

Contribution of fencing strategy to biodiversity conservation and socio-economic development in northern province, Rwanda: a case study of the community surrounding Volcano National Park.

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ABSTRACT

The Northern Rwandan Volcanoes National Park (VNP) is a globally recognized biodiversity hotspot. It is under growing threat from conflicts between people and wildlife, as well as pressure from land use change that degrades habitat. Fencing was chosen as one of the methods of conservation to protect its biodiversity and lessen wildlife conflicts with nearby residents. Less is known about the ways in which this approach influenced the socio-economic and ecological growth of the neighborhoods surrounding the park. This project investigated how fencing strategies play a role in balancing socio-economic development and biodiversity conservation in the regions surrounding Volcanoes National Park in the northern province of Rwanda. In order to assess how the park's fencing design contributes to lowering human-wildlife conflict, protecting habitats, and enhancing the standard of living for nearby populations, the study employed a mixed-methods approach that included questionnaires, interviews, and field observations. Findings show that fences have improved food security and economic stability for those living close to the VNP while also somewhat lowering the frequency of crop raiding and animal predation. Nonetheless, the study also highlights the significance of inclusive management techniques and community concerns around access to traditional resources. The results highlight how important it is to combine ecological preservation with local development objectives in order to reap the long-term advantages of conservation. Additionally, the study identifies the wildlife species that are most and least impacted by the technique, as well as the function that fencing plays in preserving endangered wildlife species and the effects that the strategy has on local customs and cultural values. The study recommends that the Rwanda Development Board enhance community participation, strengthening community outreach programs for the importance of the fence, improve benefit-sharing, and strengthen awareness. Local leaders should support communication and community conservation, while researchers should examine the cultural impacts of fencing.

Keywords: Fence ecology, human-wildlife conflict, community livelihoods, Volcanoes National Park (VNP), Northern Province, Rwanda.

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BACKGROUND

Globally, fencing has been a widely used strategy in protected area management to mitigate human-wildlife conflict and preserve biodiversity (King et al., 2017). It has been applied in countries like South Africa, Australia, and the United States, using electric and physical fences which have significantly reduced wildlife incursions into farmlands, thereby reducing crop damage and retaliatory killings (Hayward & Kerley, 2009).

The oldest national park in Africa, it was created in 1925 and provides vital habitat for a variety of different wildlife and plant species, including golden monkeys and mountain gorillas (Plumptre et al., 2017). One of Africa's most important conservation areas is Volcanoes National Park, which is situated in Rwanda's Northern Province and is well-known for its endangered mountain gorilla population as well as its contributions to ecotourism and biodiversity preservation (Munanura, Backman, & Sabuhoro, 2013).

Fencing protected areas is increasingly recognized across Africa for its effectiveness in reducing illegal encroachment and poaching (Hayward & Kerley, 2009). Fencing is frequently used in conservation contexts to shield fragile species from outside hazards and to stop wildlife from invading agricultural or human areas (Guinness, 2015). Fences thus serve as a non-lethal method for regulating interactions between humans and potentially dangerous wildlife. It not only supports conservation objectives but also enhances local livelihoods by reducing risks associated with wildlife (Kioko, Muruthi, Omondi, & Chiyo, 2008). In Rwanda, human-wildlife conflicts have been reported as a persistent challenge affecting both conservation efforts and local livelihoods (Sun, Bariyanga, & Wronski, 2025). Considering the Volcanoes National Park, it is a refuge to endangered mountain gorillas and other wildlife species that frequently venture into nearby communities, leading to crop raiding, property damage, and occasional threats to human

safety (Guinness, 2015). These conflicts are primarily driven by the proximity between human settlements and the park (Munanura et al., 2013). Fencing consists of a 76-kilometer dry-stone wall commonly known as "buffalo wall", which was designed to prevent buffaloes and mountain gorillas from straying into farmland and damaging crops (Guinness, 2015). Despite these perceived benefits, the contribution of fencing to both animals inside the park and the socioeconomic development of communities around the park remains understudied.

PROBLEM STATEMENT

Human activities have significantly reduced wildlife habitats (Ceballos & Ehrlich, 2002), threatening biodiversity in Volcanoes National Park, home to endangered species like the Mountain Gorilla (Uwayo et al., 2020). Increasing population, agriculture, and human-wildlife conflicts continue to pressure the park, causing crop damage and livelihood risks (Kalpers et al., 2003). Although fencing has been introduced to address these challenges (Uwayo et al., 2020), its effectiveness in balancing biodiversity conservation with socio-economic benefits remains insufficiently studied (Sun et al., 2025; O'Neill et al., 2022). This research investigated how fencing strategies play a role in balancing socio-economic development and biodiversity conservation.

OBJECTIVES

The main objective of this research is to assess the contribution of fencing strategies to ecological and socio-economic development around Volcanoes National Park, Northern Province, Rwanda. The specific objectives are the following: To evaluate the socio-economic advantages that the fence strategy offers the local community; To examine community opinions and attitudes concerning the fence strategy and its effectiveness; And to assess how the stone wall fence method affects the preservation of wildlife in and around Volcanoes National Park.

