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ASSESSING DRIVERS OF RESOURCE-USE CONFLICT IN MAKAO WILDLIFE MANAGEMENT AREA, MEATU DISTRICT, TANZANIA

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Abstract: Protected areas (PAs) have become a significant point of conflict regarding resource use because they exist in economically underdeveloped areas harboring significant biodiversity. The research evaluated how restricted access to agricultural land, grazing areas, human encounters with wildlife and household characteristics influenced conflict occurrences. The study was conducted in Makao Wildlife Management Area in four villages, Makao, Jinamo, Mwabagimu, and Sapa, employing multinomial logistic regression methods to determine the most effective conflict predictors. Data was collected using a questionnaire from 363 respondents. In-depth interviews and focus group discussions were used to supplement data. Results demonstrate that respondents who faced restrictions on grazing and cultivation activities experience higher levels of conflict ($p < 0.05$), supporting Hypothesis 1. Human-wildlife conflicts resulting from crop raiding, livestock attack and human injury influenced conflict ($p < 0.01$), validating Hypothesis 2. Household size and WMA proximity, along with other socio-demographic factors, were significant ($p < 0.05$), partially supporting Hypothesis 3. The study suggests strengthening community participation in WMA decision-making, benefit-sharing and developing compensation or insurance mechanisms for wildlife damage as long-term sustainability of WMAs.

Keywords: *Resource-Use, human-wildlife conflict, conservation, governance*

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Introduction

Community-based conservation (CBC) has been a top priority in the 21st century due to the fundamental transformation in attitude and perspective it represents in global resource conservation (Rihoy & Anstey, 2010). Participation of local communities in the management of wildlife resources has gained international recognition as sustainable resource use has become a crucial component of wildlife conservation efforts (Gereta & Roskaft, 2010). Wildlife conservation on a global scale has been conducted through Protected Areas (PAs), which have resulted in the resettling of local communities, denial of access to the natural resources on which they have relied for centuries, and consequently, conflict between conservation authorities and local communities over natural resource use (Gruber, 2010; Mfunda & Roskaft, 2010).

Community-based conservation in Africa dates back to the colonial era, when protected areas (PAs) were established without considering local land use or obtaining consent from local communities. This created social-environmental conflicts because local communities were evicted from their ancestor's land without compensation (Stone, 2015). Tanzania served as a prime example of this conservation pattern (Kideghesho et al., 2016). However, in the 1980s, Tanzania initiated legislative reforms and policies promoting community engagement in wildlife management, including creating Wildlife Management Areas (WMAs) on village lands (URT. (2012). This marked a significant shift towards involving rural communities in wildlife conservation and allowing them to benefit from it. WMAs empower locals to manage natural resources outside PAs, migratory routes, and wildlife corridors, enhancing financial viability and governance through government initiatives, regulations, and guidelines (Lwankomezi *et al.*, 2023; URT. (2012).

Resource use conflict has attracted several scholars; some have focused on the common struggle as a source of conflict (See Ehrhart 2022), while others have focused on competition as the outcome of accessing limited resources (Elisa et al., 2024). Nyhus (2016) identifies three main factors which cause resource conflicts: limited resources, weak governance and conflicting stakeholder needs, while Salerno et al. (2016) linked conflict with negative implications, evoking unpleasant emotions and devastation. It is apparent that conflict is a part of everyone's existence and must be viewed as a daily occurrence. The occurrence of conflicts around protected areas in Africa shows how conservation approaches lack effectiveness because of not incorporating conflict management strategies and disregarding social and political aspects of resource management (Hohbein et al., 2022). This is because enforcement of strict conservation rules leads to local economic criminalization as they do not offer sustainable alternatives to traditional livelihoods (Gruber, 2010).

In Tanzania, Wildlife Management Area (WMA), identified by the Wildlife Policy 1998 (revised to 2007) as a new protected area category for community-based wildlife management aimed to transfer wildlife management authority to local communities for achieving conservation targets and supporting rural economic development (URT, 2012). WMA performance has been criticized due to its contradictions, which affect operational success, fairness, public acceptance and bureaucratic nature (Kicheleri et al., 2018). The establishment process was government-driven and externally motivated (Mariki, 2015). Its

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evaluations have shown weaknesses in formulation, functioning and demonstrate a general lack of consensus in decision-making concerning WMA governance (Lwankomezi *et al.* 2023; Mgonja 2023). WMA is a top-down approach that excludes community participation in essential decision-making processes. The practice of excluding communities from decision-making has created negative feelings toward conservation organizations while damaging their trust and leading to fights over essential resources, including land and water, grazing areas and forest resources.

Despite the promotion of Community-based conservation models such as Wildlife management areas in Tanzania, the actual performance remains unclear because researchers provide limited evidence on their ability to resolve resource conflicts and achieve fair conservation outcomes. For example, Lwankomezi et al. (2021; 2023) have focused on theoretical advantages such as local community involvement and benefit sharing, while Kicheleri et al. (2018) focused on power struggles in the management of WMA. Others have focused on conservation success without addressing resource access conflicts (Mgonja, 2023). Research about conflict in WMA areas lacks analytical depth because it focuses on descriptive analysis instead of exploring the root causes and imbalances that affect local communities (Bluwstein et al., 2016). The research lacks sufficient data to demonstrate how WMAs impact various social groups, including gender, resource access, income status and proximity to WMAs. The absence of context-specific research about conflict patterns, social and spatial distribution, makes it difficult to understand why WMAs succeed or fail in particular locations.

