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Illegal Activities for Survival: Understanding the Influence of Household Livelihood Security on Biodiversity Conservation in Tanzania

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Abstract: Illegal access of resources within protected areas to meet basic needs plays a significant role in the interaction between individuals, protected areas, and neighboring communities in Africa. However, our understanding of how household livelihoods are linked to this type of illegal access at a household level is limited. Additionally, research on poaching tends to focus on commercial poaching and wildlife trafficking. This study addresses this gap by examining the complex relationship between three types of livelihood security (i.e., food security, financial security, and educational security) and the likelihood of participating in illegal activities in communities surrounding Tanzania's Mkomazi National Park. To gather data, we surveyed 267 heads of household in 8 villages that were randomly selected out of the 22 villages that border Mkomazi National Park. Structural modeling analysis was used to analyze the data. Our findings indicate that food security is the primary driver of engagement in illegal activities within the park; education security and financial security have limited influence on the likelihood of subsistence poaching when accounting for food security. Interestingly, we observed a correlation between financial security and increased illegal grazing, which can be attributed to individuals with greater financial means purchasing more cattle and thereby increasing the demand for fodder. Addressing food security should be prioritized in efforts to mitigate subsistence poaching within protected areas. Our research highlights the importance of developing sustainable alternatives to ensure food security and meet other essential needs in communities adjacent to Mkomazi National Park. By striking a balance between improving livelihoods and fostering conservation efforts, conservation and development organizations can work towards a sustainable future for both protected areas and people.

Keywords: livelihoods; subsistence poaching; biodiversity; protected areas; wildlife crime

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1. Introduction

The concept and the practice of establishing national parks and protected areas have different histories. However, the most formal designation can be traced back to the establishment of Yellowstone National Park in 1872 [1]. Since then, there has been increasing development of global initiatives, policies, and strategies for conservation using the protected areas model [2]. Global and individual countries' governments have sought to improve human well-being by making policies that promote sustainable development approaches [3,4]. These approaches include improved education, health, and environmental quality to incentivize biodiversity conservation [5]. Efforts in protected areas (PAs) are expected to move beyond conservation, however. They are also expected to improve the well-being of those communities adjacent to conservation areas by delivering social and economic benefits [6–8].

Numerous studies have demonstrated the connection between household livelihood and the natural environment [8–10]. The resources that the environment provides enhance human well-being and consequently overall human welfare [8,10,11]. Research suggests that this connection is especially vital in developing nations, where people are heavily reliant on natural resources for sustenance [12,13]. This reliance on natural resources underscores the importance of aligning biodiversity preservation efforts with the pursuit of human well-being. Natural resources are central to the livelihood strategies of poor communities [14]. Bush meat, traditional medicines, firewood, fish, and timber are resources essential to the livelihood of most poor people living in rich biodiversity areas [14,15]. This link between poverty and dependence on biodiversity produces a tradeoff between community livelihood needs and biodiversity conservation in which humans are perceived as a threat to biodiversity protection.

Protecting PAs from external threats may foreclose certain human activities and potentially negatively affect human well-being. In response to these limitations, communities often resort to illegally accessing and using resources within PAs, believing that these areas were theirs long before they were designated as protected. Historical data on the establishment of PAs in the United States and East Africa, among other places, indicates that these PAs were established through the eviction and prosecution of local communities by colonial powers and governments [16,17].

While the importance of integrating benefit sharing and community participation into wildlife management has been acknowledged [18,19], there is a lack of empirical evidence explaining how rural communities perceive the connection between protecting natural resources and achieving sustainable livelihoods. In Tanzania, research on community conservation has primarily focused on community involvement [20,21], integrated conservation and development projects [22], human–wildlife interactions [23], household livelihoods in wildlife management areas [24,25], and the contribution of ecotourism to household livelihoods [26]. It has largely overlooked the connection between livelihoods and community participation in illegal activities in Tanzania's national parks and the impacts of PAs on livelihoods [27–29]. As exceptions to this rule, Abukari and Mwalyosi [27] highlight the importance of understanding and addressing local communities' perceptions of PAs with regards to their overall impact on livelihoods and community development, while Knapp et al. [28] emphasize the connection between illegal hunting activities and socioeconomic status. Given the historical establishment of the parks and the significant reliance of local people on natural resources, the interaction between people and parks is an important factor in conservation that merits further investigation.

The primary objective of this research is to understand the influence of household livelihood security on illegal activities in Mkomazi National Park, specifically focusing on (a) the influence of food security on illegal activities, (b) the influence of education security on illegal activities, and (c) the influence of financial security. A better understanding of these influences will help to inform the park management about future conservation and community development needs and priorities.

2. Conceptual Framework

Illegal activities in developing countries' national parks have been found to be closely associated with poverty [28,30]. However, the psychology behind poaching, including the factors that motivate it, remains underexplored [31–33]. To address the link between perception of objective well-being and illegal activities, we propose adopting a household livelihood security (HLS) framework [34]. This framework emphasizes the importance of livelihood security, or sufficient and sustainable access to resources and income to meet basic needs [34,35]. These needs include access to food, clean water, healthcare facilities, educational opportunities, housing, time for community participation, and social integration [34,35]. Households can be deemed secure when they possess secure ownership of resources, as well as access to income and income-generating activities. This includes

having reserves and assets to mitigate risks, cope with unexpected events, and handle unforeseen circumstances.