RESEARCH QUESTION

Below are the related research questions, which reflect the specific objectives mentioned above: What are the socio-economic benefits of the fencing strategy to the local populations that surround the park? What are the community's perspectives and attitudes concerning the fencing strategy and its effectiveness? What is the contribution of the stone wall fence technique to the conservation of biodiversity in and around Volcanoes National Park?

HYPOTHESIS

The hypotheses of this research are the following: The

socio-economic development of the community adjacent to VNP is significantly correlated with the stone wall fence; Communities close to VNP benefit greatly from the stone wall fence because it lowers human-wildlife conflict, including crop invasion, and livestock loss; The fence strategy contributes significantly to biodiversity conservation around Volcanoes National Park.

METHODOLOGY

Research Design

To thoroughly evaluate how the stone wall fencing strategy supports ecological integrity and socio-economic development around Volcanoes National Park, this study employed a mixed-methods cross-sectional study design, combining both qualitative and quantitative approaches. The cross-sectional design enabled the collection of data at a single point in time from different stakeholders to assess the current impacts of fencing on biodiversity conservation and community livelihoods.

Quantitative data were collected through semi-structured questionnaires (Williamson, 2018), administered to local households and park authorities. These focused on human-wildlife conflict, agricultural productivity, income levels, and employment opportunities following fencing interventions. Qualitative data were gathered through interviews and focus group discussions (Lanshima & Abdulkarim, 2021) with community leaders, conservation experts, and local government officials to capture perceptions, experiences, and socio-economic impacts.

Both primary and secondary data sources were used as primary data came from residents and park staff, while secondary data were obtained from literature and online sources. Questionnaires included both closed-ended and open-ended questions and were self-administered with prior informed consent.

Interviews and discussions were audio-recorded, transcribed verbatim, and analyzed using thematic analysis to identify key patterns related to conservation and development outcomes. A quota sampling technique (Sharma, 2017) was applied to ensure representation of key stakeholder groups, including community members, park staff, and local leaders.

Population and Sample Size

From 22 April 2025 up to 14 August 2026, the research was carried out across six local administrative sectors, including Rugarama & Gahunga in Burera District, Kinigi & Nyange in Musanze District, and Jenda & Kabatwa in Nyabihu District of twelve (12) sectors in three Districts that cover Volcanoes National Park, namely Burera, Musanze, and Nyabihu, where dry-stone wall fencing was installed to protect park wildlife from conflict with the surrounding communities (Figure 1).

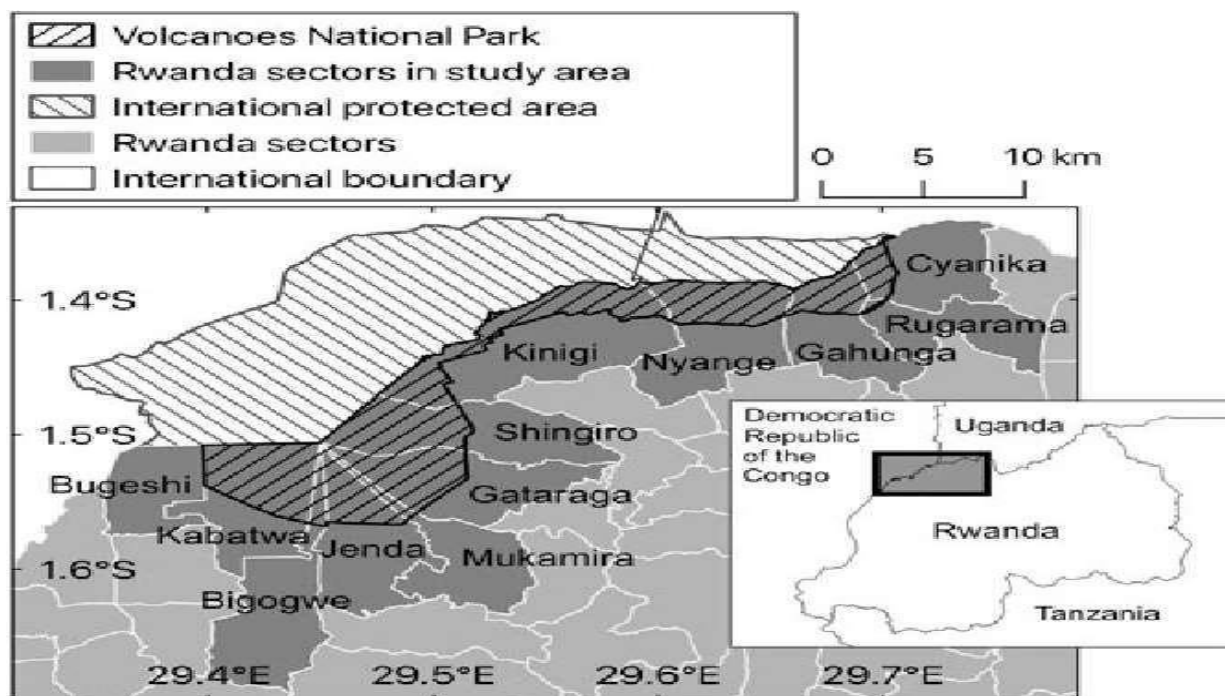


Figure 1: Location of 12 sectors adjacent to VNP

The sample size of 360 respondents was determined using the resource-based approach, considering limitations in time, budget, and available enumerators while ensuring adequate representation. The study adopted a structured sampling design in which, in each sector, two cells were selected from the fenced zone and two from the control site, giving four cells per sector. From each cell, 30 residents were randomly sampled with equal gender representation (50% male and 50% female), resulting in 120 respondents per sector and 360 across three sectors. The sample further included 342 local community members, 6 park staff, and 12 local leaders to capture diverse perspectives. The choice of 30 respondents per cell was guided by feasibility in field data collection while still allowing meaningful analysis, thus ensuring a balance between practical constraints and methodological soundness.

