Development of a participatory community-based bat-human interaction monitoring program in Bundibugyo District, Uganda
A Phase 1 Report from STOP Spillover
Reporting period: October 2022 to February 2023

Photo credits: Uganda country team

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CONTENTS

STOP SPILLOVER

Strategies to Prevent Spillover (or "STOP Spillover") enhances global understanding of the complex causes of the spread of a selected group of zoonotic viruses from animals to humans. The project builds government and stakeholder capacity in priority Asian and African countries to identify, assess, and monitor risks associated with these viruses and develop and introduce proven and novel risk reduction measures. "Spillover" refers to an event in which an emerging zoonotic virus is transferred from a non-human animal host species (livestock or wildlife) to another, or to humans.

ACRONYMS

AFROHUN: Africa One Health University Network

GPS: Global Positioning System

ODK: Open Data Kit

OH-DReaM: One Health Design Research and Mentorship

PA: Participatory Assessment

SBC: Social Behavioral Change (SBC)

SOP: Standard Operating Procedure

STOP: Strategies to Prevent

USAID: U.S. Agency for International Development

INTRODUCTION

Since 2000, Uganda has documented a total of six Ebola outbreaks involving the districts of Gulu (2000), Bundibugyo (2007), Luwero (2011 & 2012), Kibaale (2012), Luwero (2012), and Mubende and Kasanda (2022). Additionally, three outbreaks of Marburg viral haemorrhagic fever have occurred in the country in recent years in Ibanda district (2007), Kabale district (2012), and Kween district (2017). The recent Marburg outbreak in Kween district was traced to rock salt mining in a bat cave [1]. While the viral reservoir for Ebola virus disease has not been definitively determined, *Rousettus aegyptiacus* has been identified as the reservoir for Marburg virus. Zoonotic spillover has been associated with activities that increase human-bat contact [1]. Likely bat-human interface areas include caves and mines with roosting cave-dwelling bats (especially *R. aegyptiacus*); human dwellings for tree-dwelling insectivorous bats [2], and bat hunting, processing, and consumption. Other identified and more generic activities that may lead to increased spillover risk include land-use change, development, large-scale agricultural intensification, and deforestation [3-5].

To both improve understanding of the risk factors for potential spillover and to develop interventions to reduce human exposure to bats, which will reduce spillover risk, a community-based bat-human interface monitoring program was recommended. The purpose of this community-based bat monitoring program is to build the capacity of local community members to monitor key human-bat interaction interfaces in both space and time. Specifically, they will be able to identify bat roosts, feeding sites and bat-human interfaces that might pose risks for zoonotic spillover events. Maintaining this intervention over time will enable collection of information on seasonality of bat roosting behaviour, bat population composition, changes and risks for zoonotic disease spillover to the human population. This will guide development of risk maps and an early warning system for potential bat related spillovers. Additionally, the data generated during the community-based bat-human interface monitoring program will allow us to measure the efficacy of other interventions looking at social behavioural changes and technologies to reduce human contact with bats.

ACTIVITY OBJECTIVES

This document thus provides detailed steps for the development of a community-based program for monitoring bat human interactions in Bundibugyo District. It outlines the key activities that have led to the establishment of the bat monitoring program.

The specific objectives covered under this reporting period are indicated in Table 1 below.

Table 1: Specific objectives

| |
|---|
| **Objective 1.1.** To carry out an infrastructure community mapping of buildings, roads, and points of interest related to public health in Bundibugyo. |
| **Objective 1: 2.** To establish an ecological baseline about bats and bat-human interactions in Bundibugyo district using participatory epidemiology tools. |
| **Objective 1: 3.** To establish standard operating procedures and data collection tools to be used by bat monitoring agents during the data capture process. |
| **Objective 1: 4.** To train community bat monitoring agents in basic bat ecology and on monitoring bat-human interactions. |
| **Objective 1: 5.** To commission the participatory community-based bat-human interaction monitoring programme. |

ABOUT BUNDIBUGYO DISTRICT

The STOP spillover project team used an outcome mapping process from which national stakeholders selected the bat-human interface as a priority spillover risk in the country, and Bundibugyo district as a starting point. Bundibugyo is located in Western Uganda approximately 378 kms by road, from the capital city, Kampala. It is located along the Rwenzori Mountain ranges and in close proximity to the Democratic Republic of Congo. Predominant ethnicities include the Bamba-Babwisi and the Bakonjo however, other ethnicities coexist with them including the Batooro. The district lies between two conservation areas, the Semliki National Park and the Rwenzori National Park, which has led to a high level of human-wildlife-forest ecosystem interactions. The area has plenty of rock shelters and caves that are habitats for wildlife, including bats. The people of Bundibugyo are largely farmers who depend on cocoa, coffee and vanilla to earn a living. Farming activities evolve around the two major rainy seasons of March-May and July-November.

OBJECTIVE 1.1. INFRASTRUCTURE COMMUNITY MAPPING.

STOPS Uganda OH dream team worked with Humanitarian OpenStreetMap Team (HOT) to carry out an Infrastructure mapping of community buildings (households, schools, churches, etc), roads, and points of interest related to public health. The initial part consisted of a gap analysis of missing infrastructure (roads, buildings, health centers, etc) in Burondo sub-county, Harugale sub-county, and Ntandi town council. The updated maps of the interface area were later printed and verified by the community during community meetings. Final maps were printed and delivered to the district and also to USAID as deliverables. The interactive maps can be accessed here https://bit.ly/StopSpillOverUg.