The household livelihood security framework offers insight into the complex needs of families and communities [36]. Within the context of East Africa, for instance, the framework has been used to assess the livelihood impacts of community-based wildlife conservation programs and to study tourism's influence on capital assets, household resiliency, and subjective well-being in park-adjacent communities [37,38]. Expanding the application of this framework to examine the involvement of households or communities in illegal activities can help reveal the motivations behind such behavior in PAs. The framework's main components include financial security, food security, health security, education security, and empowerment. The components are measured using various indicators that are determined through rural participatory approaches [39]. At the household level, these components are measured by considering households' access to administration of assets; involvement in production and other income-generating endeavors; consumption and trade; and participation in livelihood activities [34,40,41]. The model emphasizes the actions, perceptions, and choices of households that aim to sustain their living conditions and prioritize their needs [42]. It is based on the principles of human capability, access to assets, and the presence of economic activity [36]. The interactions between humans, wildlife, and wildlife management have both positive and negative impacts on household livelihood resources, community relationships with conservation institutions, and livelihood strategies, including farm and non-farm employment opportunities [43,44]. These impacts are felt in households' livelihood security, including food security, financial security, and education security. Human–wildlife conflicts, for example, contribute to household vulnerability, as households struggle to achieve secure livelihoods in the face of external environmental factors such as crop and livestock losses due to predation, disease eruptions, changes in governance, floods, and earthquakes [45].

The use of this framework can inform conservation activities in the PAs of developing countries. Communities living adjacent to PAs face costs such as loss of land and limited access to resources, which in turn limit their livelihood opportunities [46–50]. Livelihood security affects how the poor make decisions, weigh risks, and balance competing interests [48,51]. In their pursuit of resources necessary for their livelihoods, these communities often prioritize short-term benefits over longer-term conservation benefits and find themselves running up against conservation laws that label them poachers [52,53]. Enhancing their livelihood would make it possible to address the challenges faced by communities living adjacent to PAs and pro89mote sustainable conservation practices. In the context of the HLS framework, we examined the hypothesis that the perception of food livelihood insecurity among households in communities near Mkomazi National Park positively impacts their inclination to engage in illegal activities, considering their livelihood security.

3. Material and Methods

3.1. Study Site

The study was conducted in communities adjacent to Mkomazi National Park. Mkomazi National Park is a transboundary national park at the northern border of Tanzania, between Tanzania and Kenya (Figure 1). It is situated at latitude 4° 11′–4° 25′ South and longitude 37° 41′38° 45′ East and has an altitude between 230 and 1630 m above sea level [54]. Mkomazi's vegetation consists of Acacia-Commiphora bushlands, wooded grassland, open grassland, and dry montane forest [55]. The park is surrounded by 22 villages with a total of approximately 45,000 inhabitants and shares a border with Kenya, making it an important Tsavo-Mkomazi transfrontier conservation ecosystem. The major income activities in these communities are small-scale farming and livestock keeping. These communities have a history of eviction dating back to the 1950s that has influenced their perceptions of and relationship with the park [56]. Currently, Mkomazi National Park is under the jurisdiction of Tanzania's national park system, which restricts the consumptive utilization of wildlife resources. The historical presence of conflicting conservation activi-

ties, such as the eviction of indigenous people, illegal harvest of park resources, ecotourism, and community livelihood-based activities such as livestock keeping and small-scale farming, makes Mkomazi National Park and the adjacent communities ideal for research on the link between livelihood and illegal activities in PAs.

