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Community-Based Conservation and Ecological Integrity: An Assessment of Kibale and Queen Elizabeth Conservation Areas in Uganda

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Abstract
Community-based conservation in four national parks and four wildlife reserves in Kibale and Queen Elizabeth Conservation Areas, Uganda is explored. This study investigated how community-based conservation protects ecological integrity through evaluation of the extent to which communities participate in conservation, its usefulness, and the challenges they face, using a survey. Data was collected May 2018 to April 2019 using literature review, focused group discussions, Key Informant Interviews, and semi-structured questionnaires from 259 respondents selected from the local authorities and households adjacent Kibale and Queen Elizabeth Conservation Areas. This study analysed data using Cronbach's alpha coefficient, Kruskal-Wallis Analysis of Variance, Pearson Chi square test, and Univariate Analysis of Variance; and presented the results in tables and figures. The study established that local communities participate in conservation education and awareness, benefit sharing, and boundary management programmes which contribute to biodiversity conservation and ecological integrity. Recognition of indigenous people's property; knowledge of Key Park attributes; and participation of local authorities and private sector improves people-park relations, and creates acceptance of wildlife. Community-based conservation results into increased community knowledge and collaboration, community-based tourism, private sector involvement; growth in eco-lodges and campsites, and collaboration between local communities and park management. Local community participation creates trust, belonging, acceptance, and reduces pressure on the park resources. The study concludes that Community-based Conservation is integral to conservation of biodiversity and protection of ecological integrity. However, it's challenged by poor governance, limited community involvement in conservation-related decision making, community involvement in illegal activities, and unrealistic community expectations. The wildlife agency should provide incentives to meet community needs, strengthen the benefit sharing scheme, formulate community conservation related policies, and also create and strengthen community conservation institutions to participate in conserving biodiversity and ecological integrity. Future research should explore local community perceptions and attitudes towards wildlife conservation.
Keywords: biodiversity conservation, local community participation, wildlife protected areas
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1. Introduction

Community-based conservation (CBC) is any voluntary initiative of "natural resources or biodiversity protection conducted by, for, and with the local community" (Western & Wright, 1994, p. 7). It aims "to enhance wildlife/biodiversity conservation and to provide incentives, normally economic, for local people" (Campbell & Vainio-Mattila, 2003, p. 421). CBC initiatives aim at protecting biodiversity while promoting local development (Gómez-Baggethun & Muradian, 2015) with main strategies of (i) integrating conservation and livelihood goals, (ii) providing economic and development benefits in return for conservation, and (iii) providing communities control over their natural resources (Nilsson et al., 2016). Community-based conservation is promoted as a means to re-aggregate the common resource, provide biodiversity conservation, and enhance human livelihoods under increasing pressures from population growth, land use changes, and other forces (e.g., Galvin, 2009; Reid et al., 2014). Local land users are thought to be ideally central to crafting and implementing conservation and development initiatives in a CBC model (Agrawal, 2003; Armitage, 2005; Black & Cobbinah, 2017). Appropriate approaches to balance the public need for sustaining biodiversity and natural heritage and private need for basic livelihood and culture maintenance are always under discussion and practice around the world (Lele et al., 2010; Brooks et al., 2013). While there is no fixed set of governance institutions that are appropriate to effectively govern resources (Ostrom, 2007; Andersson & Ostrom, 2008), CBC institutions are often exemplified by nongovernmental organizations (NGOs), private individuals, and layers of government that represent, facilitate, or at least support local communities in conservation governance and resource management (Baival & Fernández-Giménez, 2012). Community-based conservation institutions offer incentives to sustainably manage natural

resources and have some measure of devolution of resource management responsibilities (Berkes, 2007; Plummer & Armitage, 2007; Suich, 2010; Morton et al., 2016).

Global experience both in developing and developed countries has confirmed that community participation in protected area management can be adapted to different social-ecological conditions with different conservation targets (Selfa & Endter-Wada, 2008, Brooks et al., 2013; Li, 2014). Research has also revealed that many factors can impact the success of community participation, such as formulation and implementation of laws and regulation, acceptance of local knowledge and development demand, provision of social welfare, etc. (Calfukura, 2018).
Recent studies on protected areas in Uganda revealed limited information on CBC and therefore, little was documented. CBC has marginally performed better, as an approach to Protected Area management than the traditional top-down approach although it does not address all the threats to PAs, and therefore more pragmatic approaches that go beyond the PA boundaries and which address PA threats be pursued to address human welfare issues and conserve PAs into the future (Mugisha, 2002). Collaborative management agreements and benefit sharing agreements will lead to increased forest income for households in Rwenzori Mountains National Park (Jagger, 2008). The Ugandan Government has made remarkable steps to conserve biodiversity in a country where human population density is increasing at one of the fastest rates in the world (Hartter et al., 2015). There is a positive correlation between participation in CBC projects and perceived benefits of living near the park (Kolinski & Milich, 2021). These findings did not explicitly reveal to what extent CBC protects ecological integrity which this study addressed. Against this background, we hypothesized, first, that communities participate in conservation programmes of the protected areas; second, that CBC is useful in conserving biodiversity and protecting ecological integrity; and third, that communities experience various challenges during their participation in conservation programmes. We tested these hypotheses using three specific objectives, and these were: (i) to evaluate the extent to which communities participate in the protection of ecological integrity, (ii) to evaluate the usefulness of CBC in protecting ecological integrity, and (iii) to identify the challenges facing CBC.

