The Rufford Foundation
Final Report

Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Abel MUSANA
Project title	Human – Mountain Gorilla Conflict and Conservation Implications Around the Volcanoes National Park, Rwanda.
RSG reference	25383-1
Reporting period	July 1st 2018 – May 31st 2019
Amount of grant	5000
Your email address	abelmusana@gmail.com
Date of this report	June 1st 2019

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
To evaluate the impact of the conflict for mountain gorillas, for farmers and resultant local attitudes to mountain gorilla conservation				
To Propose solutions to mitigate consequences of Human – gorilla conflicts around the VNP				

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

There were no major problems encountered in the execution of this project. However, in most cases, it was obliged to be flexible during the field data collection schedules due to other on-going programmes and scheduled activities by the local government and the Park management.

3. Briefly describe the three most important outcomes of your project.

- The biggest conservation outcome this project contributed towards is the conservation of mountain gorilla through a better understanding of the dispersal and ranging behaviour of mountain gorilla outside of the Volcanoes National Park.
- The project provided baseline information on different determinants of gorilla ranging behaviour and crop-raiding to support evidence-based mountain gorilla conservation strategies in Volcanoes National Park where a wide variety of park's animal species are involved in conflicts with neighbouring communities and the impact they cause to them is significant. Direct gorilla damage of crops is commonly one of the main drivers of human-conflict around the Volcanoes National Park, and many tools exist for reducing such damage.
- Finally, the project proposes different HWC mitigation measures, not currently in use around VNP but which are used in other places where crop raiding is an issue to wildlife conservation and farmers as they were prosed by different stakeholders who participated in this project.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

First of all, local community participated in this project as they were consulted in the survey. A structured survey using questionnaires was conducted outside the VNP where crop raiding cases by habituated and regularly tracked mountain gorilla are known to occur, to evaluate the perception and repercussions of mountain gorilla conflict. The survey will be conducted within an area covering 1 km along the park boundary and 135 farmers met were invited to participate in the survey. Secondly,

during the implementation of this project, we met and collaborated with a cooperatives of crop guardians that we encouraged to continue their contribution of using friendly methods to guard their crops.

5. Are there any plans to continue this work?

Yes. This work will continue as part of a long-term mountain gorilla monitoring programme whereby a research oriented data collection sheet targeting mountain gorilla outside of the park has been integrated. Data to be collected will serve other researchers who will be putting interest to this topic. In collaboration with the park management and existing community based conservation cooperatives; it is envisaged that some members will be provided trainings to safely know how to peacefully co-exist with primates (mountain gorillas) or friendly scare them off community land.

6. How do you plan to share the results of your work with others?

In addition to a targeted this research project's results publication in a peer - reviewed journal, it is also envisaged that findings of this project will be shared using presentations flyers, posters, brochures. Targeted audience is composed of conservation practitioners; conservation researchers, local authorities and community people living in area adjacent to the Volcanoes National Park.

7. Timescale: Over what period was The Rufford Foundation grant used? How does this compare to the anticipated or actual length of the project?

The project spanned over approximatively 11 months beyond the anticipated 10-month period fixed during project planning. The slight delay was caused by small delay encountered in the community survey.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Daily subsistence allowance for the Team Leader for field reconnaissance	250	250		The budget of the activity was used as planned
Training of 4 field enumerators for 3 days (Transport, venue hiring and food)	50	50		Used for the planned activity
Transport for field work - enumerators Surveying community around the park: 4 people*30 days*25 £	2000	2250	-250	The option of hiring 2 field car and fuel it was chosen to ensure transport

Transport for field work - Gorilla distribution and home-range use data collection - 2 people*30 days*25 £	1150	1150		Used for the planned activity
Buying a GPS Unit and batteries (Garmin)	300	150	+150	We hired a GPS from a land surveying company for the duration of the project and the balance was used to cover part of the transport need that was exposed
Daily allowance for 2 enumerators for 2 months	1000	1000		Used as planned
Report production and results dissemination/ publication	250	100	-150	Part of the amount was reallocated to transport and the remaining amount will be used to pay publication fees or producing posters which is aimed in results dissemination
Total	**5000**	**4950**	**-50**	1 UK Pound Sterling = 1176 Rwanda Francs

