The Impact of Bwindi Mgahinga Conservation Trust and Uganda Wildlife Authority's Funded Community Livelihood Projects in the Mitigation of Illegal Activities within Bwindi Impenetrable National Park

By

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IV) Acronyms/Abbreviations used

BMCT…….Bwind Mgahinga Conservation Trust

CARITAS…….. Churches Around Richmond Involved To Assure Shelter

CTPH……..Conservation Through Public Health
FAO…….Food and Agriculture Organisation
GIS……..Geographical Information Systems

GPS…….Global Positioning System

ICAN…… Integrated Community Agriculture Nutrition

IGCP……International Gorilla Conservation Program

ITFC…….Institute of Tropical Forest Conservation

ICDPs……..Integrated Conservation and Development Program

KDC…….Kinkiizi Development Company

LADA……Literacy Action Development Agency

NAADS…….. National Agriculture Advisory development Services

NDP…….National Development Plan

OWC…… Operation Wealth creation

PAs……..Protected Areas

RS…….Revenue Sharing

RTZ……..Razing the Village

SDG…….Sustainable Development Goal

UBOS……..Uganda Bureau of Statistics

USAID……..United States Agency for International Development

UWA……Uganda Wildlife Authority

VIP……Ventilated Improved Latrines

WWF…… World Wildlife Fund for nature

V) Acknowledgements

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Data for the 1997, 2002, 2006 and 2011 mountain gorilla census was got from the ITFC research data archives while that of 2018 gorilla was provided by IGCP. The 2018 Bwindi-Sarambwe population surveys of mountain gorillas, other large mammals and human activities were conducted by the Protected Area Authorities in the Democratic Republic of Congo and Uganda (l'Institut Congolais pour la Conservation de la Nature [ICCN] and the Uganda Wildlife Authority [UWA]) under the transboundary framework of the Greater Virunga Transboundary Collaboration. The census was supported by the Rwanda Development Board, International Gorilla Conservation Programme (IGCP; a coalition of Conservation International, Fauna & Flora International and WWF), Mammalian Ecology and Conservation Unit of the UC Davis Veterinary Genetics Laboratory, Max Planck Institute for Evolutionary Anthropology, The Dian Fossey Gorilla Fund, Institute of Tropical Forest Conservation, Gorilla Doctors, Conservation Through Public Health, Wildlife Conservation Society Uganda Country Office, WWF Uganda Country Office, and Bwindi Mgahinga Conservation Trust. The census was funded by Fauna & Flora International, WWF, and Partners in Conservation at the Columbus Zoo & Aquarium.

VI) Executive Summary

Illegal resource access is a pressing biodiversity conservation and protected area management challenge. At Bwindi Impenetrable National Park (Bwindi) in south western Uganda, poaching and unauthorised access to forest resources is rife, driven primarily by poverty. An Integrated Conservation and Development Program (ICDP) was established in Bwindi in 1994 to address local community livelihhoods, whilst dissuading illegal activity and associated impacts on the protected area. The Bwindi Mgahinga Trust (BMCT) and Uganda Wildlife Authority (UWA) and other development organisations have been implementing ICDP initiatives that involve funding and implementing community livelihood projects around Bwindi over the past 25 years. These projects are premised on the fact that improving local people livelihoods will reduce local pressure on the park's resources and therefore illegal activities. The overall objective of this study was to assess the impact of the various community based livelihood initiatives funded by BMCT and UWA in the mitigation of illegal activities in Bwindi. We combined data collected from questionnaire interviews with illegal activity location data collected as part of the past five gorilla censuses of 1997, 2002, 2006, 2011 and 2018. We analysed the data using a combination of statistical and machine learning ecological niche modelling techniques.

Results show that the funding and implementation of local community projects around Bwindi has a positive impact of reducing illegal activities within Bwindi park. The number of ICDPs funded in parishes around Bwindi was the most important driver of illegal activity patterns and this was most especially in 2018, when there was a dramatic decline of illegal activities with increased funded community projects. Illegal activities were at highest occurrence in the neck and southeastern parts of Bwindi in the parishes of Buremba, Mpungu, Nyamabare, Kiyebe and Mushanje. These five parishes are illegal activity hotspots of Bwindi. These were the same parishes with the least number of community projects funded by both BMCT and UWA's revenue sharing programs. Similarly, the parishes with the least number of funded community projects were assessed to be the poorest in Bwindi using the UBOS 2018 rankings. Furthermore, illegal activities increased with accessibility (time of travel in minutes from

the nearest human settlement) and with the increase of funded community projects. illegal activities were highest at the park edges and decreased into the park interior.

Fifty nine percent (59%) of the interviewed respondents claimed not have benefited at all from any community projects funded by the development organisation working around Bwindi. Of those who had benefited from the funded community projects, UWA's revenue sharing (RS) projects were the most popular (31%) followed by RTV (Razing the village) with 21% and the BMCT's projects ranked third with 14%. Community projects funded by Twist Uganda and Change a life were considered the least popular by the respondents. Furthermore, results show that overall most respondents who had never or had benefited less from the community projects preferred common good projects over individual household projects and those who had received quite a number of community projects in their parishes preferred individual household projects.

In conclusion, the study notes that the presence of high number of funded community projects has a positive effect of reducing illegal activities in Bwindi. Indeed the parishes with the most funded community intervention projects experienced fewer illegal activities. BMCT, UWA and other development organisations should fund more targeted community projects in those parishes where the poorest households are located. We also suggest funding of community projects that are for individual households than the common good projects to help improve household incomes and therefore contribute to the mitigation of illegal activities within Bwindi. The funding of these community projects should be focused in the identified illegal activity hotspots, particularly the neck and the southeastern parts of Bwindi park.

1. Introduction

Globally, the phenomenon of community and individual wellbeing and conservation of biodiversity is attracting international and local debates as to what policy interventions best address both people's livelihood needs and at the same time protect biodiversity (Hughes & Flintan, 2001; Salafsky, 2001). There is often a contest between local communities and protected area management premised on inadequate benefits from Protected Areas (PAs) to address community livelihood needs yet it is the communities that bear the bulk of the conservation costs. The Bali Congress specifically recognized that people living in or near protected areas can support management *"*if they feel they share appropriately in the benefits flowing from protected areas, are compensated appropriately for any lost rights and are taken into account in planning and operations*"* (McNeely & Miller, 1984). However, since the Bali Congress, there has been a continued loss of biodiversity as well as deterioration of human welfare around protected areas in developing countries. As such during the last three decades strategies for conserving PAs better emerged and these included but are not limited to the Integrated Conservation and Development (ICD) strategy. The Integrated Conservation and Development (ICD) aims at linking conservation outcomes with development impacts. It arose in the 1980s and 1990s in response to the widespread failures of 'fortress conservation' and the growing trends within development policy towards local participation and stakeholder involvement (Blomley *et al*,. 2010).

Over the past three decades, the Bwindi Impenetrable National Park (Bwindi) has been employing the ICDs strategy as way of managing the park with the adjacent local people. The ICD strategy was established in Bwindi in 1994 to address local community poverty and associated challenges with Bwindi's conservation. These included; the multiple use program, tourism development, revenue sharing and the Bwindi Trust that funded local community livelihood projects (Blomley *et al.,* 2010). The ICD was initiated on the premise that local people's livelihoods would be enhanced while at the same time ensuring sustainable conservation of Bwindi biodiversity. Bwindi Impenetrable National Park (Bwindi) in south-western Uganda is a biodiversity hotspot

of global conservation importance and yet is surrounded by an ever increasing high human population that continually threatens the biodiversity within. The biodiversity threats in Bwindi include but not restricted to poaching and uncontrolled exploitation of forest resources (water, poles, timber and other nontimber forest products). With other compounding threats such as climate change and human wildlife conflicts, it is increasingly becoming apparent that poverty is the overarching driver of illegal resource access including poaching in Bwindi.

One of the most pervasive human threats on tropical forest protected areas like Bwindi is illegal resource extraction most notably wildlife poaching for bushmeat consumption and trade (Becker *et al.* 2013; Fa and Brown 2009; Fa *et al*. 2006; Ripple *et al.* 2016). The predicted growth in Africa's human population, coupled with poverty and need for animal protein are likely to increase bushmeat poaching for sustenance and income (Fa *et al*. 2002; Fa *et al*. 2006; Ripple *et al*. 2016). The Poachers may be making rational decisions about the hunting activities they partake in. These decisions could be linked to their socioeconomic status and the available livelihood opportunities. In particular, poverty is widely considered the leading driver of poaching in protected areas (Knapp *et al*. 2017)**.** It is now widely accepted that poverty drives biodiversity loss – the dependency of poor people on biodiversity drives unauthorised resource use within protected areas, as individuals seek to meet daily subsistence needs or improve the security of their livelihoods (Twinamatsiko *et al*. 2014).

The Bwindi Mgahinga Trust (BMCT) and Uganda Wildlife Authority (UWA) have been implementing social economic interventions around Bwindi over the past 25 years with the premise of reducing local pressure on the Bwindi biological resources for livelihood purposes. BMCT interventions are in form of direct social economic projects within the park's neighbouring parishes, whilst UWA's interventions take the form of revenue sharing that is channelled through the local government system to park edge parishes. These interventions are meant to complement each other but most importantly improve local people's livelihoods while ensuring sustainable management of protected areas by decreasing the reliance of local people on the park's resources.

1.1 The Bwindi Mgahinga Conservation Trust fund

The BMCT was established and registered under the Uganda's Trustee's Incorporation Act (CAP. 147) in 1994 as a conservation trust fund mandated to work in parishes around Bwindi Mgahinga Conservation Area (BMCA) by funding community projects bordering Bwindi and Mgahinga. The major aim of BMCT is to provide long-term reliable support for community livelihood projects, promoting research, conservation of biological diversity and sustainable use of natural resources in the BMCA whilst promoting the well-being of neighbouring communities. The underlying principle of BMCT is that the conservation of the national parks should benefit local communities nearby the BMCA who are often excluded from accessing protected area resources and suffer crop damage by wild animals. Therefore, the Trust provides 60% of its financing to community projects that promote the conservation of biological diversity and sustainable development and resource use. Since 1994, BMCT has been focusing on three areas: a) social welfare, infrastructure, education and training; b) productive enterprise; and c) programs explicitly addressing to the needs of the minority Batwa community. To date, some of the funded BMCT community projects include; beekeeping, passion fruit growing, coffee growing and tree nurseries, as well as community infrastructure involving the construction of classrooms, water tanks and latrines, two high-school level science laboratories, a girls' dormitory, a vocational training centre for women, eight health units, and solar power for a remote health unit which required refrigerated storage for vaccines. Other funded community projects include; woodlots establishment, Irish potatoes, rice and passion fruit, and for the purchase and consolidation of land.

1.2 Uganda Wildlife Authority's Revenue Sharing program

The UWA's revenue sharing (RS) is one of the first ICDs to be piloted at Bwindi in 1996 and thereafter rolled over to other Protected Areas (PAs) in Uganda under CAP 200 of the Uganda Wildlife Act (2000). Originally, the purpose of the programme was to share 12 % of park gate entry fees generated from tourism revenues with local communities bordering the park. This percentage was later increased to 21% of the park's gate fees. According to the regulation, the overall goal of revenue sharing *is "to ensure strong partnership between protected areas management, local communities and local governments leading to sustainable management of resources in and around protected areas".* Currently, UWA is implementing new RS guidelines adopted by implementing

partners in 2013. This is in line with the RS policy that was enacted by the parliament of Uganda where 21% of gate entry fees is shared amongst communities neighbouring Uganda's PAs (UWA. 2000a; UWA. 2000b). At Bwindi, USD 10 of gorilla levy is also shared annually to supplement the 21% park entry gate fees.

2. Problem statement

The ICDPs aim at linking conservation outcomes with development initiatives around Bwindi and is premised on the idea that when local community livelihoods are improved, incidences of illegal activities will reduce. Despite the ICDPs, at a practical level, there appears to be a wide disparity in the way the definitions and approaches are being implemented at Bwindi (Blomley et al. 2010). The ICDPs that aim at protecting the wildlife populations by mitigating poaching have historically relied upon income-based poverty metrics in efforts to reduce poverty and incentivise local inhabitants to discontinue poaching and other illegal activities (Knapp et al. 2017). The local community projects funded through revenue sharing and Bwindi Trust have helped improve local people's attitudes towards Bwindi (Blomley et al. 2010) but the extent to which these projects have contributed towards reducing poaching and other illegal activities within Bwindi remains poorly understood. Although it is always assumed by many, no study has yet assessed the relationships between the revenue sharing/Bwindi trust funded local community projects and the illegal activities Bwindi.

It is now almost three decades since the ICDPs were introduced in Bwindi yet even with a few success stories, the realisation of the ICDP goals still remain elusive. For example, although there seems to be improved local people's attitudes towards Bwindi, poaching and other illegal activities persist. This is exacerbated by the fact that the poverty levels at the periphery of Bwindi remain well above 40% (Hickey et al. 2019). Currently, these community conservation programmes are being critically examined to see if they meet the conservation and development objectives for which they were intended to achieve (Blomley et al. 2010). As such this study evaluated the impacts of the Bwindi Trust and UWA's revenue sharing funded community projects in the mitigation of illegal activities including poaching in Bwindi. Hence, this study, used both social economic and ecological data to examine the impact of these funded community interventions in mitigating illegal activities in Bwindi.

3. Study Objectives

The overall objective of the study was to assess the impact of various community livelihood interventions funded by BMCT and UWA in the mitigation of illegal activities and poaching and in Bwindi. The Specific objectives were;

3.1 Specific objectives

1. To assess and map the number and types of community intervention projects funded by BMCT and UWA over the past five years in the frontline parishes of Bwindi.
2. To map the spatial patterns of illegal activities in Bwindi over a 5-year systematic assessment period; 1997, 2002, 2006, 2011 and 2018.
3. To identify the hotspots of illegal activity in Bwindi.
4. To identify the key drivers of illegal activity in Bwindi, including the relationship between the funded community livelihood projects and spatial patterns of illegal activities in Bwindi.
5. To determine and compare the socioeconomic status of households that have benefited from BMCT and UWA's funded community projects with those that have not benefited from the interventions.

3.2 Research question

Do the various community projects funded by BMCT and UWA contribute to the mitigation of illegal activities in Bwindi?

3.3 Study Hypothesis

There is no significant relationship between the funded local community projects with the observed illegal activities within Bwindi over the years.

4. Methods

4.1 Study Area

The study was undertaken in Bwindi and its adjacent 25 frontline parishes (Figure 1). Bwindi is located in south-western Uganda at 0°53′ to 1° 08′S and 29° 35′ to 29° 50′E and occupies an area of 331 Km^2. It arguably ranks topmost as an important PA for conservation in the Albertine Rift biodiversity hotspot (Bitariho et al. in press; Plumptre et al. 2007). Bwindi's terrain is rugged with undulating hills, steep slopes, ridges and narrow valleys with an elevation that ranges from 1190 to 2607 meters above sea level. The vegetation of Bwindi is of medium-elevation moist evergreen forest and high elevation sub-montane forest. Bwindi is immediately surrounded by 25 community

administrative parishes, occupied by a human population density of up to 300 people per km^2, 95% of whom rely on subsistence farming for livelihood (Plumptre et al. 2004; Bitariho *et al* in press). A parish is the second smallest administrative unit in Uganda's local government administrative structures comprising of a range of between 8 to 12 villages. while a village is the smallest administrative unit that constitute several households (Bitariho et al. 2006; Bitariho et al. in press). Because of Bwindi's terrain, local communities tend to erect houses on hill ridges sometimes leading to scattered households in the parishes/villages.

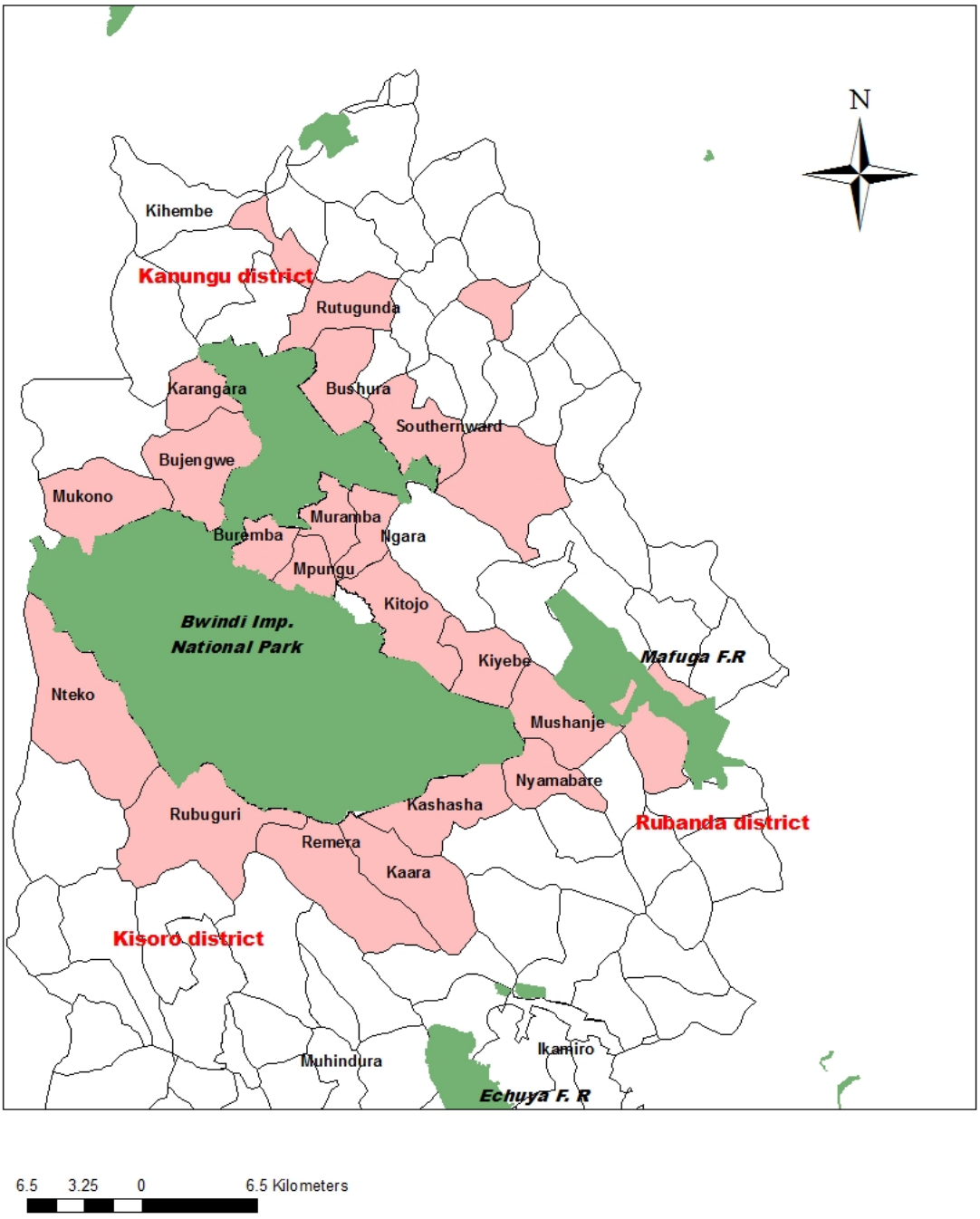

Figure 1 Map of the Study area

4.2 Data collection

4.2.1 Mapping illegal activities in Bwindi.

Data on illegal activity locations was collected during the previous Bwindi mountain gorilla's census (1997, 2002, 2006, 2011 and 2018). The 1997, 2002, 2006, 2011 gorilla census data was got from the ITFC research archives while that of 2018 was kindly provided to ITFC by IGCP within a Memorandum of Understanding. During these gorilla censuses, survey teams followed a "sweep" method, where an irregular network of reconnaissance routes across the entire park were walked while recording the locations of all encountered signs of illegal activity (Guschanski et al. 2009; Hickey et al. 2019; McNeilage et al. 2001; McNeilage et al. 2006). The illegal activities observed during these censuses included; evidences of snares, pole cuttings, tree cuttings, firewood collection, Wild honey collection, sights of hunting dogs/poachers etc. For this study, these illegal activities were grouped or lumped into one entity of "illegal activities".

