furthermore, the likelihood ratio test revealed that factors of age (χ^2= 6.492; df = 2; p = 0.038) and education (χ^2= 22.150; df = 4; p = 0.000) influence the attitude of the respondents. However, sex (χ^2= 0.142; df = 2; p = 0.932), family size (χ^2= 1.330; df = 2; p = 0.514), marital status (χ^2= 5.212; df = 4; p = 0.266), religion (χ^2= 1.177; df = 2; p = 0.555) and occupation (χ^2= 3.494; df = 2; p = 0.174) did not influence the attitude of the people towards crop raiders. Elderly respondents were likely to have a negative attitude toward crop raiders as compared with the younger adult respondents (B = 0.651; Wald χ^2= 2.291; SE = 0.430; OR = 1.917), suggesting strong positive association between age and negative attitude towards crop raiders. Having primary (B = -1.425; Wald χ^2= 11.796; SE = 0.415; OR = 0.240) and secondary education (B = -3.124; Wald χ^2= 8.434; SE = 1.076; OR = 0.044) decreased the likelihood of negative attitude when compared to respondents who were illiterates. The results highlight the significance of educational programs and awareness campaigns in cultivating favorable perceptions of predators within the community.

DISCUSSION

Living near conservation areas can lead to conflicts between humans and wildlife, causing damage, destruction of crops and livestock, and potential harm to residents (Studsrød & Wegge, 1995; Sillero-Zuberi et al., 2007; Karanth et al., 2013). The rise in human population, the utilization of natural resources by individuals for their daily requirements, policies preventing encroachment and hunting, the overlapping of territories of wild animals with human habitats, wildlife habitat loss, the movement of wild animals beyond forest boundaries, and the successful conservation efforts leading to the recovery of wildlife populations are all recognized as contributing elements to human-wildlife conflicts (Woodroffe & Ginsberg, 1998; Linnell et al. 2001; Macdonald & Sillero-Zubiri, 2002; Ogra, 2008; Ahmed et al., 2022; Ibrahim et al., 2023). The Abobo district, which is associated with Gambella National Park is home to both a human population and a diverse array of wildlife, which has led to various conflicts. A recent study has shed light on the issue of livestock depredation, which occurs due to the resident's engagement in both crop production and livestock keeping for their livelihoods (Gebresenbet et al., 2018; Abie, et al., 2024). Such overlap in activities has resulted in encounters between humans and wild animals who share the same habitat.

Most often, wild animals particularly warthogs, anubis baboons, grivet monkeys, bushpigs and porcupines were identified as crop pest by residents. These animals were also reported to

Table 2: Parameter estimates of variables in the multinomial logistic regression model used to predict local people's attitudes toward crop raiders.

Explanatory variables	Category	Positive attitude				Negative attitude			
		B	Wald χ2	SE	OR	B	Wald χ2	SE	OR
Age (Years)	27-45 vs 46-56	-0.618	1.005	0.617	0.539	0.651	2.291	0.430	1.917
Education	Primary vs none	-1.401	3.561	0.743	0.246	-1.425	11.796	0.415	0.240*
	Secondary vs none	0.489	0.214	1.057	0.613	-3.124	8.434	1.076	0.044*

Parameters for positive attitude (n = 20) and negative attitude (n = 147) are presented while parameters for the neutral attitude (n = 43) were taken to be the reference category for each of the scenarios. * Indicate the significance of parameters at 5%; B = regression coefficient and OR = odds ratio; SE = standard error. "Greater than 45 years" for age group, "none" for education were considered as reference categories for comparison.

cause damage to crop in various regions of Ethiopia (Gebeyehu & Bekele, 2009; Datiko & Bekele, 2013; Kumssa & Bekele, 2013; Nibret et al., 2017; Mohammed et al., 2017; Goudar et al., 2017; Sebsibe & Yihune, 2018). All crop raiders exhibited a small effect size indicating uniform crop damage in all villages. On the other hand, bushpigs displayed varying levels of crop damage with a medium effect size ($\omega = 0.324$) suggesting differences in crop damage occurrence among villages. One of the key factors influencing crop damage is the proximity to forest edges or potential surrogates (Studsrød & Wegge, 1995; Linkie et al., 2007). Scarcity of forest-derived food resources or instead of being opportunistic (Naughton-Treves et al., 1998) could be other factors. Nevertheless, the cultivation of palatable crops in proximity to a protected area is also a factor that cannot be overlooked, as it tends to attract wild animals (Datiko & Bekele, 2013).