9. Looking ahead, what do you feel are the important next steps?

In the future, the park management can systematically explore the possibility of recording all expenses related to crop-raiding and set mechanisms of a fair compensation of local farmers. Further study to explore ways and means of establishing a buffer zone around the park to allow proper management of human – wildlife conflicts is needed. There is also a need of systematic local community and local authorities' sensitisation about living in harmony with park animals when they range outside of the park.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did The Rufford Foundation receive any publicity during the course of your work?

The Rufford logo and full acknowledgement for the funding support will be made on the final project findings report, presentations in the conference or talks envisaged and any publication or distribution material coming from this work will be communicated to the grant provider.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

The completion of this work was possible thanks to the efforts of different people: the field work team with **Charles Kayijamahe** who additionally supported the project with his data analysis and mapping skills, **Francois Ndungutse**, coordinator of a local community conservation cooperative who along with **Bernard Bizimana** participated as field surveyor facilitators. Fidele Nizeyimana, ecological monitoring agent of the Volcanoes National park who provided a valuable support to easily

access mountain gorilla long-term monitoring data as well as the team of park trackers who facilitated access to the visited mountain gorilla groups.

12. Any other comments?

I would like to express my sincere gratitude to Rufford Foundation for having provided the financial support to undertake this research project. Further annexes below.

Annex 1 below

Annex 1

1. **Frequencies of mountain gorillas outside of the park**

From long-term data of a 48-month period of observation and data collection, we selected 4 mountain gorilla groups that were recorded outside the park in five villages that are subjects of this research project. Figure 1 shows changes in cases of ranging outside of the studied gorillas' groups.

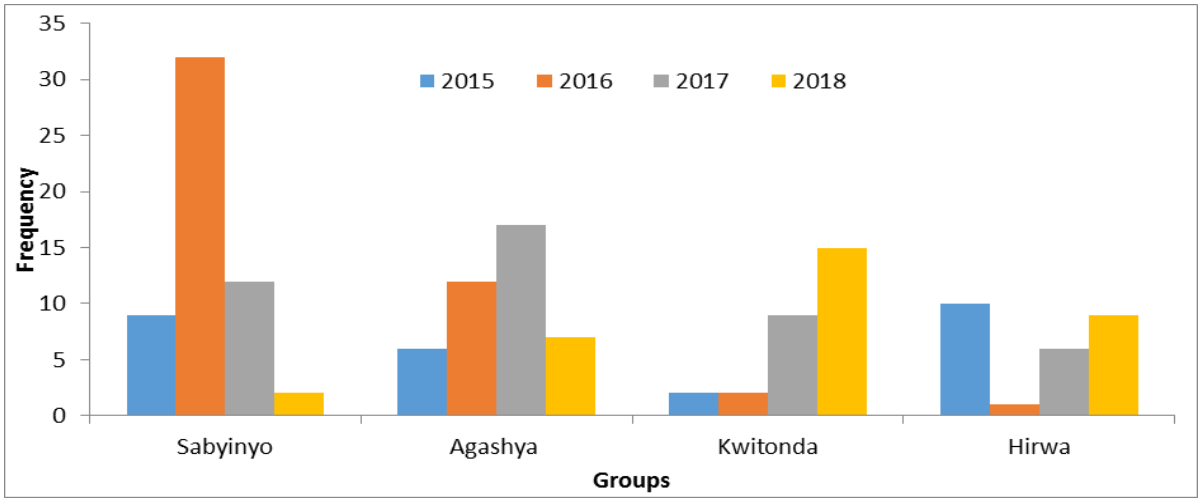


Figure 1: Frequency of mountain gorilla outside of the VNP

2. **Seasonal patterns of crop raiding by mountain gorilla in VNP**

Based on the long term data, by dividing the year into 4 quarters (January - March, April- June, July -September, and October - December), we analysed the seasonality in mountain gorilla's use of the area adjacent to the park from 2015 to 2019. Crop raiding incidents by mountain gorillas in VNP differed by months for the period of the study as presented in Figure 2.