4.2.2 Drivers for modelling and identifying illegal activity hotspots in Bwindi.

Based on our own research experience, knowledge, study objectives and published literature, we selected spatially explicit drivers for their potential importance to illegal activity. The covariates included those characterising the environment: accessibility, terrain ruggedness, elevation, friction, slope, aspect and tree cover; and those related to the BMCT/UWA implemented ICDs: number of implemented ICD projects. We downloaded the environmental driver datasets from the web in raster format. For drivers related to ICDs, we derived them from the georeferenced ICD locations collected during village transects. We then converted the ICD location data to vector and finally raster data formats for use in the modelling process.

4.2.3 Assessing the socioeconomic status of households around Bwindi.

We used household interviews to assess the socioeconomic status of households around Bwindi. Before the interviews, we stratified the households into three categories grouped by the districts and parishes' administrative structures. The three categories of the districts are Kisoro, Rubanda and Kanungu districts and the parishes are the 25 frontline parishes around Bwindi. The stratification helped to cater for study precision, considerations of study costs and effectiveness of our sampling procedures in study area (Bennett et al. 1991; Clark and Steel 2007). We then used a simple random sampling procedures for the 25 frontline parishes from which 13 parishes (half of the

total) were selected for the household interviews. The random sampling was done through attaching, listing and writing numbers of all the 25 frontline parishes on pieces of paper, placing them in a box, shuffling them and then randomly selecting the first 13 parishes.

4.3 Sample size determination for household interviews

Using a list of number of households found in each of the 13 parishes obtained from the latest UBOS household census data, the sample size of the required households for interviews in each parish was calculated using Slovin's formula as recommended by Singh and Masuku (2014); Susanti et al. (2019); Yamane (1967). The Slovin's formula for sample size calculation is;

$$\mathbf{n = N / (1 + N e^2)}$$

Where **n** = Number of households to be sampled per parish. **N** = Total number of households per parish as determined from recent UBOS population census data and **e** = Error tolerance (level). We then used the confidence interval of 95% and margin error of 5% for the households that were sampled in the study area. It was anticipated that during the interviews of the sampled households, those that have benefited and not benefited from the BMCT interventions and UWA's revenue sharing funds would be encountered and interviewed.

4.4 Household interviews

We collected data on the number and types of funded community projects through a semi-structured household interviews (*see appendix for questionnaire*). In addition, we took GPS coordinates of each household that received an intervention (including the communal interventions). We also reviewed documents and reports of BMCT and UWA to understand the social economic transformations attributed to the BMCT and UWA's community interventions. The annual statistical abstracts of Uganda Bureau of statistics and the local government reports on the social economic status of the selected parishes was also used to compare with statistics from this study.

4.3 Data analysis

4.3.1 Household Interviews data

Interview data was analysed using excel to compare the social economic statuses of households that have benefited from BMCT and UWA's funded community interventions and those not benefiting over the past five years. Descriptive statistics

were used to compare different household livelihood security characteristics. GPS data together with the type and number of interventions recorded were analysed and overlaid on map of Bwindi to show the distribution of the social economic interventions by parish using speciallised spatial analysis functions in R.

4.3.2 Illegal activity data

We imported the resultant geospatial data of illegal activities into the Geographical Information System (GIS) in the R statistical computing language for processing and preparation. Because our drivers' data originally had different projection, resolution and extent, we manipulated projections, grid cell size and alignment, and the spatial extent to ensure consistency across all driver data layers using specialized functions in R. This included converting vector data to raster format using the *rasterize* function of the "raster" package[(5)]. We used the *projectraster* function of the same package to project all data to Latitude/Longitude projection with a grid cell size (resolution) of 1-km. We used bilinear interpolation and nearest neighbour resampling methods for continuous and categorical drivers, respectively.

We used the number of community funded projects (ICDPs) to assess the relationship between the implemented ICDs and illegal activities. We first summed up the number of ICDs implemented in the frontline parishes neighbouring each of the four Bwindi sectors; Nkuringo, Southern, Buhoma and Northern sectors. We then assigned the number ICDs to each of the sectors and created a .shapefile of the number of ICDs for the four sectors, which we later rasterised for use as a covariate.

We plotted the illegal activity location data on the Bwindi map to locate where illegal activity has been recorded. We then used the *spsample* function in "sp" package to create 50,000 random points for which, together with each of the illegal activity locations, extracted the associated driver data. We used the *extract* function of the "raster" package for the extraction. We used the resultant dataset to compute a correlation matrix between all possible pairs of continuous drivers, using Pearson Pearson's correlation plot to test for multi-collinearity among drivers. We assumed drivers with a correlation $r < 0.7$ or $r > 0.7$ to be correlated. We used raincloud and bar plots in the "ggplot" R package(7) to visualize the data distribution of the continuous and categorical covariates, respectively, between illegal activity locations and a random sample (Fig. 2).

4.3.3 MaxEnt Modelling

We implemented the MaxEnt models using the maxent function in the “dismo” package. Before modelling, we used the ENMevaluate function in the “ENMeval” package to tune our models, i.e. identify optimal parameter settings needed to maximize model predictive ability while avoiding overfitting. We split the illegal activity locations into two separate partitions (80% for training, 20% for testing). We ran five year specific models; 1997, 2002, 2006, 2011 and 2018. We used feature types, the maximum number of iterations and regularization parameters identified by the model with the lowest AIC value as returned by the ENMevaluate process (Muscarella et al. 2014). We set the number of background points to 10000 for all models. We used Area Under the Curve of the Receiver Operating Characteristic (ROC) curves to assess model performance. We assumed models with an AUC value of 0.70 to be of good model fit. We used the jackknife procedure to assess variable importance, based on permutation importance, to identify the most important drivers of research location selection.

4.3.4 Illegal activity hotspot map

We generated the illegal activity hotspot map from the five census years predicted distributions. We first normalized the predicted distributions rasters to range from 0 to 1. We then weighted the prediction rasters based on a Linkert scale; with the year model with highest AUC getting a 5 and the year model with lowest AUC getting a 1. Finally, we generated the illegal activity hotspot map by calculating a weighted mean for the five rasters.

4.3.5 Relationship between community projects (ICDs) and illegal activities in Bwindi

We analysed the relationship between the implemented ICDs and illegal activity only for the 2018 census data. This is because the number of ICDs was an important driver in the MaxEnt models for only 2018. We extracted the values for the predicted probability of illegal activity for the 2018 illegal activity locations in each of the four sectors. We then compared the predicted probability of illegal activity at the locations in the four sectors using the Kruskal-Wallis non-parametric test. We assumed statistical significance at 5% level of significance.

2. Results

5.1 Social demographic profile of respondents

A number of demographic parameters were used to understand the social composition of respondents. The identified characteristics were gender, ethnicity, age, marital status and the length community members have stayed in their respective areas. Table 1 shows the distribution of respondents per demographic category expressed in percentages. The distribution of gender among the respondents was almost equal but with the female respondents slightly more than their male counterparts (Table 1). Majority of respondents (91% were Bakiga by tribe. Overall, the study interviewed mostly respondents in the age category of 21-40 years (56%) while those in the age category below 20 was the least interviewed (Table 1). Age distribution among respondents is an important component in socioeconomic assessments since it informs the kind of responses that can be generated from the respondents (Kumar 1989). Furthermore, 83% of the respondents were married and 86% had spent more than 10 years in the study parishes (Table 1). Demographic profiling of a community is important because it helps understand the structure and composition of the community. This in turn helps understand the needs of the communities including appreciating their problems and challenges.

Table 1 Demographic characteritic of respondents (n = 773 respondents)

Demographic characteristic	**Category**	**Percentage distribution (%)**
Gender	Female	52
	Male	48
Ethnicity	Bafumbira	8
	Bakiga	91
	Banyakore	0.3
	Batwa	0.7
Age of respondents	Below 20	2
	21-40	56
	41-60	24
	Above 60	18

Marital status	Married	83
	Single	13
	Widow/er	3
	Separated	1
Length of stay in the village	Less than 5 years	7
	Between 5-10 years	7
	More than 10 years	86

5.2 Education level of respondents during household interviews

We examined the highest level of achievement in education by respondents and results indicate that on average the highest attained education level of most respondents was primary level (66%) followed by those respondents with no formal education (17%) across all the parishes (Table 2). Mpungu parish had the highest number of respondents with primary education (79%), followed by Kiyebe (68% and Buremba (67%) parish respondents. Nteko parish had the highest number of respondents with no formal education (24%) and Mpungu parish the least. Basic education is a fundamental human right and a component of well-being. Education is also a key determinant of the lifestyle and status an individual enjoys in a society. Elsewhere studies have shown that educational attainment has a strong effect on the behaviour and attitude of individuals (Chen *et al.* 2013; Hicks and Streeten, 1979). Also the level education is used as a yardstick for the measurement of economic wellbeing of a person (Landenberg 2002). The average percentage of people who attain primary education at national level in Uganda is ~ 36 % (UNESCO 2016). This is an indication that perhaps the areas around Bwindi are economically better based on their education level as compared to the national average.

Table 2 Percent level of education of respondents (n = 773 respondents)

Parish	No formal education	Primary school	Secondary school	Tertiary school
Buremba	17	67	12	4
Karangara	16	61	17	6
Kiyebe	16	68	13	3
Mpungu	10	79	7	4
Nteko	24	57	15	4
Average	17	66	13	4

5.3 Household characteristics and social economic status of Respondents

Table 3, presents the distribution of households by construction materials used on roofing and building walls of houses for respondent. Overall all respondents have houses with iron sheets roofing with almost no grass thatched houses available in the study area. This is much higher than the national average which was estimated at 75% and 24% respectively (UBOS, 2018). Furthermore, overall, about 30% of the respondents had houses made of brick walls while majority of respondents (70%) owned houses made of mud and wattle (Table 3). This result is much lower than the Uganda national average at 67% and 33% for brick and mud and wattle houses respectively. Nteko parish registered the highest number of households (47%) made out brick walls while Kiyebe registered the highest number of houses made out of mud and wattle (97%), followed by Mpungu (71%) as Table 3 shows. Our results are consistent with the results from the UBOS household survey of 2016/2017 which documented Kigezi region as having the second least number of brick wall houses after Karamoja.). Our study shows that households in the sampled parishes were much better off than those from average Uganda national levels (UBOS 2017). However, a comparison of material used to build walls of houses showed that the Uganda national average (67%) was higher than in our study sites (30%). The differences in the use of bricks and iron sheets for house construction gives a small indication of the economic welfare of the different parishes in the study area compared to the rest of the country. There was however, some outliers for example while the rest of the other parishes averaged at 30% for brick use. Kiyebe parish had a much small

percentage at 3% for the same. This could perhaps indicate Kiyebe was much less economically versatile than the other parishes.

Table 3 Types of materials used for house construction by respondents (n = 773)

	Type of roofing		Material of housing	
Parish	% Grass thatched	% Iron sheets	% Bricks	% Mud & wattle
Buremba	0	100	41	59
Karangara	0	100	27	73
Kiyebe	0	100	3	97
Mpungu	1	99	29	71
Nteko	1	99	47	53
Average	**0**	**100**	**30**	**70**

5.4 Water and Sanitation issues for Respondents' houses

As table 4 shows, overall, 99% of households used pit latrines while only 0.4% used bushes or did not have any toilet facilities. Of those with Pit latrines, only 0.4% were of the Ventilated Improved Latrines (VIPs) types. Furthermore, majority of the respondents (66%) had access to improved sources of safe drinking water with the rest few having no access to safe drinking water (Table 4). These results show that the study area were better off in terms of households with pit latrines than the Uganda national average where 83% use pit latrines and 6% have no toilets (UBOS, 2018). Also, these results are consistent but lower than national average which puts households with improved and unimproved water sources at 78% and 28 % respectively. Karangara had the highest number of households (89%) accessing improved water sources followed by Mpungu at 86% (Table 4). Nteko had the least number of households (23%) accessing improved water sources. This is probably due to BMCT's water projects funded by Swarovski in those parishes. Our study did not record illegal park entry for water access by the different communities around Bwindi. However, one would assume that in Nteko most of the water access for household use is got from rivers flowing out of Bwindi or through illegal park entry since majority of respondents from Nteko (77%) used unsafe water sources (table 4) .

Table 4 Types of toilet facilities and sources of water used by respondents (n = 773)

Parish	Type of toilet			Source of water	
	% with No toilet	% with Pit latrine	% with VIP toilets	% uses Improved & Safe water source	% uses Unsafe water source
Buremba	0	99	1	70	30
Karangara	0	100	0	89	11
Kiyebe	0	100	0	61	39
Mpungu	1	99	0	86	14
Nteko	1	98	1	23	77
Average	0.4	99	0.4	66	34

5.5 Food consumption (meals) by households per day

Table 5 indicates that on average majority of households (68%) took two meals a day with only a few households (30%) taking three meals a day. Furthermore overall, very few households (1.4%) took only one meal a day. This result is better than that of the Ugandan national average where 9.3% of households have only one meal a day. Kiyebe (with highest number of illegal activities) had the highest number of households (~3%) that took only one meal a day. Results further indicate that on average 82% of the households never went without a meal, while 13% of households had ever gone at least twice in week without any meal. Most of the households that have atleast missed meals were located in the parishes of Kiyebe, Buremba and Mpungu. On the other hand 4% of the households have gone once without food in a space of one week and these were mostly in the parishes of Buremba, Mpungu and Nteko (Table 6). From the results, its apparent that households that take only one meal a day or miss meals are most likely finding alternative means of food from Bwindi park (poaching). These results are therefore consistent with the illegal activities observed in those parishes (Mpungu, Kiyebe, and Buremba) as previously mentioned.

Table 5 Number of meals taken by respondents by percentage per day (n= 773)

Parish	% takes one meal a day	% takes two meals a day	% takes three meals a day
Buremba	1	67	32
Karangara	1	62	37
Kiyebe	3	74	23
Mpungu	1	70	29
Nteko	1	69	30
Average	1.4	68	30

Table 6 Number of households that have gone without a meal the past 1 week (n = 773)

Parish	% Never	% Once	% Twice	% Three or more
Buremba	88	0	12	0
Karangara	85	0	14	1
Kiyebe	81	18	1	0
Mpungu	83	0	17	1
Nteko	75	0	23	2
Average	82	4	13	1

5.6 Comparisons of funded community projects and presence of illegal activities

A total of 95 community projects funded by both BMCT and UWA were recorded in all the sampled parishes located adjacent Bwindi as Figure 2 shows. Of these, 52% were funded by BMCT and 48% by UWA's revenue sharing programme. From the figure 2, it is evident that the parishes with the most funded community projects in descending order were; Southern ward with 18 projects, Nteko with 16 projects, Karangara with 14 projects, Bujengwe with 13 projects, Kashasha with 10 projects, Remera and Rutugunda all with 8 projects. The Parishes with the least number (or none) of community intervention projects funded by both UWA and BMCT were in ascending order; Mushanje (0), Kiyebe (1 UWA funded project), Buremba (3 projects) and Mpungu with 4 community projects funded (Figure 2).

When comparisons between the funded community projects in the Bwindi adjacent parishes and presence of illegal activities adjacent those parishes are made as Figure 2 shows, it is evident that those parishes with the least number of community projects (Mushanje, Kiyebe, Buremba, Mpungu, Nyamabare, and Kitojo) had the highest number/density of illegal activities in the adjacent forest areas of Bwindi (Figure 2 & 3). Parishes with the most number of community projects (Southern ward, Nteko, Karangara, Bujengwe, Remera and Rutugunda) had the least number/density of illegal activities recorded in the adjacent forest areas of Bwindi (Figure 2 & 3). As described in the methods, the recorded evidences of illegal activities during the 5 gorilla census periods included; setting up of snares, sights of poachers/hunting dogs, cutting tree poles/stakes, pitsawing and collection of firewood and honey. These were grouped/combined together as "illegal activities" for conveniency of this study. Overall, the figure 2 & 3 show that those parishes with the highest number of illegal activities were those with the least number of community projects funded by both BMCT/UWA and vice versa for those with the least illegal activities.

The figure 3 further shows the hotspots of illegal activities in Bwindi the past 5 gorilla census periods (since 1997 to 2018). From the figure, it is evident that the illegal activity hotspots were located in the parish forest areas of Buremba, Mpungu, Kitojo, Kiyebe, Mushanje, Nyamabare and Kaara. These are the parishes with the least (or no) community intervention projects funded by both UWA and BMCT (with the exception of Kashasha parish). Furthermore, the predicted probability of illegal activities differed significantly with the number of community projects (ICDPs) funded (Kruskal-Wallis chi-squared = 56.369, df = 3, $p < 0.001$, n = 88). As figure 4 shows, increase in the number of funded projects (ICDPs) led to decrease in illegal activities. The predicted probability of illegal activities were highest in the parishes with the lowest number of community projects (ICDPs), and lowest in the parishes with the highest number of community intervention projects (Figure 4). The implication of this therefore is that the UWA, BMCT and other development organisations funded community interventions projects have a positive impact of reducing illegal activities in Bwindi Impenetrable National Park.

Figure 5 shows the different types of community intervention projects funded by both UWA and BMCT the past 5 years. These were; agricultural support projects (e.g terraces, supply of seeds etc.), tourism support projects, education support projects (schools), healthy support projects (healthy centers), human wildlife conflict management interventions etc. Of these interventions, the most funded community projects by both UWA and BMCT in descending order were; road construction projects, water and sanitation projects, schools support and tourism support projects that included community halls too. The least types of community funded projects were the tree planting and the human wildlife management intervention projects (Figure 5).