2. Materials and Methods

2.1 Description of the study area

Our study covered an area bounded by altitudes 0 °34' South and 1 °09' North and longitudes 29 °28' West and 30 ° 56' East in the Albertine Graben, Uganda. The wildlife protected areas studied were 4 national parks and 4 wildlife reserves. Specifically, they were Kibale National Park (795 km^2), Semuliki National Park (220 km^2), Toro-Semliki Wildlife Reserve (542 km^2) and Katonga Wildlife Reserve (207 km^2) in Kibale Conservation Area; and Queen Elizabeth National Park (1978 km^2), Rwenzori Mountains National Park (995 km^2), Kyambura Wildlife Reserve (157 km^2) and Kigezi Wildlife Reserve (330 km^2) in Queen Elizabeth Conservation Area (Fig.1). The landscape experiences a bimodal rainfall pattern occurring during March-May, and August- November. Annual rainfall ranges from 800 mm to 1600 mm, and is greatly influenced by altitude. The landscape lies astride the equator. It experiences small annual variation in air temperature; and the climate is generally hot and humid, with an average monthly temperatures varying between 27 ℃ and 31 ℃, with maximums consistently above 30 ℃ and sometimes reaching 38 ℃ Average minimum temperatures are relatively consistent and vary between 16 ℃ and 18 ℃. The average monthly humidity is between 60 and 80%. The high air temperatures result in high evaporation rates causing some parts to have a negative hydrological balance. The drainage consists of three main lakes; Lake Albert, Lake Edward, and Lake George and there are a number of rivers and streams. A wide variety of vegetation ecosystems and species are known to exist in this landscape; on the mountain and escarpment slopes and in the valleys and flats. The main vegetation ecosystems include montane forests, tropical forests (including riverine and swamp forests), savannah woodlands and grassland mosaics, papyrus and grassland swamps. (NEMA, 2009)

2.2 Data collection

2.2.1 Sampling

We determined the sample size of the respondents using purposive (Kendra, 1989) and simple random (Kothari, 2004) sampling techniques to collect focused information from 259 respondents disaggregated as 208 from local residents and 51 from local authorities adjacent the national parks and wildlife reserves.

2.2.2 Research Design

We conducted this study through a survey research design from May 2018 to April 2019 with permission from Uganda Wildlife Authority. Data were collected using focused group discussions (FGDs), key informant interviews (KIIs), semi-structured questionnaires, review of park documents and relevant journals, and use of Geographical Information System /remote sensing. We sampled households in the range of ≤10km from the PA boundary (Fig. 1) as these were believed to have much interaction with the wildlife PA (Gandiwa et al., 2014). Each household was considered a sampling unit, and interviews were restricted to one respondent per household. Heads of households were interviewed face-to-face. In their absence, another member of the household of 18 years and above was interviewed. Interviews were conducted mainly in local languages. For each sampled household, Global Positioning System (GPS) points were collected using Garmin eTrex GPS and exported to Geographical

Information System (GIS) software ESRI ArcGIS version 10.31 for map production. We administered semi-structured questionnaire to capture information about respondents' socio-demographics, and their participation in protecting ecological integrity in the adjacent the national park or wildlife reserve. In addition, we held one FGD with park staff for each of the 8 wildlife protected areas. Each FGD had 5 to 7 park staff, and was used to collect information on the areas of community-park collaboration in wildlife programmes. We also held KIIs with 16 representatives from the private sector players involved in community conservation work. Through this survey, we generated both qualitative and quantitative responses. More relevant and secondary data were obtained from existing literature including park reports, general management plans and annual operation plans, published journals, and field reports on community participation in conservation.