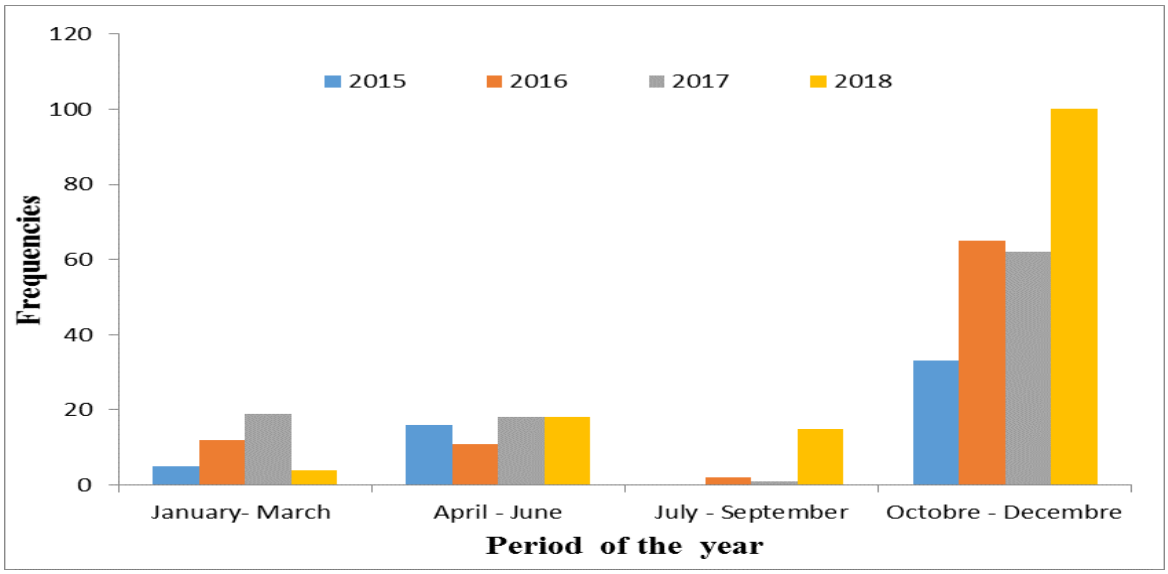


Figure 2: Seasonal patterns of crop raiding by mountain gorilla in VNP, Rwanda.

3. Spatial patterns of crop raiding by mountain gorilla in VNP

Most of the damage events occurred in fields located within 100 m from the forest edge, indicating that farms closest to the forest edge were the most frequently raided by mountain gorillas as illustrated in figure 3 and table 1:

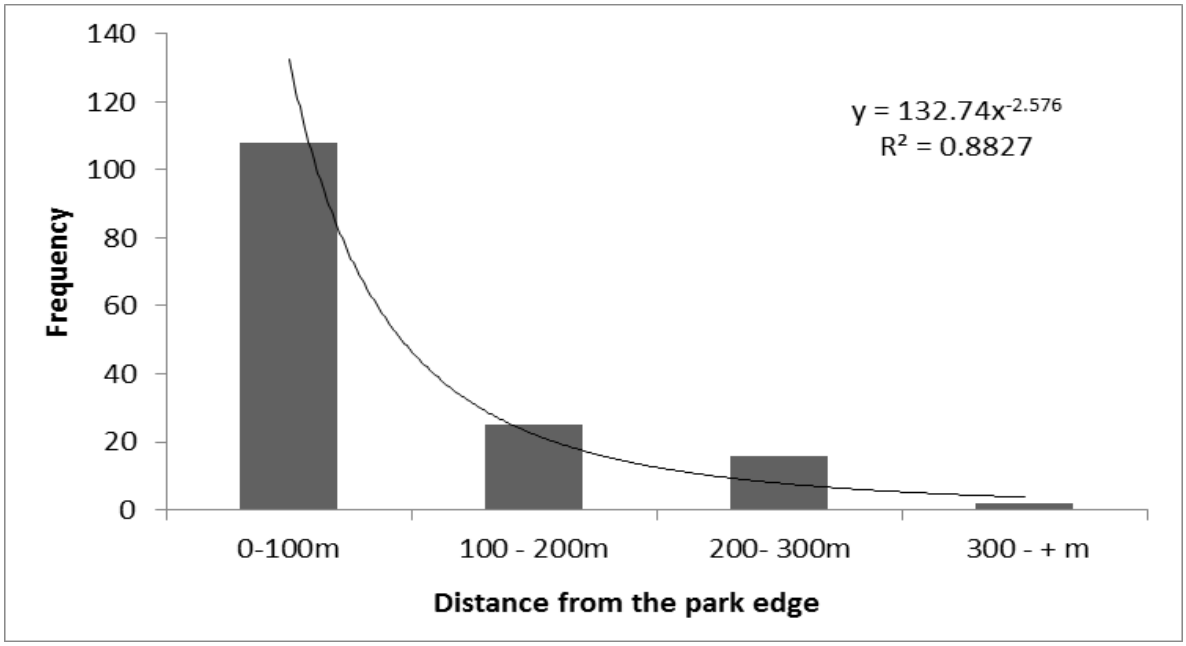


Figure 3. Frequency of gorilla damages as a function of the distance from the forest edge.

Table 1. Spatial patterns of gorilla crop raiding around VNP.

Gorilla Family	Mean Number of Individuals	Mean Distance of raid from Parks boundary (m)	Farthest distance of raid from Parks boundary (m)	Number of times of raid	Mean of times of raid /month/Family
Sabyinyo		110.3	1000	55	1.14
Agashya		127.65	400	42	0.87
Kwitonda		246.07	700	28	0.58
Hirwa		98.26	270	26	0.54
Total				**151**	

4. Gorilla feeding behaviour outside of the Park

Mountain gorillas are reported to damage some plant species when they range outside of the park including certain plants belonging to local communities. Figure 4 shows the frequencies of the plants species that are preferred by mountain gorillas based on four years of data. There were five main plant species recorded; plant/crop type with a record percentage that was less than 2 was categorized into "other".