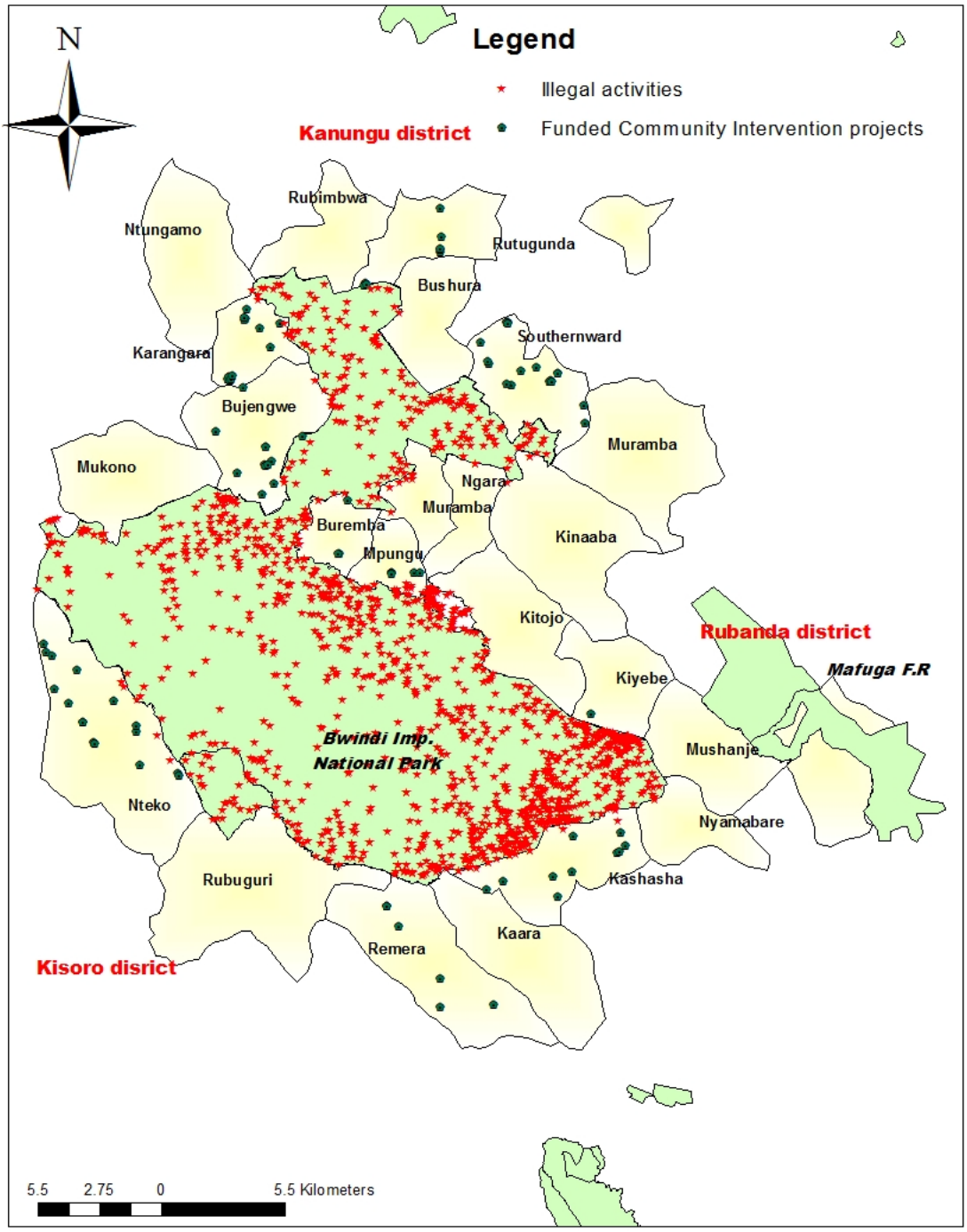

Figure 2 Location of funded Community interventions projects in relations to illegal activities observed in Bwindi

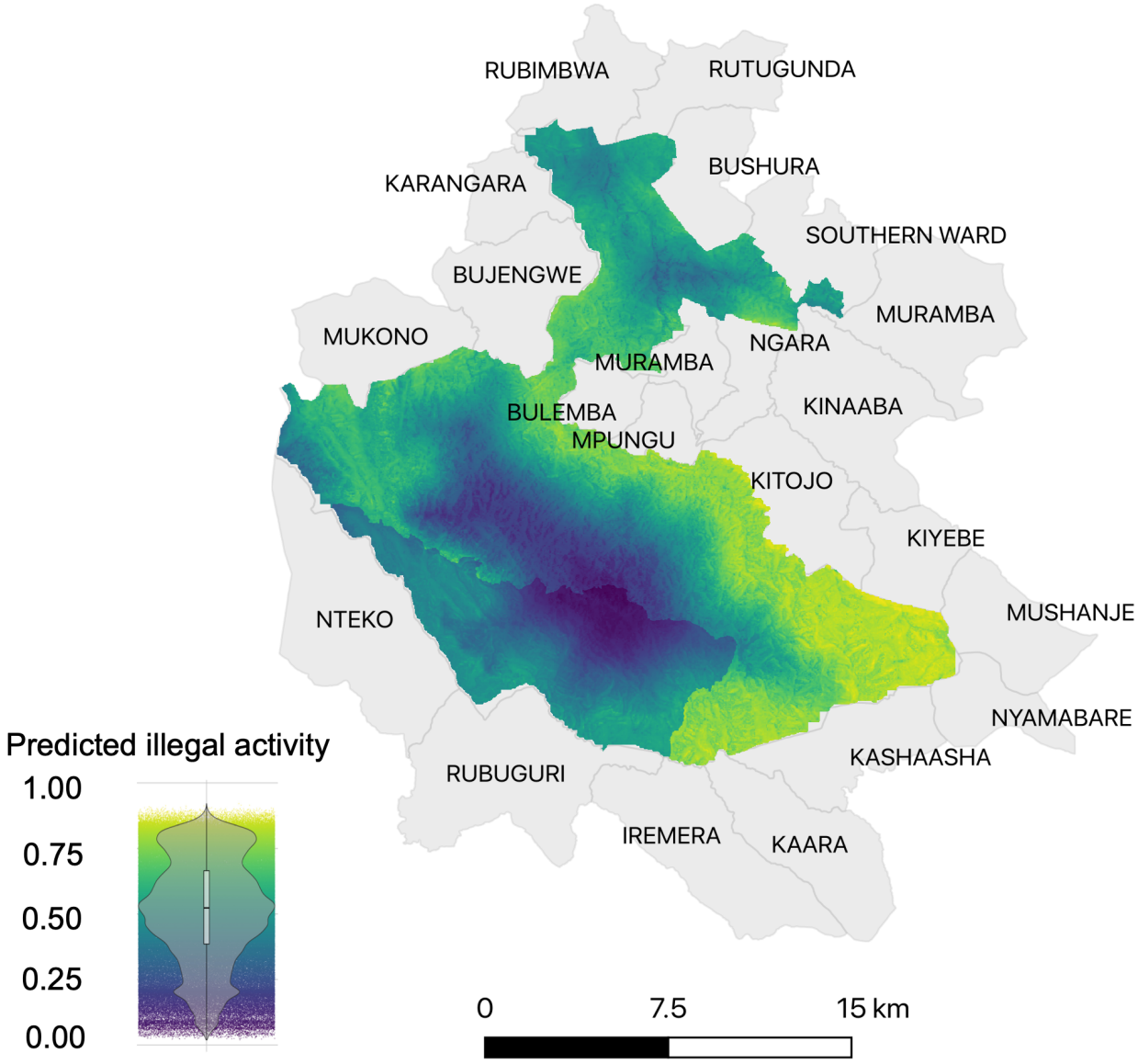

Figure 3 Predicted probability illegal activity hotspots of in Bwindi

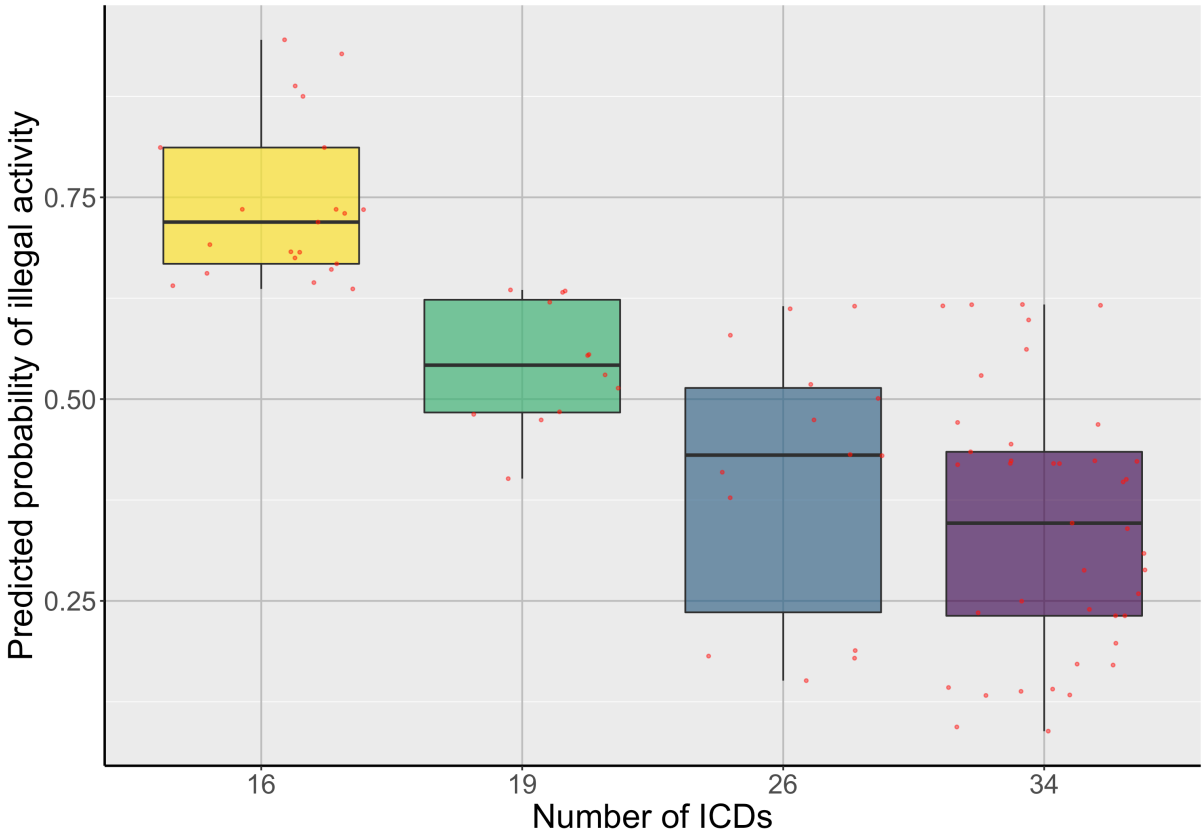

Figure 4 The relationship between predicted probability of illegal activities and number of community intervention projects (ICDPs) funded by BMCT and UWA

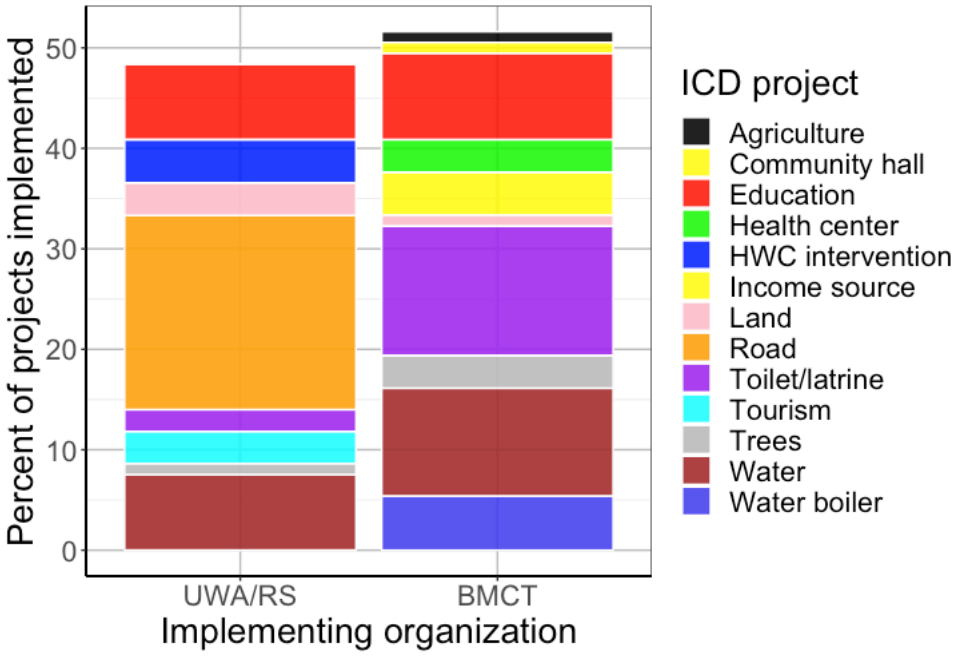

Figure 5 Types of projects funded by UWA and BMCT in the parishes around Bwindi the past 5 years

5.7 Patterns of illegal activities in Bwindi

The past 5 gorilla censuses in Bwindi recorded a total of 2,343 illegal activity observations (Figure 6).The highest number of these combined illegal activities were recorded in 2002 and 2006, and these declined in the subsequent three gorilla censuses that followed, with 2018 witnessing the least number of illegal activities (figure 6A). Many of the combined illegal activities were recorded close to the park boundary, particularly in the south-eastern part of the park as previously mentioned. These were in the parishes of Nyamabare, Kiyebe, Kashasha and Mushanje. As discussed previously, with the exception of Kashasha parish all these parishes had the least number of the community funded projects. Relatively few illegal activity events were recorded in the forest interior and in the northern sector of Bwindi.

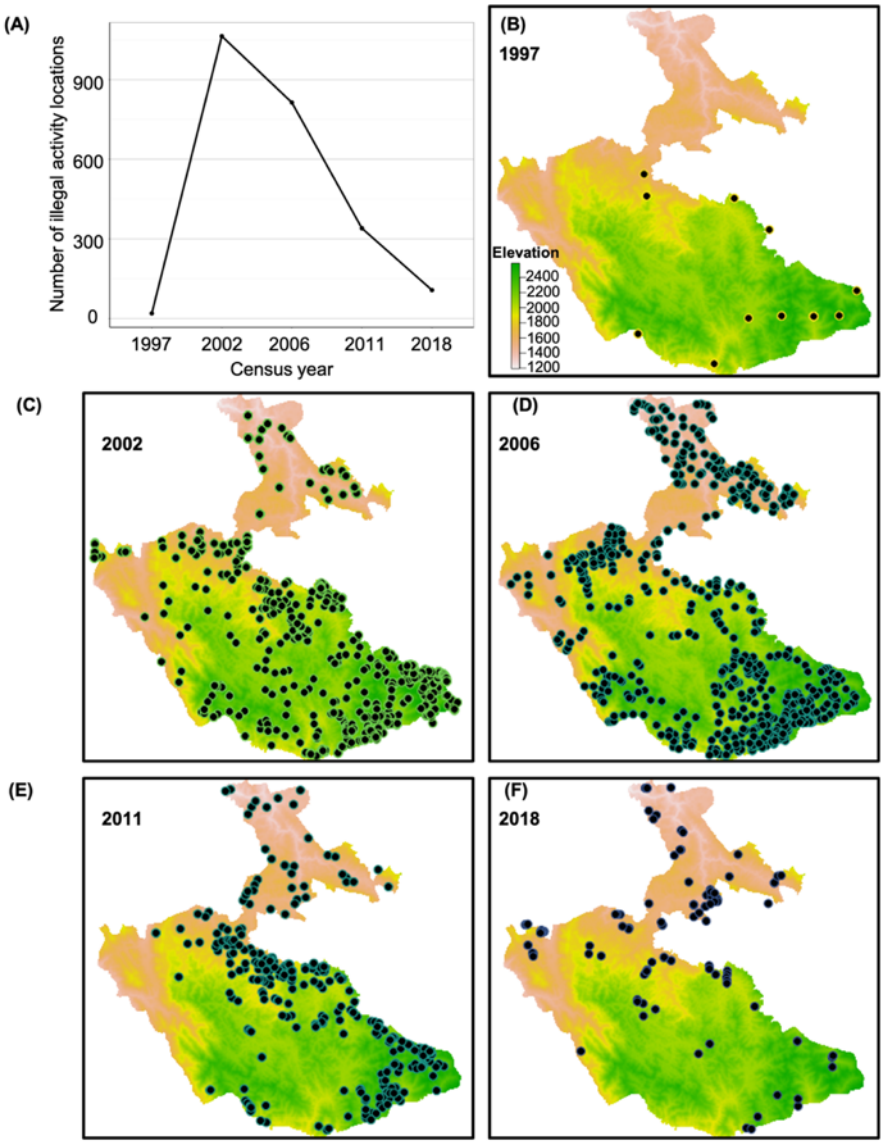

Figure 6 Temporal (A) and Spatial (B, C, D, E & F) patterns of illegal activities recorded over the 5 gorilla census periods in Bwindi

5.8 Drivers of illegal activities and spatial patterns in Bwindi.

None of the drivers of illegal activities in Bwindi were collinear (Figure 7). The predictive performance of our models was satisfactory, with an average model AUC of ≥ 0.667 (Figure 8); hence, the models are particularly useful in identifying the most important drivers and specific areas of illegal activities ("illegal activity hotspots") (Figures 10). The key drivers of illegal activity differed among the gorilla census years. Accessibility (travel time in minutes from the nearest settlement) was the most important driver of illegal activities in Bwindi over a three year census period (1997, 2006 and 2011) as Figure 8 shows. Overall accessibility to the Bwindi park seems to be the key driver to

illegal activities in Bwindi but other compounding factors such as elevation and presence/number of funded community projects also influence presence of illegal activities in Bwindi. This is true for the 2002, 2006, 2011 and 2018 gorilla census periods. Elevation was the most important driver of illegal activities in 2002 census (Figure 8). The effect of presence and number of community interventions projects funded (ICDPs) was the most important driver of illegal activities in Bwindi for the year 2018 gorilla census period. Perhaps this could be the cumulative effect of all the community funded projects interventions over the years since 1997.

Overall, the most important drivers of illegal activities in Bwindi were; accessibility, elevation and presence and number of community projects interventions (ICDPs). These had the highest AUC values when used in isolation of all the censuses' full models, suggesting that they the most important drivers of illegal activities distribution in Bwindi over the years (Figure 9). These drivers also reduced the AUC values of the full models the most when omitted for their respective year models (Figure 9), suggesting further that they had the most parameters that aren't present in the other drivers. Specifically the relationship between the community projects funded (ICDs) and illegal activities were more strong in relationship for the year 2018 (Figures 8 and 9), resulting into a dramatically low probability of predicted illegal activity distribution in 2018 (Figure 8). This is perhaps as discussed before a result of the accumulation of the funded community projects over the years.

In the years when accessibility, elevation and number of ICDs were the most important drivers of illegal activity distribution, they explained on average 65.1%, 29.2% and 45.8% respectively of the illegal activity distribution (Figure 9). In fact, among all the drivers we considered, the data distribution of the recorded locations compared to random (available) locations only differed for accessibility, elevation and number of ICDPs (Figure 11), suggesting a clear bias in illegal activity distribution with these drivers in the respective years when they were the most important drivers .