Data Collection

Participants with different age categories have been involved in this research to explore different views and experiences. The interview and focus group discussion (Williamson, 2018) were conducted in Kinyarwanda to enable a better understanding of questions among participants and were later translated into English. Key informant interviews and focus group discussions with park management staff, local leaders, and local communities have been conducted to supplement the ecological data. These stakeholders provided relevant qualitative information about wildlife movements both before and after the fence placement because they have extensive, long-term knowledge of the park's ecosystems.

The integration of expert opinion with empirical data allowed researchers to provide a comprehensive interpretation of ecological changes and the influence of fencing on biodiversity. The community living near the Volcanoes National Park also uses questionnaires, they provided information about the movements of animals from the park and detect any fence damage. A well-monitored fence strategy can effectively assist biodiversity conservation and ensure that ecological integrity is preserved while fitting with regional socioeconomic and environmental goals due to the development of community ownership and engagement.

Data Analysis

Both quantitative and qualitative techniques were used in the data analysis to assess how the stone wall fence intervention influenced the preservation of biodiversity and the socioeconomic advancement of the VNP surrounding populations. For statistical analysis, SPSS software (Rahman & Muktadir, 2021) has been used, and for qualitative data, thematic methodologies were employed. Quantitative data from structured questionnaires have been analyzed using chi-square tests (Krishna Pasupuleti, 2024) to ascertain whether categorical factors such as the existence of a stone wall fence and observed improvement in local livelihoods, biodiversity, and human-wildlife conflict are significantly correlated (Nyiratuza, Maniriho, Ming'ate, & Mireri, 2024). The qualitative information received from respondents via interviews and focus group discussions has been manually categorized and transcribed to find recurring trends like wildlife conflict, community benefits, and

livelihood support to ensure the biodiversity conservation of Volcanoes National Park. In thematic analysis, thematic coding has been used to identify themes and patterns across interviews. Data were organized in tables for comparison across various participant groups, namely park staff, local leaders, and community members, to enable manual coding. This systematic approach (Krishna Pasupuleti, 2024) ensures that the analysis remains transparent, rigorous, and grounded in participants' perspectives.

Ethical consideration

This research was presented to the University of Rwanda College of Science and Technology in August 2025, for the award of a Master's degree in Biodiversity Conservation and Natural Resource Management.

RESULTS

Demographic Characteristics of Respondents

To improve gender balance, we collected data from an equal number of men and women (Table 1).

Table 1: Age and sex of respondents

Sex	Frequency (n)	Percentage (%)
Male	180	50
Female	180	50
Total	360	100

Out of 360 responders, the sample was evenly split (50%) between males and females. The majority of responders (33.6%) were between the ages of 31 and 40, followed by those aged 41 to 50 (24.2%), 18 to 30 (21.9%), and beyond 50 (20.3%). This suggests that the sample population was dominated by people aged 31 to 50, which means the economically active population was well represented (Figure 2).