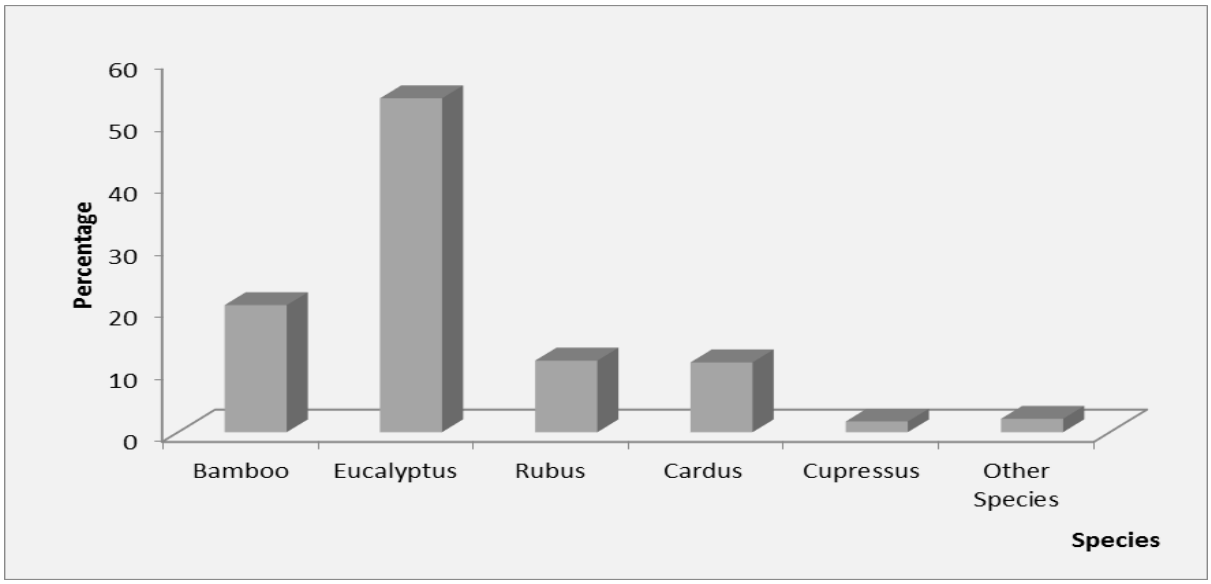
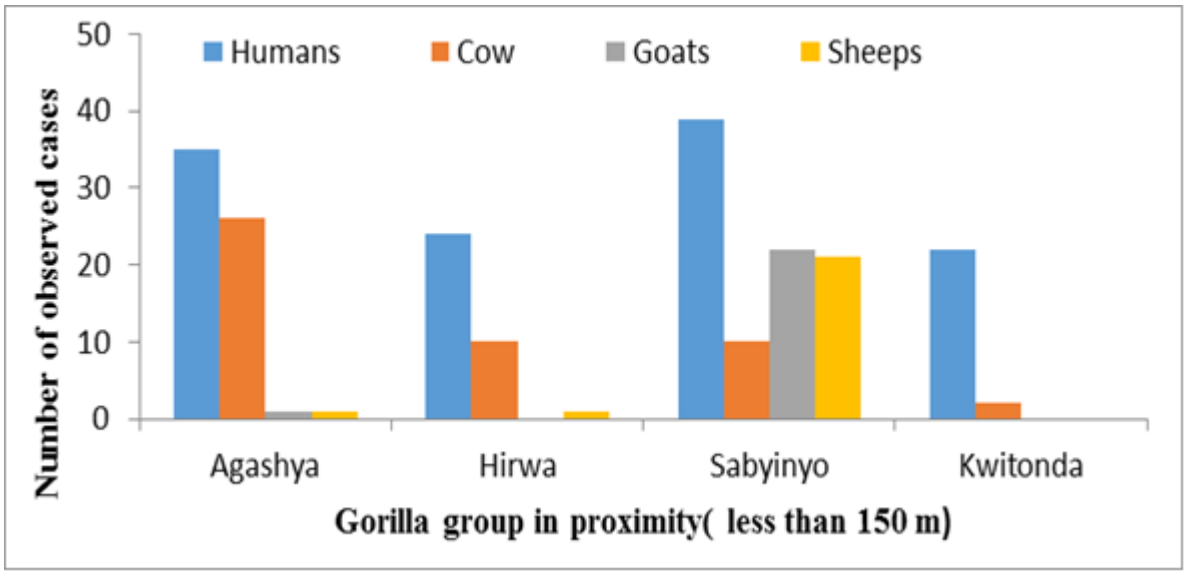


Figure 4. Plant species eaten by mountain gorillas around VNP

Overall, eucalyptus (*Eucalyptus camaldulensis*) and bamboo (*Sinarundinaria alpina*) are the plant species that are raided most by mountain gorillas outside Volcanoes National Park, followed by raspberry spp. (*Rubus spectabilis*), thistle (*Carduus* species) and cypress.

5. Gorilla, domestic animal and human interface around VNP

In the area adjacent to mountain gorillas' home range around the VNP, gorillas, humans and domestic animals are increasingly coming into direct proximity, competition, and conflict with each other. VNP gorillas, when they range outside of the park have regular contact with humans and domestic animals including cows, goats and sheep. Figure 8 illustrates cases of proximity between gorillas and people and domestic animals where the distance was less than 150 m.



6. Local perceptions and conservation implications of gorilla crop raiding around VNP

- Overview of the respondents

In all five villages where the survey was undertaken, 71% of the responses were from males while 48% of the responses were from females. This helped to avoid bias in data that were collected because it was important to get views from both gender parties. From 45 respondents who have been victims of crop raiding, 60% of them owned at least 8 acres of land, and 40% owned one to four acres.