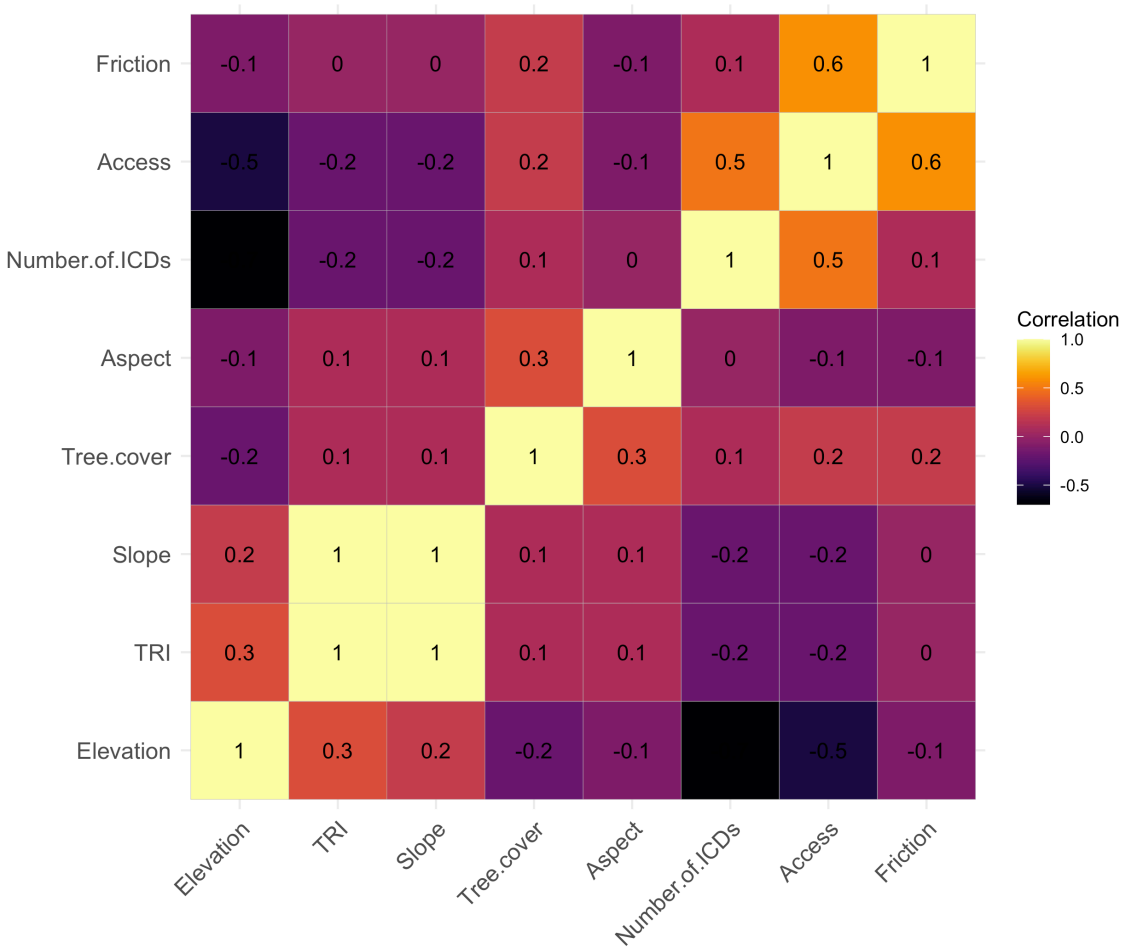

Figure 7 Spearman correlation matrix among the drivers of illegal activities in Bwindi

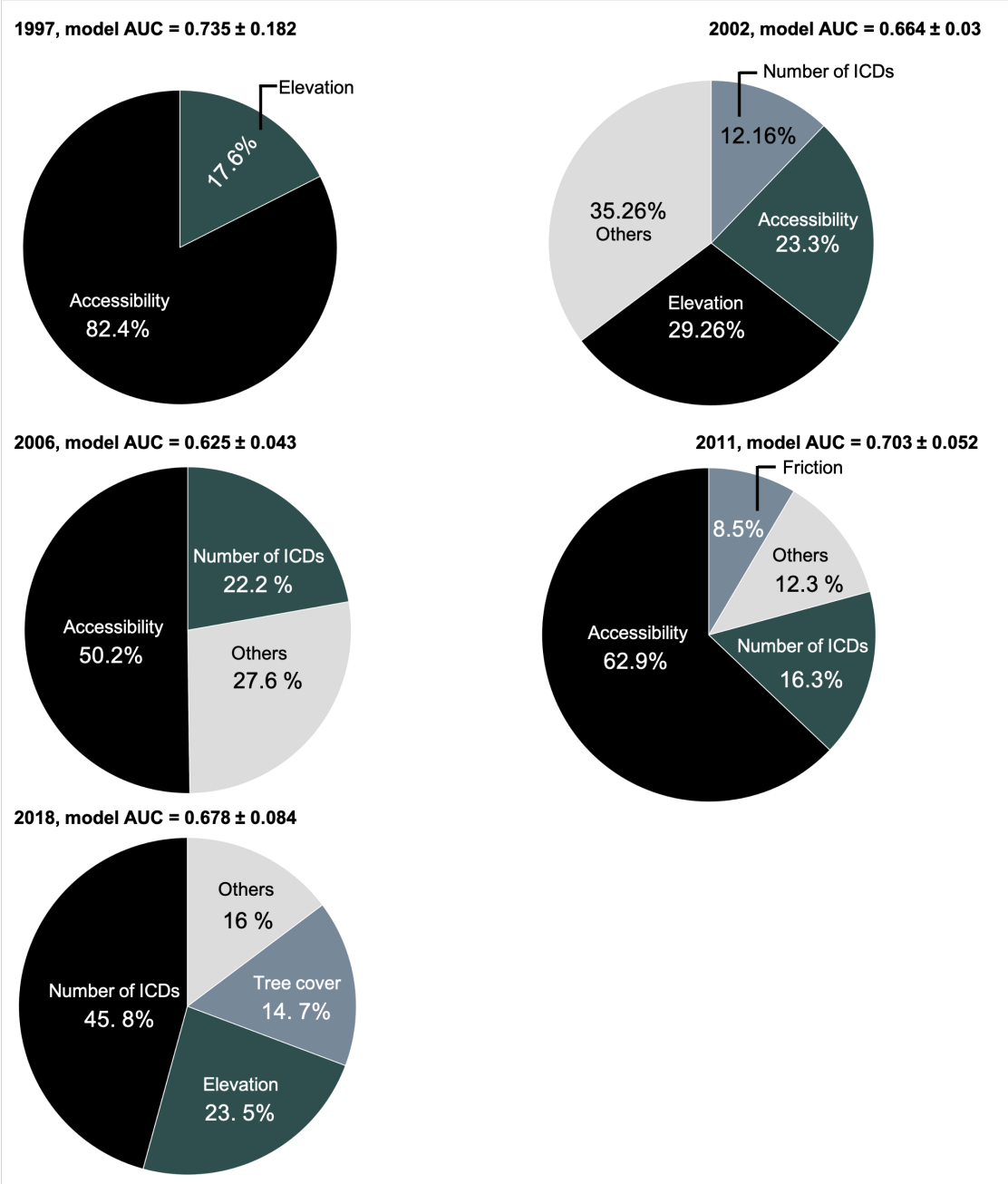

Figure 8 Permutation of the importance of key drivers of illegal activities in Bwindi for each of the 5 gorilla census years

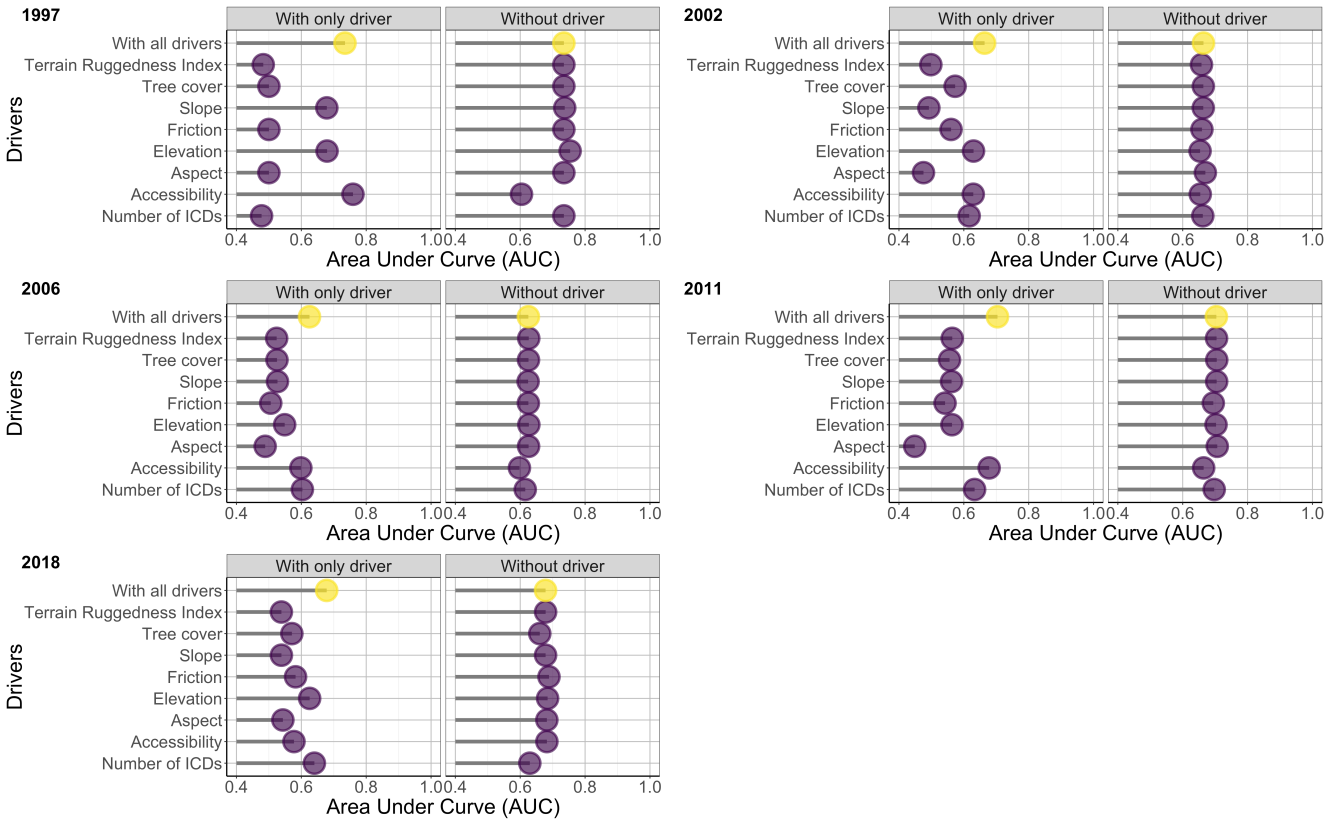

Figure 9 AUC JackKnife tests for each of the census years model showing the illegal activity driver importance

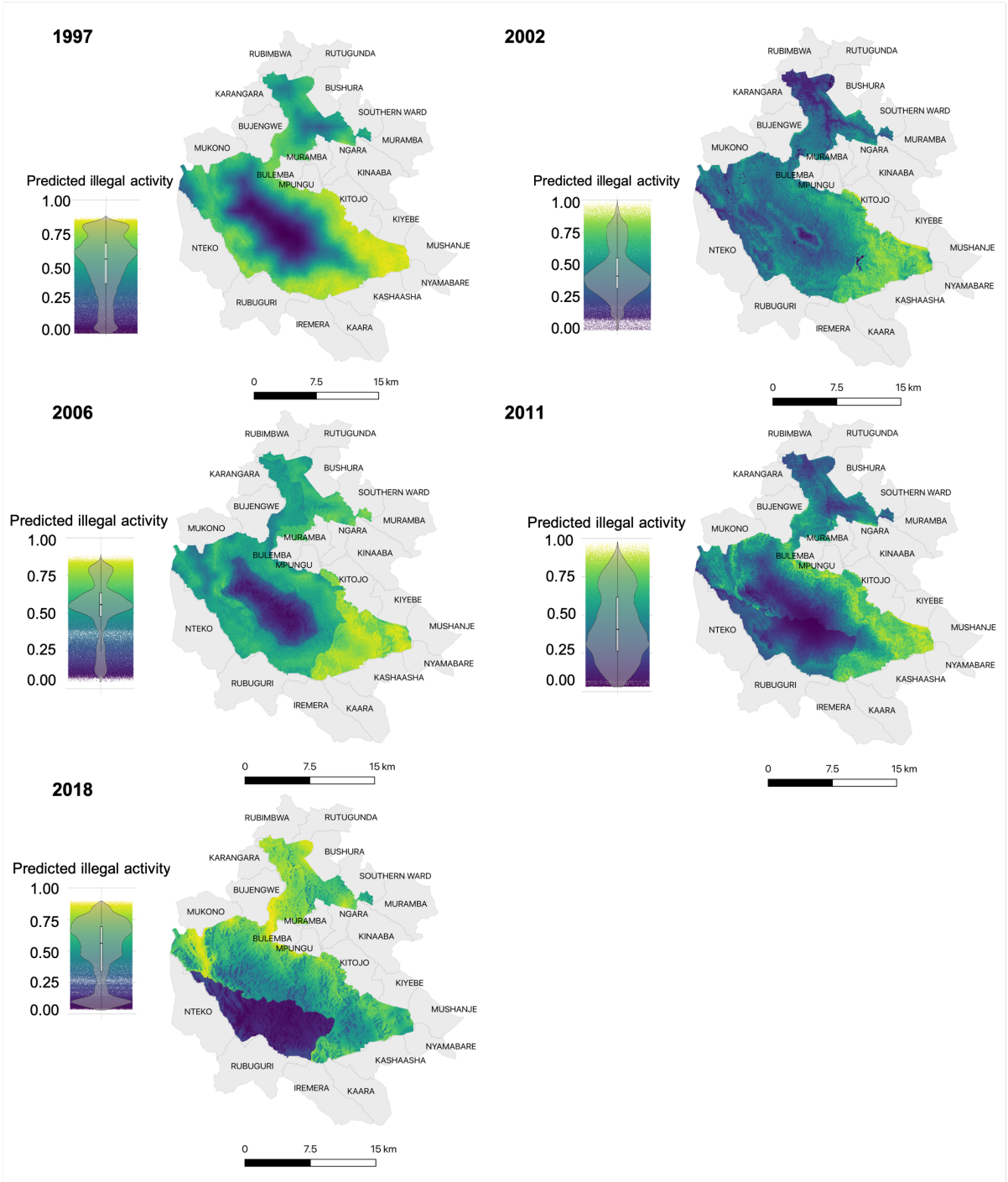

Figure 10 The predicted probability of illegal activities distribution in Bwindi (the violin plots show the predicted probability of illegal activity distribution values, also used here as a map legend. The violin plot shows the median and the interquartile range of the predicted probability of illegal activity distribution).

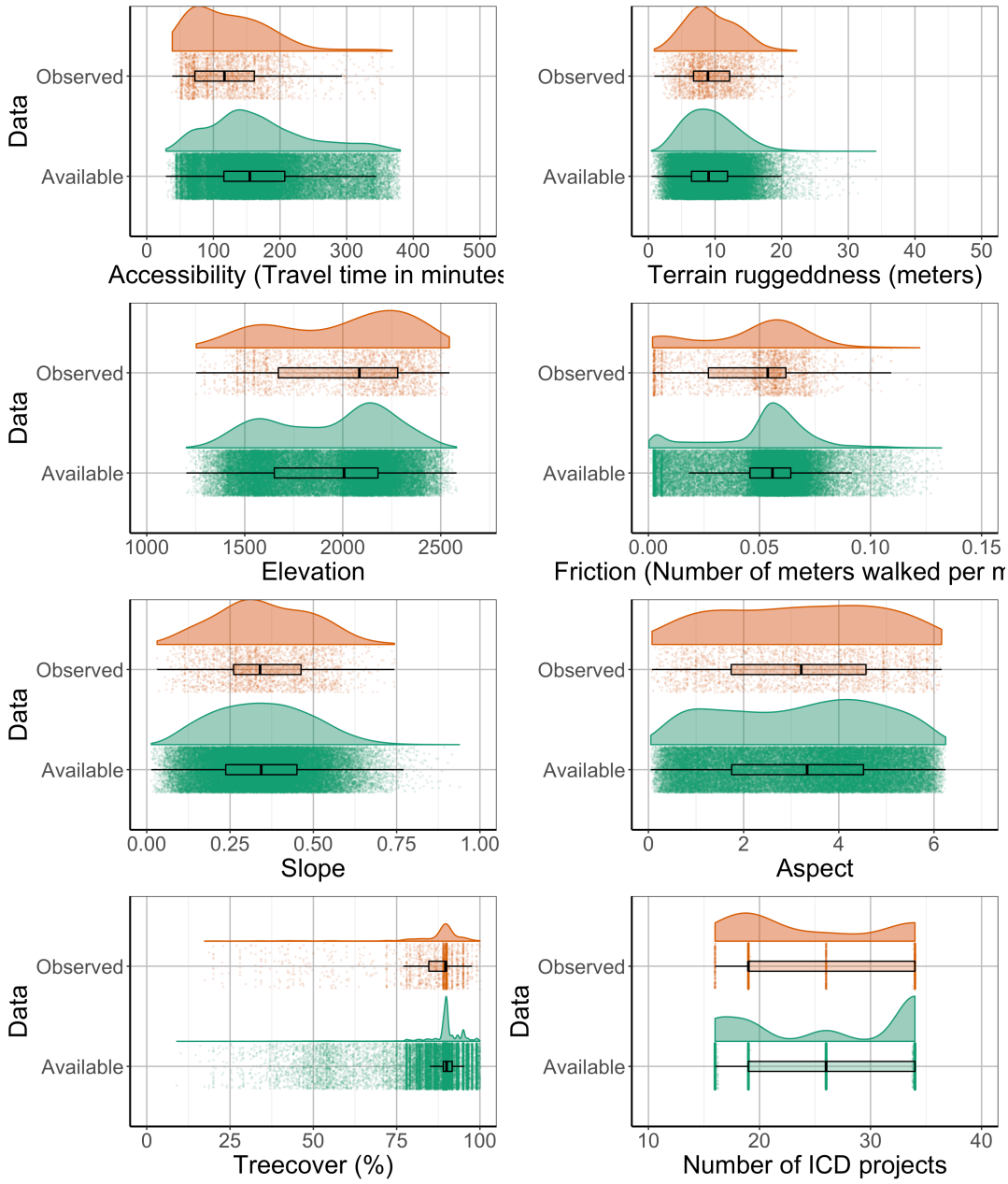

Figure 11 Data distribution of driver values compared between the observed (recorded) and random locations (across the landscape)

5.9 Knowledge and perceptions of illegal activities occurrence by respondents

Most local people don't want to be associated with illegal activities and hence our survey on illegal activities within the sampled area was done through direct and indirect questioning. As the figure 12 shows, almost all respondents acknowledged knowing that illegal activities existed in Bwindi National Park. Only very few respondents (3%) claimed to have no knowledge of illegal activities within their respective parishes (Figure 12). In Mpungu parish all respondents had knowledge of illegal activities within their communities. In general there was an overwhelming

knowledge of illegal activities with at least 90% of respondents in every parish confirming that they knew about illegal activities within their communities (Figure 12). There was a very small percentage of respondents (12%) that mentioned they had no knowledge of illegal activities within their parishes (Figure 12). Some of these respondents did not want to be associated with illegal activities and while others claimed they stayed very far away from the park to know about such activities. For example, people would say “I heard about illegal activities in other national parks like Queen Elizabeth National but not here in Bwindi” (extract from household survey 2020).

Furthermore, as figure 13 shows, respondents from Buremba parish had the highest percentage of respondents (24%) who perceived illegal activity levels within their communities to be extremely high, followed by Mpungu (12%) and Kiyebe (7%) parishes. Respondents from Karangara parish had the least of respondents (2%) who perceived illegal activities to be at high levels (Figure 13). The majority of respondents (60%) in all the parishes believed the level of illegal activities were rare within their communities as Figure 13 shows. When we asked about the extent of illegal activities, on average across all the parishes’ majority (61%) mentioned that the extent was barely significant and others (2%) even mentioned that illegal activities were non-existent in their parishes (Figure 13). Other studies around Bwindi and other national parks which have interviewed people on illegal activities have found that local people tend to downplay the extent of illegal activities within their villages as they are sometimes think this information may be used against them (Tukahirwa and Pomeroy 1993; Namara 2000; Nampindo and Plumptre 2005).