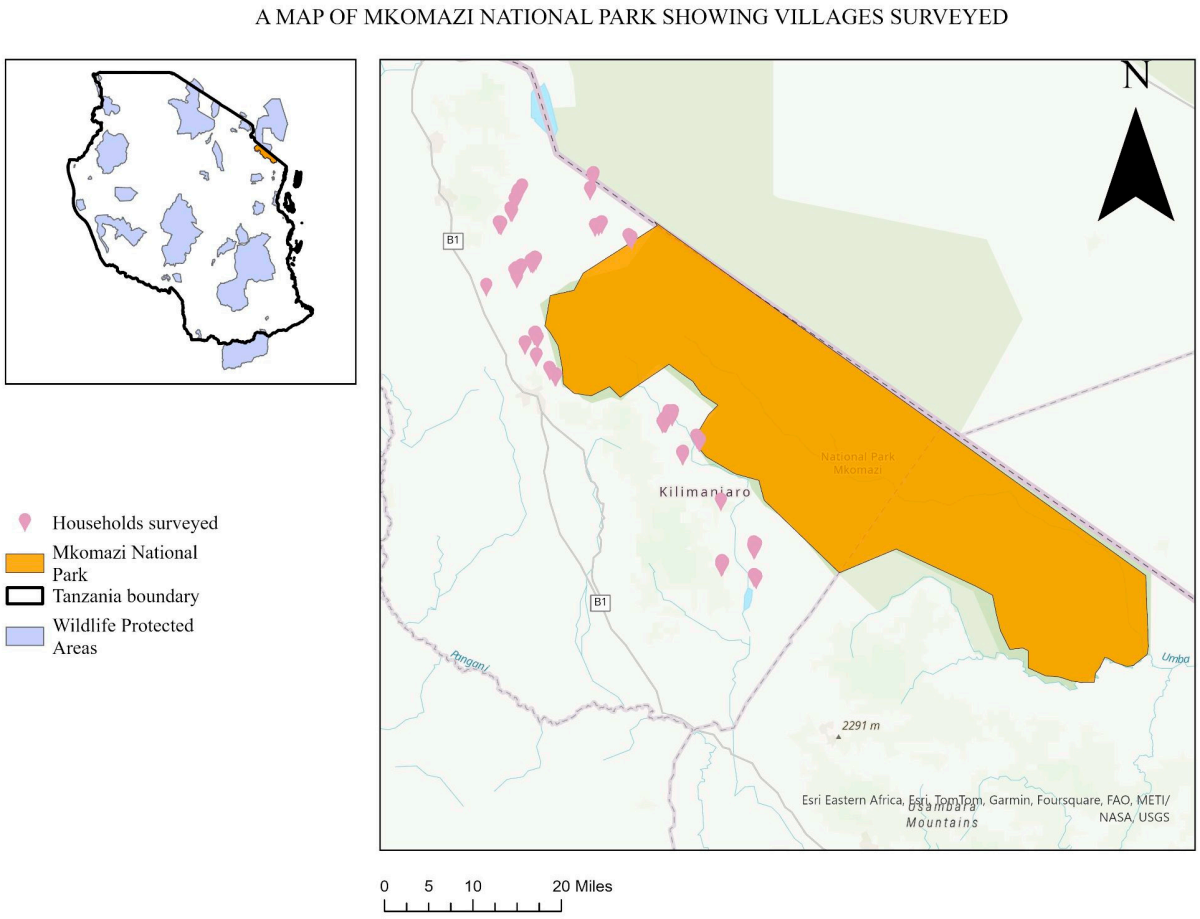


Figure 1. Map of the study areas indicating villages involved in the survey.

3.2. Data Collection

Research participants were randomly selected from village household registers by assigning household numbers and using computer-generated random numbers. Household heads representing the household as a single unit of analysis were recruited. The data were collected with the help of four survey enumerators who were all college graduates and were familiar with the research area. The survey enumerators were proficient in conducting household surveys based on previous experience. Before data collection began, a pre-test of the household survey questionnaire was conducted. Under the supervision of the lead researcher, each survey enumerator tested the questionnaire in the field. This process aimed to establish a common understanding of the meaning and purpose of each survey question. The survey enumerators underwent a week of training focused on conducting household surveys with the use of Open Data Kit (ODK)-enabled Android smartphones. Subsequently, the survey enumerators had the Kobo Collect app installed on their Android smartphones. Throughout the training, the survey enumerators practiced administering the questionnaire in the presence of the lead researcher to ensure clarity and consistency. The survey enumerators consisted of one woman and three men, all of whom were fluent in both Kiswahili and English. They were introduced to the households in the community by local leaders during the data collection. Given the diversity of local languages used in the study areas, the English questionnaire was not translated into Swahili. Instead, the lead researcher worked closely with the survey enumerators to ensure that they had a robust

and consistent understanding of the meaning and purpose of each question. This approach aimed to ensure that the enumerators sometimes translated the questions into Swahili if the interviewees could not understand the English version.

The lead researcher obtained research authorization from the Tanzania Commission for Science and Technology. All survey respondents were introduced to the project using a plain language statement. This statement explained the study and its aims and methods and included information about the interviewees' right to withdraw from the study prior to or at any time during the survey. Participation was voluntary. The questionnaire survey was administered in June 2023.

The questionnaire was comprised of seven sections. The first section covered household demographics, the second focused on household assets and income, and the third explored household productivity. The fourth and fifth sections addressed access to education and health, respectively. The sixth section examined household well-being indicators, while the last section inquired about human–wildlife conflicts and conflict mitigation.

3.3. Data Analysis

3.3.1. Data Screening

The data were analyzed using a structural equation modeling procedure (SEM) to quantify the relationship between household livelihoods (education, food, and financial securities) and the intent to participate in poaching and illegal grazing in Pas. A factor analysis was conducted to verify the quality of latent constructs used SEM. Prior to factor analysis, the data were tested for the coherence between variables using the Kaiser–Meyer–Olkin (KMO) test. The overall (KMO) value of 0.80 was considered satisfactory for performing factor analysis. The intercorrelation between variables was also tested using Bartlett's sphericity test, which hypothesizes homogeneity of the variables' correlation matrix. The test produced a chi-square value of $\chi^2 = 5854.966$, with $df = 741$ and a p-value less than 0.0001 ($p < 0.0001$). This result shows that the correlation matrix is not an identity matrix and suggests that there are correlations between our variables and that the data are suitable for factor analysis.