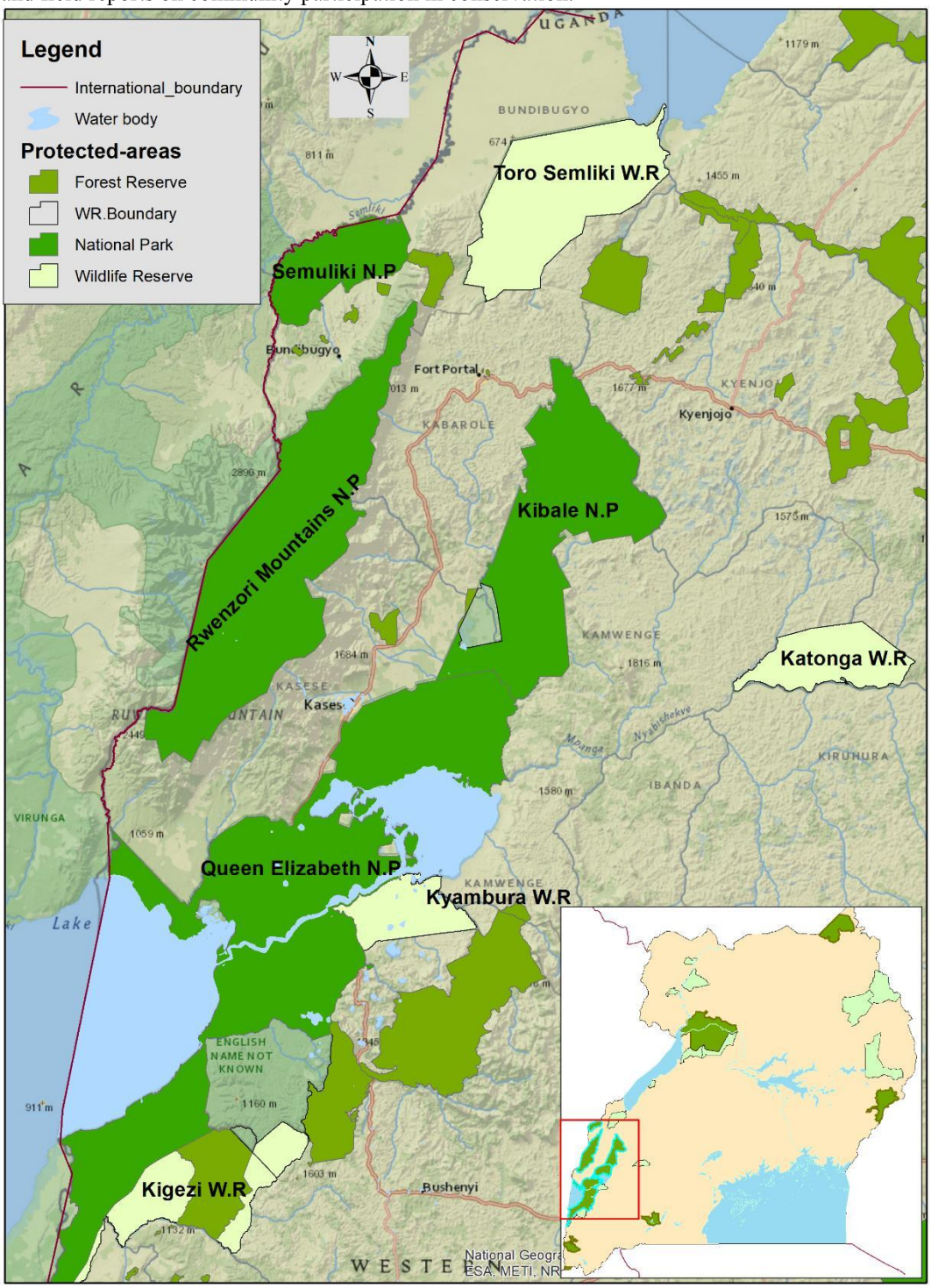

Fig 1: Map of the study area

2.3 Statistical analysis

Data were analysed using descriptive and inferential statistics as in the Statistical Package for the Social Sciences (SPSS) Version 22. The statistical tests used in analysis were Cronbach's alpha coefficient, Kruskal-Wallis Analysis of Variance (ANOVA) (F), Pearson Chi square test (χ^2), and Univariate Analysis of Variance. To determine the scale's internal consistency, the scales were tested for reliability using the Cronbach's alpha coefficient (α). The scales' reliability ranged from 0.58 to 0.82 in all the communities. These reliability results were all acceptable as the recommended value for α is 0.76 for all the measures. Also, the Univariate Analysis of Variance test revealed $F_{(1)} = 0.811$ at significance level of 0.003 which was less than 5% hence generally accepted. This meant that there were only 0.811 possibilities out of 100 that the results were due to chance when the confounding variable (sex of respondent) is controlled.

3. Results

3.1 Extent of community participation in the protection of ecological integrity

Community participation in the protection of ecological integrity was explored using 259 participants living adjacent the wildlife protected areas. Their socio-demographic characteristics included gender (females 33.2%, males 66.8%, N=259); age with age group 32-45 having more respondents (57.5%, N=259), followed by age group 18-31 (27.4%) and ≥46 (15.1%). Majority of the community respondents had attained primary education (42.4%, N=259), followed by secondary education (29.7%), diploma and degree (17.5%), and certificate (10.4%). The respondents own land adjacent the parks (81.9%, N=259); and of these, 73.1% own 1-5 hectares, 21.2% own over 6 hectares and 5.7% own less than 1 hectare (Table 1).

Table 1: Socio-demographic Characteristics of the Survey Respondents

Socio-demographic characteristic	Category	Frequency	%	N	χ^2	df	p	Cramer's Value
Sex of the respondent	Male	173	66.8	208	23.558,	1	.000	.231
	Female	86	33.2	208				
Age of the respondent	18-31 years	71	27.4	205	137.263	3	.000	.350
	32-45 years	149	57.5					
	46-60 years	19	7.4					
	61+ years	20	7.7					
Level of education of the respondent	Primary	110	42.4	195	88.051,	4	.000	.159
	Secondary	77	29.7					
	Certificate	27	10.4					
	Diploma	25	9.6					
	Degree	20	7.9					
Land holding	Owns land	212	81.9	194	79.258	1	.000	.302
	Landless	47	18.1					
Acreage (if owns land)	<1 hectare	14	5.7	212	162.091	2	.000	.249
	1-5 hectares	155	73.1					
	>6 hectares	45	21.2					
Length of residence	1-3 years	11	4.3	190	174.884	3	.000	.610
	4-6 years	18	6.9					
	7-9 years	12	4.6					
	10 years and above	218	84.2					
Occupation of respondents	Formal employment	30	11.6	194	69.023	4	.000	.598
	Business	41	15.8					
	Religious leaders							
	Peasant farmers	148	57.1					
	Fisherfolk	40	15.5					
Distance of household from the park boundary	<5km	194	75.1	193	190.465	2	.029	.201
	5-10km	47	18.2					
	>10km	18	6.7					

Local communities adjacent the parks participate in conservation education and awareness programmes as

revealed by the statistically significant test results with χ^2 (1, N = 259) =46.013, p=.000, Cramer's Value=.588 and ($F_{(3,\ 256)}$ =22.574, p=.000). The high Cramer's Value of 0.588 indicates a very strong effect of community conservation education and awareness programmes towards conserving biodiversity. The conservation education and awareness programmes in the communities include outreach programmes (Fig. 2), in-park visits, talk shows, and drama in the communities; and awareness meetings, in-park visits, debates, contests, and distribution of educational materials (Fig. 3) in schools. As a result, local communities participate in the development of general park management plans [χ^2 (1, N = 259) = 35.16, p =.260, Cramer's Value=.270 and $F_{(3,\ 256)}$ =0.250, p=.861]. However, communities do not participate in resolving human wildlife conflicts (χ^2 (1, N=259) =20.538, p=0.303, Cramer's Value= .216 and $F_{(3,\ 256)}$ =4.211, p=.007. (Table 2) These conflicts were mainly handled by the local authorities and park management without involvement of local communities. Community respondents intimated that "We are not given opportunities to participate in handling human wildlife conflicts". Further, there were no community conservation institutions established which would otherwise participate in resolving human wildlife conflicts—which conflicts arise from resource access, park boundary contentions, crop raiding, loss of livestock to predators, and human injuries and death resulting from animal attacks.