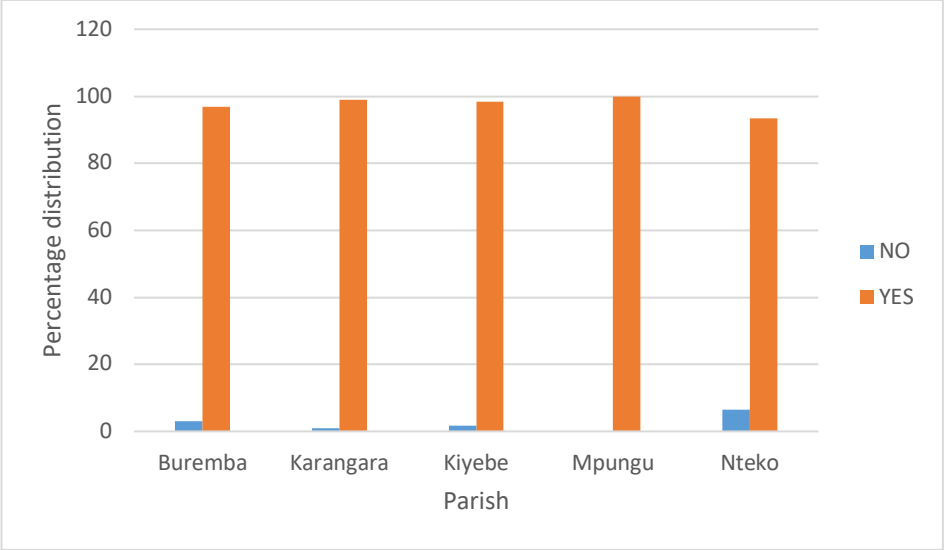

Figure 12 Extent of knowledge of illegal activity occurence within Bwindi by respondents (n = 773)

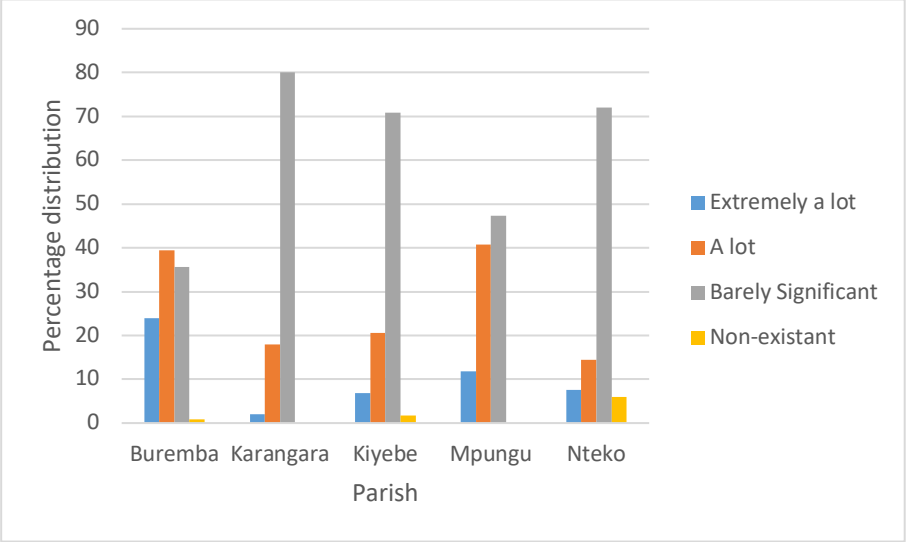

Figure 13 Perception of the extent/level of poaching within respondents own parishes

5.10 Motivations for engaging in illegal activities by respondents

We examined the motivations that may encourage people to engage in illegal activities. Results show that poverty (80%) and the need to increase income (35%) were the most mentioned as why local people carry engage in illegal activities (Figure 14). Respondents who mentioned poverty as their reason for illegal access of resources such as bushmeat, firewood, medicine and building poles explained they did it to support their basic needs. However, those who mentioned increasing their income did it for mostly commercial purposes and sold most of their resources. Harrison *et al.* (2015) also found that illegal activity in Bwindi was motivated by poverty

and resentment to the park. However, from our results we found that resentment for the park was ranked third by respondents as why people may engage in illegal activities. In most cases the local people adjacent national parks are engaged in illegal activities as a source of livelihood survival mechanisms and in some cases to increase their household income.

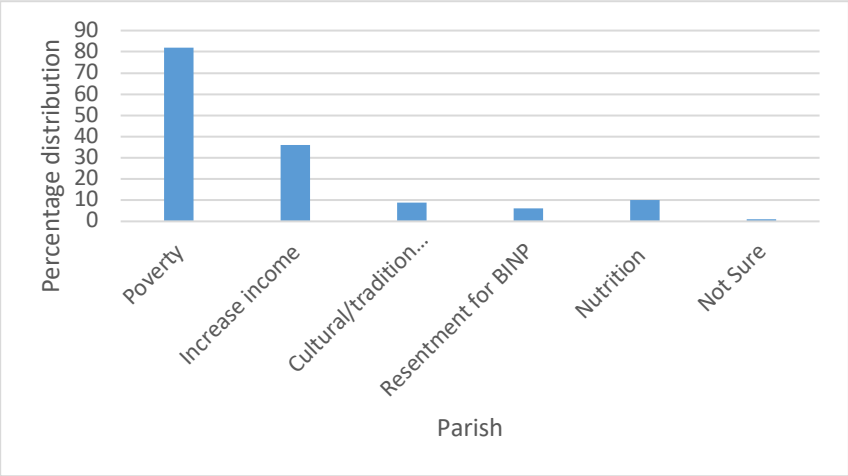

Figure 14 Motivations for engaging in illegal activities by respondents (n = 773)

5.11 Suggestions on how illegal activities in Bwindi can be reduced

We explored the perceptions of respondents on how best to reduce illegal activities in Bwindi (Table 7). On average, most respondents (~27%) felt that funding and implementation of community intervention projects (ICDPs) in the parishes adjacent Bwindi and most especially those aimed at individual households income (e.g livestock support) would persuade people not carry out illegal activities in the park. The sensitization of the communities was ranked second with a percentage of 25% while provision of employment in the park was ranked third (Table 7). A good number of respondents (~9%) on the other hand think that imposing tougher penalties on the wrongdoers (poachers, etc.) would reduce/stop illegal activities within the park (Table 7). Also interesting to note was that community initiatives such as the common good projects (3%) such as community water tanks and infrastructure developments(7%) like roads and schools were ranked last and second last respectively as suggestions that could stop or mitigate illegal activities within Bwindi (Table 7). Yet these (the common good projects) are the focus of most development organisations around Bwindi including BMCT and UWA.

Table 7 Suggestions by respondents on how illegal activities could be reduced in Bwindi (n = 773)

Parish	%Employment opportunities	%Individual household benefits	%Infrastructure development	%Not sure	%Rigorous law enforcement	Sensitisation	Common good benefits	Tougher penalties
Buremba	8	28	4	7	12	26	3	12
Karangara	15	24	7	4	13	26	4	7
Kiyebe	16	25	8	2	14	23	3	8
Mpungu	12	33	8	0	10	28	1	8
Nteko	14	25	6	2	17	22	5	8
Average	**13**	**27**	**7**	**3**	**13**	**25**	**3**	**9**

5.12 Attitudes of respondents towards the conservation of Bwindi Park

Almost all respondents (over 90%) across all the parishes acknowledged that they benefited from Bwindi National Park (Figure 15). There were a number of respondents from Nteko parish (10%), Buremba (5%) and Mpungu (2%) who claimed that they did not get any conservation benefits from Bwindi (Figure 15). The reasons associated with the conservation benefits are shown in table 6. Overall most of the respondents (45%) associated benefits from conservation of Bwindi with its ability to modify climate, followed by benefits from tourism (13%) and employment opportunities (7%) as Table 8 shows. Benefits associated with UWA's revenue sharing were ranked at 3% while benefits associated with BMCT were ranked at 2% by respondents (Table 8).

On the hand, respondents also observed the costs from being near Bwindi National park. According to the respondents, in most cases these costs outweighed the benefits highlighted above (Figure 16). Buremba parish had the highest number of respondents (80%), followed by Kiyebe and Mpungu who perceived that they incurred and experienced more costs from the conservation of Bwindi National Park than not while Karangara parish had the least (40%) (Figure 16). The reasons attached to respondents perceptions on conservation costs of Bwindi are indicated in table 9. Most respondents (58%) associated the conservation costs to crop raiding by wildlife that come from Bwindi National Park (Table 9). Buremba parish had the largest number of respondents (74%) who associated the conservations costs to crop raiding while Karangara had the least. The imprisonment and harassment of family and friends found in the park was mentioned as the least (0.1%) reason associated with conservation cost of being near Bwindi park (Table 9). The villages where people

mentioned they had no conservation costs were mostly second and even third villages (non frontline villages) away from the park where people did not experience any conservation costs.

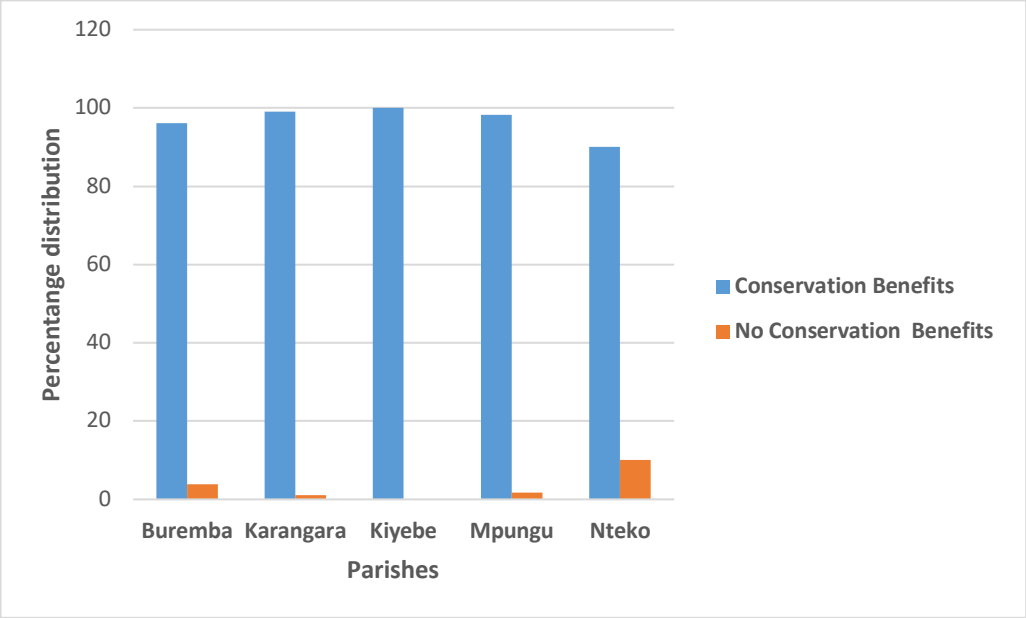

Figure 15 Perceived conservation benefits by respondents per parish

Table 8 Perceived benefits associated with the conservation of Bwindi by percentage by respondents (n = 773)

	Benefit from BMCT	Benefit from other NGOs	Benefit from R.S	Conservation of wildlife	Jobs	No Benefit	Climate modification	Revenue to Gov't	Resource harvest	Tourism
Buremba	0.00	2.33	39.53	2.33	6.98	3.88	33.33	1.55	2.33	7.75
Karangara	6.00	1.00	14.00	1.00	4.00	1.00	59.00	1.00	3.00	10.00
Kiyebe	1.14	0.00	37.14	2.86	1.14	0.00	45.14	1.14	2.86	8.57
Mpungu	2.37	1.18	20.71	0.00	7.69	1.78	47.93	0.59	5.33	12.43
Nteko	1.00	1.50	8.00	0.50	13.00	10.00	41.50	0.50	0.50	23.50
Average	2.10	1.20	2.88	1.34	6.56	3.33	45.38	0.96	2.80	12.45

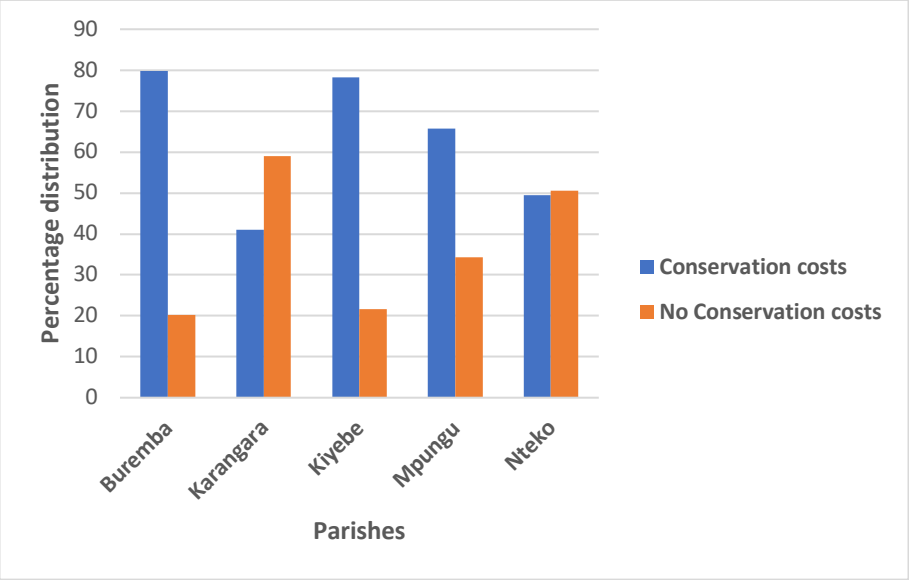

Figure 16 Perceived conservation costs by respondents per parish

Table 9 Reasons associated with the conservation costs of Bwindi by respondents (n = 773)

Parishes	%Creation of Bwindi caused shortage of land	%Crop raiding	%Imprisoning of family and friends	%Loss of access of resources like timber. Bush meat. medicine	%No conservation costs experienced
Buremba	0.0	73.6	0.0	6.2	20.2
Karangara	0.0	37.0	0.0	4.0	59.0
Kiyebe	0.0	72.0	0.0	6.3	21.7
Mpungu	1.2	61.5	0.0	3.0	34.3
Nteko	1.0	44.0	0.5	4.0	50.5
Average	0.44	57.62	0.1	4.7	37.14

5.13 Impacts of BMCT, UWA and other Community projects on People's livelihoods

5.13.1 Knowledge of BMCT and UWA's funded community projects

In order to fully understand the impact of both BMCT and UWA's Revenue Sharing (RS) projects, we examined how well respondents knew or understood these two entities (Figure 17 and 18). As the results show, overall most respodents had a good knowledge and understanding of both BMCT and UWA's RS funded community projects. Only few respondents (less than 33%) had a vague or no understanding of the BMCT or UWA's RS community funded projects. As the figure 17 and 18 show, whereas some respondents in the study parishes had no complete knowledge about

the BMCT funded projects (from 6% to 33%), there were no respondents that did not know about the UWA's RS programs. A good number of respondents (32%) from Nteko parish claimed to have no knowledge about BMCT. It was only in Karangara parish with the biggest number of respondents (91%) who clearly understood the BMCT and its projects (Figure 17). On the hand, all respondents from Buremba and Mpungu parish (100%) knew UWA's revenue sharing programs. However, some respondents from Nteko parish (16%) said they had no clear understanding of UWA's RS program (even though they knew the UWA RS programs).

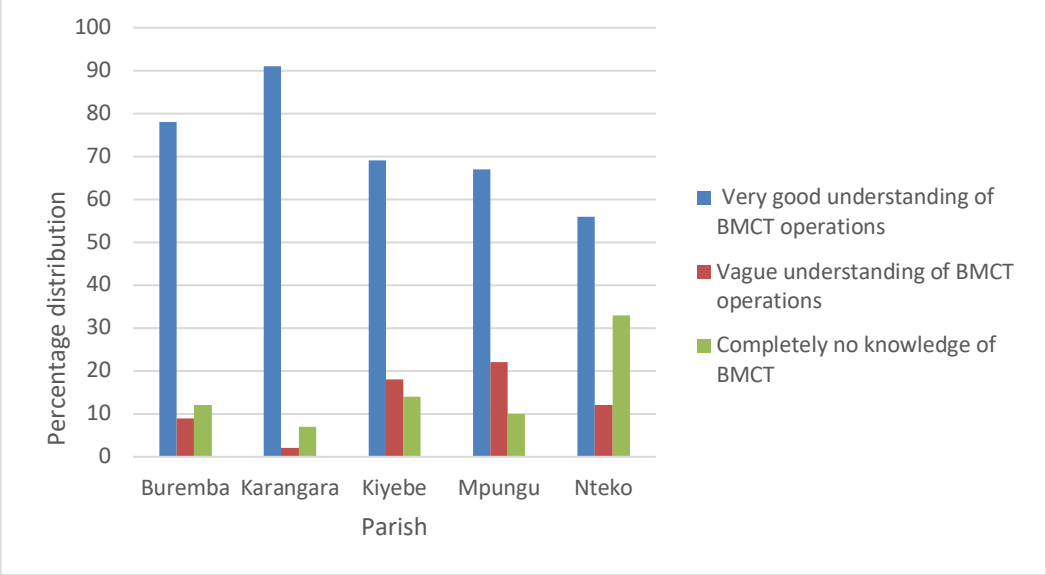

Figure 17 Knowledge and understandig of BMCT funded community projects by respondents (n = 773)

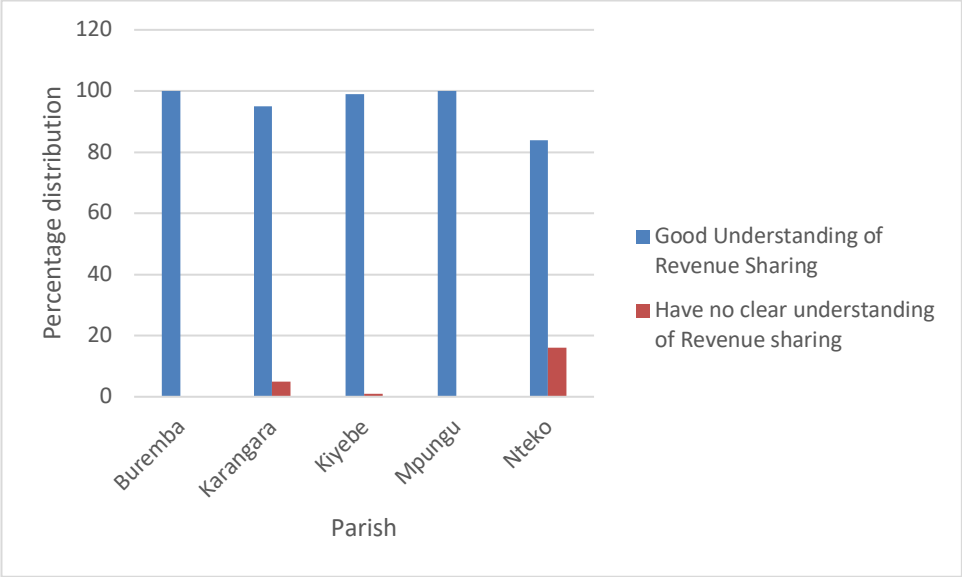

Figure 18 Knowledge and understanding of UWA's revenue sharing funded community projects by respondents (n = 773)

5.13.2 Perceptions of benefits of BMCT and UWA's funded community projects

As the results show in table 10 and 11, overall, majority of respondents (>83% for BMCT and 77% for UWA's RS) claimed not to have benefited from either BMCT or UWA's RS funded community projects. On the other hand, when the BMCT and UWA's RS funded community projects are compared, majority of respondents (20%) felt that they benefited more from the UWA's RS than from the BMCT projects (8%). The results in the table 9a and 9b show that the respondents perceived that UWA's RS funded community projects improved their livelihoods to a greater extent than those of BMCT. Of the community projects funded by BMCT, most respondents felt they benefited more from support for schools (education), followed by community water tanks and Batwa support projects while the least were the tree planting projects (Table 10). As results in table 9b further show, in regards to UWA's Revenue Sharing funded projects, livestock support was perceived as the most important for the improvement of local people livelihoods by the respondents (25%) this was followed by the road construction projects. The least popular UWA's revenue sharing funded project was that of Problem Animal Management with 12% of respondents recommending it for livelihood improvement (Table 11). For a parishes such as Kiyebe, Buremba and Mpungu over 83% of respondents mentioned they had never benefited from any of BMCT projects (Table 10) while but also worth noting is that Kiyebe ranked as one of the two poorest of the five parishes from our livelihood assessments.