To account for the lack of multivariate normality of the data, Mardia's test was conducted. The results indicated significant skewness of 567.7623, $p < 0.001$, and kurtosis of 2059.4250, $p < 0.001$, suggesting the data do not follow a multivariate normal distribution. To account for this lack of multivariate normality, robust common factor analysis was applied for the exploratory factor analysis [57]. All analyses were performed using the Lavaan Package in R [58].

3.3.2. Exploratory Data Analysis

Exploratory data analysis was chosen instead of PCA because the goal was to identify a latent factor structure [59]. We used an iterated robust principal axis extraction method with initial communalities estimated by squared multiple correlations because this method is more tolerant of non-normality and can recover weak factors [60]. We applied parallel analysis and screen plots to determine the appropriate number of factors to retain [61]. We also considered parsimony and theoretical convergence. We allowed no intercorrelation between factors, and so varimax rotation was applied [62].

3.3.3. Reliability Analysis

The reliability of the items used for the latent factors was assessed using Cronbach's alpha coefficient. The Cronbach's alpha values for latent constructs exceeding the cutoff of 0.7 were considered sufficient to demonstrate the questionnaire's reliability. Additionally, we used a minimum average variance extracted cutoff value of 0.35. In this way, we aimed to capture sufficient evidence of convergent validity for the sample size used [63,64].

3.3.4. Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was performed to validate the instruments and assess the alignment of the data with the hypothesized model [65]. CFA is a tool within SEM that specifically examines the relationships between observed measures or 'indicators' and latent variables or 'factors' in measurement models. In the analysis, the maximum likelihood robust estimator was used to account for non-normality and to handle multilevel analysis with unbalanced groups [66].

3.3.5. Structural Equation Modeling

The hypothesized relationships between each of the livelihood variables (food, education, and financial securities) with illegal activities were studied. The relationships were also analyzed by breaking illegal activities into their types (poaching and livestock grazing) to unmask any hidden relationship when these activities are indexed as an overall illegal activity. The indices used for estimating the goodness of fit of the model were the chi-square goodness of fit value <0.05, comparison fit index (CFI < 0.09), and root mean square (RMSA < 0.05), following [67,68]. Two models were evaluated: one with the illegal index as a single index against livelihood variables and the second with illegal activities broken into poaching and illegal grazing against livelihood variables

4. Results

4.1. Demographics of Respondents

We surveyed 267 households, with the household heads representing diverse ethnic groups. The surveyed communities consisted of approximately equal numbers of farmers (N = 143) and pastoralists (N = 110), also from diverse ethnic backgrounds. Farmers made up the majority, followed by pastoralists (Table 1). Interestingly, there were slightly more female-headed households surveyed than male-headed households. The average age of the surveyed heads of household was 49 years, and their annual income averaged USD 1115. Most heads of household (74%) had only completed primary education. The main crops grown in these communities were rice, maize, and beans.

Table 1. Demographic characteristics of the respondents (n = 267).

Variable		Number	Percentage, %
Gender			
	Female	137	51.30
	Male	130	48.70
Educational level			
	No formal education	51	19.10
	Primary education	198	74.10
	Secondary education	16	6.00
	University postgraduate	1	0.40
	Vocational education	1	0.40
Occupation			
	Farmer	143	53.6
	Pastoralist	110	41.2
	Business person	14	5.20

4.2. Measurement Model

4.2.1. Validity and Reliability

Through an exploratory factor analysis using common factor analysis, 27 out of the 37 items in the measurement instrument were retained (Tables 2 and 3). Items with a

recommended factor loading of less than 0.4 [69] and those with cross-loading of more than 0.3 on two or more items [64] were removed. This resulted in three dimensions of livelihood security, food security perception (FoSP), education security perception (ESP), and financial security perception (FinSP) (Table 1); and three dimensions of illegal activities, bush meat related poaching perception (BPP), socially motivated poaching perception (SMP), and illegal livestock grazing perception (ILGP) (Table 3).

Table 2. Three measures of livelihood security were predicted from responses to questionnaire items using exploratory factor analysis. Bolded factor loadings indicate those items that strongly contributed to the measure.