Makao wildlife management area was established in 2007 and officially gazetted in 2009 (URT, 2012). Makao wildlife management area holds immense significance in conservation within Tanzania's protected areas. It is a crucial wildlife corridor linking the Maswa Game Reserve, Ngorongoro Conservation Area, and the Serengeti National Park (URT, 2012). Despite the establishment of Makao Wildlife Management Area to promote coexistence between conservation and local livelihoods, limited empirical evidence exists on how resource restrictions and human-wildlife interactions shape local conflicts. There is also limited research analysing the scope of resource-use conflicts and their root causes in this area. Therefore, current literature leaves a gap in the understanding of drivers of resource use conflicts that threaten human-wildlife coexistence. This study addresses this gap by evaluating how resource access limitations influence conflict, examining the impact of human-wildlife interactions, and assessing the socio-demographic factors affecting conflict likelihood. Specifically the following hypothesis are addressed (i) *Households with limited access to essential natural resources (e.g., land for cultivation, grazing areas, firewood, and water) are significantly more likely to report resource-use conflict in Makao* Wildlife Management Area *(ii) Households experiencing human-wildlife interactions—such as crop damage, livestock predation, or human injury—are significantly more likely to perceive conservation-related conflict in Makao* Wildlife Management Area *(iii) Socio-demographic factors—such as education level, household size, economic activity, and proximity to the* Wildlife Management Area *boundary—significantly influence the likelihood of experiencing or perceiving resource-use conflict. Therefore, understanding resource use conflicts is* essential to conservation stakeholders since it aims to identify and suggest ways Wildlife Management Areas might contribute to long-term conservation and community well-being.

Materials and Methods

Description of the study area

Makao Wildlife Management Area is in Meatu District, Simiyu Region, with the coordinates 3°21'30.8" Latitude, 34°51'11.3" Longitude (Figure 1). Makao Wildlife Management Area was gazetted in 2009 and covers 780 km^2 and comprises seven villages (Sapa, Mbushi, Iramba ndogo, Mangudo, Jinamo, Mwabagimu, and Makao) in the south-western Serengeti Ecosystem. Makao Wildlife Management Area is a crucial ecological zone, serving as a wildlife corridor that connects the Maswa Game Reserve, Ngorongoro Conservation Area, and Serengeti National Park. Its preservation is vital to the survival of the mega-biodiverse Serengeti ecosystem. The ecosystem is inhabited by approximately 70 larger mammal species and around 500 avifauna species. It is a habitat for one of the world's largest herds of migrating ungulates and the highest concentrations of large predators. This remarkable species diversity is attributed to varied habitats, including riverine forests, swamps, kopjes, grasslands, and woodlands. The environment supports a diverse array of fauna, including roughly 70 species of larger mammals and around 500 species of avifauna. This makes it a notable home for one of the largest herds of migrating ungulates and a region with large predators. Agriculture and livestock keeping are the main economic activities. In the Makao Wildlife Management Area, human settlement and natural resource extraction are prohibited. The permissible applications encompass scholarly research and recreational observation of wildlife. Most restricted activities include limited cow grazing, firewood collecting, hunting (including game cropping, resident hunting, and trophy hunting), and beekeeping.

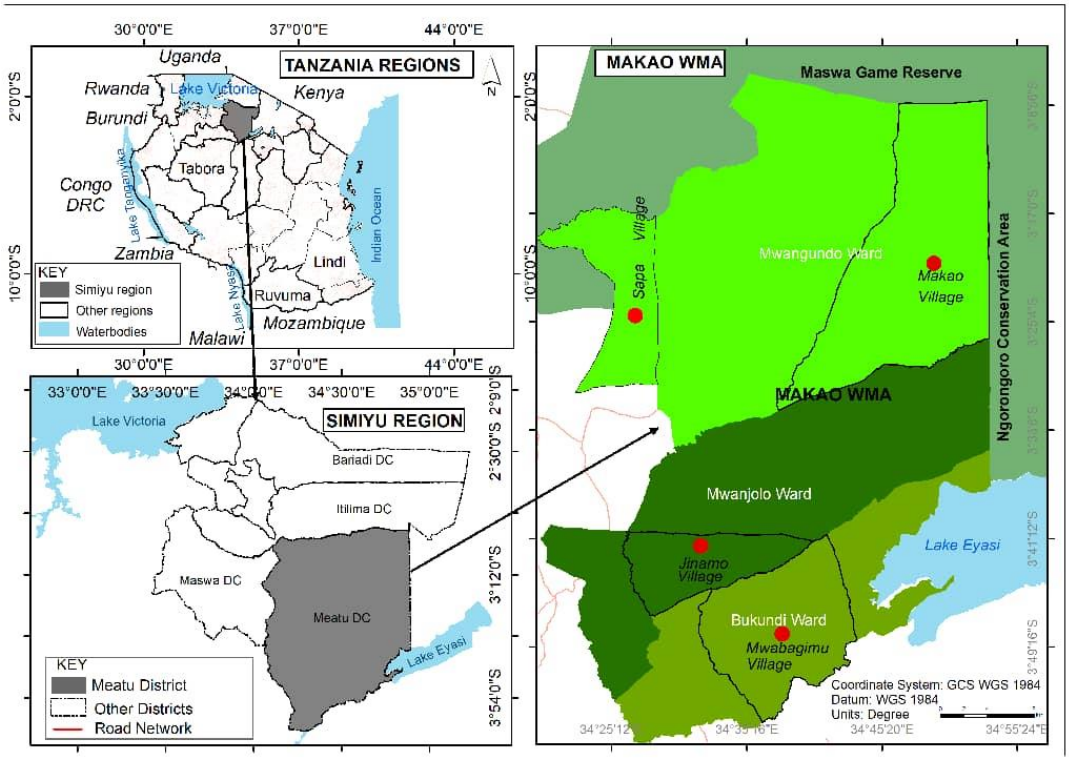

Figure 1. The study area

Data collection

The study adopts a concurrent triangulation design for collecting data, enabling the collection of quantitative and qualitative data at the same time to enhance understanding of the study purpose (Gibson, 2017). This approach ensures that the strength of one data type is used to overcome the weakness of the other and that the validity of the findings is enhanced through triangulation (Dawasiri et al., 2018).