The next steps will involve community mapping of bat distribution using a crowdsourcing app developed by HOT in partnership with the OHdream teams. The data collection map will include

existing or newly identified bat roosts or bat feeding spots, level of bat-human interface, and ', hotspots' where this interaction is highest at a given time witnessed and reported by the community.
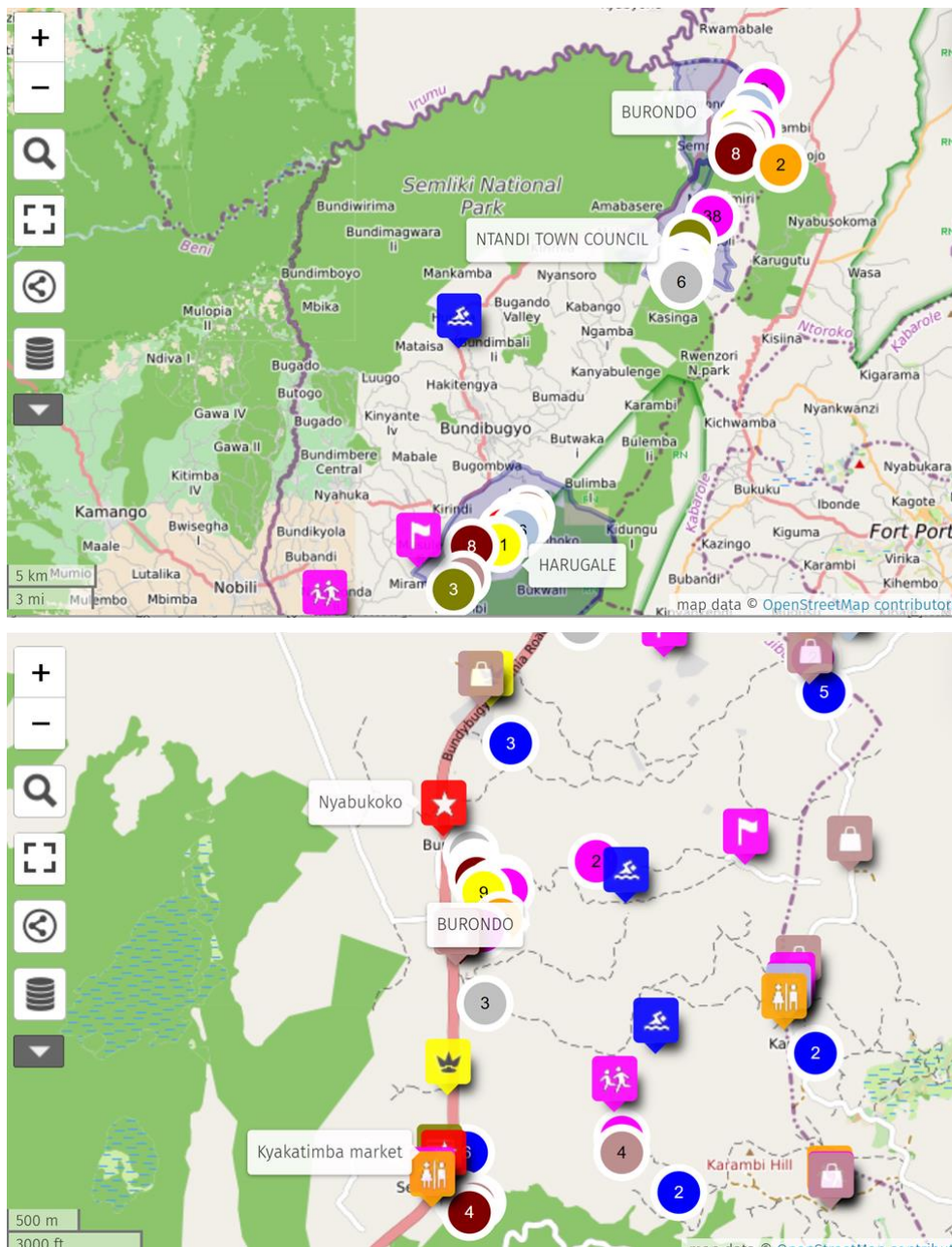
Figure 1. Map of Bundibugyo showing the 3 bat-human interface project areas (top) and map of Burondo sub-county (bottom) showing key infrastructure.

OBJECTIVE 1:2. ESTABLISHING AN ECOLOGICAL BASELINE ABOUT BATS IN BUNDIBUGYO

We used a Participatory surveillance (PS) approach to establish an ecological baseline about bats in Bundibugyo district. Participatory surveillance makes use of direct observation and local knowledge systems to develop best-bet scenarios on local issues. We used PS tools to develop overviews of bat population ecology, bat-human interactions, and the associated risks for spillover of infectious agents. The information obtained will also be useful in the triangulation to validate the modelling and mapping approaches to studying bat distribution.

Participants

Up to 19 professionals coming from a range of One Health disciplines appropriate to address the mitigation of spillover risk from bats to man were selected to attend the 10-day training. Participants included; Veterinarians, bat ecologists, conservation biologists, ICT, social workers, medical personnel, environmentalists, public health practitioners, and administrators. Participants were drawn from local government officials at the interface district, One Health-Design Research and Mentorship (OH-DReaM) working groups, tour guides, park rangers, surveillance focal persons, Redcross community surveillance volunteers, and parish administrators. The list of participants is attached as Annex 1.

Training modalities

The PS was conducted over a 10-day period. The first 3 days involved training participants in a number of skill sets that included:

- **Participatory epidemiology (PE) tools**: This session was facilitated by Jeff Mariner (Tufts University) and James Bugeza (National Livestock Resources Research Institute, Uganda). Participants were introduced to participatory epidemiology as a tool for participatory rural appraisal techniques. Participants were then taken through the different participatory epidemiology data collection tools including; Informal interviewing (semi-structured interviews, with key informants, focus group discussions), ranking and scoring tools (simple ranking, pairwise ranking, proportional piling, matrix scoring), visualization tools (Mapping, and seasonal calendars), direct observation (transect walks and examination). Figure 2 shows the class demonstration on the use of PE tools.

Figure 2. Participants were grouped into 3 groups in line with the intervention sites, each group was tasked to create a topic of interest and demonstrate on the use of participatory epidemiology tools. Photo credits: Country team.