Items	Factor Loadings					
	1	**2**	**3**	**4**	**5**	**6**
Food security (FoSP)						
We eat our preferred food regularly	−0.14	0.16	0.74	−0.09	0.03	−0.05
We eat three meals a day regularly	−0.09	0.10	0.78	0.10	0.01	−0.10
We eat meat regularly	0.05	0.07	0.72	−0.04	0.08	−0.08
We eat fruits and vegetables regularly	0.00	0.22	0.69	0.07	0.07	−0.16
We use wood to cook food regularly	−0.20	0.00	0.30	0.04	−0.16	−0.12
We buy food to eat we cannot produce regularly	−0.07	0.01	0.31	−0.09	−0.34	0.03
Financial security (FinSP)						
We own enough land for agriculture	0.07	0.07	−0.19	0.02	0.56	−0.03
We own enough livestock	0.08	−0.08	−0.10	−0.05	0.54	0.00
We have access to loan and finance facilities	0.13	−0.05	0.03	0.02	0.50	0.06
We have the finances to deal with hardships	0.14	0.01	0.20	0.04	0.59	0.06
We have financial savings	0.09	−0.14	0.07	0.02	0.70	−0.05
We are satisfied with our current employment	−0.08	0.15	0.20	−0.07	0.57	−0.01
We can afford to buy clothing	−0.06	0.20	0.14	0.00	0.23	0.03
Educational security (EdSP)						
We have access to schools	−0.04	0.61	0.12	0.05	−0.07	0.05
We can afford to pay fees for primary education	−0.05	0.80	0.13	−0.02	−0.03	−0.02
We can afford to pay fees for secondary education	0.10	0.54	0.23	0.01	0.14	0.05
We can afford to buy scholastic materials	−0.06	0.95	0.04	−0.01	−0.08	−0.02
We can afford to buy student uniforms	−0.08	0.96	0.02	−0.03	−0.07	−0.01
We can afford to pay fees for university education	0.01	0.38	0.42	−0.08	0.22	−0.02
We can afford to buy clothing	−0.06	0.20	0.14	0.00	0.23	0.03

Note: N = 267. The extraction method was factor analysis with varimax rotation. The factor loading cutoff point was 0.3.

Table 3. Factor analysis of illegal activities in Mkomazi National Park. Questions in bold successfully load to latent constructs of the three types of illegal activities. Factors that load > 0.5 were selected for inclusion in the latent construct.

Item	Factor Loadings					
	1	**2**	**3**	**4**	**5**	**6**
Bush meat poaching (BPP)						
To get bush meat to eat	0.18	0.00	−0.08	0.23	−0.07	**0.75**
For bush meat to sell	0.12	0.02	−0.21	0.16	0.03	**0.85**
Get money for basic needs	0.12	0.06	−0.15	0.17	0.09	**0.89**
Socially motivated poaching (SMP)						
Because of social pressure	0.10	−0.03	0.07	0.69	−0.04	0.12
To exercise their indigenous rights	0.11	−0.03	−0.01	0.59	0.01	0.11
To collect hides, skins, and ornaments	0.17	0.09	−0.12	0.88	0.04	0.15
In retaliation for crop damage by wildlife	0.05	−0.02	0.02	0.86	0.02	0.09
Illegal grazing (ILGP)						
Because they lack pasture outside the park	0.89	0.08	−0.15	0.03	0.08	0.14
Because they lack water outside the park	0.86	0.08	−0.13	0.07	0.02	0.13
Because pasture areas are closer	0.72	−0.10	−0.01	0.12	0.00	0.06
Because it is expensive to keep cattle indoors	0.68	−0.05	−0.12	0.10	0.23	0.07
Because pasture in the park is available	0.90	0.03	−0.10	0.02	0.12	0.14
Because they value cattle over wildlife	0.59	−0.07	0.03	0.10	0.20	−0.07
Because I live near the park	0.56	−0.09	0.07	0.10	−0.03	0.04

Note: N = 267. The extraction method was factor analysis with varimax rotation. The factor loading cutoff point was 0.3.

4.2.2. Reliability Analysis

We tested the extent to which each questionnaire item measured the index of livelihood or illegal activities using Cronbach's alpha. We obtained higher alphas for all constructs except the financial security constructs, which showed lower values but were still within the acceptable range (Table 4) [70].

Table 4. Three measures of livelihood security (food security, financial security, and education security) and illegal activities (bush meat poaching, socially motivated poaching, and illegal grazing) were generated based on participants' responses to Likert-scale questions in the questionnaire. Each question was measured using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Measures were formed by grouping logically and highly correlated questions.

	Corr	**Alpha If Item Deleted**	**C. Alpha**
Food Security Index			0.84
We eat our preferred food regularly	0.74	0.80	
We eat three meals a day regularly	0.77	0.78	
We eat meat regularly	0.72	0.80	
We eat fruits and vegetables regularly	0.72	0.81	

Table 4. *Cont.*

	Corr	Alpha If Item Deleted	C. Alpha
Financial Security Index			0.71
We own enough land for agriculture	0.48	0.68	
We own enough livestock	0.52	0.66	
We have the finances to deal with hardships	0.61	0.66	
We have financial savings	0.71	0.63	
We are satisfied with our current employment	0.57	0.65	
Education Security Index			0.89
We have access to schools	0.72	0.88	
We can afford to pay fees for primary education	0.89	0.84	
We can afford to pay fees for secondary education	0.59	0.91	
We can afford to buy scholastic materials	0.90	0.85	
We can afford to buy student uniforms	0.90	0.84	
Bush Meat Poaching Index			0.91
To get bush meat to eat	0.79	0.91	
For bushmeat to sell	0.89	0.85	
Get money from sales of bush meat for basic needs	0.90	0.84	
Socially Motivated Poaching Index			0.85
Because of social pressure	0.71	0.82	
To exercise their indigenous rights	0.61	0.85	
To collect hides, skins, and ornaments	0.87	0.76	
In retaliation for crop damage by wildlife	0.83	0.78	
Illegal Grazing Index			0.91
Because they lack pasture sources outside the park	0.87	0.88	
Because they lack water outside the park.	0.85	0.88	
Because pasture areas in the park are closer to their homes	0.74	0.89	
Because it is expensive to keep cattle indoors	0.75	0.89	
Because pasture in the park is availablethroughout the year, while other areas are overgrazed or owned by farmers	0.91	0.87	
Because cattle are more important than wildlife	0.64	0.90	
Because I live near the park where water andpasture is available	0.58	0.91	