A total of 363 respondents were interviewed using a semi-structured questionnaire. The respondents included the heads of households selected randomly using a simple random sampling technique from each village, Makao (95), Mwabagimu (95), Jinamo (91), and Sapa (82). Sample distributions were proportional to each selected village's households' number. The villages were selected because of resource use conflict and disinvolvement in WMA formulation (Lwankomezi *et al.* 2023). The names were gathered from the village chairs' household register. In each study village, a random number generator (http://stattrek.com/Tables/Random.aspx) was used to create random numbers of households to be surveyed. The questionnaire assessed the occurrence of resource use conflict (existence/non-existence). We assessed the level of conflict with four levels (Decreased, no changes, increased, and not sure). Conflicts was determined using five measurements forming "perceived conflict determinants": (1) *land for cultivation, (2) grazing areas, (3) firewood, (4) water*, (5) *crop damage, (6) livestock predation, (7) human injury (8) education level, (9) household size, (10) economic activity, (11) proximity to the WMA boundary.* Four focus group discussions (FGDs) were conducted with a group size of five participants per session. Key informant interviews were conducted with village executive officers from the study villages, district game officers, and officials from the Makao Authorized Association and Wildlife Division. These key informant interviews gathered valuable insights and information from these knowledgeable individuals. Interviews with key informants were conducted until no new information was obtained or until the data saturation point was reached (Guest et al., 2006). The focus group discussions and interviews with key informants discussed causes, types of conflict, available conflict reporting and resolution mechanisms.

Data analysis

Content analysis was used to analyze data from interviews and focus group discussions, as suggested by Bengtsson (2016). All data were recorded, transcribed, translated and analyzed by grouping 'respondents' answers to each question and developing information by classifying each group of answers. The responses were ranked by scores and categorized into related themes. The inductive analytic process was to identify, explain, clarify, and interpret linked categories conveying similar meanings (Creswell, 2013). Descriptive statistics were used obtaining the mean, median, and percentage. Data were analyzed using the Statistical Package for Social Science (SPSS) version 21. To check the uniformity of the data entry, a frequency run was carried out for all variables to verify any values that may have been entered incorrectly. Chi-square tests were used, and statistical significance was set at p-values < 0.05. This study later employed the multinomial logistic regression methods to determine the most effective conflict predictors in the study area. The model was used because the occurrence of conflict contained more than two distinctive categories, and it enabled the study unordered categorical outcomes while handling both continuous and categorical independent variables. The odds ratio estimates showed how different socio-economic and ecological factors affect the chances of household conflict reporting at specific levels. Therefore, the model provided a strong method to study complex conflict patterns. The Hosmer-Lemeshow goodness-of-fit test was used to determine the accuracy and model goodness of fit by evaluating the

outcome and predicted probabilities. Further, the multicollinearity indicated independent variables operated within acceptable limits, with a Variance Inflation Factor (VIF < 5).

Ethical consideration

Respondents and village leaders were informed by explaining our research objectives and methods, and seeking their consensus. Permission is obtained from the Open University of Tanzania, Tanzania Wildlife Authority (TAWA), Meatu District Council, and Makao Wildlife Management Area to conduct the study. Before data collection, respondents were briefed on the survey's aim and then asked for permission to participate. We proceeded with data collection after receiving their verbal consent. Responses were recorded anonymously, and private places were used during the interview to minimize biased information. Confidentiality of their information and identities was ensured, and proper acknowledgement of sources was maintained. Data was anonymized and secured on computers protected by passwords. Responses were aggregated during the analysis and reporting processes to ensure that no participant traced back to the information collected.

Results

Demographic profiles of respondents

Table 1 presents the demographics of respondents. Males represent the majority of respondents (61%), and (39%) of respondents fell within the age range of 31–45 years. Most respondents (75%) had attained informal education and primary education, indicating that conservation strategies should be tailored to communities with low literacy levels. Half (50%) of respondents lived within 3km of WMA, implying that the close distance between residents and wildlife habitats makes their resources more susceptible to conflict. The majority (42%) practice mixed livelihoods that combine crop cultivation with livestock management, making them susceptible to disputes. The average household size was 6 members, creating increased resource requirements.