Fig. 2: Community sensitization and awareness in Bikone Nyakalengija, adjacent Rwenzori Mountains National Park

Fig. 3: Education and awareness sensitization on conservation of the park at Good Samaritan Primary School in Kisinga Sub County, adjacent Rwenzori Mountains National Park

Local communities participate in the benefit sharing schemes mainly resource access ($F_{(3, 256)}$ =0.388, p=.000), revenue sharing ($F_{(3, 256)}$ =0.797, p=.000), and wildlife enterprises/business opportunities ($F_{(3, 256)}$ =10.943, p=.000). However, they do not participate in wildlife use rights programme ($F_{(3, 256)}$ =14.301, p=.091). (Table 2) These statistically significant results on the benefit sharing schemes indicate their influence on local community participation in conservation. The schemes not only create appreciation and acceptance of wildlife in the communities, but also contribute income to the existing community-based tourism groups. Specifically, the revenue sharing scheme finances community conservation, problem animal management interventions, community based tourism, income generating activities, and also offsets the costs of invasion of local communities by wild animals. This was revealed by the statistically significant response from the communities on the question, "Does your community receive funds from the park under revenue sharing scheme?" (χ^2 (1, N = 259) =1.310, p=.000, Cramer's Value=.084 and $F_{(3, 256)}$ =0.797, p=.000). These funds motivate communities to participate in conservation of wildlife (χ^2 (1, N = 259) =17.609, p=.001, Cramer's Value=.340 and $F_{(3, 256)}$ =5.008, p=.003). The high Cramer's Value of 0.340 indicates a very strong effect of the revenue sharing scheme towards motivating local communities to conserve biodiversity in the parks. However, communities were dissatisfied with the management of the funds especially the channel of disbursement (through the local authorities) to finance local community interventions (χ^2 (1, N = 259) =.939, p=.001, Cramer's Value=.816 and $F_{(3, 256)}$ =506, p=.679) (Table 2). The high Cramer's Value of 0.816 indicates a very high level of dissatisfaction with the channel of disbursement of funds. They proposed direct disbursement to the parishes.

Table 2: Results of Kruskal-Wallis One way ANOVA and Pearson Chi-square on Community Participation in Conservation of Wildlife Resources

Issue	Kruskal-Wallis One way ANOVA	Chi-square test statistic, (χ^2)
Do you participate in wildlife conservation education and awareness programmes?	$F_{(3, 256)}$ =22.574, p=.000	χ^2(1, N = 259) =46.013, p=.000, Cramer's Value=.588
Why do you participate in wildlife conservation programmes? (willingly, out of concern for wildlife, and continual availability of the in-park resources)	$F_{(3, 256)}$ =2.957, p=.001	χ^2 (2, *N* = 259) = 46.013, *p* =.000, Cramer's Value=.588
Do you influence park decision making in the park?	$F_{(3, 256)}$ =0.250, p=.861	χ^2(1, N = 259) =35.16, p=.260, Cramer's Value=.270
Does your household/community access resources within the national park?	$F_{(3, 256)}$ =0.388, p=.000	χ^2 (1, N = 259) =10.055, p=.000, Cramer's Value=.247
Do you need a resource use agreement to access in-park resources?	$F_{(3, 256)}$ =1.796, p=.152	χ^2 (1, N = 259) =1.972, p=.000, Cramer's Value=.576
Do you need a permit to access in-park resources?	$F_{(3, 256)}$ =3.180, p=.027	χ^2 (1, N = 259) =3.469, p=.000, Cramer's Value=.325
Does your community receive funds from the park under revenue sharing scheme?	$F_{(3, 256)}$ =0.797, p=.000	χ^2 (1, N = 259) =1.310, p=.000, Cramer's Value=.084
Do funds received under the revenue sharing scheme motivate you to participate in conservation of the park resources?	$F_{(3, 256)}$ =5.008, p=.003	χ^2 (1, N = 259) =17.609, p=.001, Cramer's Value=.340
Are you aware of wildlife enterprises/business opportunities the PA provides?	$F_{(3, 256)}$ =10.943, p=.000	χ^2 (1, N = 259) =24.734, p=.000, Cramer's Value=.345
Are you aware of wildlife use rights the PA provides?	$F_{(3, 256)}$ =14.301, p=.091	χ^2 (1, N = 259) =31.359, p=.000, Cramer's Value=.388
Do you generate conservation-based income as a community?	$F_{(3, 256)}$ =1.903, p=.133	χ^2 (1, N = 259) =6.926, p=.074, Cramer's Value=.219
Are you satisfied with the channel through which receive revenue sharing funds are received?	$F_{(3, 256)}$ =506, p=.679	χ^2 (1, N = 259) =.939, p=.001, Cramer's Value=.816
Have any park animals strayed onto your farm/family dwelling?	$F_{(3, 256)}$ =1.245, p=.000	χ^2 (1, N = 259) =4.203, p=.000, Cramer's Value=.240
Did your family receive some form of compensation for the damage caused by stray park animals?	$F_{(3, 256)}$ =1.1641, p=.190	χ^2 (1, N = 259) =2.949, p=.400, Cramer's Value=.201
Is the park more of a liability to you?	$F_{(3, 256)}$ =.639, p=.591	χ^2 (, N = 259) =2.899, p=.821, Cramer's Value=.134
Do you participate in resolving human-wildlife conflicts?	$F_{(3, 256)}$ =4.211, p=.007	χ^2 (1, N=259) =20.538, p=0.303, Cramer's Value= .216
Does the collaboration between park management and the community contribute towards protection of ecological integrity?	$F_{(3, 256)}$ =10.103, p=.000	χ^2(1, N = 259) =25.99, p=.000, Cramer's Vaflue=.452
Are you aware of the park boundaries?	$F_{(3, 256)}$ =4.717, p=.001	χ^2 (1, N = 259) =9.657, p=.001, Cramer's Value=.230
Do you participate in maintaining the park boundaries?	$F_{(3, 256)}$ =1.723, p=.060	χ^2 (1, N = 259) =3.876, p=.275, Cramer's Value=.153
Do you think the park has contributed to the increase in number of wildlife animals?	$F_{(3, 256)}$ =1.132, p =.001	χ^2 (1, N = 259) =1.642, p=.650, Cramer's Value=.095
Do the benefits enjoyed by communities from the PAs contribute to poverty reduction?	$F_{(3, 256)}$ =2.957, p=.001	χ^2 (1, N=259) = 38.479, p=.001, Cramer's Value= .283.