4.2.3. Confirmatory Factor Analysis

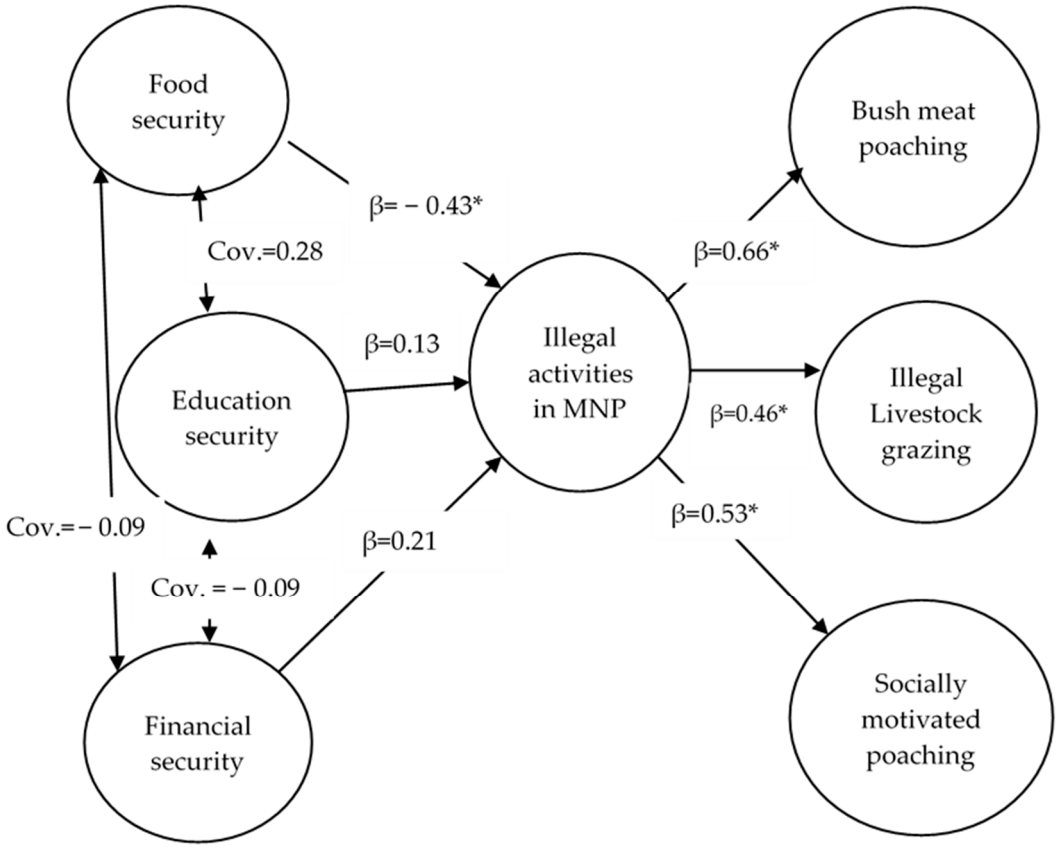
To improve the model fit (Table 5), we examined modification indices. Upon examination, we grouped the illegal livestock grazing questions into three items, averaging items with the highest and lowest loadings. Additionally, three items were correlated to improve the fit: "afford scholastic material" was correlated with "can afford to buy uniform", "access to school" was correlated with "afford to pay school fees", and "we own land for agriculture" was correlated with "we own livestock". Each correlation between latent factors was less than 0.9, suggesting sufficient discriminant validity between factors [64].

Table 5. The structural equation model with acceptable model fit measures. These measures demonstrate that the hypothesized model fits the data well.

Fit Index	Recommended Threshold	Model Output	Remark
P	$P \geq 0.05$	0.001	Accepted
CFI	$CFI \geq 0.90$	0.932	Accepted
TLI	$TLI \geq 0.90$	0.919	Accepted
RMSEA	$RMSEA \leq 0.08$	0.051	Accepted
SRMR	SRMR	0.066	Accepted

4.3. Structural Model

Our hypothesized structural model (Figure 2) demonstrating the three hypotheses of this study and the model fit statistics is shown in Table 6. This model produced two significant paths and explained 18.2% of the variations, and its model fit statistics are presented in Table 6. The paths are described in Sections 4.2.1 and 4.2.3. Table 6 presents the structural equation model with the regression of each illegal activity's variable against the three livelihood variables to unmask the impact of each total variability.



Note: * indicate significant results $p < 0.05$.