Crop invaders are attracted to crops such as maize, teff, and sorghum near Chebera Churchura National Park in Ethiopia (Datiko & Bekele, 2013). The informants in the present study also confirmed a similar situation with respect to the most commonly grown crops in the study area where sesame followed by maize and rice were highly preferred by crop raiders. However, damage to green gram, sweet potato and sorghum was infrequent as their cultivation was uncommon. Reports of the occurrence of crop damage among respondents from different villages exhibits varying intensities, with effect sizes ranging from small (Cohen's omega: 0.152 for sweet potato) and medium (Cohen's omega: 0.313 for green gram) to large (Cohen's omega: 0.561 for sesame). This indicates variations in the extent of crop damage among villages. Notably, the disparity in sesame damage was statistically significant. Many respondents suggested eradicating crop raiders completely or displacing or reducing their numbers in the study area. Nevertheless, it has been reported that the elimination of a particular species of crop raiders may result in an unoccupied territory, thereby inviting another group of that species to occupy that emptied territory (Lamarque et al., 2009). It is widely acknowledged that crop raiders namely warthogs, grivet monkeys, anubis baboons, bushpigs and porcupines, are commonly generate negative attitudes among rural inhabitants in many other parts of Ethiopia (Gebeyehu & Bekele, 2009; Datiko & Bekele, 2013; Kumssa & Bekele, 2013; Nibret et al., 2017; Mohammed et al., 2017; Goudar et al., 2017; Sebsibe & Yihune, 2018). Likewise, local people had a negative attitude about these wild animals in the present study area. However, some respondents exhibied positive attitudes towards crop raiders which can be attributed to their positive biophilia or optimistic views on nature's balance (Røskaft et al., 2007; Goudar et al., 2017; Mohammed et al., 2017). Hence, the conflict situation demands the implementation of improved management strategies in the study area.

Experiencing crop loss to wild animals may lead to negative attitudes (Goudar et al., 2017). PCI_2 values revealed high potential for conflict or low consensus or high disparity within positive and negative attitudinal segments for crop raiders. Besides, disparity among negative attitudes was more than that of positive attitudes across all crop raiders. In fact, this disparity differed significantly for warthog. This indicates that people hold a negative attitude even in the absence of any crop destruction caused by crop raiders. This negative attitude could be attributed to the potential consequences on household food security and loss of income resulting from crop damage (Ogra 2008; Songhurst & Coulson 2014). A study on wild pigs in the American states of Georgia and Illinois (Harper et al., 2016) revealed a low potential for conflict and a disliked of wild pigs as responses of people skewed towards disagree for positive statements (Haper et al., 2016).

Social profiles that reflect the negative attitude of the community against crop raiders were the age of the individuals and low educational attainment. (Kellert, 1985; Kleiven, et al., 2004). In the study area, elderly respondents were more associated with negative attitudes toward crop raiders, which were similar for different crop raiders (Gebeyehu & Bekele, 2009; Datiko & Bekele, 2013; Kumssa & Bekele, 2013; Nibret, et al., 2017; Mohammed et al., 2017; Goudar et al., 2017; Sebsibe & Yihune, 2018). The cumulative experience of crop damage and associated loss incurred among older people could be the reason for a negative attitude towards crop raiders as compared to younger people as reported by Ericsson and Heberlein, (2003) for carnivores. Education is the most significant element that influences people's perception of wild animals and their conservation in Ethiopia (Yosef, 2015) as education promotes the development of positive attitudes (Røskaft et al., 2007). In the present study, illiterate informants had a negative attitude towards crop raiders as compared to the informants with primary and secondary education. Furthermore, illiterates were more inclined to engage in pastoralism or agropastoralism, relying on natural habitats for their sustenance. As a result, they hold a negative attitude towards crop raiders due to the damage they cause to agricultural yield and the resulting food and income losses.

In conclusion, the data explicitly indicates that crop damage by wild animals is prevalent in the communities located in the frontier area of the Gambella National Park in the Abobo district of

the Gambella region, Ethiopia. This study suggests that loss of sesame followed by maize, rice, green gram, sweet potato, and sorghum was related to a prevailing negative attitude toward crop raiding species among respondents. Furthermore, the negative attitude persisted despite respondents not encountering any crop damage by crop raiders, as evidenced by disparity among attitudinal segments and the skewed responses for crop damage caused by crop raiders. In fact, the study showed that socio-demographic factors such as age and illiteracy can further amplify a negative attitude towards crop raiders. These findings reveal challenges for both existing and future conservation initiatives in the study area. Therefore, it is essential to strike a balance between the needs of residents living near protected areas and goals for wildlife conservation in a way that promotes mutual coexistence and equitable resource utilization. Resolving conflicts requires collaborative approach, particularly when it comes to implementing conservation strategies that are sustainable and culturally sensitive.

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