- **Basic bat ecology:** This was an interactive discussion led by Mr. Bernand Matovu (Makerere University) who made a presentation on basic bat ecology in line with community knowledge as documented in the participatory assessment. The presentation and discussion rotated around; bat species, characteristics, feeding habits, reproductive behavior, bat roost definitions, seasonal variations, echolocation, importances and dangers associated with bats among others. Participants were shown pictures of bats and asked to comment if they can describe the characteristics or if they have observed such general features among bats at the interface area.
- **Mapping resources:** This session was led by Mr. Allan Mbabani (OpenStreet Map Uganda) who presented and discussed an interactive map of the interface area showing key infrastructure like churches, hospitals, schools, waterbodies, main roads, community markets, households, and national parks among others. Map sketches of the 3 sub-counties (Ntandi, Burondo, and Harugale) were displayed showing mapped bat roosts that could be improved by the surveillance teams. Once the monitoring agents are recruited, these paper maps will be used to pinpoint bat roost locations by the community.
- **Development of PS data capture tools**: Using the participant groups created in line with the 3-interface sites, participants were requested to develop participatory surveillance data collection tools. After the group discussions, plenary presentations were made by each group, and later the data capture tools were harmonized and the final participatory surveillance tools were developed, ready for field deployment. Developed tools included a checklist for the focus group discussion (Box 1, and Annex II).

Box 1. Participatory surveillance checklist at the bat-human interface

1. Welcome remarks by contact persons
2. Introduction
3. Overview of the activity and consent
4. Livelihood/economic activities
5. Challenges faced by the community.
6. Human-wildlife interaction
    - Common wild animals in your area.
    - Where they are found
    - How commonly do they see the bats,
    - Bat (probe for the types, sizes, colours, roosts, and characteristics)
    - Importance of bats.
    - Norms and cultural beliefs.
    - Dangers of bats to the community.
7. Human-bat interaction points in relation to specific activities.
    - Hunting, who hunts, why they hunt, methods of hunting, handling, preparation, and the trade chain.
    - Farming; levels of interaction, dangers, control measures.

Field data collection methods

Having been taken through the use and development of PE tools, participants carried out guided field practice for a period of 5 days in Harugale subcounty, Ntandi Town council and Burondo Subcounty.

- **Focus group discussions:** On each of the field days, the team held community discussions using the checklist indicated in Box 1 above as a guide. Communities were mobilized within purposively selected villages across the 3 study sites. In total, for each study site, 4 interviews were conducted with community members ranging between 10-15 participants per meeting. Community participants comprised of both males and females of varying ages, ethnicity and religious beliefs. For each interview, the study team selected an interviewer and a note taker as demonstrated in Figure 3, with focus group discussions taking between 2-3 hours per meeting.

Figure 3: A focus group discussion and community use of proportional pilling in ranking commonly destroyed fruits by bats. Photo credits: Country team

- **Key informant interviews:** After conducting a few focus group discussions, key informants from each of the different groups were identified to dig deeper in the bat-human interactions points at the interface area. Key informants included bat hunters, consumers, traditional healers, tourist guides, and selected participants living with bats in households. A sample key informant interview is indicated in Figure 4.

Figure 4. A key informant interview for a bat consumer in Ntandi Town Council. Photo credits: Country team

- **Transect walks, direct observations and bat roost mapping:** This was done after every focus group discussion to explore the patterns and coherence among all information provided to enable triangulation of key aspects. The team together with selected community key informants visited bat roosts that included trees, households, gardens and caves. Each roost was observed, photographed, GPS coordinates taken and an ODK data capture form (Appendix VI) was recorded by the OpenStreen Map team. Figure 5 demonstrate an example of this PE method in Semuliki National Park and Harugale Subcounty.

Figure 5: Transect walks, direct observations and bat roost mapping in Semuliki National Park and Harugale subcounty bat cave observation and mapping. Photo credits: Country team.

OBJECTIVE 1:3. ESTABLISHING STANDARD OPERATING PROCEDURES FOR BAT MONITORING.

In order to standardise the monitoring process, we developed a framework to guide participatory community-based bat-human interaction monitoring in Bundibugyo District. The framework provides a detailed description of the planned community-based program for monitoring bat human interactions. It outlines the activities that will be involved, the data to be collected, indicators to be monitored, frequency of monitoring, data processing, analysis and reporting. It should be noted that this document could be used in other regions of the country implementing a similar bat monitoring program during the scale up period.

Selection of sentinel bat-human interaction monitoring sites

Within Bundibugyo district, three (3) regions were selected by stakeholders during a 3-day outcome mapping process for research and intervention activities around the bat-human interface. The regions considered and reasons for consideration are indicated below and in the map in Figure 1.

1. Burondo subcounty (neighbors Semuliki National Park)
2. Harugale subcounty (neighbors Rwenzori Mountains National Park)
3. Ntandi town council (represents areas with bats in homesteads, schools, churches and also has areas where bat hunting is known to occur).