Table 1. Socio-demographic of respondents

Villages	Sex (%)		Age – years (%)				Education (%)			WMA Proximity		Occupation (%)			HS
	M	F	18–30	31–45	46–60	> 60	IE	PE	SA	< 3 km	≥ 3 km	CF	LK	ML	
Makao	62	38	24	37	27	12	30	48	22	57	43	39	23	38	**6.1**
Mwabagimu	64	36	21	41	25	13	33	46	21	52	48	40	22	38	6.4
Jinamo	61	39	27	40	23	10	27	45	28	48	52	36	22	42	5.9
Sapa	57	43	28	37	22	13	25	44	31	45	55	33	19	48	5.7
Average	61	39	25	39	24	12	29	46	25	50	50	37	21	42	6

HS**:** household size**;** M: male; F: female; IE: informal education; PE: primary education; SA: secondary and above; km: kilometer; CF: crop farming; LK: livestock keeping; ML: mixed livelihood

Source: Field data (2024)

Existence of Resource Access Conflict

Resource access conflict exists throughout all four villages because 65.6% of participants confirmed its presence (Table 2). The two villages near the Makao Wildlife Management Area showed the highest rates of conflict at 71.6% in Makao and 67.4% in Mwabagimu. The village of Sapa had the lowest rate of conflict at 57.3% because it exists farther from the WMA boundary and faces fewer direct conservation restrictions.

Table 2: Awareness of resource access conflict

Villages		Makao	Mwabagimu	Jinamo	Sapa	Average
Existence of Resource Access Conflict	Yes	71.6	67.4	64.8	57.3	65.
	No	28.4	32.6	35.2	42.7	34.4

Source: Field data (2024)

H₁: Households with limited access to essential natural resources are significantly more likely to report resource-use conflict in Makao Wildlife Management Area.

The logistic regression model found significant correlations between access to natural resources and self-reported conflict (Table 3). The complete model demonstrated that 41% of conflict reporting variance was explained (Nagelkerke $R^2 = 0.41$), and the Hosmer–Lemeshow goodness-of-fit test confirmed an acceptable model fit at $p = 0.61$. Grazing land restrictions proved to be the most influential and statistically important factor in conflict prediction ($B = 1.225$, $p = 0.015$). The restriction of grazing land produced a 3.4 times higher chance of conflict among affected households than those without such restrictions. Households with restricted firewood access experienced a significant rise in conflict ($B = 1.047$, $p = 0.034$), leading to a 2.85 times higher probability of reporting conflict. The restrictions on firewood create both physical challenges for families. Reduced cultivation land access ($B = 0.915$, $p = 0.039$) increased the risk of conflict by 2.5 times. The odds ratio for water access reached 2.02 but failed to meet the 5% statistical significance threshold ($p = 0.087$).

Table 3: Resource access in Makao Wildlife Management Area

Independent Variable	B (Coefficient)	S.E.	Exp(B) (Odds Ratio)	p-value	Interpretation
Limited access to cultivation land	0.915	0.437	2.50	0.039*	Households are 2.5x more likely to report conflict.
Limited access to grazing land	1.225	0.512	3.40	0.015**	Strongest predictor: 3.4x higher likelihood of conflict
Limited access to firewood	1.047	0.498	2.85	0.034*	Significantly increases conflict likelihood.
Limited access to water	0.703	0.416	2.02	0.087	Not statistically significant (at $p < 0.05$)
Constant	-1.841	0.655	0.16	0.005**	Baseline (intercept)

Source: Field data (2024)

H_2: Households experiencing human-wildlife interactions are significantly more likely to perceive conservation-related conflict in Makao Wildlife Management Area.

The logistic regression analysis between human-wildlife interactions and reported conflict shows a strong statistically significant relationship between wildlife-related damages and community conflict perceptions (Table 4). The model explained 47% of the variance in reported conflict (Nagelkerke $R^2 = 0.47$), a relatively high explanatory power for social-ecological studies, and the Hosmer–Lemeshow test ($p = 0.74$) confirmed a good model fit.

The most important factor affecting conflict among the predictors was human injury or death from wildlife ($B = 1.872$, $p = 0.001$). The second strongest predictor was crop damage by wildlife ($B = 1.634$, $p = 0.002$), with affected households being 5.1 times more likely to report conflict. Livestock predation was also significant ($B = 1.230$, $p = 0.013$), increasing the odds of conflict reporting by 3.4 times.

Table 4: Types of human-wildlife Conflict

Independent Variable	B (Coefficient)	S.E.	Exp(B) (Odds Ratio)	p-value	Interpretation
Crop damage by wildlife	1.634	0.512	5.12	0.002**	Strong predictor: 5.1x more likely to report conflict
Livestock predation	1.230	0.487	3.42	0.013*	Significant predictor: 3.4x more likely to report conflict
Human injury or death from wildlife	1.872	0.599	6.50	0.001**	Highest impact: 6.5x more likely to report conflict
Constant	-2.052	0.661	0.13	0.003**	Baseline probability of conflict (when all predictors = 0)

Source: Field data (2024)

H_3: *Socio-demographic factors significantly influence the likelihood of experiencing or perceiving resource-use conflict.*

There was a substantial relationship between household attributes and conflict experiences (Table 5). The model accounted for 44% of the conflict reporting variance through Nagelkerke $R^2 = 0.44$, while the Hosmer–Lemeshow test ($p = 0.66$) verified an excellent model fit. Distance from the WMA boundary emerged as the most significant predictor of conflict occurrence ($B = 1.370$, $p = 0.004$). Households within 3 km of the WMA experienced 3.9 times more conflict incidents than households farther away. Household size significantly contributed to conflict reporting ($B = 0.267$, $p = 0.018$), and each additional household member raised the odds of reporting conflict by 31%. Economic activities played an important role in determining the level of conflict experiences. Households engaged in farming and livestock activities experienced 2.6 times higher conflict rates than households focused on one livelihood type ($B = 0.965$, $p = 0.016$). Education level emerged as a surprising factor because it showed an opposite pattern to conflict reporting ($B = –0.853$, $p = 0.046$). Households with secondary or tertiary education reported conflict at 57% lower rates.