Local communities participate in collaborative resource management where protected area management shares benefits, decision-making, authority and responsibility in the management of protected areas or their resources with the local people. Through this collaboration, communities enjoy a multiple of benefits from the wildlife protected areas which contribute to poverty reduction (χ^2 (1, N=259) = 38.479, p=.001, Cramer's

Value= .283 and F $_{(3, 256)}$ =2.957, p=.001) (Table 2). The high Cramer's value indicates that collaborative resource management plays a vital role in conservation and poverty reduction in the communities. The community benefits were: resource access and use (21%), employment (19%), environmental services (18%), community tourism enterprises (17%), appreciating wildlife and beauty (8%), revenue sharing (5%), culture related benefits (5%), scholarships (5%), and wildlife use rights which trailed with (2%) (N=259).

Local communities around Queen Elizabeth National Park participate in the management of Queen Elizabeth Man and Biosphere reserve. Queen Elizabeth National Park, a UNESCO Man and Biosphere (MAB) Reserve, has 11 fishing enclaves which include Hamukungu, Kahendero, Kasenyi, Kashaka, Katunguru in Rubirizi, Kayanja, Kisenyi, Katwe-Kabatoro, Rwenshama, Kazinga and Katunguru in Kasese which were all gazetted except Katunguru in Kasese. From the FGDs, local communities participate through waste management, and setting up apiaries.

On the whole, local communities cited various reasons for their participation in wildlife conservation programmes, and these were mainly: willingly participate, out of concern for wildlife, and continual availability of the in-park resources (χ^2 (2, N = 259) = 46.013, p =.000, Cramer's Value=.588 and F $_{(3, 256)}$ =2.957, p=.001) (Table 2), and the high Cramer's value indicates very strongly that the reasons for participation were fundamental. In addition, community commitment to wildlife conservation was motivated by key factors: incentives, cultural attachment, and collaboration with other stakeholders, guaranteeing resources for future conservation and recognition of indigenous people's rights to conservation, among others. (Fig. 4)

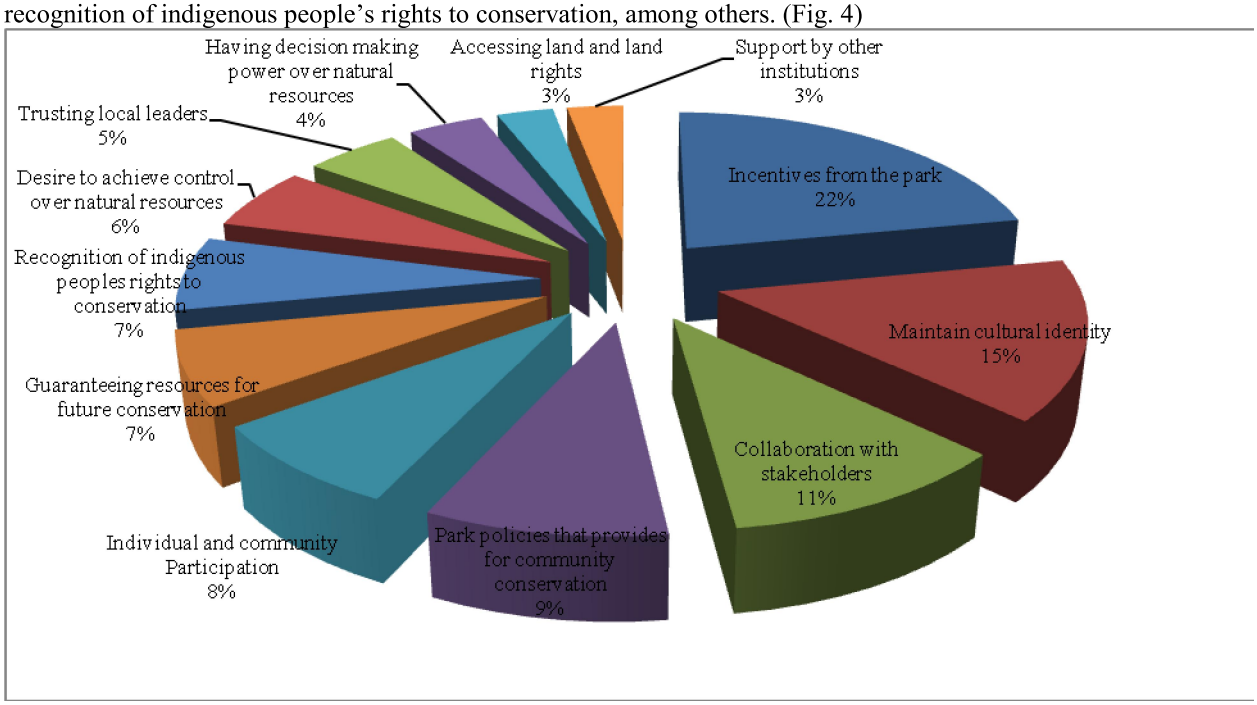

Fig. 4: Factors that motivate Communities to Commit to Conservation Programmes and Activities