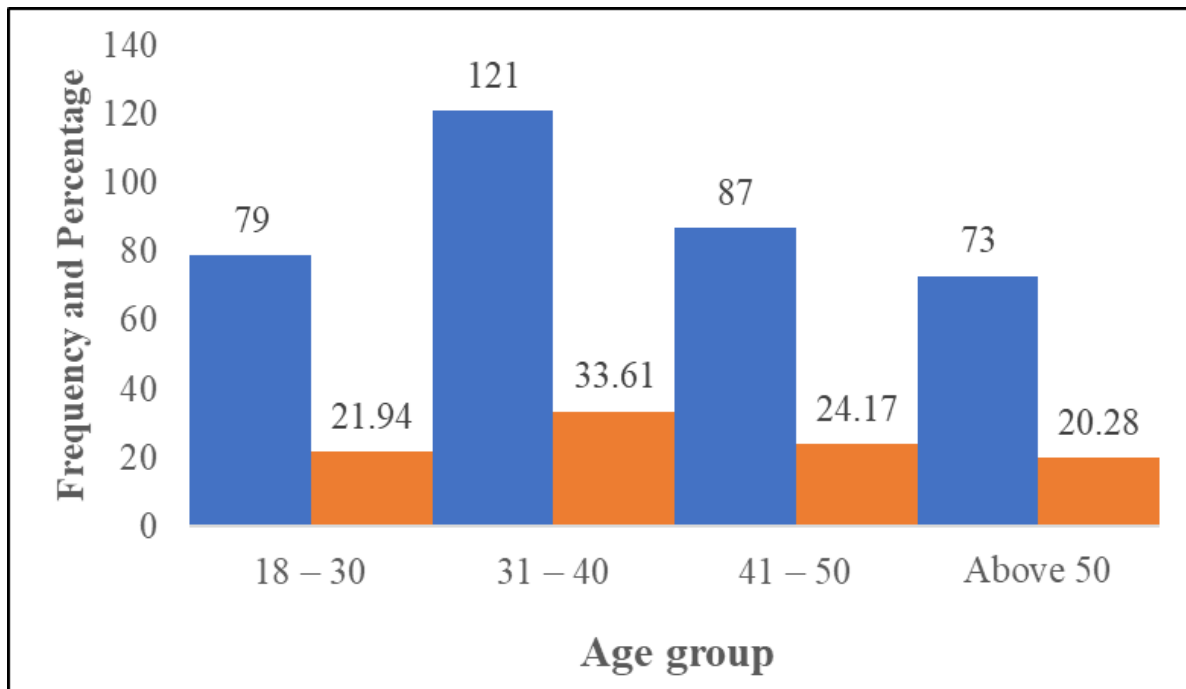


Figure 2: Age distribution of respondents

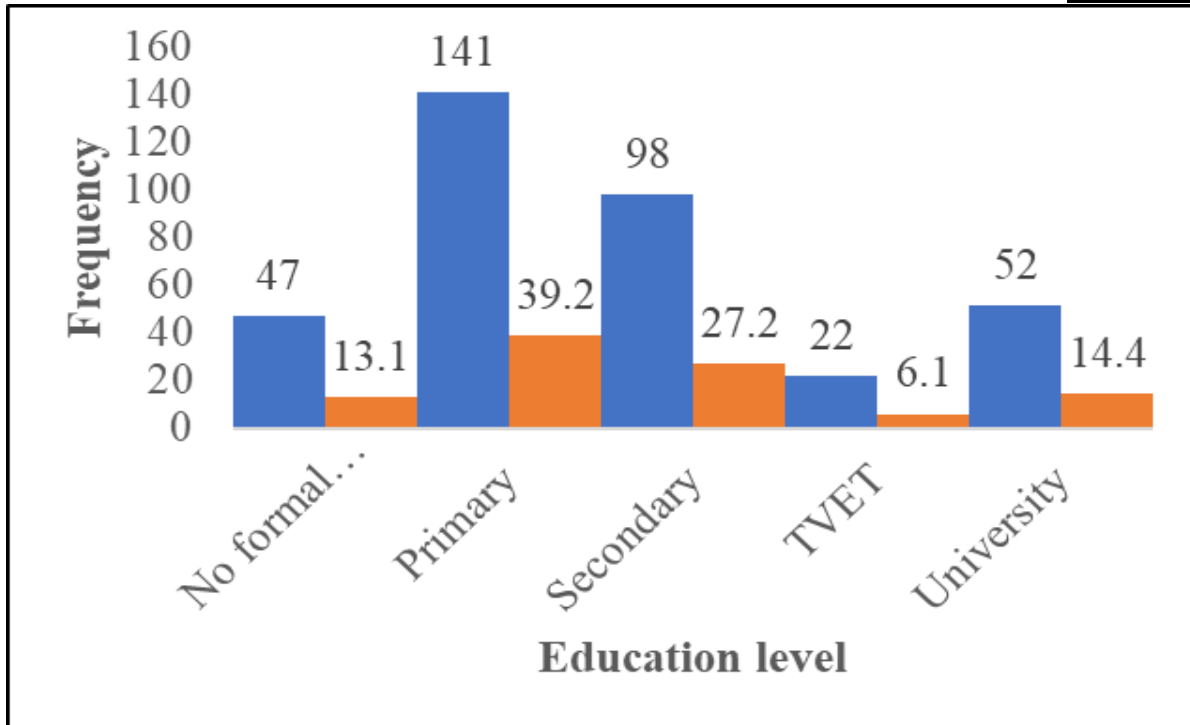


Figure 3: Education level of respondents

A significant proportion of respondents (39.2%) completed primary school, whereas only 14.4% completed higher education. Farming was the most common occupation (69.7%), confirming the study area's agrarian nature (Figure 3).