The project team held participatory community meetings from which it was agreed that within each of the three sub-counties, five parishes should be selected for monitoring making a total of fifteen parishes in the district. Each parish will have one (1) bat monitoring agent, making a total of fifteen (15) agents across the bat-human interface sites (Figure 6 summarizes the setup of the monitoring framework). Each parish has between 4-8 villages. Monitoring agents will identify bat roosts within these villages that will include caves, homesteads, schools, churches, and trees among others. The initial plan is that each agent will monitor a maximum of five (5) sentinel roosts, making a total of 75 roosts to be monitored. Based on the results and performance, sites will be increased gradually to levels agreed upon with the community members.
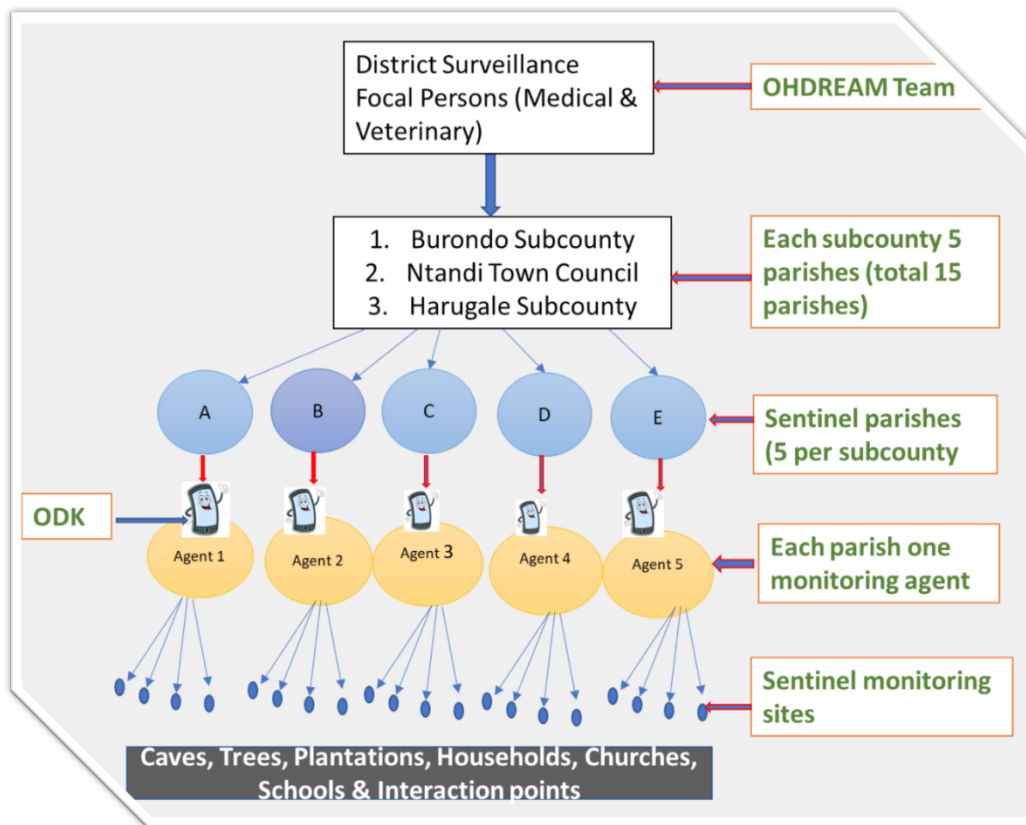
Figure 6. Graphic description of the Bat Monitoring plan

Selection of monitoring agents

Monitoring agents were selected following a community participatory process. Communities were tasked to come up with a criterion for selecting agents and later nominate names for subsequent consideration (see Annex III for list of agents and sentinel sites). Box 1 indicates some of the parameters considered for selecting monitoring agents and sentinel surveillance sites. The monitoring agents are responsible for collecting data using the mobile ODK tool, make observations on bats, making pictorial/video documentation of bats, identifying new roosts, identifying key informants for bat-human interactions, recording bat sounds among others.

Box 2. Considerations for selecting monitoring agents and sentinel sites

Key considerations for selection of sentinel parishes.

- The parish should have a considerable population of bats.
- The parish should have prominent bat roosts
- The parish should have a number of households to be considered for household-based bat surveillance.
- The parish should have manageable villages, in terms of terrain, village size, and population commitment.
- The parish should have easy accessibility to the bat roosts to avoid agents and supervisors climbing a great distance on the hills.

Key considerations for selecting monitoring agents.

- The potential agent should have basic Knowledge on the use of smartphones, or be easily trained.
- The potential agent should have basic knowledge about bats in the local context
- The potential agent should have prior participation in data collection for other agencies.
- The potential agent should be willing to work and communicate as observed from previous engagements with other agencies.
- The potential agent should have a good knowledge of the area and preferably a resident of the area for easy monitoring.
- The potential agent should be a person of high integrate as observed from previous engagements or recommendations.
- The potential agent should be stable and reliable in the community of operation.

Parameters being monitored and how

The bat-human interaction data is collected using an ODK tool using android mobile devices through, direct observation, opportunistic encounters and purposeful searches or surveys. The data capture tool is indicated under Annex IV. A given place is identified as a bat roost based on the fact that it hosts bats for a considerable amount of time during the year (both seasonal or permanent). Table 1 summarizes the approaches being used at a given roosts/sentinel sites during bat population monitoring.

Table 1. Approaches being used at a given roosts/sentinel sites during bat population monitoring.

Sentinel site/Roost Type Description	Method of Counting /estimating bats	Data element (s)	Timing	Duration	Frequency
Cave Roost (Caves are permanent roosts but not found everywhere)	Total roost counts	•Bat species/ Type •Estimated Number of Bats in the roost	Any time convenient for the monitoring agent But preferably between (09:00hrs and 14:00hrs)	Variable (depending on nature of cave roost and Number of bats and or species in the roost)	Twice (02) a month (At beginning of the month and Mid-month)
	Roost-exit counts	• Bat species/ Type • Estimated Number of Bats flying out of the roost	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	Range between One to TWO hours	Two (02) times per month. (At beginning and Middle of the month)
	Acoustic surveillance	• Number of Bat passes per minute analysed from Echolocation bat call data	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	One Hour	Two (02) times per month. (At beginning and Middle of the month)
Tree Roost (Tree roots are usually for fruit bats	Total roost count	•Estimated Number of Bats at tree roost	Any time convenient for the monitoring agent But preferably between (09:00hrs and 14:00hrs)	Variable (depending on nature of tree roots and Number of bats or species at the roost)	Twice (02) a month (At beginning of the month and Mid-month)
	Roost-Exit counts	• Bat species/ Type • Estimated Number of Bats flying out of the roost	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	Range between One to TWO hours	Two (02) times per month. (At beginning and Middle of the month)