Table 5: Socio-demographic factors influencing conflict

Independent Variable	B (Coefficient)	S.E.	Exp(B) (Odds Ratio)	p-value	Interpretation
Education level (Secondary/Tertiary)	-0.853	0.429	0.43	0.046*	Higher education reduces the likelihood of reporting conflict.
Household size (per additional member)	0.267	0.112	1.31	0.018*	Larger households are more likely to report conflict.
Economic activity (Mixed livelihood)	0.965	0.401	2.63	0.016*	Mixed livelihood households are 2.6x more likely to report conflict.
Distance from WMA (<3 km)	1.370	0.485	3.94	0.004**	Households near the WMA are almost 4x more likely to report conflict.

Independent Variable	B (Coefficient)	S.E.	Exp(B) (Odds Ratio)	p-value	Interpretation
Constant	-1.752	0.597	0.17	0.003**	Baseline probability (when all predictors are zero)

Source: Field data (2024)

Perspectives from qualitative data

Resource access conflict

All study villages indicate that WMA establishment led to land access restrictions, which broke down the traditional ways people used resources. Respondents from Makao and Mwabagimu communities stated that their traditional communal grazing lands were transformed into wildlife reserves. One herder during the focus group Discussion noted that, "*Our cattle used to move freely without any restrictions before the WMA was established. The rangers now force us to leave, claiming that the grass area belongs to wildlife. But our cattle also need grass"*. The farmers of Jinamo villages explained that WMA have restricted their ability to expand their farms because they are restricted from using previously cultivated areas converted to WMA. A woman farmer in Jinamo noted during a focus group discussion. *"We are told not to cultivate near the boundary, but where should we go? The available land does not provide enough space for our expanding family sizes"*

Existence of Conflicts

All villages showed consistent reports involving wildlife leading to repeated damage of crops, livestock and periodic attacks on humans. Farmers experience regular animal attacks, which include elephants, baboons and wild pigs, that cause substantial damage to their crops. The farmer from Makao noted "*We stay overnight in farms guarding and chasing elephants". Livestock predation came out as one of the conflicts.* Focus group discussions between herders in Sapa and Mwabagimu communities highlighted livestock predation. A local herder from Sapa shared this experience: "*Our cattle are killed with no compensation, we are told to protect wildlife, but who protects our cattle*?" This shows that the local community consider institutional protection to be unjust.

Socio-demographic influences

Access to information, livelihood type, family size and WMA proximity influenced levels of conflict exposure and varying perceptions about conservation governance fairness. Education level emerged as the primary factor as participants who had only informal education linked the WMA to land loss and restricted livelihoods. Family size was also mentioned as one respondent noted, *"A big family requires additional food supplies and more land for cultivation, but farming more will result in invading the WMA"*

Discussion

Resource Access Conflict

Restricted access to grazing areas is most likely to increase conflict with conservation authorities as it threatens household survival. Lyakurwa et al (2024) reached a similar conclusion in Mkomazi National Park. Bluwstein & Lund (2015) in Burunge Wildlife Management Area, show how a village split into two parts lost its historical dry-season grazing land after a safari investor and WMA-associated entity took complete control of the area. The grazing ban forced herders to break conservation rules by entering the protected zone, which resulted in increased predator attacks and penalties that intensified conflicts with wildlife. Salerno et al. (2016) found that households near protected areas faced more wildlife encounters and worse food security. The prohibition of grazing access made wildlife damage more expensive for residents, which created a direct link between restricted access and increased human-wildlife conflict. However, in Namibia, the implementation of local zoning plans and compensation schemes led to decreased wildlife damage and better human-wildlife relations because controlled grazing access combined with community benefits and local control reduced conflict (WWF, 2028). Similarly, Mnyawami (2020) indicates that Village Land Use Plans in Ikona WMA brought clarity to grazing and wildlife zones, which resulted in decreased spatial overlap by 40 -49% of reported conflicts. The findings from this study show that wildlife-focused policies in Tanzania created institutional barriers which generated opposition toward conservation programs.

Limited firewood access led to a substantial increase in conflict risk despite being the primary household energy source in the study area. This was because mostly local communities use firewood for energy, and restrictions create immediate and obvious challenges affecting women and children who perform firewood collection duties. This implies that resource-related conflicts reflect gendered inequalities and uneven labor distribution. Kaswamila (2009) indicated that restricted firewood collection in villages around Tarangire–Manyara ecosystems led women and children to enter the forest illegally to obtain firewood and other products, which increased wildlife encounters. This shows how limited access to survival resources leads to more human-wildlife conflicts and negative feelings toward park authorities. Similarly, Mekonen (2020) in Ethiopia shows how people encounter wildlife during firewood gathering, which follows patterns found throughout East Africa. Mekonen (2020) establishes direct links between wood-fuel extraction and resource exploration activities, which result in elevated HWC occurrences when forest access becomes limited. Therefore, denying firewood access forces communities to bear additional costs, creating household tension and community-wide anger toward WMAs. Research conducted in Uganda by Nakaawa et al. (2015) indicates that governance structures determine conflict outcomes instead of actual restrictions on access because implementation of co-management reduced illegal forest entry, dangerous wildlife encounters and strengthened their cooperative relationships. The research supports the use of managed firewood, clear zoning and contractual agreements to eliminate or reverse the expected conflict that results from resource limitations.