Farmers were asked which animals damaged their crops most frequently and to rank mountain gorilla if included according to its perceived severity. The top 5 most cited in order were buffalos, golden monkeys, mountain gorillas, elephants and duiker as illustrated in Table 2. Each species was given a score based on their ranking by farmers. Weighted ranks were calculated from the ranks farmers assigned to different wildlife species to indicate how species compared with each other with respect to the crop damage they caused. This enabled an overall raider's score to be calculated using The Kendall Coefficient of Concordance formula: Overall ranking = Σ (score × n) / N where n is number of respondents ranking the species and N is total number of respondents in the sample.

Table 2. Wildlife species reported as being responsible for crop damage by respondents interviewed during the questionnaire survey (n = 135)

Species	# of households reporting it	# of households ranking species first	Weighted Rank
Buffalo (*Cyncerus caffer*)	135	103	1
G. monkey *(Cercopithecus mitis kandti)*	126	53	2
M. gorilla *(Gorilla beringei beringei)*	98	32	3
Elephant (*Loxodonta africana*)	59	11	4
Duiker (*Cephalophus nigrifrons*)	39	7	5

In VNP, 32% of respondents reported problems with Mountain gorillas. Nevertheless, most respondents claimed that other animal species, including golden monkeys, buffalos, elephants and duikers were the most problematic crop pests. There was a significant difference between study villages in response to the question over which species raided crops most frequently ($\chi2 = 38.81$, df = 21, $P<0.06$), but for the most destructive ($\chi2 = 17.013$, df = 28 $P = 0.695$) and the most feared ($\chi2 = 4,375$, df = 6, $P = 0.319$) species there was no difference. Buffalos were ranked as the first most frequent crop pest entering farmlands (76.29%) and first most destructive (17%), but elephant was the most feared (31%) species.

- Reported types of crop damaged by mountain gorillas

Irish potatoes, maize, wild papaya, and pyrethrum were the plants species most commonly grown in the study area. These plants species are associated with (agro) forestry species composed especially of eucalyptus and bamboo. Data were collected on crops most affected by gorilla crop raiding. Eucalyptus, bamboo and wild papaya were considered by local farmers to be the crops most preferred by mountain gorillas (Table 3). There are other plants species that are eaten by mountain gorillas when they are outside the park, which were reported in rangers' reports but not reported by farmers because they do not grow them in their fields or they are of less economic importance for them.

Table 3. Most seriously damaged crops by mountain gorillas according to respondents.

Most damaged crop reported	**Percentage of farmers citing crop**
Eucalyptus *(Eucalyptus spp)*	83.7
Bamboo (Sinarundinari *alpina*).	70.03
Wild papaya (*Carica papaya*)	45.92

VNP gorillas that range near park boundaries selected Eucalyptus bark and bamboo leaves and shoots most commonly as reported by 83.7% of the respondents. It was reported that gorillas eat eucalyptus every time they range outside the park as this tree species is available in fields adjacent to the park.

- Mountain gorillas crop raiding protection strategies in VNP

The main method used locally to protect fields from wildlife, and especially mountain gorillas, is guarding/ patrolling the fields and chasing out intruding animals, including groups of gorillas (Figure10). Strategies used by farmers to reduce the intensity and severity of damages by mountain gorillas around VNP range from individual and households' efforts to those that require community and conservation partner support. Guarding techniques were reported being used to respond to crop-raiding by mountain gorillas around VNP. Of the farmers interviewed (N= 135), 45.5% reported that they shouted (make noise) to prevent crop raiding, 26.7% claimed that they had never done anything to avoid a gorilla crop raiding, and friendly chasing was reported to be used by 11.1 % of the respondents. This latter method was reported to be used only when there was a presence of the park staff at the site of incidence. The fourth guarding method that was reported to be used in protecting farms from gorilla damages is the use of an ordinary umbrella with dominance of red colour. Farmers use the technique either alone or in combination with other techniques and this was reported by 6.35 of respondents. Daily crop guarding activities were undertaken by children aged 7- 14 years as reported by 69 % of the respondents (N=135).