Sentinel site/Roost Type Description	Method of Counting /estimating bats	Data element (s)	Timing	Duration	Frequency
Crevice Roost (These are Crevices in rocks or walls of infrastructures were bats live). Humans usually cannot enter these	Roost-exit counts	• Bat species/ Type • Estimated Number of Bats flying out of the roost	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	Range between One to TWO hours	Two (02) times per month. (At beginning and Middle of the month)
	Acoustic surveillance	• Number of Bat passes per minute analysed from Echolocation bat call data	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	One Hour	Two (02) times per month. (At beginning and Middle of the month)
Man-Made structurer (House, Bridges, Church, school etc.) Bats here would be expected to hang in the Roofing structures	Total roost count (for structures with normal roofs)	•Bat species/ Type •Estimated Number of Bats in the roost	Any time convenient for the monitoring agent But preferably between (09:00hrs and 14:00hrs)	Variable (depending on nature of cave roost and Number of bats and or species in the roost)	Twice (02) a month (At beginning of the month and Mid-month)
	Roost-exit counts	• Bat species/ Type • Estimated Number of Bats flying out of the roost	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	Range between One to TWO hours	Two (02) times per month. (At beginning and Middle of the month)
	Acoustic surveillance	• Number of Bat passes per minute analysed from Echolocation bat call data	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	One Hour	Two (02) times per month. (At beginning and Middle of the month)
Foraging Grounds, Places where bats go to look for food. Bats may also occasionally roost there. E.g.: Cocoa gardens, Banana Plantations, Coffee gardens or Bush land	Tally counts	• The number of Bats observed flying(foraging) at a given site. • Type/ species of bats encountered	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	One hour	Two (02) times per month. (At beginning and Middle of the month)
	Acoustic surveillance	• Number of Bat passes per minute analysed from Echolocation bat call data	Either early morning (06:00Hr to 07:00Hrs) or Evening time (18:00Hrs to 20:00Hrs)	One Hour	Twice a day (morning and Evening) two times a month (At beginning and Middle of the month)

OBJECTIVE 1: 4. TRAINING OF BAT MONITORING AGENTS AND DISTRICT SURVEILLANCE FOCAL PERSONS

Participants

Participants for the training included 15 community-selected monitoring agents, each agent representing a parish, and in total 15 parishes (5 parishes from each of the 3 sub-counties). The team also included 9 district members (both government and non-government) as district surveillance focal persons to supervise the monitoring agents at the district, sub-county, and parish levels. The central AFROHUN team had 6 members with varying expertise (bat ecologists, ICT, social sciences, surveillance, and statistics) that acted as facilitators and overall supervisors (see Annex 5 for list of participants).

Training on basic bat ecology

Participants were taken through the basic biology of bats, which included bat speciation, feeding habits, reproduction, and behavior among others. Participants were taken through the different parameters that will be monitored around bats and how this will be done. The monitoring agents will directly observe bats and record them as a Mega bat (fruit bat) or Micro bat (Insectivorous bat) using the local names. Additionally, the monitoring agents will go ahead to record other elementary parameters such as the Colour and size.

Training on the use of the ODK tool

Each participant was given an android mobile device and monitoring agents were given hands-on training on the data collection tool using their own mobile devices. The training started by showing the agents how to install the ODK on the mobile devices, and later through a step-by-step answering of the question on the tool. At this moment, some errors or questions that needed modifying were identified and edited to suit the local context (Figure 7). The final tool was uploaded and updated on each device in preparation for field roost visits.

Figure 7: Training of fifteen (15) Bat monitoring agents on the use of Kobo collect tool. *(Photo Credit: OHDREAM team).*

Field visits and tool validation

Having installed the data capture tools and trained monitoring agents and supervisors on how the monitoring process will be done, the next step was to validate the tools through an initial data collection process. Participants were divided into three (3) groups to represent each sub-county, each group having agents, OHDREAM, and district supervisors. Each group collected data using the tool from different roost types that included caves, tree roosts, households, churches, and schools (Figure 8).

The team reconvened and visualized the initial set of data that had been collected. Demonstrations were done on how the data will be visualized to ensure data quality and confirm authenticity of the information collected by each agent. Challenges seen while using the tool in the field were forwarded and discussed. Refinements and edits on the tool were done and the new tool was deployed.

Figure 8: Field illustration on the use of kobo collect tool to collect data from different bat roosts.

OBJECTIVE 1:5. COMMISSIONING OF THE PARTICIPATORY COMMUNITY-BASED BAT-HUMAN INTERACTION MONITORING PROGRAMME

Participants

The commissioning of the bat monitoring program was done on 21st of February 2023 through a multisectoral stakeholder engagement. Participants included the fifteen (15) monitoring agents, district surveillance focal persons who are part of the participatory surveillance, OHDREAM Team members, representatives from Bundibugyo district local government (Chief Administrative Officer, L.C. V, production/Veterinary, environment, education and health departments), Uganda Wildlife Authority, Tourism companies and Redcross.

Launching the bat monitoring program

The Chief Administrative Officer (CAO) launched the bat monitoring program (Figure 9) and advised the monitoring agents to collect all the satisfactory data to enable the project get detailed necessary information that will be used to draw a good conclusions and way forward. The CAO further appreciated the STOP spillover project efforts in Bundibugyo, and promised to support the project as required by the project team.

Figure 9. Launching the bat monitoring program with the required gadgets by the monitoring agents.

CONCLUSION AND NEXT STEPS

The journey towards the establishment of the bat monitoring program started with a participatory surveillance training and field visit to enable establishment of an ecological baseline about bats in Bundibugyo, coupled with the training of the required team of stakeholders to supervise the process. This was followed by the development of the required data collection tools and standard operating procedures to guide the monitoring process, and later the recruitment and training of monitoring agents. Having completed all the necessarily preliminary steps, the bat monitoring program was launched and agents commissioned to start the data collection phase.

The next steps will involve:

1. Continuous monitoring of bats and bat-human interactions for the next six months.
2. Discovery, mapping and monitoring of new sentinel bat roosts.
3. Purchase and installation of echolocation call recording for Acoustic bat surveillance.
4. Training of the monitoring agent on the use of echolocation call recording for Acoustic bat surveillance
5. Designing a dashboard to enable visualisation of the collected information in real time.
6. Bat trapping and specimen collection to enable bat species identification and testing for STOP spillover priority pathogens.