Households with limited access to cultivation land experienced conflict. Findings resonate with the study conducted in Makao Wildlife Management Area, which found that 85.4% of participants faced restricted access to agricultural land, which they linked to rising conflicts over resource usage (Lwankomezi et al., 2021). Findings in East Africa affirm that restricted farmland access near protected areas often correlates with heightened conflict, because limits on cultivation directly threaten household

food security and livelihoods (e.g., Lwankomezi 2021; Saruni et al. 2018; Vedeld et al. 2012). However, a robust counter-theme in the literature shows that restriction per se is not determinative: when restrictions are introduced within participatory, transparent governance frameworks that provide zoning, negotiated access, compensation, or benefits, they can reduce spatial overlap with wildlife and lower conflict (e.g., Mnyawami 2020; Nakakaawa et al. 2015; WWF 2018). The broader theoretical insight (Lund et al., 2006) is that governance quality and tenure legitimacy mediate whether farmland restrictions produce resistance or cooperation**.** Lund et al. (2006), in their review of African land rights and land conflicts, show that farmland restrictions do not result in disputes because the outcome depends on governance systems, clear land ownership and local community acceptance. The authors warn against making basic assumptions about direct cause-and-effect relationships.

Local food security depends on subsistence agriculture. This indicates that cultivation restrictions result in immediate livelihood insecurity for local communities because local food security depends on subsistence agriculture. Research by Vedeld et al (2012) in Mikumi National Park showed that farm size reduction and restricted access to land lead to major harvest reductions, which makes households more susceptible to hunger while they must resort to dangerous and unlawful farming methods. Saruni et al. (2018) in Kilosa and Kiteto indicate that limited arable land creates more competition among farmers, who then encounter wildlife more frequently in their conservation boundary areas, which results in destructive encounters. The result creates a self-reinforcing cycle where land conversion leads to economic instability, which drives people to use resources in ways that create conflicts. The reduction of available land through conservation measures, which fail to provide new sources of income or compensation, leads local communities to view these actions as direct attacks on their right to subsist. The study supports the theory that conservation area conflicts originate from fundamental livelihood restrictions rather than misunderstandings about conservation goals.

The study shows that water access restrictions create higher conflict probabilities, but the results failed to reach statistical significance at the 5% level. Water availability depends on additional variables, including seasonal patterns, NGO programs, and alternative water sources beyond WMA management. The positive relationship between water scarcity and conflict potential shows that inadequate water access remains an active threat which could grow stronger under deteriorating climate conditions. Water scarcity does not automatically lead to conflict, for example. Studies conducted in Ghana (Asamoah, 2025), Guinea-Bissau (Silveira, 2024), Tanzania (Mnyawami, 2020) and South Africa (Matimolane & Mathivha, 2025) demonstrate that water scarcity does not always produce direct conflicts between groups. The research indicates that water scarcity will not lead to disputes when governance systems include all stakeholders and water management institutions operate well. The institutional and social factors which act as mediators between water scarcity and conflict determine whether water stress will trigger social unrest. The research shows that water scarcity functions as a significant risk factor for conflict, but its ability to create conflict depends on how well governance systems function and how resilient communities are.

Therefore, resource access inequalities create the material foundation for conflicts to emerge. WMAs aim to link conservation and development, but their resource access restructuring prioritizes biodiversity needs over rural subsistence requirements. The substantial influence of grazing, cultivation, and firewood access on conflict development supports the argument that conservation governance becomes illegitimate when it ignores basic livelihood requirements.

Human-wildlife conflict

Human injury or death combined with crop damage and livestock predation resulted in a significant increase in conflict reporting in households with odds ratios measuring 6.5, 5.1 and 3.4, respectively. This implies that wildlife is an immediate threat to human security and livelihoods, thus influencing negative community views about conservation efforts. Multiple studies prove that wildlife creates an urgent danger to human safety and economic stability throughout various protected areas, which depend on farming and pastoral activities. Research conducted in Serengeti and Kibale, and other conservation areas, demonstrates that wildlife attacks on crops and livestock and human injuries directly cause food shortages, financial damage and fear among local populations (Kideghesho et al., 2016). The combination of financial losses and emotional distress leads people to hate wildlife and conservation organizations which results in dangerous actions against protected animals and conservation staff. The combination of economic instability and personal threats from wildlife in these areas creates negative views about conservation since people believe it favors animals over human survival needs.

Research exists which warns against making general connections between wildlife threats and negative conservation perspectives. Research conducted in Uganda and Tanzania and across global CBNRM programs demonstrates that communities develop more positive attitudes toward conservation when they receive direct financial benefits through revenue sharing and employment opportunities, and regulated access and compensation programs (Nyhus, 2016; Salerno et al., 2015; Nakakaawa et al., 2015). This research indicates that wildlife presence does not automatically lead to negative conservation attitudes because public opinions depend on how well institutions govern wildlife areas and how fairly they distribute benefits. The way people view wildlife as either a threat or an asset depends on how well conservation institutions establish equitable relationships between humans and wildlife.

The incident of human injury or death from wildlife made the perception of conflict six times more probable for affected households. This result highlights the existential dimension of conservation conflict: when human lives are directly endangered, conservation institutions are often viewed as prioritizing wildlife over human safety. Kolinski & Milich (2021) argue that such experiences create deep emotional and political resentment, transforming wildlife into a symbol of injustice and state neglect. Households that experienced crop damage from wildlife were five times more likely to report conflicts with local authorities. The repeated wildlife attacks on crops and livestock fields in Makao's subsistence-based agricultural areas indicate a systematic removal of human needs to protect wildlife, which goes beyond economic loss to represent a fundamental threat to human security. Households face increased resentment because they must bear the loss of expenses without any institutional backing. These findings

resonate with Galley & Anthony (2024), who argue that uncompensated crop raiding is the most apparent and politicized conflict from conservation practices.