Table 10 Perceptions of impacts of BMCT funded projects on livelihoods by respondents (n = 773)

Parish	%Have never benefited	%Benefited but no livelihood improvement	%Benefited and livelihood improved
School support			
Buremba	78.29	5.43	16.28
Karangara	53.00	7.00	40.00
Kiyebe	99.43	0.00	0.57
Mpungu	59.17	10.65	30.18
Nteko	80.00	16.00	4.00

Average	**76.07**	**8.28**	**15.65**
Community water tanks			
Buremba	87.60	6.98	5.43
Karangara	34.00	11.00	55.00
Kiyebe	98.29	1.71	0.00
Mpungu	83.43	7.69	8.88
Nteko	94.50	3.50	2.00
Average	**83.96**	**5.56**	**10.48**
Batwa support			
Buremba	44.96	44.96	10.08
Karangara	76.00	18.00	6.00
Kiyebe	98.86	1.14	0.00
Mpungu	81.66	14.79	3.55
Nteko	60.50	37.00	2.50
Average	**73.22**	**22.90**	**3.88**
VSLA support			
Buremba	96.12	0.00	3.88
Karangara	89.00	4.00	7.00
Kiyebe	97.71	1.14	1.14
Mpungu	93.49	2.96	3.55
Nteko	89.00	11.00	0.00
Average	**93.14**	**4.27**	**2.59**
Tree planting support			
Buremba	96.90	2.33	0.78
Karangara	94.00	5.00	1.00
Kiyebe	97.71	1.14	1.14
Mpungu	97.04	0.00	2.96
Nteko	86.00	13.00	1.00
Average	**93.92**	**4.66**	**1.42**
Overall average	**83**	**9**	**8**

Table 11 Perceptions of impacts of UWA's funded revenue sharing community projects on livelihoods by respondents (n = 773)

Parish	Have never benefited	Benefited but no livelihood improvement	Benefited and livelihood improved
Livestock support			
Buremba	41	13	45
Karangara	86	3	11
Kiyebe	54	10	35
Mpungu	66	9	24
Nteko	90	1	9
Average	**68**	**7**	**25**
Road Construction			
Buremba	96.12	0.00	3.88
Karangara	73.00	0.00	27.00

Kiyebe	60.00	2.86	37.14
Mpungu	73.96	1.18	24.85
Nteko	82.50	0.50	17.00
Average	**76.58**	**1.03**	**22.38**
Problem Animal Management			
Buremba	75.19	0.78	24.03
Karangara	86.00	0.00	14.00
Kiyebe	99.43	0.00	0.57
Mpungu	82.84	2.96	14.20
Nteko	90.00	0.00	10.00
Average	**87.58**	**0.78**	**11.64**
Overall average	**77**	**3**	**20**

5.13.3 Popularity of development organisations funding Community projects around Bwindi

We examined the perceptions of respondents on the popularity of the different development organisations that fund community intervention projects around Bwindi parishes. These were the different development organisations that respondents perceived contributed meaningfully towards their livelihood improvement (Table 12). Of the 773 respondents, 59% claimed not to have benefited at all from the development organisation working around Bwindi while the rest (41%) acknowledged to have benefited from the community project interventions (Figure 19 & 20). Most respondents from Karangara, Kiyebe, Mpungu and Nteko parishes claimed not to benefited at all from the funding of community projects around Bwindi (Figure 20). It was only in Buremba parish where majority of respondents (60%) thought they had benefited from the community projects funded by the different development organisations working around Bwndi. Nteko parish had the majority of respondents who claimed not to have benefited from the community projects funded by the different development organisation working around Bwindi (Figure 20).

Results from Table 12 show that UWA's revenue sharing (RS) funded community projects were the most popular for household livelihood improvement (31%) followed by RTV (Razing the village) with 21% agreeing and the BMCT's funded community projects ranked third with 14% among respondents. There were other community projects mentioned by respondents and these included those funded by the International Gorilla Conservation Program (IGCP), Conservation Through Public Health (CTPH), Gorilla Organization, Change a life Bwindi, Compassion, CARE,

Diocese of Kigezi, ICAN, local government, LADA, singing gorilla, WWF, Twist Uganda, KDC and USAID, etc. (Table 10). Community projects funded by Twist Uganda, USAID and Change a life were considered the least popular by respondents. UWA's revenue sharing community projects are popular because the projects involve large stakeholders especially local government structures and are widely publicised on local radios, churches and in community meetings unlike those of BMCT projects and probably other development organisations. It is also important to note that BMCT targets small groups of people within a parish to work with while RS targets much larger population within the frontline villages. Although respondents viewed RS disbursement of funds and processes to be fraudulent, especially when the local government is concerned, respondents felt that they atleast got "something" from it.

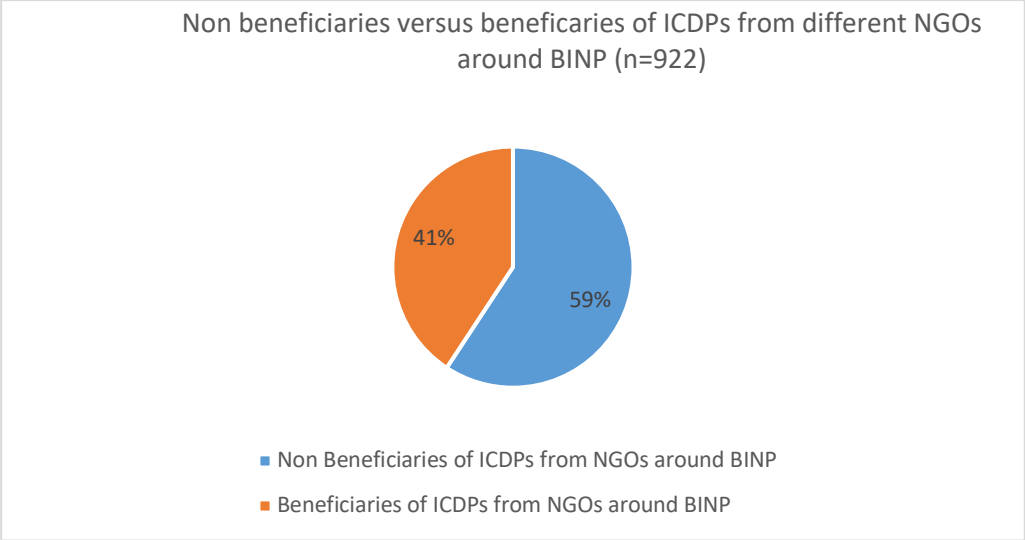

Figure 19 Percent number of beneficiaries and non-beneficiaries from all funded community projects around Bwindi

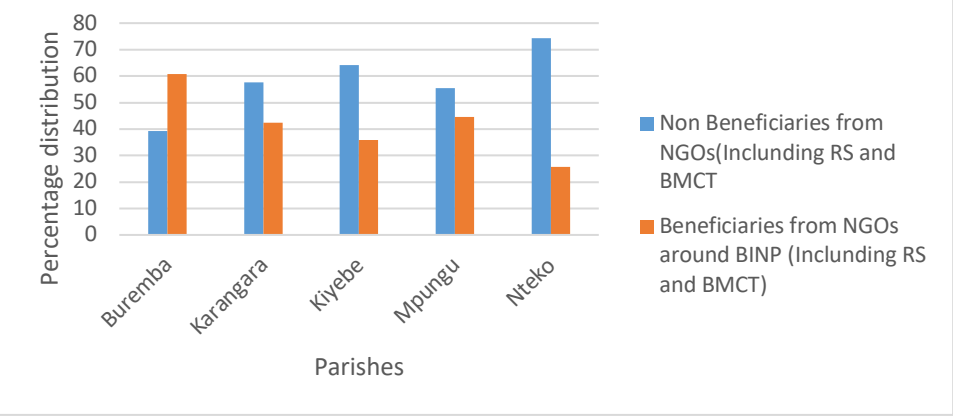

Figure 20 Percent beneficiaries and non-beneficiaries from all funded projects by respondents per parish

Table 12 Popularity status of the different development organisations working around Bwindi among respondents (n = 378)

Parish	%UWA's RS	% RTV	% BMCT	% CARITAS	%NAADS /OWC	&NCCDF	%Others
Buremba	28	40	10	1	5	0	16
Karangara	35	13	29	4	15	0	4
Kiyebe	39	0	3	39	9	0	9
Mpungu	28	46	10	0	7	0	10
Nteko	24	5	16	0	3	34	17
Average	**31**	**21**	**14**	**9**	**8**	**7**	**11**

***Other**s=IGCP,CTPH, gorilla organization, Change a life Bwindi, compassion, CARE, diocese of Kigezi, ICAN, local government, LADA, singing gorilla, WWF, Twist Uganda, KDC and USAID

5.13.4 Preferences of Common goods versus individual households projects

Overall most respondents who had not benefited from the funded community projects (of the 51% as previously pointed out) preferred common goods projects over individual household projects. And most of those who had benefited more from the funded community projects (of the 49%) preferred individual household projects. Respondents who preferred common good projects were from the parishes such as Kiyebe and Mpungu that have benefited least from the funded community projects. While those that preferred common good projects over individual household projects were Nteko and Karangara that have more funded community projects (Figure 21). Most respondents mentioned that communities with common good projects everyone benefited while for individual household projects only few individuals benefited. The individual household projects included rain water harvesting tanks, heifers and vegetable growing. In contrast the respondents that preferred individual household projects emphasized the necessity of one having a project they really owned and managed as they wished. For example many would a give an example, "with a household project I know it's mine and I would look after it better than if it was a community project". Also respondents mentioned that with household projects they were able to use them as they wished. They mentioned that in case they had a problem and were cash strapped, they would sell the project (for example livestock) and solve their problems.

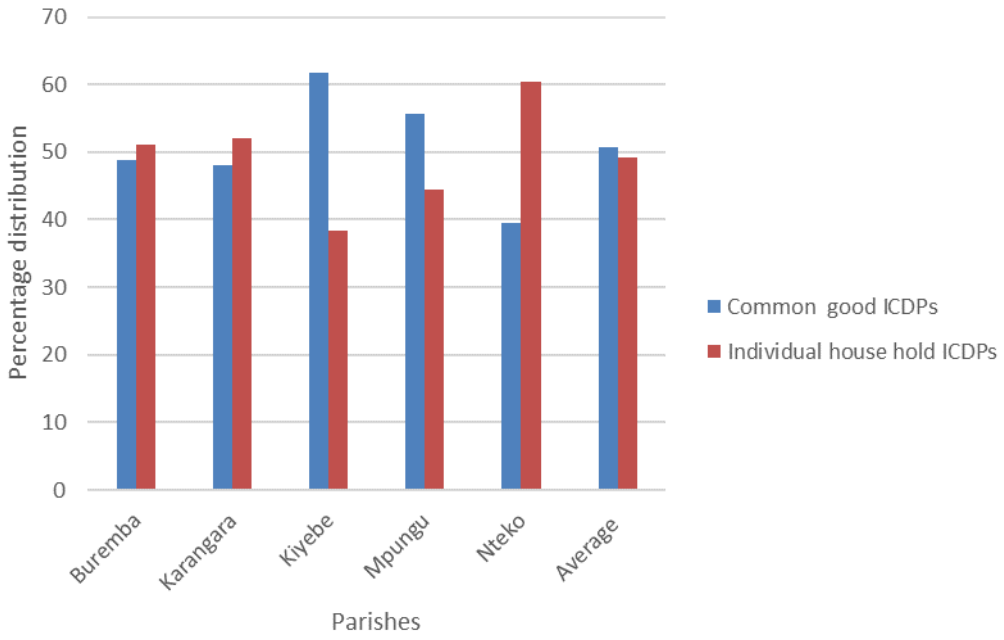

Figure 21 Preferences of common good projects versus individual household projects by respondents (n = 773)

3. Discussion

6.1 Profiles of households adjacent Bwindi study parishes

6.1.1 Housing Conditions of respondents

The characteristics of households dwellings and various aspects of households living arrangements provide an important indication of the well-being of household members. The type of materials used to construct the household's dwelling unit gives a general picture of the structural condition of the building based on the durability and permanency of the materials and also provides a general indication of the socio-economic status of the household. Good quality walls ensure that household members are protected from harsh weather conditions and other hazardous factors. The results indicate that respondents from Nteko parish were well off than those of Kiyebe and Mpungu parishes basing on the nature of their houses. Actually respondents from Kiyebe and Mpungu can be classified as the poorest. This is also consistent with the results previsouly shown above in those parishes where illegal activities were prevalent in Kiyebe and Mpungu. Poorer households tend to forage more in forests as a safety net/insurance than the well-off households (Bitariho *et al.* 2016). The highest number of illegal activities observed in the parishes of Kiyebe, Mpungu and others are a result of poorer households in those parishes. The Universal Declaration of Human Rights of 1948 recognizes the right to housing as an important

component of human rights and economic welfare. In addition, the government of Uganda recognizes the strategic social and economic importance of housing in the national economy (MLHUD, 2016)

6.1.2 Water and sanitation issues for households

Sanitation is a critical component of human life and this is reaffirmed by the importance the SDGs and NDP III. SDG 6 goes beyond drinking water to also address sanitation and hygiene issues. Access to proper sanitation ensures dignity and helps prevent the spread of diseases such as cholera that are associated with faecal contamination. The source of water is an important determinant of the health status of household members. Safe and clean water is a prerequisite for reducing many common killer diseases of both adults and children such as diarrhoea, dysentery and cholera. The importance of access to safe drinking water is underlined by the fact that it is one of the SDGs (SDG 6). It is also important to note clean water and good sanitation is also considered a yardstick for an economically versatile household in developing countries like Uganda (Franken Berger and McCaston 1998). Ninety nine percent of the respondents in our study area had access to pit latrines compared to the 83% of the national average with same. This is probably connected to education and housing characteristics of our study population. Statistics by UBOS have shown that households with higher education levels and good housing are more likely to have a better sanitation system than those without a good education and housing. In regard to access to water, households within our study area had an average of 66% respondents with access to water from improved sources (Table 3) which was lower than the national average of 78 % (UBOS 2017).

6.1.3 Food consumption by households

Goal 2 of the Sustainable Development Goals aims at ending hunger achieving food security and improved nutrition and promote sustainable agriculture. In developing countries like Uganda many people do not have enough food to meet their daily energy needs. More than a quarter of children less than 5 years in developing countries are malnourished (FAO 2010). This is in most cases caused by poverty and ignorance on dietary needs. Hence, food consumption of a population can inform on its socio-economic welfare. Meal consumption has been considered by the World Bank and FAO as important measure of the welfare of a household and as such these results can give a snippet view into the livelihoods of respondents from the different parishes.

6.2 Spatial patterns of illegal activities and Funded Community Projects

As the results show and from other studies carried out in Bwindi, the most prevalent locations of illegal activities is the South Eastern parts of the Bwindi park and also areas around the park neck (McNeilage *et al*, 2006; Hickey *et al,* 2019). These are areas most exterior than interior of Bwindi National Park and adjacent local community areas Park (Hickey *et al* 2019). These are the park areas adjacent the parishes of Kiyebe, Mpungu, Buremba, Nyamabare and Mushanje. These parishes (Kiyebe, Mpungu, Buremba, Nyamabare and Mushanje), have received less or no significant Community projects funded by BMCT, UWA's revenue sharing programs and other development organisations working around Bwindi park. On the other hand, parishes such as Nteko, Bujengwe, Karangara and Southernward received more community funded project interventions and experienced the least illegal activities over the study period. As pointed out by Twinamatsiko *et al* (2014) and Blomley *et al* 2010, local communities likely to be involved in illegal activities around Bwindi, are those from the poorest communities and usually those with large families. These are the same local communities who have benefited less from ICDPs (Twinamatsiko *et al*, 2014; Blomley *et al,* 2010; Hughes and Flintan 2001). As results in section 5.5 to 5.7 show the poorest households were those with the least funded community projects by UWA and BMCT. Community project incentives realised as a result of creation of protected areas are vital for getting people appreciate the protected areas and mitigating or getting involved less in illegal activities (Ostrom, 2000; Castro & Nielsen, 2001). ICDPs are premised on the fact that local people's livelihoods will be enhanced while at the same time the local people are helping in the sustainable conservation of biodiversity in protected areas. As pointed out by Bitariho *et al* (2016); Wunder *et al*. (2014) and Debela *et al*. (2012), forest foraging is the most available and probably only alternative (apart from farming) source of livelihood to most rural poor households in the tropics. This is probably the reason why the highest forms of illegal activities were observed in the forest areas adjacent the parishes that have benefited the least from the funded community project initiatives.Whereas, law enforcement is a crucial factor in mitigating illegal activities, it cannot be overemphasised therefore that the funding and implementation of local Community project interventions in communities adjacent protected areas contributes

significantly in reducing or stopping illegal activities all together around Bwindi. Infact, Blomley *et al* (2010) notes that linking local people to a park resource and helping them generate a steady stream of benefits increases willingness to manage and protect that resource over the long term.

The high intensity of illegal activities at the park boundary highlights the positive relationship between accessibility and local community physical access to park resources. Accessibility is a well recognised driver of illegal activity at protected areas, particularly those surrounded by highly populated settlements, as accessibility brings natural resources to human settlements. Hunting of wildlife, for instance, has been reported to increase with road expansion in the Congo rainforest basin (Wilkie et al. 2000). In fact, increasing illegal hunting and associated wildlife trade in previously pristine landscapes has been attributed to increasing accessibility in form of roads (Kleinschroth et al. 2019). The areas surrounding are experiencing unprecedented infrastructure development indirectly.

6.3 Local people attitudes and perceptions on the conservation of Bwindi

According to Blomley et al (2010), UWA's revenue sharing program and BMCT funded community projects are important components that help reconcile conservation and development interests by creating an appreciation for the two parks by the local communities. Indeed this was exhibited by this study findings which have found out that areas with more of these community funded projects experienced the least illegal activities. The conservation impact of revenue sharing and BMCT seems to be mainly through changing attitudes towards conservation, which also may indirectly contribute to increased cooperation and reduction in illegal activities in Bwindi (Blomley *et al*., 2010). Other park benefits mentioned by most respondents was the value of Bwindi in climate modification such as bring more rains and better/fertile soils for agriculture Tourism was also ranked high by respondents as a benefit from Bwindi. This study findings are in agreement with Blomley *et al*., (2010) who state that tourism appears to be a strong ICD strategy because it changes attitudes and increases cooperation, and this appears to have translated into strong local support for conservation. The UWA's revenue sharing programs and some of the BMCT's funded community

projects are related to tourism (community halls, crafts, etc.) and therefore have improved the local community attitudes towards Bwindi Park.