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ANNEX

ANNEX ONE: LIST PARTICIPANTS FOR THE PARTICIPATORY SURVEILLANCE

		Participatory Surveillance Activity	
	Venue: Bundibugyo		
	Dates: 14th to 25th November.		
S/N	Name	Address/Role	Contact
Tufts			
1	Jeff mariner	Tufts:	Tufts
2	Ghersi Chavez, Bruno (Virtual)	Tufts:	Tufts
AFROHUN			
1	James Bugeza	NALIRI: Trainer	O772523516
2	Bernard Matovu	OHDREAM team	O701919675
3	James Robert Ochieng	OHDREAM team	O752583626
4	Nalukenge Lillian	OHDREAM team	O773043255
5	Kato Charles D	OHDREAM team/Team Lead	O703320705
6	Amuya Norah Joyce	ICT and digital data capture tools	O778798945
7	Naluwagga Flavia	Research Assistant-Surveillance/rappattoire	O703120527
8	Tubihemukama Methodius	Statisitic and data handling	O750681822
9	James Baguma Natweta	Social Behaviour Change	O775989895
Bundibugyo			
1	Bwambale Robert	District Surveillance Focal Person (vet). Bundibug	O773981298
2	Rusamba Johnson Ndyanabo	Rwenzori and Semiliki Ecotourism and Disaster m	O772528123
3	Samson Ndyanabaisi	District Veterinary Officer. Bundibugyo	O774681995
4	Muhindo David Kasumba	District Surveillance Focal Person (medical). Bundibugyo.	
5	Alex Sekalombi	Redcross CP3 community surveillance program vol	770863976
6	Kule Joshua	Redcross CP3 community surveillance program vol	O771973168
7	Kabasinguzi Kuluthum	Environmental Officer. Bundibugyo	O772966096
8	Bagonza Majid	District Health Educator. Bundibugyo	O772364148
9	Kule Charles	Surveillance focal person Bughendera sub county. Bundibugyo	
10	Muhindo Samuel	Parish Admin Burondo. Bundibugyo	O779557136
11	Tham Anzire Bwambale	Parish Admin Ntandi. Bundibugyo	O779784341

ANNEX TWO: SUMMARY OF FOCUS GROUP DISCUSSION FINDINGS PER STUDY SITE

No.	Parameter	Subcounty or Town Council		
		Harugale	**Ntandi**	**Burondo**
1	Ethnic groups (Rank)	Bakonjo	Bakonjo, Babwisi and Bamba	Bakonjo, Babwisi, and Batuku.
2	Religious beliefs (Rank)	1.SDA, 2. Anglicans and 3. Catholics and 4. Moslems	SDA, Anglicans Catholics, and Moslems	SDA, Anglicans and Catholics and Moslems
5	Major source of livelihood	Bricklaying Farming (cocoa, bananas, beans, vanilla matooke, passion fruits, cabbage, eggplants, and coffee) Animals rearing [cattle, goats] Trade in cocoa, vanilla, poultry, goats, sheep, and chicken Saving groups and credit schemes Food relief from NGOs like world harvest mission. Offering manual labor in people's gardens to earn money Charity support from neighbors and well-wishers especially when hit by landslides	Farming (cocoa, bananas, beans, soya beans and coffee, cassava, vanilla, sweet potatoes) Livestock rearing which included goat rearing. Trading majorly in agricultural produce, fish, eggs, and meat. Bricklaying Fishing Hunting Charcoal burning Sand mining and stone quarrying Electrical installation and mechanics. Lumbering Herbalist Saloon Whole selling of cocoa and coffee	Farming (coffee, beans, sweet potatoes, bananas, and cocoa) Livestock ;(goats and chicken) Fishing (river semiliki), Hunting (not common as they are restricted by UWA), Business (fish mongering, Saloon Whole selling of cocoa and coffee). Charcoal burning, Brick laying and stone quarrying Selling of firewood Farming, hunting, Trading
6	Main livelihood challenges identified	Theft from cocoa companies and other individuals which brings about premature harvesting, especially for the cocoa Destruction of crops by wild animals Poverty Poor yields of crops	Accidents during lumbering Price fluctuations for cocoa, Poor transport network Landslides	Limited extension services for they are cattle farmers Theft Poverty, Poor yields of crops in times of heavy rains and drought

		Food insecurity Landslides Bananas affected by bacteria wilt Animal diseases like diarrhea cough and eye disease) Crop pests and diseases affecting cocoa, coffee, cassava, cabbage, and vanilla especially flowering stage The war which has destructed growth of agricultural produce, The unstable market for vanilla and other cash crops Poor health services.	Overtaxing by the government. Destruction of crops by wild animals Bad weather conditions Food insecurity Bats feeding on their crops Bat excreta spoiling ceiling and clothes.	Inaccessible water services and health services, Landslides (the place is mountainous), Scarcity of trees for timber, Poor transport wild animals escape from the park and eat their livestock and as well destroy their crops, Food insecurity, Inaccessibility to health and education services, and Over-dependence on NGOs.
7	Common wild animals	Squirrels, buffalos, wild pigs, baboons, Monkeys, Bats, Mangoes and edible rats, snakes, ostriches, Chimpanzees	Elephants, warthogs, buffalos, baboons, monkeys and bats, bush pigs, and giant rats	Squirrels, Buffalos, wild pigs, baboons, monkeys and bats Mangoes, edible rats, wild birds, snakes, buffalos, tortoises
8	Bat types identified	Small bats(insectivorous) are white or grey, especially on the abdomen. Big bats (fruit-eating bats) black bats living in caves, big trees, rivers, and valleys	• Small bats. • Big bats. • Medium bats	Small bats (insectivorous) locally known as kakelibho Big bats (fruit-eating bats) locally known as mulubu
9	Bat characteristics (according to local knowledge)	**Small bats**: black in color, and small in size, live in dark places and also feed on mosquitoes, and also produce rat-like sounds, they also have small eyes, noses, and ears. Weak and move only during the day. **Big bats**: both brown and black in color locally known as "emirima", big in size, keep knocking the walls thus causing a lot of disturbance don't live in houses, feed on fruits, some feed on nectar and they are also the eaten type, they rest facing upside down and produce a base-like sound. slow flying speed10 bats exchanged for one	**Big bats**: both brown and black species, big in size, feed on crops and fruits, have a dog-like face, big wings with umbrella-like shape, big eyes with sharp teeth, produce a bell-like ultrasound, dog-like face, they move at night, defecate through the mouth **Small bats**: black and small in size locally known as "obukorokombi" seen at	**Big bats**: both brown and black species, big in size, feed on crops and fruits, have a dog-like face, big wings with umbrella-like shape, big eyes with sharp teeth, and produce a bell-like ultrasound, dog-like face. **Small bats**; black and brown in color and small in size, nostrils short with split lips have an anus and defecates small droppings, Dog-like eyes, produce rat-like sounds, small wings, rat-like ears, black and brown in color, rest upside and down, live in dark places, and feed on mosquitoes.