Figure 2. Hypothesized structural model showing factors influencing individuals' choices to participate in illegal activities. Food security is a significant factor. Note: β = standardized coefficients, Cov = covariances: CFI = 946, RMSEA = 0.051, χ^2 = 404.866 (240), p = 0.001.

Table 6. Food security is a key factor in influencing individuals' choices to participate in illegal activities, as seen in the relationship between illegal activities and earning a living in the vicinity of Mkomazi National Park.

Model	β	SE
Bush meat hunting		
Food security	−0.326 *	0.094
Education security	0.086	0.084
Financial security	0.081	0.079
Socially motivated hunting		
Food security	−0.170	0.099
Education security	0.112	0.099
Financial security	0.089	0.081
Illegal livestock grazing		
Food security	−0.189 *	0.102
Education security	−0.001	0.099
Financial security	0.246 *	0.073

Note: * indicate significant results $p < 0.05$.

4.4. Influence of Food Security on Illegal Activities in Mkomazi National Park

Food security is measured by how respondents perceive access and availability of food sources. Indicators of food security (Table 2) with standardized loading ranging from λ = 0.69 to 0.78 indicating the indicators used to measure the food security construct were highly correlated. The most important indicators were "we eat three meals a day regularly". This finding suggests that people are likely to go to national parks to poach in order to obtain three meals a day. Food security significantly predicted the likelihood of participating in illegal activities (β = 0.43 p = 0.001). This implies that, when considering education and financial security, food is the primary driver of poaching in Mkomazi National Park (Figure 2). Bush meat hunting was found to be the predominant type of illegal activity (β = 0.66, p = 0.01) and was significantly predicted by food security indicators.

4.5. Influence of Financial Security on Illegal Activities in Mkomazi National Park

The structural equation models reveal that, when considering food as a factor, the significance of financial security in determining the likelihood of engaging in illegal activities diminishes (Figure 2). Specifically, there is no significant relationship (β = 0.21) between financial security and illegal activities. This finding provides evidence that people engage in poaching primarily for food rather than for commercial purposes. Consequently, households that are relatively financially secure and able to purchase food are less likely to view poaching as a means of obtaining sustenance. However, when examining separate regressions (Table 6), financial security emerges as a significant determinant of illegal grazing (β = 246, p = 0.001). This positive relationship suggests that as household financial security increases, so does the likelihood of owning more cattle, which in turn increases the probability of participating in illegal grazing within the park.

4.6. Influence of Education Security on Illegal Activities in Mkomazi National Park

The finding suggests that education has the least impact on the likelihood of participating in illegal activities in the park (β = 0.13). When regressed with food and finance (Figure 2), as well as in separate regression analysis (Table 6), education is not a significant predictor of illegal activities. Additionally, there appears to be a positive relationship between education security and the likelihood of engaging in illegal activities, implying that if a household values education, it increases the likelihood of poaching. This trend might suggest that individuals may resort to poaching in order to fund their education.

5. Discussion

This study examined the relationship between livelihood security and intent to engage in illegal wildlife activities in communities adjacent to Mkomazi National Park, Tanzania. Our findings indicate that food security is the primary factor influencing households' intentions to participate in illegal activities within the park; education security and financial security have minimal impact on the likelihood of engaging in illegal activities. However, when illegal activities were considered by type (i.e., poaching and livestock grazing), illegal grazing of livestock was found to be significantly influenced by household financial security. The intention to engage in bush meat hunting is strongly correlated with food security, suggesting individuals resort to poaching as a means to obtain sustenance.

Human livelihoods play a crucial role in shaping the relationships between wildlife, parks, and communities located adjacent to national parks. When livelihood strategies are lacking, communities may resort to illegal means of survival. Numerous studies have emphasized the importance of conducting in-depth analyses of the link between poverty and illegal environmental behaviors [30,71]. In many developing countries, poverty levels in the communities living near national parks may explain increases in poaching motivation driven by food insecurity [72]. Recognizing that people's thoughts and actions are influenced by their well-being or lack thereof, it is imperative to investigate how improving household livelihoods can be leveraged to promote positive environmental behaviors.

5.1. Influence of Food Security on Illegal Activities in Mkomazi National Park

Household heads who have a positive perception of food security were found to be less likely to participate in illegal activities when considering factors such as education and financial security. One possible explanation for these findings is that individuals with limited resources are less capable of mitigating the negative impacts of free-roaming large wildlife mammals that damage crops and prey on livestock. This can lead to food insecurity in some households. Cultural preferences for bush meat and people's dependence on it as a source of protein may have also contributed to the results obtained in this study. Our results are consistent with those of a previous study conducted in [73], which examined the influence of food access on illegal forest use in Volcanoes National Park. While our study does not directly link poaching to food security, other researchers have found that wild foods, including bush meat, contribute to food security for billions of people in South Africa [74]. Local hunters in impoverished communities often hunt to meet their nutritional requirements and recognize the importance of bush meat as a source of protein [75–78]. However, when access to park resources is restricted in communities near PAs that aim to conserve biodiversity, the lack of alternatives can drive poor local people to poach.