Despite the above mentioned local community park benefits and therefore positive attitudes towards Bwindi park, a number of respondents have described the costs their incur as a result of establishment of Bwindi Park. As was mentioned by other studies such as Bush and Mwesigwa (2008); Blomley *et al,.* (2010); Gray and Rutagarama (2011); Twinamatsiko *et al.,* (2014), crop raiding from wildlife that come out of the park is the biggest costs local communities face and therefore affects their attitudes towards Bwindi park in a negative way. Most local people feel crop raiding incidences affects their livelihoods and therefore negatively impacts on their attitudes towards the conservation Bwindi. Indeed this is in agreement with this study.

6.4 Impacts of BMCT and UWA's revenue sharing funded Community projects

Integrated Conservation and Development (ICD) interventions are important for improving park-community relations. In agreement with this study, Blomley *et al.* (2010) notes that UWA's revenue sharing programs and BMCT's community funded projects were significant in changing local people attitudes towards the conservation of Bwindi, which also may indirectly contribute to increased cooperation and reduction in illegal activities. Infact, tourism was cited by 78 per cent of community members as a factor in increased reporting of illegal activities and cited by 76 per cent as a factor in increased willingness to assist in fire control. However as noted by Twinamatsiko *et al* (2014); Harison *et al.,* (2015) some of these interventions tend to benefit the elite and well off community members rather than the poorest households that depend greatly on park resources. This is an elite capture and inequitable distribution of conservancy-related benefits which is a major negative social outcome of community conservation programs (Barnes and Child, 2014; Collombet al., 2010; Saito-Jensen et al 2010). This is the reason why households from the parishes of Kiyebe, Mushanje, Nyamabare, Mpungu and Buremba were observed to have benefited the least from these community projects. As this study shows, these same households had the least ranking for houses with bricks, highest number of respondents eating one meal and poor housing sanitation. These parishes also highest number of complainants about

crop raiding. It is therefore not surprising as the results showed, that these are the same parishes that experienced highest number of illegal activities.

6.5 Preferences of Common goods versus individual households projects

Results showed that overall respondents preferred common goods projects over household projects. Whereas, common good project offer long-term sustainability and impact throughout the whole community, household projects have the potential of increasing income for individual households (Weber et al, 2011). According to Blomley *et al* (2010), to date the bulk of projects supported through BMCT and park revenue sharing have tended to be social infrastructure, common good projects such as school construction or refurbishment, health centres, roads and bridges. Indeed these are the most popular projects among the communities adjacent Bwindi Park. However, these projects are supposed to be funded by the local government/government. Therefore, BMCT and UWA are "filling" in a gap that should have been handled by the government/local government. Therefore, if the local communities had schools, health facilities, roads etc. well funded by the government/local government preferences would probably change to individual households projects. Indeed as this study shows, parishes with already funded common good projects preferred individual household projects to common goods projects. As such the individual household income generating projects are increasingly being funded by BMCT (covering initiatives such as mushroom growing, honey production and processing, and handicraft making) and provide important additional income sources to local communities (Blomley *et al.,* 2010). Blomley *et al.,* (2010) further note that if UWA's RS and BMCT's funded community projects are to be successful, the two entities will need to find a balance between common goods and individual household projects. This will be in order to satisfy two important constituencies; on one hand, households impacted negatively by the park and the other hand politicians and local leaders who are keen to see impact at a wider community level and therefore, increasing overall support for Bwindi conservation. However, common good projects are bedeviled with poor governance, lack of ownership and poor sustainability than individual household projects (Ostrom, 1999; Brett, 2003). Therefore, what is important with the common goods projects is to have good governance and management of these projects. Within the existing local community governance structures around Bwindi are the well respected and good

governance structures of Engozi stretcher groups (Bitariho, 2013, Bailey *et al.,* 2021). These are informal structures that could be utilised to manage the common good projects funded by UWA and BMCT.

4. Conclusions

This study has shown that using the UBOS well being parameters (household structures, water and sanitation, etc.) most households around Bwindi were better off tha most other Households in Uganda (e.g Karamoja and Gulu). Perhaps this is due to the impact of the different development organisations around Bwindi that have funded and implemented various community projects. However, despite the overall good picture show, a number of households from the parishes of Kiyebe, Mpungu, Buremba and Nteko had the least rankings and had the poorest households by UBOS standards. It is in those parishes that most former forest dwellers, the Batwa live. Furthermore, it is in those parishes (except Nteko) that the presence of illegal activities were mostly found.

The presence of funded community projects has a positive effect of reducing illegal activities in the forest areas adjacent community parishes of Bwindi. Indeed the parishes with the most funded community intervention projects experienced fewer illegal activities. Despite this fact, a number of people around Bwindi are yet to get tangible benefits from the various community projects funded by the different organisations. These were located mostly in the parishes of Kiyebe, Buremba, Mpungu, Mushanje, Nyamabare and Kaara whose forest adjacent areas are hotspots of illegal activities. Furthermore, we conclude that whereas respondents found individual household ICD projects such as livestock support and household water tanks more beneficial for improving household income, the common good projects were generally popular among households around Bwindi. The sustainability of the common good projects could be made better if the governance and management issues of those projects are solved.

The revenue sharing projects and community projects funded by UWA, RTV (Razing the village and BMCT respectively are the most popular projects among households around Bwindi. These projects have significantly contributed to the improvement of

household livelihoods among local people living adjacent Bwindi. In turn these projects are significantly helped in the mitigating of illegal activities within Bwindi Impenetrable National Park.

8. Recommendations

Monitoring and evaluation of the funded community projects by the different funding organisations is a key necessity for the success and effectiveness of the projects. Unfortunately this is a least considered by most development organisations ICDPs (O'Neill 2007; Botrill et al. 2011). BMCT and UWA need to develop and implement monitoring and evaluation tools for the various community projects funded. Respondents confirmed that there was very little if any follow up of the funded projects by BMCT and UWA. Whereas a recently introduced development organisation RTV was ranked highly by respondents, we found that their monitoring was more elaborate and participatory and went beyond the project cycle, according to respondents. UWA, BMCT and other developmental organisation around Bwindi need to pick lessons from RTV.

Only a small proportion of the community members around Bwindi are able to access Trust projects unlike those of UWA's RS. This implies that the impact of BMCT funded community projects is in turn also limited. As such BMCT could work towards establishing a niche by funding community projects that target the poorest of the communities. Most issues that affect the poorest households around Bwindi are crop losses from wildlife and a need for livelihoods including lack of alternatives to park resources.. Those who bear more the conservation costs and the poorer members of society are more likely to engage in illegal activities as this study has shown. These should be the target of the BMCT funded projects.

BMCT funded community projects have a lot of similarities and overlap with most other development organizations funded projects around Bwindi. Some of these include UWA's revenue sharing programs, NAADs and Operation Wealth Creation. This makes the beneficiaries unable to distinguish between Trust projects and those of other organizations especially those that are not related to the park. This could affect

the impact of the Trust on conservation. BMCT need to devise strategies or projects that are unique to it and are directly related to parks' conservation;

On whether the BMCT should fund common good projects or individual livelihood projects. From this study, the livelihood projects seem to influence community more to like conservation and stop engaging in illegal activities than common good projects despite their popularity. Majority of the individual household project beneficiaries seem to continue engaging in the livelihood projects long after the Trust support has ended. This indicates that the projects are central to the household livelihoods. However, the link between common good projects and conservation tends to fade from peoples' minds with time (Babaasa *et al.,* 2017).

The other recommendations after this study include;

1. Monitoring of the community projects should be more vigilant and regular. Even after project cycles where possible, especially for household projects
2. Monitoring should be measured against indicators that allow us to know if people's lives are improving and how this affects conservation of Bwindi
3. Local communities need regularly sensitisations and awareness of the BMCT projects. Perhaps this could be through sensitization by LCSC members, publicised in media and public gatherings. This would necessitate increasing the LCSC budget to include an element of sensitisation and community awareness.
4. BMCT needs to clearly and precisely label projects funded by them to avoid confusion with the other funded projects of different organisation. There is a possibility of other development organisations using BMCT funded community projects to falsely make their accountabilities to the communities and others
5. There is need for increased community projects that target individual households than the common good projects on order to focus and enhance individual household incomes. This could be done in tandem with the operation wealthy creation (OWC) by government.
6. There should be a targeted and increased funding of the community projects for the parishes identified (Kiyebe, Mpungu, Buremba, Mushanje, Nyamabare and Kaara) as hotspots illegal activities in Bwindi.

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10. Appendix

10.1. Demographic characetristics of respondents

Demographic characteristic	Parish	Category	Percentage distribution
Gender	Buremba	Female	45.7
		Male	54.3
	Karangara	Female	54.0
		Male	46.0
	Kiyebe	Female	55.5
		Male	44.6
	Mpungu	Female	55.6
		Male	44.4
	Nteko	Female	52.0
		Male	48.0
Ethnicity	Buremba	Bafumbira	0
		Bakiga	99
		Banyakore	1
		Batwa	0
	Karangara	Bafumbira	2
		Bakiga	98
		Banyakore	0
		Batwa	0
	Kiyebe	Bafumbira	0
		Bakiga	100
		Banyakore	0
		Batwa	0
	Mpungu	Bafumbira	0
		Bakiga	100
		Banyakore	0
		Batwa	0
	Nteko	Bafumbira	29
		Bakiga	69
		Banyakore	0
		Batwa	3
Age of respondents	Buremba	Below 20	3.9
		21-40	48.8
		41-60	23.3
		Above 60	24.0
	Karangara	Below 20	3.0
		21-40	49.0
		41-60	33.0
		Above 60	15.0
	Kiyebe	Below 20	1.7
		21-40	59.4
		41-60	25.1
		Above 60	13.7
	Mpungu	Below 20	1.2
		21-40	58.6
		41-60	26.0
		Above 60	14.2
	Nteko	Below 20	0.5
		21-40	54.5
		41-60	23.5
		Above 60	21.5

Marital status	Buremba	Married	86.0
		Single	2.3
		Widow/er	10.1
		Separated	1.6
	Karangara	Married	76.0
		Single	3.0
		Widow/er	18.0
		Separated	3.0
	Kiyebe	Married	78.3
		Single	4.0
		Widow/er	17.1
		Separated	0.6
	Mpungu	Married	86.4
		Single	3.6
		Widow/er	7.7
		Separated	2.4
	Nteko	Married	87.0
		Single	1.5
		Widow/er	11.5
		Separated	0.0
Length of stay in the village	Buremba	Less than 5 years	5.4
		Between 5-10 years	6.2
		More than 10 years	88.4
	Karangara	Less than 5 years	11.0
		Between 5-10 years	8.0
		More than 10 years	81.0
	Kiyebe	Less than 5 years	6.9
		Between 5-10 years	5.1
		More than 10 years	88.0
	Mpungu	Less than 5 years	7.7
		Between 5-10 years	85.8
		More than 10 years	6.5
	Nteko	Less than 5 years	7.0
		Between 5-10 years	8.5
		More than 10 years	84.5

10.2. Research Tool: Impacts of Community livelihood interventions in the mitigation of wildlife poaching in Bwindi Maringa Conservation Area

1. Name (optional)_____
2. Sex (circle) Male Female
3. Age: (circle) +60 41-60 21-40 Below 20
4. Ethnicity: (circle) Bakiga Bafumbira Batwa
   other_____
5. What is your position in the community? _____
6. How long have you lived in this village? (circle) <5 years 5-10 years >10 years

7. What is your marital status? (Tick) a) Married. b)Single (never married) c)Co-habiting e)Widow/er f)Divorced and separated
8. Date:_____ Interview Ref # _____
9. Interviewer names:_____
10. Describe household location: LC1: Parish:
11. Density of neighbours nearby: (circle) none few/some many
12. Main type of surrounding land: (circle) farmland forest village/centre other: _____
13. Nearest village/trading centre (circle) under or over 1 hour walk
14. Nearest road for vehicle use (circle) under or over 1 hour walk
15. GPS Northing_____ Easting_____
16. If married. Number of wives _____
17. Number of people in the household

Age	Number of males in this household	Number of females in this household
+60		
41-60		
21-40		
<20		
	Total number: Of these n. financially dependent on you:	Total number: Of these n. financially dependent on you

18. What is your level of education? (tick)
- No formal education b)
- Primary school _____
- Secondary school _____
- Tertiary_____
- Other (please detail)_____

19. Do you have (and look around for evidence): (tick)
- Hand-washing water facilities at toilets (Done by) _____
- Drying rack (Done by) _____
- Kitchen with a smoke escape out-let (Done by) _____
- Toilet (Done by) _____
- Toilet cover (Done by) _____

20. Where do you obtain water? (tick all that apply; if more than one circle main source)

☐ Protected source
☐ Protected spring
☐ Bore hole
☐ gravity flow scheme

☐ Unprotected source
☐ Lakes
☐ Ponds
☐ Rivers
☐ Spring

21. How many of these diseases have you and others in your household had in the last 6 months:

Total number (not occurrence): Tuberculosis. Measles. Polio. AIDS. Malaria. Scabies. Cough. Diarrhoea

22. List the 3 most important income-generating activities to your household (most important

First) - such as farming. Livestock. Tourism-related activities. Forest resource utilization. Village market sales

Income-generating activity	Who in household does this

23. Are these activities enough to address your household needs? (circle) Yes / No. If no. what do you suggest as measures to meet your livelihood needs? (Probe efforts)

24. On average how many meals do you and your family have a day? (circle) 1 2 3+ A DAY

25. How often do you / your family go hungry per week: (circle or tick)

- Never
- Once or twice a week
- Three or four times a week
- Above five times a week

What is your current thinking about Bwindi or Mgahinga National Park?

- Very positive
- Positive
- Neutral
- Negative
- Very negative

Give reasons for your score

26. What conservation costs do you bear as a result of the National Park (Bwindi or Mgahinga)?

27. What current conservation benefits do you get from Bwindi or Mgahinga National Parks (Probe economic and ecological benefits?)

28. If 1 is the worst and 5 the best. What number best represents your life at the moment? (circle) 1 = worst; 2 = somewhat bad; 3 = average; 4 = fine; 5 = best

29. Discuss reasons for score with links to natural resources/park existence if appropriate (for example. they need household building materials or fuel wood. bear costs of conservation. get benefits etc.)....

30. In your community what are the current motivations for people who poach (Probe details

Of the answer)

- Poverty Income (To sell meat or cannot afford domestic meat)
- Cultural/tradition Societal
- Resentment to the park (if mentioned find out why)
- Nutrition

Notes:

31. To what extent do you think poaching exists in this community

- 1=Extremely a lot
- 2= A lot
- 3=Barely
- 4= Never

Notes

32. When was the last time someone was arrested for poaching in this
    - 3 months
    - 3-6 months
    - 6-9months
    - 9-12 months
    - More than a year

33. What do you think would encourage people to stop poaching in the park

- Rigorous law enforcement
- Social economic benefits (BMCT and RS)
- Infrastructure projects (water. roads. schools. health centres)
- Employment with UWA
- Tougher penalties for offenders

34. Tell me what you know about BMCT (Bwindi Mgahinga Conservation BMCT)

35. How have these BMCT projects improved your livelihood particularly your income

BMCT project	Know it	Increase income Yes/no. Rank with 1= highest	If yes. How	If no why
Village Savings and Loans Association				

Batwa support				
Trees/Agro forestry				
Arable farming				
Livestock rearing				
Heifer project				
Poultry farming				
Fish farming				
School support				
Road construction				
Energy saving stoves				
Problem animal management				
Ecotourism				
Bee keeping				

36. In general how has the improved income from BMCT projects made your life and that of your household better comparable to before

37. How do you feel about not benefiting or improving your livelihood from some of the BMCT projects

38. The process of benefit I went through to get BMCT (BMCT) livelihood project was fair?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

39. Do you agree that a benefits from these BMCT projects are significantly enough to stop people from poaching around BINP/MGNP

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

40. In your opinion what more can be done by BMCT projects to improve livelihoods and incomes of poachers in order to discourage them from poaching

41. Tell me what you know about UWA's revenue sharing program

42. How have these revenue sharing projects improved your livelihood particularly your income

BMCT project	Know it	Increase income Yes/no. Rank with 1= highest	If yes. How	If no why
Livestock				
Batwa support				
Trees/Agro forestry				
Health centres				
Road construction				
Problem animal management				
Water				
Bee keeping				
Education support				

43. In general how has the improved income from UWA's revenue sharing projects made your life and that of your household better comparable to before

44. How the BMCT projects improved your(probe and quote explanation):
    - Income and assets(eg number livestock. monthly income. harvests. house. motorcycle compared to before)
    - Health and sanitation (number of times you and family fall sick. kind of toilet you have compared to before)
    - Education(your children in school compared to before)
    - Provision of clean water(protected or un protected. distance from water source compared to before)
    - Food and nutrition(how often you eat and whether balanced diet compared to before)
    - Dependence on forest resources (Bush meat. honey. firewood. medicine. weaving compared to before)

45. How do you feel about not benefiting or improving your livelihood from some of the UWA's revenue sharing projects

46. The process of benefit I went through to get revenue sharing livelihood project was fair?
- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