Despite local community participation in wildlife conservation programmes, indigenous people's property was not protected by park management. This was asserted by local communities in their response to the question of whether the park animals had strayed on people's farm or dwelling, where the responses revealed a statistically significant response in community responses with χ^2 (1, N = 259) =4.203, p=.000, Cramer's Value=.240 and F $_{(3, 256)}$ =1.245, p=.000. The wild animals (especially problem animals and vermin) destroy property (crops, livestock), cause injury/death to humans, and spread zoonotic diseases to livestock. Compensation for loss of indigenous peoples' property was not done (χ^2 (1, N = 259) =2.949, p=.400, Cramer's Value=.201 and F $_{(3, 256)}$ =1.1641, p=.190). Because of this, local communities viewed the parks as a liability to them, (χ^2 (1, N = 259) =2.899, p=.821, Cramer's Value=.134 and F $_{(3, 256)}$ =.639, p=.591). (Table 2)

Despite community participation in wildlife conservation programmes, local communities still pose a threat to wildlife conservation. The FGDs with park staff revealed that the local communities adjacent the wildlife protected areas threaten both wild fauna and flora, specifically, through: spread of invasive alien species from the community to the wild, spread of fires from agricultural fields to the wild, armed poaching and illegal wildlife trade/trafficking in wild meat and Ivory, poisoning of lions, grazing into the parks, illegal park resource off-take, boundary encroachment through agricultural development and urbanization, and zoonotic and vector-borne diseases transmission, which all constrain conservation efforts.

The local authorities and private sector also participate in the conservation of the park and its resources. When asked about their role in the conservation of the park and its resources, they indicated mobilization and sensitization

(36%), supporting programmes that generate economic and other benefits to local communities (29%), reconciling the goals of conservation and development in the communities (20%), participation in resolving human-wildlife conflicts (12%), and participation in the formulation of park general management plans (3%) (χ^2 (1, N = 259) = 17.021, p =.000, Cramer's Value=.261). The high Cramer's value indicates that local authorities play a vital role in conservation of biodiversity and ecological integrity. Specifically, they participate in conservation-related initiatives mainly: i) removal of snares from the PAs, ii) conservation education, iii) carrying out research on wildlife, iv) operating science centres, v) promote use of improved cook stoves to reduce on the demand for fuelwood from the park, vi) promote community tourism and cultural values, vii) conduct nature walks, viii) maintain tourism trails in collaboration with UWA, ix) carry out chimpanzee habituation, x) monitor access and use of in-park resources, xi) translocation of selected game from the ranches, xii) human-wildlife conflict resolution, and xiii) maintain access roads to tourism sites. These initiatives generally contribute to conserving the wildlife through empowering community participation and resource management, enterprise-based conservation, and handling conflicts between the park and community.

3.2 The usefulness of CBC in the protection of ecological integrity

Local community participation has resulted into increased community knowledge of Key Park attributes, mainly, park boundary management ($F_{(3, 256)} = 4.717$, $p = 0.001$, $\alpha = .001$), wildlife population ($F_{(3, 256)} = 1.132$, $p = .001$, $\alpha = .001$), increase in frequency of fires in the savanna parks ($F_{(3, 256)} = 3.426$, $p = 0.001$, $\alpha = .001$), increase in invasive species ($F_{(3, 259)} = 8.352$, p=.000), and community-based tourism ($F_{(3, 256)} = 1.903$, p=.133) (Table 2). Further, collaboration between local communities and protected area management has also improved. The private sector supports community conservation work through capacity building, and providing finances to fund conservation-related projects that help in contributing towards conservation of the wildlife protected areas (χ^2 (1, N = 259) =25.99, p=.000, Cramer's Value=.452 and $F_{(3, 259)} = 10.103$, p=.000) (Table 2). Specifically, local communities participate in boundary maintenance through dual management (e.g in Kibale National Park, Kalinzu-corridor and Kasyoha-Kitomi Forest Reserve), and taungya system (e.g in sections of Rwenzori Mountains National Park). These management regimes serve three functions: protect the park boundary, monitor activities along the park boundary, and scare away wild animals back into the parks. Through participation, local communities gain financial and non-financial benefits. Some of the benefits are acquired through resource access—fish, honey, mushrooms, bamboo, medicinal plants, timber, building poles, grass for construction, stakes for farming, firewood, snail shells, and elephant dung for paper making. These further create appreciation and acceptance of wildlife resources. More still, there was increase in scope of community-based tourism programs, products and services to the tourists, and these include nature trails, mountain climbing, tracking of lions, birding, different cultures, art products, crafts, performance arts, conservation education, boat riding, and music, dance and drama which contribute to conservation of biodiversity in the parks. Finally, eco-lodges and campsites outside the national parks have since grown over the last decade, an indication of growth in CBC. This growth has been achieved through collaboration of local communities, CBOs/NGOs, tour industry, and park management.

3.3 Challenges facing Community Based Conservation

The FGDs with local communities, park management and private sector revealed key challenges. There was a governance challenge in managing finances to support community conservation and livelihood projects. Counter accusations between local communities and local authorities on misuse of funds received under the revenue sharing scheme and minimal tangible benefits existed. Inadequate community representation and involvement in decision making was another challenge. For instance, local communities participated minimally in identification of community projects, hence their voices were minimally captured. In addition, community involvement in illegal activities mainly entry in the park to access and use in-park resources without permits ($F_{(3, 256)} = 3.180$, p=.027) and resource use agreements with park management ($F_{(3, 256)} = 1.796$, p=.152) (Table 2), as well as engaging in armed poaching activities were common. This was reported by park rangers and acknowledged by park adjacent communities. Managing unrealistic community expectations was another challenge. The communities had a feeling that periodically they should be allowed to hunt inside the park for wild meat, income generation, and consequently livelihood improvement. Finally, negative attitudes of local communities towards wildlife conservation was a challenge, too.