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		chicken, 1 bat costs 1000shs., lower limbs have claws, big eyes, nose, and ears, very strong, move only at night **Both**; stay together in groups as a family and fight non-family members (group of 15 members, they don't feed in groups, rest facing upside down	night, usually stay in houses, nostrils short with split lips, playful, produce rat-like sounds, and are noisy at night.	
10	Roost types	Caves, coffee, cocoa, and banana plantations, holes in the backs of trees, house ceiling, churches and hospitals, Forests, House toilets, and depressions left by landslides Trees, bushes, palms, trees, oyster shells, buds of bananas, stones, or rocks.	Caves, trees, houses, and Banana plantations, Churches and mosques Trees, houses, churches Schools, Oyster shell, Toilets Buds of bananas.	Caves (kikoni cave,kanyabukoko cave),, coffee and banana plantations, holes in the backs of trees, house ceilings, churches, and hospitals Trees, Forests, House toilets, and depressions left by landslides
11	Bat fruit preference	Mangoes, Avocados, guavas, papaws straw berries, omutambo tree.	Mangoes, Avocados, omutambo tree fruits, guavas, pawpaw	Mangoes, avocados, omutambo tree fruits, guavas, pawpaw,
12	Main Crops destroyed	Coffee, maize destroyed by monkeys, bananas.	Coffee, destroy cocoa cassava, and bananas, especially in the flowering stage	Bananas, flowering maize, and cocoa, Coffee
13	Activities/points associated with bat-human interactions	Harvesting as bats come in big numbers to collect ripe crops. Rainy seasons are when small bats come to feed on the insects. Vending in markets and farming. visiting caves for cultural rituals. Hunting Fetching firewood Fetching water	Farming Fetching water, Visiting caves for cultural Rituals Schooling and teaching, Vending Hunting	Harvesting as bats come in big numbers to collect ripe crops. Rainy seasons are when small bats come to feed on the insects. Hunting as they trap bats for food, Fetching firewood by women Fetching water, Visiting caves for cultural rituals.
14	Risk groups identified	Women, men, boys as they also hunt, and girls when fetching firewood and water.	Children and staff in Ntandi primary school,	Women, Men, boys as they also hunt, and Girls when fetching firewood and water.

		Children, as they follow their culture that fruit eaten by the bats helps in teeth growth. Community members and farmers Hunters Witch doctors	People in bundimasole marketplace where huge populations gather Women (fetching water), Witch doctors Men hunt the bats, but women don't hunt the bats	Children, as they follow the culture that fruit eaten by bats, helps in teeth growth. Witch doctors
15	Cultural beliefs and myths associated with bats	Bats are believed to be drivers of night dancers as sacrifices are made They are also considered a love potion. Bats are used by witch doctors to pick hair and other materials from their target people. Believe that visiting caves with bats is the beginning of wealth. as sacrifices are made. Bat meat cures in children when eaten. Believed to cure anemia in children. Increases blood in the body when consumed. Used as medicine by the traditional healers	Bats are associated with cannibalism, Presence of bats seen flying is a security alarm that something is not right, they are said to pick hair when they randomly pass by your head. Bats are also said to be used by wizards as means of transport. Bats are believed to have a chemical that treats wounds Used to hide husbands and stick to one woman, Drivers of bad spirits Used by witch doctors to cast mad spells on people.	They believe that small bats are drivers for which to carry charms to their target people. Eating bats is a sign of keeping culture and is seen as a source of happiness in the kingdom. It is believed that visiting caves with bats is the beginning of wealth as sacrifices are made. Drivers of bad spirits, used by witch doctors to cast mad spells on people. They are also considered a love potion
16	Perceived benefits of bats	Bats reduce malaria as they feed on mosquitoes as prey Their droppings are a Source of manure Source of food for some people They bring new tree species e.g., mangoes and guavas from Congo. Used to make men strong Exchanged for chicken in Congo. Pollinates flowers	Bats pollinate fruits, feed on mosquitoes, Source of food, Improve the strength of manhood, Used as a love potion Manure from their dropping. Study and tourist attraction,	Bats reduce malaria as they feed on mosquitoes as prey, Help in seed dispersal, Droppings are a Source of manure, a source of food for some people, Soup treat malnutrition They are also an important source of income Source of income (one bat = 2000ugshs)