Households consider wildlife crop raids by elephants, wild pigs, and baboons to be directly threatening their food security and income. Repeated losses that are not addressed intensify the grievances because households feel that conservation governance lacks responsiveness and is unfair. The damage is not limited to material losses but also carries symbolic weight, strengthening local perceptions that conservation benefits outside entities (e.g., tourists, the state) at the expense of local costs. The impact of livestock predation on conflict reporting proved significant because affected households experienced a 3.4 times higher likelihood of perceiving disputes. In agro-pastoral societies, livestock is not merely an economic asset but also a cultural symbol of wealth, social status, and security. The loss of livestock to predators creates dual adverse effects, including economic loss of power and cultural destruction.

Research findings from conservation and pastoralist studies demonstrate that livestock predation results in financial damage and cultural deterioration. The Maasai and Barabaig pastoral communities use their cattle to generate economic value, to perform rituals, to demonstrate male strength and to maintain family honor and social standing. The loss of livestock to predators results in two types of damage for households because it destroys their economic resources and their cultural heritage, which includes their social status and family traditions (Goldman 2011). The combination of economic and cultural damage against conservation organizations leads to increased hostility and retaliatory behavior. Research shows that livestock predation creates more than financial problems because it inflicts cultural damage, which disrupts family dynamics and community unity.

Research indicates that the connection between livestock loss and cultural identity does not exist as a natural or automatic process. The cultural identity of East African pastoralists has shown adaptability because they use their community networks to handle losses through payment systems and multiple income streams (Salerno et al. 2015). The connection between livestock loss and cultural collapse remains weak for certain groups because they preserve traditional practices that reduce their vulnerability to predators. The combination of tourism revenue and grazing permission agreements in community-based conservation areas creates economic benefits which minimize the negative impact of predation on local communities (Nyhus 2016). The impact of livestock loss on economic stability and cultural heritage depends on how well institutions manage compensation programs, support adaptive farming practices and maintain cultural strength. The failure to prevent or compensate for wildlife predation leads carnivores to become unjust symbols, which intensifies conservation institution hostility. These research findings demonstrate that wildlife-based conflicts stem from material damages and survival threats that surpass basic community understanding of conservation objectives. The research supports the notion that human–wildlife contact is essential to conservation conflict, whereas biodiversity protection stands against human survival needs (Tshewang et al., 2021).

Socio-demographic Influences

Educational background, family size, earning source and WMA proximity influenced conflict dynamics, demonstrating both social inequality and territorial injustice. The WMA boundary proximity proved to be the most influential variable. Households within 3km of the WMA had a conflict reporting probability approximately four times higher than distant households. The conservation costs mainly affect households living near the WMA since they face the combined risks of crop losses, livestock predation, and limited resource access. The findings are supported by Matejcek and Verne (2021), who argue that protected areas create unbalanced risk distributions that benefit distant actors (conservation agencies and tourists) at the expense of heightened vulnerability for households near conservation boundaries.

Multiple studies have proven that protected areas create a direct link between their surrounding space and the occurrence of high conflict rates. Research conducted in East Africa and Asia shows that residents who live between 1 and 3 kilometres from protected area borders experience repeated wildlife intrusions which damage their crops, kill their livestock and damage their properties (Salerno et al., 2015). The risk of wildlife encounters decreases dramatically when people move farther away from protected area borders, especially in areas where wildlife travels through defined migration paths (Kideghesho et al., 2016). The research findings confirm that the Makao WMA data show households near the 3 km boundary experience conflict at four times the rate of other areas. The evidence proves that wildlife creates its most significant pressure on areas where human activities meet wildlife migration paths.

Research indicates that protected areas face different levels of conflict because distance alone does not determine the extent of conflict beyond the 3 km boundary (Treves & Naughton-Treves, 2005). The movement of species, including elephants, buffalo, and baboons, through their habitat creates damage that extends (Nyhus, 2016). The distance between protected areas and households does not determine their level of damage because certain landscapes develop conditions that lead to equal or higher losses for distant residents. Therefore, conflict results from multiple environmental and geographical elements and institutional controls, which makes the distance-conflict link strong but not applicable to all situations. The implementation of effective mitigation strategies demands a combination of spatial planning with land-use management and wildlife monitoring, and community governance, instead of using buffer-zone distance as the sole predictor.

An increase of one person in each household raised the probability of conflict by 31%. This implies that large family units needed extra food resources, land, and fuelwood supply, making them highly susceptible to natural resource limitations and wildlife attacks. The results show that people experience conservation conflicts differently because demographic factors influence their exposure. Households with many dependents experience severe resource deprivation that drives them to fight against conservation institutions. Gandiwa et al. (2013) in Zimbabwe found that household size determined exposure to wildlife because they owned bigger farms with multiple livestock, making them more vulnerable to predator attacks. In a study by Megaze et al. (2017) in Ethiopia, household size proved to be a key factor determining human-wildlife conflict because bigger households owned more agricultural land and food storage, which drew baboons and

warthogs. Mkonyi et al. (2017), using logistic regression, revealed that household size is directly linked to conflict occurrence because households with more herders become more exposed to attacks on their livestock predator.

On the other hand, Treves et al. (2011) found that some communities experienced less conflict between family members because their big households worked together to protect their fields and animals, which resulted in fewer losses. Salerno et al. (2015) found that household size did not affect their human-wildlife conflict predictions. The models showed that wealth status and grazing location were more important than the total number of people in a household.