4. Discussion

Our study evaluated how the community-based conservation protects ecological integrity, the usefulness of CBC, and the challenges communities face in participating in conservation programmes, and then recommend management strategies in future management and policy decisions. Communities participate in conservation education and awareness programme, which is an essential tool for achieving conservation sustainability. Local people's participation is key for the conservation activities at grassroots level; and awareness programme with well collaboration with local people is always a necessity for making them conscious about biodiversity

conservation and its importance (Lamichhane, 2020). Communities participate in management decision making in the development of general management plans, and implementation of community development programmes. They do not participate in resolving human-wildlife conflicts and sharing conservation-related responsibility. There is an urgent need for the policy community to implement mechanisms that foster social engagement to achieve global conservation targets (UNEP-CBD, 2020). These findings support our first hypothesis that park adjacent communities participate in conservation programmes of the protected areas. They are similar to those reported by other researchers (Andrade & Rhodes, 2012; Kothari et al., 2013; Liberati et al., 2016). Indigenous peoples and local communities need to have a voice in decision-making, as partners with others or on their own,…and equitable sharing of powers, costs, and benefits of conservation must be ensured, which will enhance public support; and local citizens must hold or share authority in management (Kothari et al., 2013). Creating partnerships with local communities, and including local communities in PA-management decision making are essential to help protect PAs (Andrade & Rhodes, 2012; Liberati et al., 2016). Park management supports park adjacent communities through the benefit sharing schemes mainly conservation awareness and education, collaborative resource management, resource access, revenue sharing, community tourism, and wildlife enterprises/business opportunities. This support results into great non-financial benefits, namely, (1) increased appreciation of wildlife, (2) garnering support for the protection of the wildlife protected areas, (3) community involvement in decision-making, (4) linking planning for conservation with planning for development, and (5) provide mechanism for communication, where views, concerns and opinions on management of the protected area can be shared between park management and communities. Strengthening the benefit sharing scheme could result into ownership and acceptance of wildlife and protected areas. National parks, and other protected areas must strive to involve indigenous people in protected area management, and protect their access rights if these areas are to be considered equitable (Blaustein, 2007).

Communities participate in community based tourism through offering various tourism programs, products and services—nature walks, mountain climbing, tracking of lions, birding, different cultures, art products, crafts, performance arts, conservation education, boat riding, music, dance and drama— through which they generate income that motivates them to participate in conservation work. Community participation in tourism could be associated with the financial benefits from the tourism industry, and this supports the findings of other researchers that tourism is a dominant mechanism to reduce poverty and provide employment near PAs (Ferraro & Hanauer, 2014; Naidoo et al., 2016). Communities play various roles in the conservation and management of biodiversity: (1) conserving nature through promoting tourism products (2) tour guiding; (3) awareness creation and education through sharing tourism information with their visitors; (4) ensuring safety of wild fauna around their tourism facilities; (5) mobilizing revenue to the parks through booking-in tourists; (6) helping expose and market the park and its resources to the world; (7) working with communities to scare away problem animals back into the wild; and (8) reducing on illegal activities through well packaged conservation messages to the communities, which should be strengthened.

Communities participate in protecting indigenous peoples' property. Community scouts and volunteers jointly with park rangers protect indigenous peoples' property from wild animals who not only *scare* them back into the wild as they guard crops against damage, but also save them from human attach. The scouts and volunteers use drums, torches, vuvuzelas, and other traditional means. National parks, and other protected areas must strive to involve indigenous people in protected area management, protect property, and access rights if these areas are to be considered equitable from an Indigenous perspective (Blaustein, 2007).

Communities minimally participate in the management of Queen Elizabeth Man and Biosphere reserve. *"*Queen Elizabeth National Park was designated as a UNESCO Man and Biosphere (MAB) Reserve in 1979 in recognition of the role it plays in providing an opportunity to explore and demonstrate approaches to sustainable resource utilization by its 11 fishing enclaves. This Biosphere reserve supports a wide range of Uganda's natural habitats and diverse landforms, including grassy plains, distinctive savanna woodlands, tropical forest, wetlands, rivers, swamps, lakes and volcanic craters; and a biodiversity hotspot within the framework of ecosystem approach for sustainable development. The reserve has a greater biodiversity, and is a model for conservation education, research and monitoring of biodiversity trends" (UWA, 2012). The vast savannah and forest animal species (Katswera et al., 2020) and the scenic landforms attract an increasing number of tourists to the reserve hence contributing greatly to the country's tourism industry. The Queen Elizabeth Man and Biosphere reserve is a home to an increasing large mammal population mainly hippopotamus, elephant, buffalo, Uganda Kob, waterbuck, Topi, lion, and leopard (UWA, 2012); and which are threatened by anthropogenic and natural factors (Katswera et al., 2020).

Local authorities participate in conservation and management programmes through (1) community mobilization and sensitization towards conservation of the wildlife PAs, (2) increasing the economic and other benefits by supporting resource access and use arrangement, (3) reconciling the goals of conservation and development, (4) participating in resolving human-wildlife conflicts, and (5) participating in formulation of park general management plans. Community-based conservation can encompass initiatives with different aims,

governance systems, and levels of local decision-making power, ranging from self-regulated to co-managed conservation strategies (Dudley, 2008). These initiatives contribute to conserving the wildlife, promoting tourism, and also help to better connect people to nature. Strong institutional arrangements with favorable policy, well coordination between government agencies and conservation partners including local communities is key to success (Lamichhane, 2020). This reinforces the assertion that multiple conservation stakeholders should embrace socio-ecological management practices to ensure biodiversity protection (Campos-Silva et al., 2021).

Local community participation in wildlife conservation programmes is motivated by various factors which are basically self-centered and these are mainly (1) incentives provided by the parks, (2) cultural attachment, (3) local stakeholder collaboration, (4) community responsive park policies, (5) community involvement in park activities, (6) guaranteeing resources for future conservation, (7) recognition of indigenous peoples rights to conservation, and (8) desire to achieve control over natural resources. Conservation efforts incorporate the interests and views of local people (Western & Wright (Eds), 1994). However, local communities present threats to wildlife resources which cause loss to floral and faunal biodiversity, and degrade their habitats and conservation in general. These threats could be attributed to anthropogenic factors including settlement, and agricultural expansion, resource off-take for livelihoods. Fires from agricultural activity, illegal uptake of in-park resources, increasing human population pressure, and boundary encroachment through agricultural development are primary threats to conservation of biodiversity (Katswera et al., 2020).