There are various factors to consider in the debate surrounding the coexistence of humans and wildlife. One factor is the impact of wildlife on communities living near national parks. While these communities benefit from the income generated by wildlife-based tourism and employment opportunities at the parks, they also face challenges such as livestock depredation and crop raiding. These wildlife-related benefits and costs directly impact households' education, income, and food security [79]. Extensive literature has explored the relationship between crop raids, livestock predation, and livelihood strategies in communities adjacent to PAs, as well as the impact on income sources, social services, and welfare [30,80,81]. Some studies have highlighted the negative effects of human–wildlife interactions on household food security, particularly among communities living adjacent to PAs and conservation landscapes [44,82]. Restricted access and the negative impact on their livelihood strategies can lead households to adopt coping mechanisms, including poaching.

5.2. Influence of Financial Security on Illegal Activities in Mkomazi National Park

An interesting finding of this study is that heightened financial security perceptions increase the likelihood of illegal grazing. This is an indication of pastoralists' financial attachment to livestock. Studies indicate that among communities living close to national parks, pastoralists tend to be wealthier than farmers [83]. The opportunity to earn more

makes pasture and water availability for livestock important for pastoralists whose entire livelihoods depend on their animals. Pasture and water availability can also be a source of conflicts between communities and park administration. To pastoralists, livestock provides the means of living, including food and money for tuition and other uses. Our study challenges the findings of Matugwa et al. [84] and Nyahongo et al. [85] who found that pastoralists tend to avoid grazing in the park due to fear of being arrested. Households with secure income can potentially own more livestock and might be ready and willing to pay penalties if their livestock are caught grazing in national parks. According to the Wildlife Conservation Act of Tanzania, owners of cattle confiscated in national parks must pay a fee of 100,000 Tanzanian shillings, which is equivalent to USD 40, regardless of the number of cattle [86]. Previous studies have indicated that livestock owners apply cost–benefit analysis before deciding whether to graze starving cattle in a park during a dry spell; because they do not fear financial penalties, wealthier individuals are more likely to graze cattle in the park illegally [83]. Our study suggests that addressing poaching and livestock grazing in PAs might require different strategies.

Financial security could not predict bush meat poaching. This might be attributed to the culture and practices of communities adjacent to Mkomazi. Pare, the most populous community consumes bushmeat, but are not predominantly hunters compared to other tribes near national parks in Tanzania; whereas Maasai, the second most populous, do not eat bush meat. These tribal practices create a limited opportunity for bush meat trade. Other studies show that most illegal bush meat hunters live in households that are more financially secure than typical households in their communities [87]. People opt for bush meat to safeguard their livestock, making them financially secure despite the risk of others taking their livestock for protein. Researchers that interviewed illegal hunters in communities adjacent to Ruaha National Park in Tanzania [28] found that the driving forces of poaching are food and money.

5.3. Influence of Education Security on Illegal Activities in Mkomazi National Park

Education attainment among households can also influence communities' perceptions of conservation. While previous studies set in Tanzania such as Shoo and Songorwa [26] have shown a connection between education security and participation in illegal activities, our research did not find sufficient evidence to link education security and illegal activities. It is believed that households capable of paying for the education of their members serve as proxies for reducing poverty and illegal activities [87]. The relationship between educational constraints and poaching in Volcanoes National Park, Rwanda, is, like the analogous relationship in this study, often weak or absent [73]. The role of education might be interpreted differently by different communities. In the farming communities adjacent to Mkomazi National Park, education is highly valued as a means to improve livelihoods, and farmers have taken advantage of the free education provided by the Tanzania government to send their children to school. In contrast, the Maasai define wealth in terms of cattle ownership, and hence, family members, including children who are supposed to attend school, contribute to cattle rearing to increase family wealth [87,88]. The diverse interpretation of education security between farming communities like the Pare and Chagga and livestock-keeping communities such as the Maasai may have influenced our research findings. Therefore, future studies might seek to understand the influence of culture on the relationship between education and conservation.

6. Conclusions

This study investigated the impact of household perceptions of food, financial, and education security on intentions to participate in illegal activities among communities living adjacent to Mkomazi National Park, Tanzania. The findings revealed that addressing food security significantly decreases communities' intentions to participate in illegal activities within the national park. Households that felt secure in terms of food were less likely to participate in illegal activities within the park. This research, therefore, suggests that while

education and financial security play a role in promoting the coexistence of humans and wildlife, food security is the main driving force behind illegal activities in Mkomazi National Park. To achieve both conservation and community development objectives, government and conservation institutions must prioritize increasing food security. Mitigating activities that threaten livelihoods, such as crop raiding and livestock predation, is one of the initial measures to ensure household food security. While this study found a strong relationship between food security and the intention to participate in illegal activities, other livelihood security factors not measured in this study may have influenced the intention to participate. To enhance our knowledge of this critical human–wildlife nexus, future studies might explore other livelihood security factors using larger datasets; they might also adopt other methods such as ethnographic approaches to shed light on how livelihood factors influence people's decisions to engage in illegal activities in PAs.

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