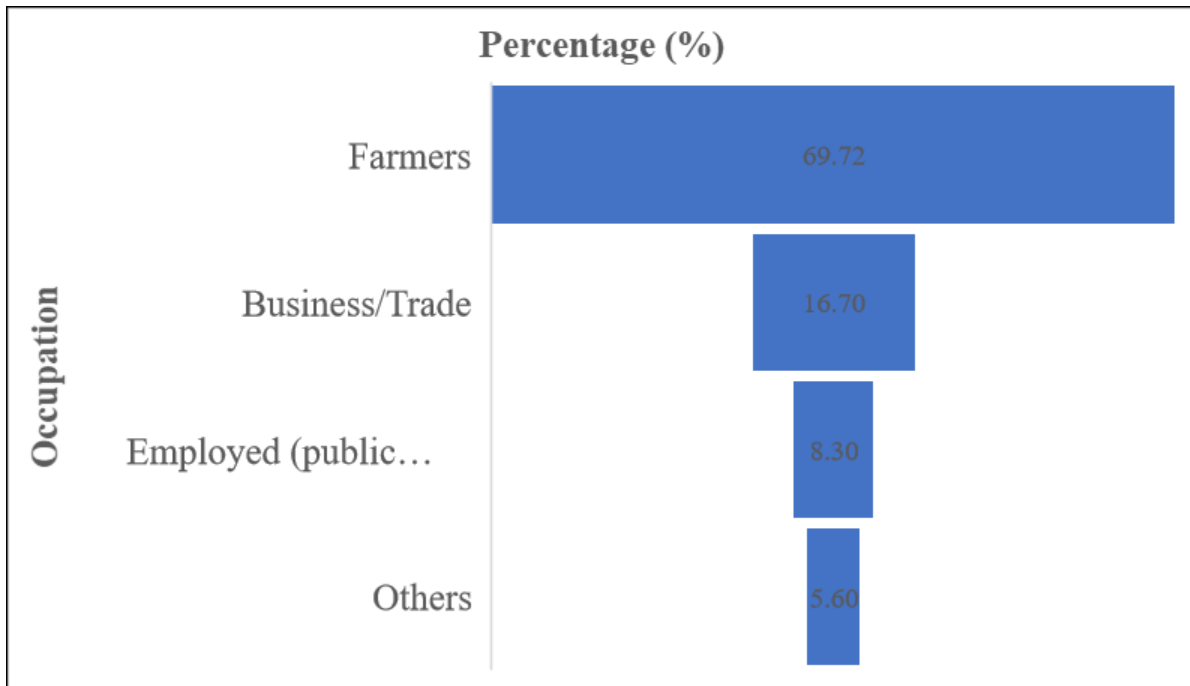


Figure 4: Occupation status of respondents

Socioeconomic benefits of the stone wall fence strategy to the community living around VNP
Employment creation

Table 1 displays the percentage of people from three stakeholder groups, Park staff, local leaders, and the local community, who acknowledged getting specific job creation benefits from the park or conservation program. The research revealed obvious patterns of unequal benefit distribution (Table 2).

Table 2: Impact of fencing on employment opportunities

Contribution	% of Respondents
Agreeing	
Park fences maintenance works	48%
Increased tourism jobs	37%
Indirect labor opportunities (e.g., transport, vendors)	29%

Perception of the human-wildlife conflict trend

The results indicate a moderate reduction in human-wildlife conflict, which resulted in a 30% decrease in crop raiding

incidents and a 27% decrease in livestock predation. Additionally, the community’s perception of the strategy on safety improved at 50%. The fencing strategy showed positive but not complete effectiveness in reducing human-wildlife conflict (Figure 5).

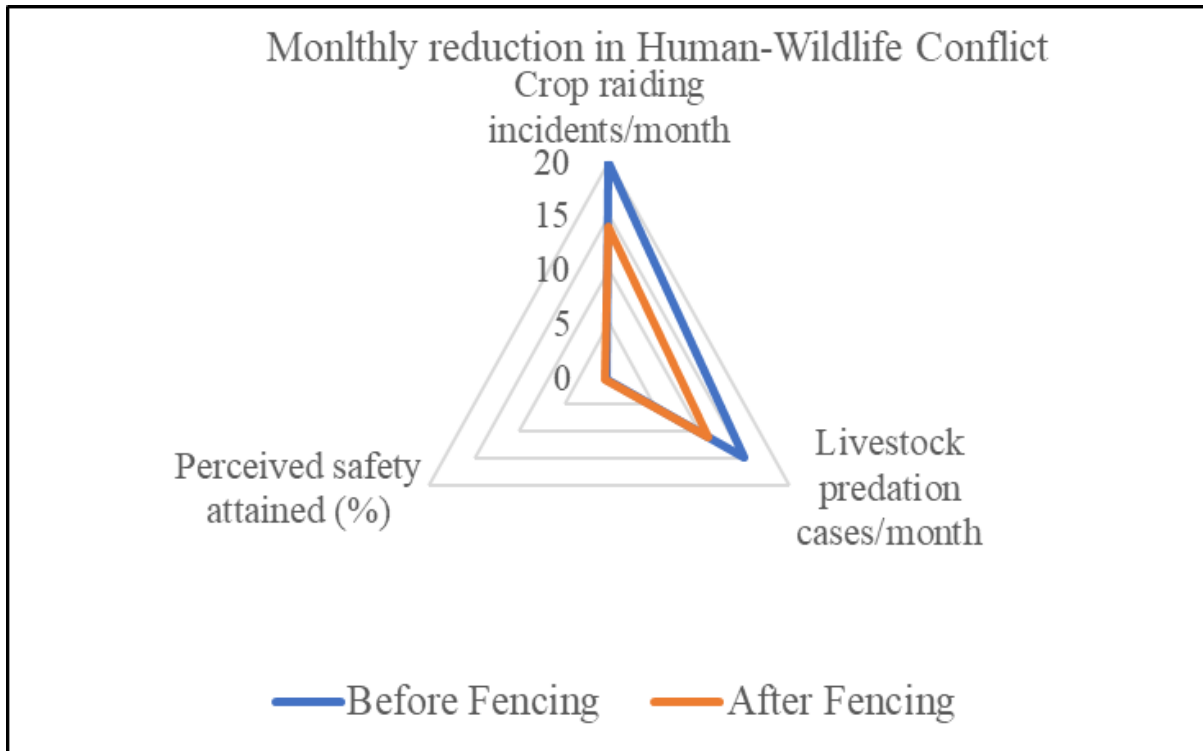


Figure 5: Perception of human-wildlife conflict trend, Economic improvement at the household level

The table compares major economic metrics before and after fencing was installed around Volcanoes National Park. The data clearly reveal good socioeconomic improvements in local areas (Table 3).