CBC creates increased community knowledge and collaboration on conservation and management of biodiversity which builds appreciation and capacity of local communities for the wise use of biodiversity and other natural resources since they now have a stake in resource conservation and management. Democratic, equitable governance must be core principles in conservation policy and practice, and communities need to own the process of self organisation and utilisation of natural resources (Kothari et al., 2013). Therefore, CBC to be effective, governments and wildlife institutions should relinquish some or even most of its powers to the local people to empower them make their decisions (Songorwa et al., 2000). CBC creates increased community participation in park boundary management through dual management, taungya system, and scaring wild animals back into the parks saving them from human attach. This community participation reduces on boundary contentions between the park and the communities, reduces on the damage the animals would cause if they had strayed into the community, and therefore contributes to achieving success in conservation. These findings support our second hypothesis that CBC is useful in conserving biodiversity and protecting ecological integrity. Further, through community participation, communities enjoy financial and no-financial benefits from the different benefit sharing schemes. The benefits contribute towards improving community livelihoods and people-park relations. In addition, community-based tourism programs and products have widened. For instance, the Uganda Carnivore Program has dedicated resources to save Uganda's lions and other carnivores such as leopards and hyenas in Queen Elizabeth Protected Area through research and monitoring, and fostering working relationships with local communities. Eco-lodges and campsites outside the national parks and wildlife reserves have since grown over the last decade. Such interventions contribute towards socio-economic transformation, and also build a lasting impression in the communities.

Despite the contribution of community-based conservation to biodiversity conservation and protection of ecological integrity it still faces various challenges. This finding concurs with our third hypothesis that communities experience various challenges during their participation in conservation programmes. The performance of community-based conservation is challenged by poor governance, poor management of revenue sharing funds and related issues in conservation, limited community involvement in conservation-related decision making, involvement of communities in illegal activities, and managing unrealistic community expectations. Finally, the findings support our third hypothesis that communities experience various challenges during their participation in conservation programmes.

5. Conclusion and recommendations

5.1 Conclusion

Using a survey of four national parks and four wildlife reserves in Kibale and Queen Elizabeth Conservation Areas in Uganda, we accurately evaluated the extent of community participation in protecting ecological integrity, the usefulness of CBC, and the challenges communities face in participating in conservation programmes. The local communities participate in conservation education and awareness programme, development of general management plans, benefit sharing schemes, and protecting indigenous peoples' property, which participation results in increased community knowledge and collaboration, increased community participation in park boundary management, financial and no-financial benefits that contribute towards improving community welfare; creating trust, belonging, acceptance of biodiversity conservation; reducing pressure on biodiversity; and improving community-park relations. Understanding community participation, its usefulness in conservation, and the challenges communities living adjacent wildlife protected areas face should guide policy-makers, conservation managers, practitioners and planners in their decision-making processes to strengthen CBC since it contributes to

the overall protection of ecological integrity. We hope this understanding can advance CBC in Uganda and globally.

5.2 Recommendations

This present study provides policy recommendations to strengthen community-based conservation as an integral part of biodiversity conservation in PAs and other natural resources. The wildlife agency, policy-makers, conservation managers, practitioners and planners should ensure increased involvement and collaboration of the park adjacent communities, local authorities, private sector, environmental decision makers, educators and education institutions in conserving biodiversity through use of information, education and communication materials and other strategies to disseminate wildlife conservation information. The wildlife agency, the Ministry responsible for Education, and the National Curriculum Development Centre should integrate environment and wildlife conservation education in the national education curricula as this will help communities and other stakeholders appreciate the value of wildlife conservation. The wildlife agency, local authorities and private sector should expand wildlife conservation education and awareness programs to target local communities to promote intangible benefits of PAs and also garner their support. The wildlife agency should revise the revenue sharing policy and guidelines to capture the entire affected frontline parishes since the existing policy only considers frontline villages to the park and yet problem animals and vermin cause damage to crops and livestock, injury and loss of life even beyond the frontline villages. The wildlife agency should consider promoting biodiversity conservation while meeting human needs through developing community livelihood policy, and designing incentives to support community projects and enterprises for the park frontline communities to contribute towards poverty reduction, strengthening community-park relations, and conservation in general. The wildlife agency in collaboration with local authorities and private sector should create and strengthen community conservation institutions (including community wildlife scouts committees) to participate in conserving biodiversity *In-situ* and *Ex-situ*. The community wildlife scouts committee would participate in aspects such as wildlife conservation outside protected areas, human-wildlife conflict mitigation, community engagement, wildlife data collection, conservation awareness, community-based tourism, enterprise identification and development, intelligence gathering on wildlife crimes and law enforcement. The wildlife agency should encourage establishment of conservancies on private land adjacent the national parks and wildlife reserves where land is available, which would contribute towards income generation in the local communities, strengthen collaboration with the park, improve on community-park relations, and ultimately improve conservation and management of biodiversity. Finally, future research should explore local community perceptions and attitudes towards the wildlife conservation with a view to improve park-people relationships; and conduct site-level assessment of governance and equity of protected areas.

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Authors' contributions

J.K. initiated and shared the research idea, drafted the concept, coordinated the data collection and analysis and wrote the first draft of the manuscript. N.M.M and C.K.T assessed the draft concept of the manuscript, made conceptual guidance to collect right data and made critical intellectual adjustments on the first manuscript to make it a clear scientifically and logically drafted manuscript. All authors assessed and approved the final copy of the manuscript for submission.

Competing interests

The authors declare no competing interests.

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