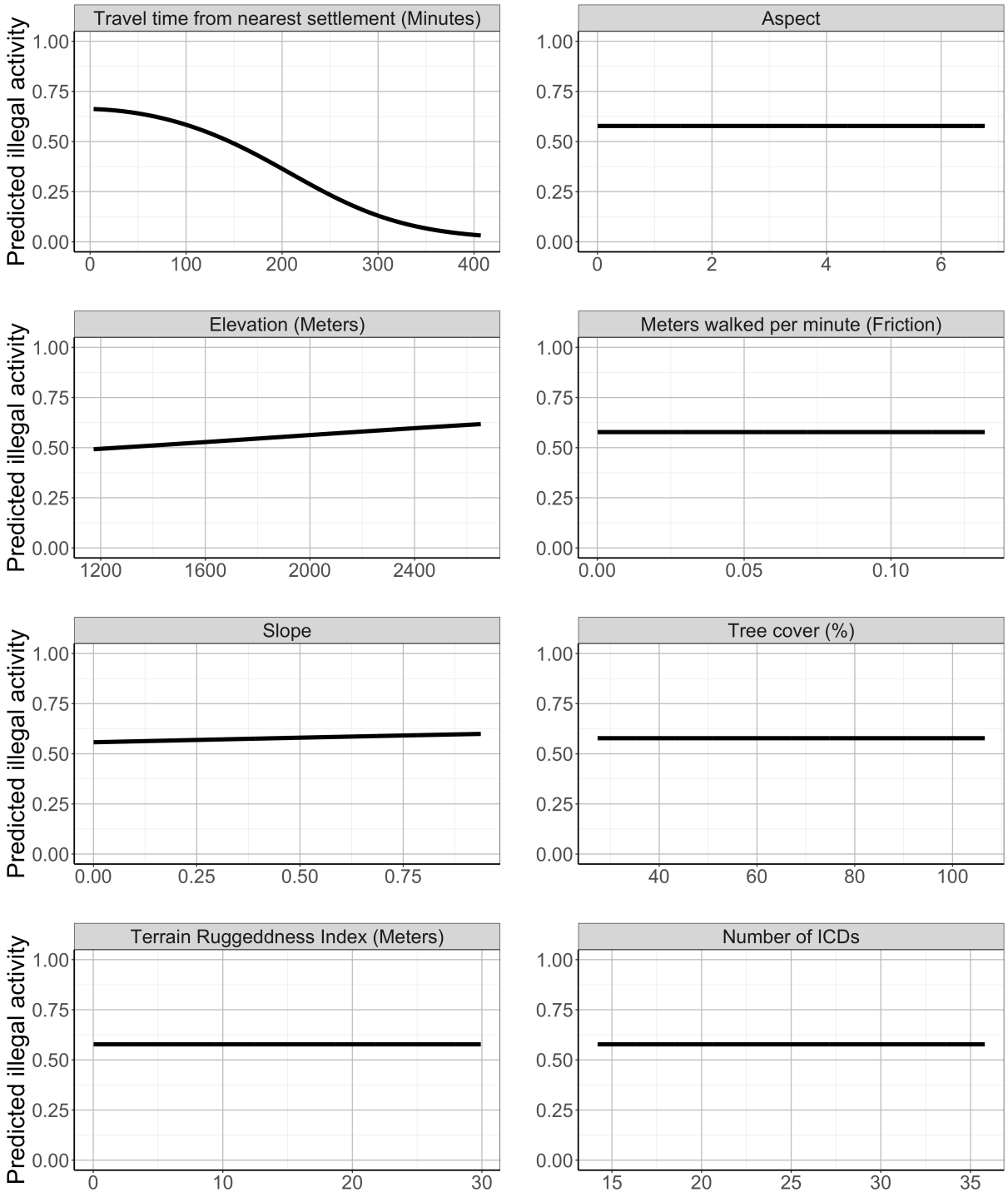
47. Do you agree that benefits from these revenue sharing projects are significantly enough to stop people from poaching around BINP/MGNP

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

48. In your opinion what more can be done by UWA ‘s revenue sharing projects to improve livelihoods and incomes of poachers in order to discourage them from poaching

49. How the UWA revenue sharing projects improved your(probe and quote explanation)
    - Income and assets(eg number livestock. monthly income. harvests. house. motorcycle compared to before)
    - Health and sanitation (number of times you and family fall sick. kind of toilet you have compared to before)
    - Education(your children in school compared to before)
    - Provision of clean water(protected or un protected. distance from water source compared to before)
    - Food and nutrition(how often you eat and whether balanced diet compared to before)
    - Dependence on forest resources (Bush meat. honey. firewood. medicine. weaving compared to before)

10.3. Relationships between the predicted probability of illegal activity and each of the drivers for the respective gorilla census years.
A) 1997


Travel time from nearest settlement (Minutes)
Aspect
Elevation (Meters)
Meters walked per minute (Friction)
Slope
Tree cover (%)
Terrain Ruggeddness Index (Meters)
Number of ICDs
Predicted illegal activity
1.00
0.75
0.50
0.25
0.00
0
100
200
300
400
2
4
6
1200
1600
2000
2400
0.05
0.10
0.25
0.50
0.75
40
60
80
100
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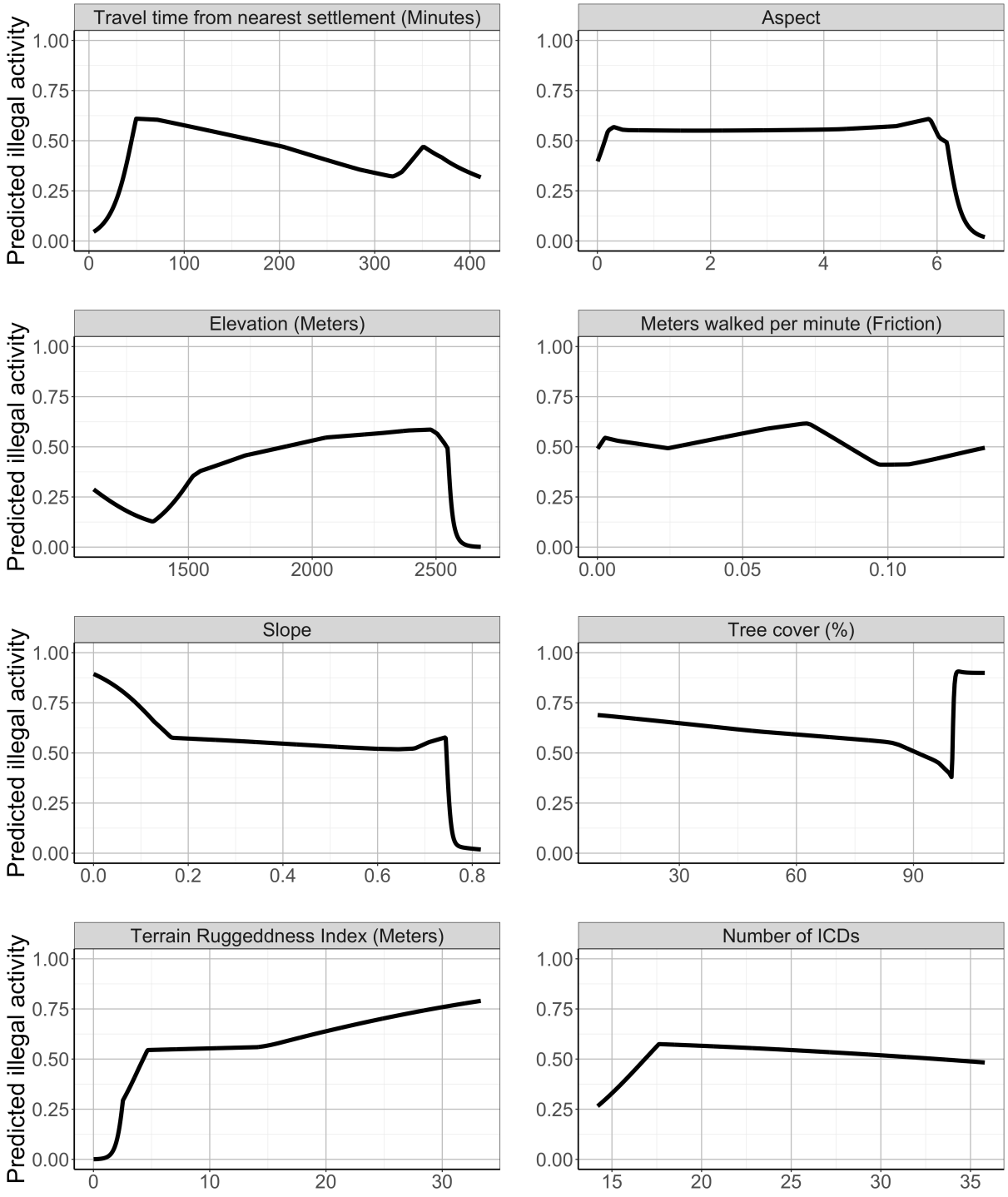
25
35

B) 2002


Travel time from nearest settlement (Minutes)
Aspect
Elevation (Meters)
Meters walked per minute (Friction)
Slope
Tree cover (%)
Terrain Ruggeddness Index (Meters)
Number of ICDs
Predicted illegal activity
1.00
0.75
0.50
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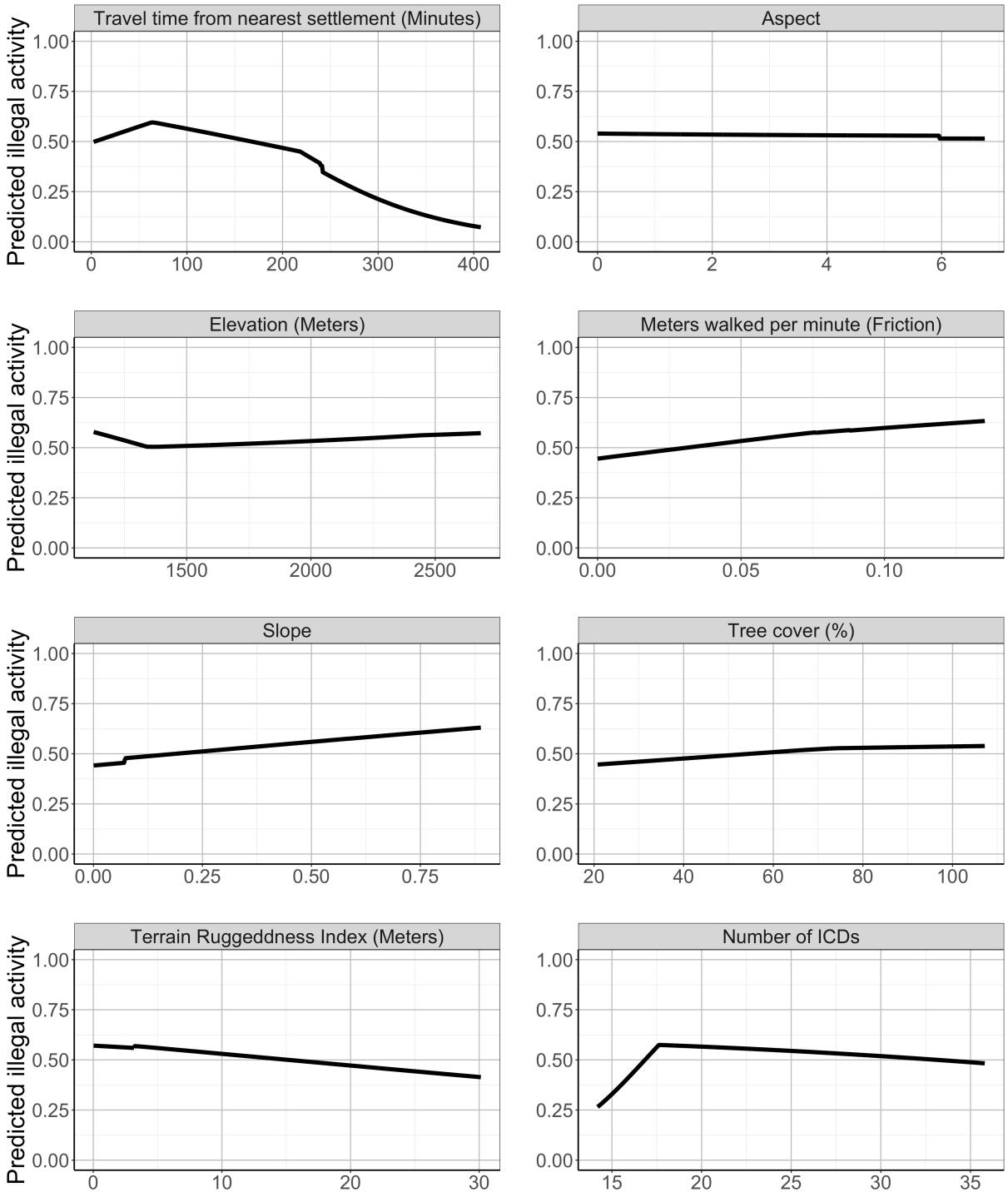
35

C) 2006


Travel time from nearest settlement (Minutes)
Aspect
Elevation (Meters)
Meters walked per minute (Friction)
Slope
Tree cover (%)
Terrain Ruggeddness Index (Meters)
Number of ICDs
Predicted illegal activity
1.00
0.75
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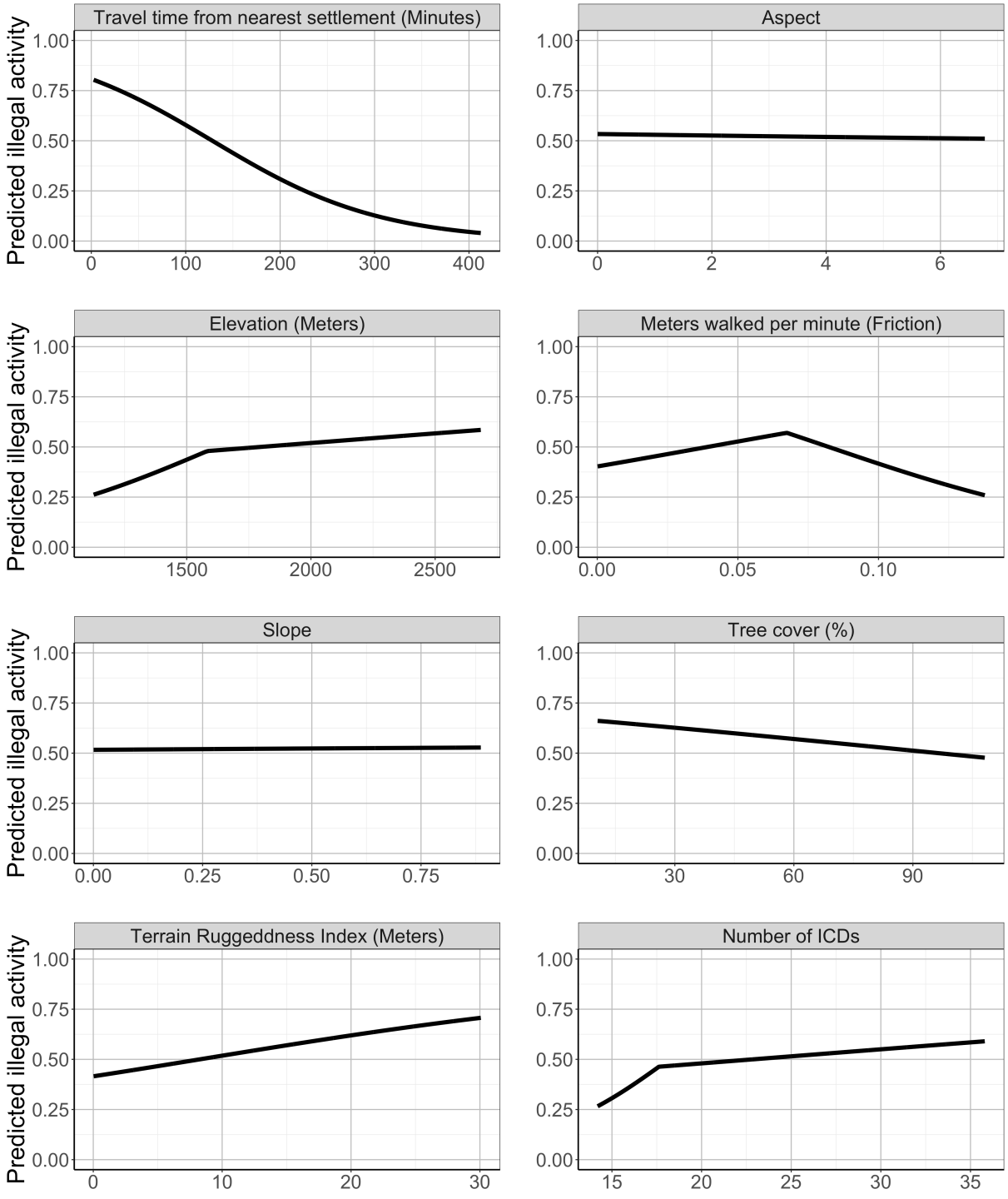
D) 2011


Travel time from nearest settlement (Minutes)
Aspect
Elevation (Meters)
Meters walked per minute (Friction)
Slope
Tree cover (%)
Terrain Ruggeddness Index (Meters)
Number of ICDs
Predicted illegal activity
1.00
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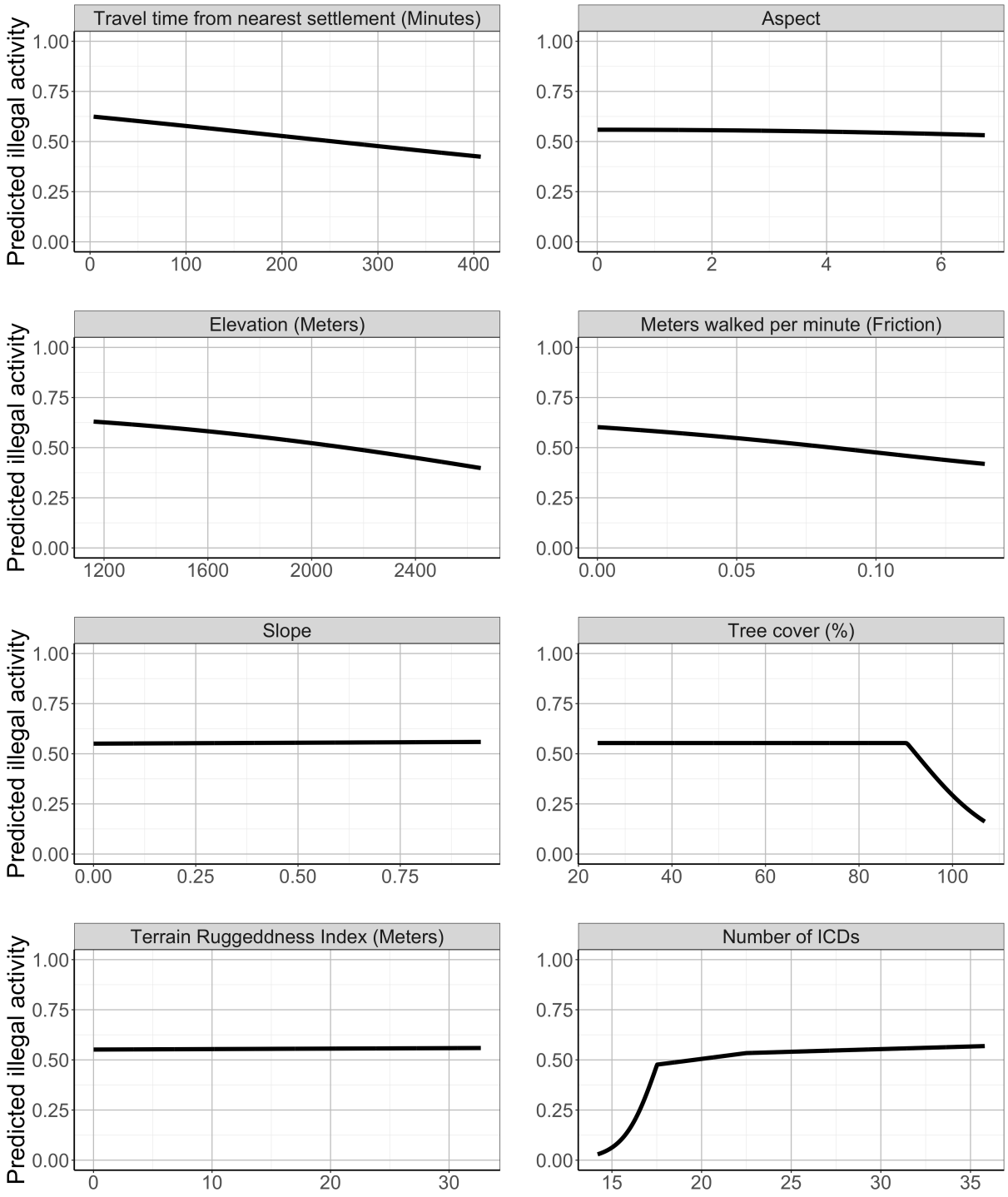
E) 2018


Travel time from nearest settlement (Minutes)
Aspect
Elevation (Meters)
Meters walked per minute (Friction)
Slope
Tree cover (%)
Terrain Ruggeddness Index (Meters)
Number of ICDs
Predicted illegal activity
1.00
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