Table 3: Economic improvement of households adjacent to fenced VNP

Economic development indicator			Pre- (Avg.)
Fencing			
Post-Fencing (Avg.)			
Monthly household income	100,000	200,000	
% Engaging in small business	27%	47%	
Increased revenue from eco-tourism (%)	16%	27%	

Relationship between socioeconomic benefits from the park

There is a significant difference in how respondents perceive the park-related benefits ($\chi^2=16.42$, Df=4 and P value=0.03, Table 4).

Table 4: Relationship between socioeconomic benefits from the park

Park Staff	Local Leaders	Community	
Socio-economic benefits	(n=6)	(n=12)	Members (n=342)
Employment Opportunities (%)	87.4%	62.6%	33.7%
Increased revenue from Tourism (%)	76.3%	81.4%	45.1%
Reduced crop raiding (%)	61.8%	51.9%	23.4%
Improved food Security and income (%)	94.1%	86.2%	68.8%

Local community opinions and attitudes towards the fence strategy and its effectiveness. Concerns of the local community about dry-stone wall fencing

There is no statistical significance between variables under study since the ($\chi^2=3.99$, Df=2 and P value=0.136, Table 5).

Table 5: Perception of respondents on fence strategy and its effectiveness

Statement / Question	Park staff (n=6)	Local leaders (n=12)	Local community (n=342)
Fencing improves wildlife protection especially Gorillas (%)	92%	85%	68%
Fencing limits access to natural resources (%)	88%	58%	14%
Fencing leads to human-wildlife conflict 90%		72%	55%
Support continuation of fencing strategy (%)	95%	77%	49%
Lack of consultation before fence reduction (%)	91%	75.8%	32.6%

Community tradition and cultural values are affected by fencing activity in the VNP.

There is no statistical significance between fencing strategy, traditional, and cultural values under study since the ($\chi^2=0.598$, Df=2 and P value=0.741, Table 6).

Table 6: Community tradition and cultural values affected by fencing activity in the VNP

Main indicators	Park Staff (n=6)	Local Leaders (n=12)	Community Members (n=342)
Collection of medicinal plants and other resources	19.8%	30.4%	33.8%
Limited access to sacred ancestral sites	41%	55.7%	58.2%
Limited access to the young generations to significant stories and areas		68.1%	77.4%
Weakened Human–Wildlife Cultural Symbolism	57.9	62%	69.1%

Alternatives to dry-stone wall fence for reducing human-wildlife conflict mitigation

Only "Noise and light deterrents" had a statistically significant difference ($p = 0.030$), demonstrating varying

levels of support across the three categories. Community members expressed significantly lower support (8.3%) than Park staff (33%) and local leaders (16.7%). This could indicate uncertainty about the method's applicability or

effectiveness at the community level. All other methods (e.g., beehive fences, trenches, monitoring teams) showed no significant differences, suggesting broad agreement among stakeholders on their usefulness (Table 7).

Table 7: Alternative methods to mitigate human-wildlife conflict in the VNP

Alternative Method to Mitigate Human-Wildlife Conflict	χ^2 (Chi-Square)	Df	p-value
Beehive fences	0.773	2	0.68
Buffer zones (non-palatable crops)	0.821	2	0.663
Live hedges/natural barriers	0.227	2	0.893
Trenches and electric	0.499	2	0.779
Noise and light deterrents	7.03	2	0.03
Community-based monitoring teams	0.471	2	0.79

Impact of fence on Biodiversity Conservation Impact of fence on wildlife species in the VNP

Certain forest-dwelling or less mobile species tend to gain from the fence method, including mountain gorillas, which may face fewer dangers from human activities due to reduced encroachment, bushbuck, and birds, which are anticipated to benefit from improved habitat security. Large or wide-ranging species like elephants and buffalo are badly impacted, most likely due to restricted migration paths, increased stress or conflict due to confinement, while Chimpanzees had little discernible influence, presumably because of their adaptability to habitat changes and mixed use of forest and edge regions (Table 8).

Table 8: Impact of fence on wildlife species in the VNP

Number of Impact	Species	Specie
positively affected	3	Mountain Gorilla, Bushbuck, and Bird species.
Negatively Affected	3	Elephant, Buffalo, Duiker
No Significant Impact	1	Chimpanzee

Impact of fence on the protection of endangered species in the VNP

Figure 6 depicts how various groups perceived the usefulness of fencing in safeguarding endangered species such as mountain gorillas in VNP, Rwanda.