Adult people, who were in most cases associated into crop guarding teams, are responsible for night guarding activities. This was reported by 95.11 % of the respondents. Crop protection was organized and fields were mainly protected on

an individual basis for daily guarding with cooperation between farmers for night guarding.

- Farmer tolerance towards crop raiding gorillas

Most (86%) respondents from the study area showed benign tolerance toward mountain gorillas when they range outside of the park, and ignored them as they are not perceived as threat to human lives. However, respondents were fearful because gorillas are increasing the time they spend outside the park and continue destroying crops. Respondents highlighted a dilemma with gorillas. On the one hand, 91% of them confirmed the confidence of having mountain gorillas as a lucrative tourism product important for both them and the country. Within this perspective, they wish that the future generations would enjoy the = same tourism experience. On the other hand, they noted that this comes at a cost to their livelihood as they damage their crops and should in turn impede on the tolerance and respect that local community do have for gorillas.

- Proposed mechanisms to reduce gorilla crop raiding

When asked what should be done to manage the problem of crop raiding by gorillas in VNP, 77.7 % (N = 135) of the respondents among local communities and 84.2% (N =19) of park managers and partners suggested that compensation for all economic loss should be the best way to deal with the problem. They added that Rwanda Development Board (RDB) should handle the crop-raiding gorilla problem. Some (15.5% of local community and 10.3% of park managers and stakeholders) suggested that there should be translocation of communities that are close to the park boundary and the establishment of a viable buffer zone around the park for which a management plan favouring activities that are not attractive to gorillas should be developed, whereas some (8.1%) were unsure of what would work. Furthermore, 89.4% of the interviewees among park managers and conservation partners (N= 19) proposed that there should be creation of a monoculture of unattractive crops which might be set as a buffer to discourage primate crop raiding including gorillas. On the question of support provided to farmers who are victims of crop raiding, Rwanda Development Board and Conservation NGOs including International Gorilla Conservation Programme (IGCP) and Dian Fossey Gorilla Fund - Karisoke Research Center (DFGF–KRC) provide limited support to victims of crop raiding in general and mountain gorillas in particular, and this was noted by 74.3% of the respondents while 25.6 of local communities responded that no assistance was provided. The type of aid provided, as reported by respondents that indicated there was limited support, included provision of guarding materials and technical support in applying methods related to crop protection from mountain gorillas' devastation.

- Mountain gorilla crop raiding and potential conservation consequences

Crop raiding touches every corner of life for the population surrounding the park. Some (34.4 %, N = 135) of the population are very furious and affirm that they don't see any importance of the VNP gorillas apart from the destruction of their crops. Crop raiding leads to an imbalance between the losses due to crop damage and the gains from VNP tourism, where the local population loses a lot as there is currently no compensation approach for damaged crops affirmed by the VNP

office and the local population. Gorilla crop raiding is a very prevalent form of human – gorilla conflict adjacent to the protected area and since its economic loss is relatively high, it detracts from efforts to protect the gorillas as indicated by 42.96 of the respondents (N = 135). Furthermore, 80% of the respondents among park managers (N=20) and 22.2 among community respondents (N= 135) reported a potential increase of disease transmission between humans and gorillas. It was said that when gorillas leave the park, they are in closer proximity to humans and therefore, human illness and diseases can be transmitted and vice versa way. The current trend of proximity between gorillas and human around the Volcanoes National Park should increase the over-habituation of gorillas which may cause gorillas to lose their fear of humans and become aggressive when they are outside in the park seeking food.

Mountain Gorilla Feeding on Eucalyptus around VNP.

Top: Mountain Gorillas in community Farm around the VNP. Bottom: Mountain Gorillas exiting the VNP for crop raiding.

Tourist seeing Gorillas outside the park.