Similarly, varied income sources from different livelihood activities do not make households less prone to conflicts. The conflict rate was 2.6 times higher among households that combined farming with livestock than those that focused on one activity. These households experience dual exposure to wildlife damage of their crops and livestock because they also face limitations on livestock grazing. The dual exposure effect reveals how diversification strategies lead to increased exposure to conservation-related threats, which contradicts the prevailing policy assumption about diversification benefits. Higher educational levels among households decreased their chances of conflict involvement. Better education leads to improved household experiences regarding dispute perception and experience because it enables people to develop alternative income sources while learning about institutions and becoming more adaptable. Findings are similar to those of Gandiwa et al. (2013); the educational process taught people about government payment systems and wildlife protection regulations, which reduced their chances of getting attacked by predators because they stayed away from dangerous areas. This narration was opposed by Dickman (2010), who argued that the reduction of retaliatory killings and conflict involvement through education remained inconsistent because cultural identity, economic vulnerability, and loss severity proved more potent than formal education.

Households with multiple income streams become exposed to two types of threats because they experience crop destruction while facing restrictions on their livestock operations. The typical policy assumption that diversification strengthens resilience proves wrong in conservation areas because mixed-livelihood households become more vulnerable to different risks. The current study demonstrates that conservation governance requires livelihood sensitivity because different economic approaches produce unique and intensified risks. Evidence has shown that conservation advantages benefit well-educated and socially prominent people who use their power to control access to benefits, thus increasing social disparities between community members.

Policy and governance implications

The research findings show that Tanzania encounters various obstacles when implementing Wildlife Management Areas (WMAs) because of its policy and governance systems. The research shows how conservation goals conflict with local economic activities, yet WMAs have established platforms which support community involvement and wildlife defence and local financial development, thus showing better results than the previous centralized conservation system (Kideghesho et al., 2016). The WMA policy framework shows promise to establish an operational system which merges conservation programs with rural development initiatives when executed properly. The WMA approach has given local communities the power to manage wildlife through Authorized Association structures, which enable their participation in wildlife governance. The WMA presence in Makao led to better patrol coverage, decreased illegal hunting activities and better conservation value understanding among residents. URT (2012) and Bluwstein et al. (2015) have shown similar results in other areas that WMAs have developed through their local participation systems and tourism-based economic development and resource authorization programs. The governance innovations demonstrate that community-based conservation achieves both ecological integrity and rural empowerment through the availability of policy support.

The research shows WMAs produce positive results which spread across different areas, but local support decreases when people feel the decision-making process and resource distribution are unfair. The power differences between local communities, conservation agencies and private investors persist after official devolution has occurred (Nakakaawa, et al., 2015). The Makao resource access disputes and human-wildlife conflicts demonstrate "partial devolution" because communities maintain official resource control, yet their ability to manage resources effectively remains restricted (Noe et al.,2017). The research findings show that policymakers should improve local government operational capacity and create effective systems for WMA management. The policies need to develop detailed rules for distributing benefits and ensure local communities maintain decision-making authority, and provide training for village natural resource committees to manage funds and negotiate agreements effectively. Strengthening governance transparency would improve accountability and reinforce local trust in conservation institutions.

The research supports the need for adaptive co-management systems because policy frameworks need to understand how ecological systems interact with social realities (Berkes, 2009). Community participation in monitoring, zoning and wildlife management decisions would lead to WMAs that fulfil local requirements while maintaining environmental sustainability. The implementation of compensation and incentive systems through policy will help minimize wildlife damage costs and decrease public opposition to conservation regulations. The Makao case shows that WMA policy frameworks enable wildlife-human coexistence through proper governance systems, inclusive participation and social oversight. The positive institutional innovations of WMAs, including local empowerment and conservation awareness, need to be built upon through governance reforms which tackle ongoing power imbalances and unequal benefit sharing. The future success of WMAs requires moving away from current nominal participation to establish actual co-ownership structures, which will grant communities full decision-making power and complete access to wildlife management resources.

Conclusion

The research investigated community-based conservation establishments in Tanzania by assessing drivers of resource-use conflict in Makao Wildlife Management Area. The study confirms that limited resource access and human–wildlife interactions significantly predict conflict occurrence in Makao Wildlife Management Area. Socio-demographic factors, especially

proximity to WMA and household size, intensify these conflicts. Addressing these issues requires participatory governance and equitable benefit-sharing mechanisms. Because the reduction of conflict risk requires better decision-making participation, clearer resource access rules and improved wildlife damage management systems. The governance system needs to enhance its transparency and accountability to build trust with local communities, which will lead to better human-wildlife coexistence. The study had limitations that need to be recognized. The study's cross-sectional design prevents researchers from establishing cause-and-effect relationships, and the single WMA focus prevents researchers from concluding about Tanzania or similar conservation areas. The study depends on self-reported conflict data, which might contain errors because people remember events differently or view situations differently. Further research should use longitudinal methods to study conflict patterns while collecting wildlife movement data and performing multiple WMA studies to validate these conflict predictors. We therefore recommend the following: Strengthen community participation in WMA decision-making and benefit-sharing, develop compensation or insurance mechanisms for wildlife damage, and integrate livelihood diversification and gender-sensitive energy alternatives (e.g., efficient stoves).

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Data sharing does not apply to this article, as no new data were created or analyzed in this study.

Authorship Contribution Statement

Emmanuel Lwankomezi: Conceptualization, writing – original draft, Methodology, Writing- Reviewing and Editing, Writing and checking references.

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