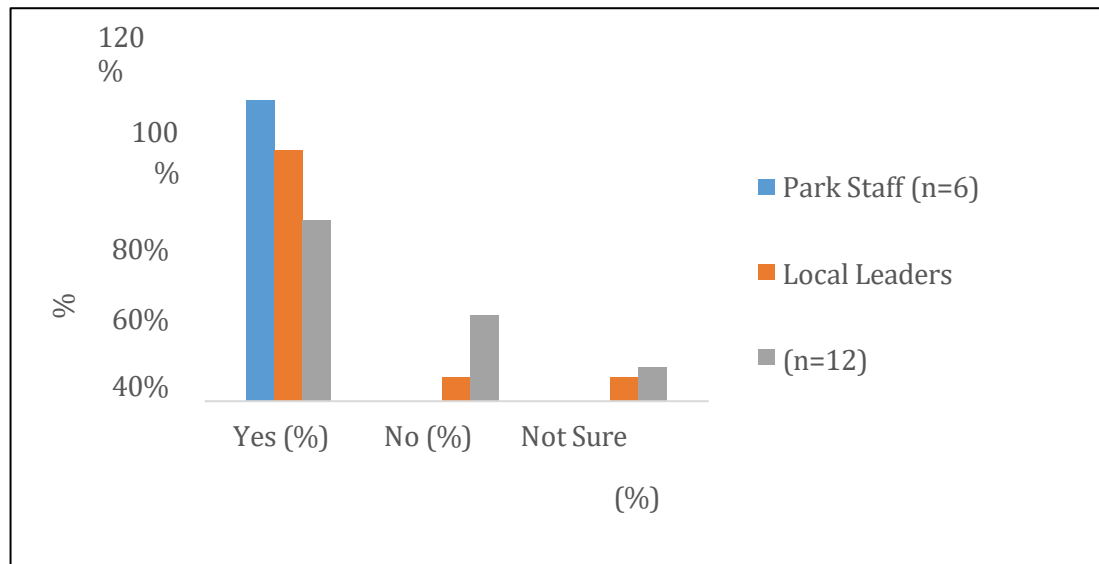


Figure 6: Perception of the effectiveness of the fence in protecting endangered species

1. DISCUSSION

The finding of the present study illustrates how various groups perceived the usefulness of fencing in safeguarding endangered species such as mountain gorillas in the VNP, Rwanda, and highlights that Certain forest-dwelling or less mobile animals benefit from the fence strategy, such as mountain gorillas, which may face fewer threats from human activities due to reduced encroachment, bushbuck, and birds, who are expected to benefit from better habitat security. Elephants and buffalo are negatively impacted by limited migration paths, stress, and conflict due to confinement. Chimpanzees have little impact due to their adaptability to habitat changes and mixed use of forest and edge regions.

The results obtained match the results obtained from research done by Ringma et al. (2017), where their research conducted on fences, a tool to minimize species extinctions, found that conservation fences are a popular management tool, especially for species threatened by invading predators. Fence networks are spreading randomly, often in response to local financing possibilities or threats, unlike other conservation measures. The exclusion fence network provided inconsistent protection, leaving 67% of predator-sensitive species unrepresented. The results found also agree with the findings of (O'Neill et al., 2022), who found that fences are an important intervention activity in conservation. The interventions are sometimes employed to avoid human-wildlife conflict, such as poaching, considering their harmful influence on habitat connectivity and the patterns and dynamics of wildlife. Wide-ranging animals, like the African wild dog (*Lycaon pictus*), require

extensive continuous habitat to meet their resource needs.

A study also conducted in the South African savanna revealed that fences create obstacles for large mammals, as they impact wildlife dynamics (Somers & Hayward, 2012). They fail to adjust for seasonal migrations of migratory species, wet season range expansion, or the dispersal of adolescent animals from their native regions. Given that wildlife species occasionally inhabit small regions, they may lose their genetic potential, and when the area's carrying capacity is exceeded, animal disease can be propagated. Additionally, the species composition may shift, and nomadic individuals may disappear.

As found above in Figure 5, the results of the study also demonstrated that dry-stone wall fences are not more effective in controlling wildlife conflicts; there is a slight decrease (30%) in crop raiding, and a 27% decrease in livestock predation in the VNP. Furthermore, fences have been seen to protect wildlife inside the park, although not entirely. The results of the study tie with a study conducted in Kenya, which highlighted that the number of crop raiding reduced up to 1 or 2 individuals, and revealed that Unfenced zones received a higher frequency of elephant crop raiding that farm inside the fenced Kimana zones. After the stone wall fence was put in place, the amount of elephant damage on their fields decreased in just four years (Kioko et al., 2008).

Table 3 presents the results, which revealed a significant difference in how the respondents' groups perceive the park-related benefits. There is an improvement in economic standards at the household level, while also demonstrating improved food security, income, and job creation, and

increased tourism revenues. These results agree with the findings of (Dawa, Dorji, & Dorji, 2021), stone wall fence has been shown to be economically and socially beneficial to families and communities in terms of social security and safety. The results also agree with the findings from reducing the overall crop guarding by 70%, whilst elephants and deer required the uppermost crop safeguarding efforts before the fence was constructed, and also demonstrated an increase in annual net benefit of rural households (Feuerbacher, Lippert, Kuenzang, & Subedi, 2021). Reduced crop raiding boost economical standards of the rural community adjacent to fenced areas (Xu & Huntsinger, 2022).

Table 5 of this study revealed that no significant difference was observed in community tradition and culture values resulting from the stone wall fencing intervention. A study conducted in China showed that fences have an impact on human movement, land practices, economic, social, and human-nature linkages in a given area system (Xu & Huntsinger, 2022). Fencing in western China created division among community members, thus leading to a drop in social gatherings, such as groups singing, dancing, as well as reciprocal relationships of friends, and shared memory. Such fencing resulted in violent territorial conflicts (Xu & Huntsinger, 2022). In addition, societal implications challenged traditional human-nature connections. Fencing in Southern and Eastern Africa separated communities from nature, limiting movement and affecting traditional practices and beliefs (Xu & Huntsinger, 2022).

Table 4 of this study shows that there is no significant difference observed in the effectiveness of the dry-stone wall. According to the respondents surveyed, the majority of the local community still crosses the dry-stone wall within the park to search for resources. The results are similar to those highlighted by Guinness (2015 during his survey. Respondents individually mentioned that the stone wall was one of the methods used to reduce crop raiding; nonetheless, the majority of them expressed dissatisfaction with its usefulness, saying "we requested the RDB to plan a dry-stone wall, but the wall constructed is not serving" (Guinness, 2015).

2. CONCLUSION AND RECOMMENDATIONS

The fence system established in the Volcanoes National Park has made significant contributions to biodiversity protection and socioeconomic development in Rwanda's Northern Province. Most importantly, the fence has helped to safeguard endangered wildlife species, such as the famed mountain gorilla (*Gorilla beringei beringei*) and other large mammals, by minimizing human encroachment, habitat degradation, and poaching. The barrier improves the security of these crucial habitats by establishing a physical border, allowing species to survive and contributing to global conservation goals.

Furthermore, the technique has slightly decreased human-wildlife conflicts, including crop raiding and livestock loss, which had previously threatened local livelihoods. This has increased food security and lowered unfavorable attitudes toward wildlife in the neighboring region. Furthermore, the

fencing program has boosted socioeconomic development by creating jobs in conservation activities, increasing revenue from tourism, and improving neighborhood income and safety.

However, the study acknowledges that the fence has not significantly created societal issues, notably in terms of traditional behaviors and cultural values. Hence, local communities still cross the stone wall for collecting and accessing sacred sites, medicinal plants, and other resources. This highlights the need and emphasizes the significance of incorporating indigenous knowledge and cultural values into conservation planning, along with encouraging an open interface between park administrators and the residents living in this area.

In terms of biological implications, the fence has helped to shape wildlife species assemblages in the park, especially for the endangered species, the mountain gorilla (*Gorilla beringei beringei*). While it provides shelter, it may disrupt normal migratory patterns, particularly for wide-ranging species, thereby influencing ecosystem dynamics. Continuous ecological follow-up is thus essential to measure the long-term effects on species distribution, diversity, and interspecies interactions.

In conclusion, while the fencing technique has resulted in major benefits for species protection, habitat conservation, and community development, its effectiveness is dependent on adaptive management approaches that are culturally sensitive, environmentally informed, and socially inclusive. Sustainable protection of Volcanoes National Park will necessitate continual coordination among partners to guarantee that nature and people coexist in harmony.

RECOMMENDATIONS

The study recommends that the Rwanda Development Board strengthen inclusive conservation by actively involving local communities in planning and decision-making, especially where cultural values are significant, while also improving benefit-sharing from tourism and conservation revenues to ensure tangible economic gains for nearby residents and enhancing outreach programs to build awareness and address concerns about fencing. Local leaders should play a key role in bridging communication between communities and park authorities and in promoting community-based conservation initiatives such as village patrols and participatory wildlife monitoring to foster local ownership. Additionally, researchers and academic institutions are encouraged to further explore the cultural dimensions of conservation, particularly the impacts of fencing on identity, spiritual values, and traditional ecological knowledge.

Limitation of the study

These included some people who denied participation in this research, mainly respondents during data collection, and financial constraints, for example, money for printing questionnaires while doing the study.

Source of funding

The study was carried out on self-sponsorship

Availability of data

Data used in this study are available upon request from the corresponding author or visit the library of the University of Rwanda - College of Science and Technology to explore the entire book of this research.

Author Biography (Short Version)

Mujawimana Alice is a Secondary Biology educator with over nine years of experience and holds a Master's degree in Biodiversity Conservation and Natural Resource Management from the University of Rwanda – College of Science and Technology. Her work focuses on inclusive, learner-centered pedagogy and environmental education.

Associate Professor Venuste Nsengimana has a PhD in “Sciences Agronomiques et Ingénierie Biologique” (Agronomy and Bioengineering) from the University of Liège, Gembloux Agro Bio-Tech, Belgium. He was serving as a research supervisor from the University of Rwanda as Senior Researcher and Director of the Centre of Excellence in Biodiversity and Natural Resource Management.

Authors contribution

MUJAWIMANA Alice designed the study, conducted data collection, cleaned and analyzed data, and drafted the manuscript while Assoc. Prof. Venuste NSENGIMANA supervised all stages of the study and provided constructive

feedback.

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Conflict of interest

The author has no conflicting interests with respect to this research.

Abbreviations and acronyms

%: Percent

IUCN: International Union for Conservation of Nature

Avg: Average

Df: Degree of freedom

eg: Example

NGOs: Non-Government Organizations

ORTPN: Rwandan Office of Tourism and National Parks

RDB: Rwanda Development Board

SPSS: Statistical Package for the Social Sciences

TBPA: Transboundary Protected Area

UR: University of Rwanda

VNP: Volcanoes National Park

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