			Used by traditional healers as medicine. Drivers for witches. Used in the treatment of asthma, Raw blood used in the treatment of anemia	Source of medicine (treat anemia) Used by witch doctors. Used in barter trade
17	Bat markets/value chains	Bats are exchanged with people from Congo for chicken. 10 bats exchanged for one chicken 1 bat costs 1000shs.	Hunters are mostly the consumers 10 bats were exchanged for 1 chicken. 1 bat costs 1000 in seasons of abundance.	One bat = 2000ugshs) Used in barter trade
18	Disadvantages/Dangers of bats	Destroy fruits and red berries of coffee Associated with diseases like Marburg and Ebola Transmit infectious agents in bananas and coffee thus spreading diseases in plants such as wilt. Cause dirtiness on floors and utensils Make a lot of noise in houses.	Bats enter houses and contaminate the uncovered foods, Guano for bats is corrosive to iron sheets causing leakage of roofs. Droppings dirt the walls, Destroy fruits and crops. Water contamination by bat excreta Discomfort as they are flying. Associated with diseases like Marburg Urine causes respiratory problems.	Weaken ceilings as they urinate Their guano is smelly Destroy fruits and red berries of coffee Associated with diseases like Marburg and Ebola Urine causes scabies Contamination of food and water in streams Dirt people's houses with their excreta, No danger apart from people scaring them that causing Ebola
19	Bat control practices	Eating them as food Using sticks to beat them Construction using transparent iron sheets Pruning of gardens, Covering pit latrines, covering space between the roof and the beam, and Closing their doors early in the evening.	Fumigation (burning carbon-containing materials) Spraying using a concoction (ash+mululuza+bhapi plants)	Eating them as food Using sticks to beat them Construction using transparent iron sheets Pruning of gardens, Covering pit latrines,

			Pruning gardens to reduce darkness and eliminate roosts. Culturally stopping women and children from eating bats is a mean of controlling the bats	Cover space between the roof and the beam, Closing their doors early in the evening.

ANNEX THREE: LIST OF BAT MONITORING AGENTS PER SUB-COUNTY

Sub county	Name:	contact	Parish	villages
Harugale Sub County	Masika Justin	0786427942	Bumate	Bimara Village; Bimara Full Gospel Church
	Mbusa Daniel	0789147319	Kihoko	Ngugho Village, Ngugho stone cave
	Mercy Orine	0777538177	Bupomboli	Kihoko II Village; S/C HQ & Kathengu's home
	Masereka Lugard	0778524652	kasulenge	Kasulenge II; Nyalulu stone cave
	Bwambale Josam	0787500507	Kitsolima	Kalhalhu Village; kalhalhu stone cave
Ntandi Town Council	Mbambu Yones	0782283017	Kahumbu	Isura II, kahumbu, Nyambowe, karongoti and Nkisya villages
	Asiimwe Gloria	0774985883	Mpulya	Mpulya I, II and III; Mpulya Central and Mpulya west cells
	Sekalombi Alex	0770863976	Bundimasoli	Bundimasoli central, Bundimasoli, Bundimasoli West, Kapepe, Kabale and Kabale central Cells
	Baluku Edson	0781375732	Ntandi	Ntandi west, Ntandi east, Bumaga I and Bumaga II cells
	Muhindo Sadam	0783974809	Nyabugesera	Bitahura I, Butahura II, Nyabugesera & Kapangu cells
Burondo Sub county	Muhindo Nyahoma Joram	0773086545	Burondo	Kinyambogo
	Thembo Edson	0785735878	Karambi	Karambi I and Kinyanjojo
	Sekalombi David	0785428419	Sempaya	Kinoni III
	Muzima Juliet	0776121712	Karambi	Burangapasi II
	Masika Ellen	0762599548	Burondo	Burondo Central

ANNEX FOUR: BAT-HUMAN INTERACTION DATA CAPTURE TOOL FOR MONITORING AGENTS

1. **Name of Data collector:**……………………………………………………
2. **Date & Time of data collection:**………………………………………..
3. **Subcounty**
   ☐ Harugale Subcounty
   ☐ Burondo Subcounty
   ☐ Ntandi Town Council
4. **Parish:**…………………………………………………………………..
5. **Village:**…………………………………………………………………
6. **GPS Location:**…………………………………………………………
7. **Type of roost**
   ☐ Tree
   ☐ Cave
   ☐ House
   ☐ School
   ☐ Church/mosque
   ☐ Hospital
   ☐ Crevice
8. **For bats in house structures, is there a ceiling?**
   ☐ Yes
   ☐ No
   ☐ Not applicable
9. **For bats in house structures, what bat excreta do you commonly encounter? (Multiple answers)**
   ☐ Fecal matter
   ☐ Urine
   ☐ Both
   ☐ Not applicable
10. **What is the average number of people accessing the roost per month?**
    ☐ *< 5 individuals*
    ☐ *6-15 individuals*
    ☐ *>15 individuals*

11. **Type of bat seen (local name)** **(Multiple answers)**
☐ Emilima (Big bats)
☐ Keribo/Kakolokombe (small bats)
☐ Both types

12. **Number of bats seen**

Emilima	Keribo/Kakolokombe
< 5 individuals	< 5 individuals
>5<15 individuals	>5<15 individuals
>15<100 individuals	>15<100 individuals
>100<500 individuals	>100<500 individuals
>500<1000 individuals, and	
>1000 individuals	

13. **Colour of the bat** **(Multiple answers)**
☐ Black
☐ Brown
☐ Grey
☐ Unknown

14. **Bat Activity (i.e., what are the bats doing?)** **(multiple answers)**
☐ Resting
☐ Sleeping
☐ Grooming/socializing
☐ Flying

15. **Proximity to human settlement (i.e., location of the roost in relation to human settlement)**
☐ Inside building
☐ Garden
☐ Compound
☐ Cave/tourist site

16. **Number of dead bats seen**
☐ 0 individuals
☐ 1-5 individuals
☐ 6-10 individuals
☐ >10 individuals

ANNEX FIVE: LIST OF PARTICIPANTS DURING TRAINING OF MONITORING AGENTS

S/N	Name	Address/Role	Contact
	Engagement and training of monitoring agents and District surveillance focal persons		
	Venue: Bundibugyo		
	Dates: 5th to 10th December.		
S/N	**Name**	**Address/Role**	**Contact**
AFROHUN			
1	James Robert Ochieng	OHDREAM team	O783117204
2	Kirangwa Peter	ICT and digital data capture tools consultant	O701704487
3	Kato Charles D	OHDREAM team/Team Lead	O703320705
4	Amuya Norah Joyce	ICT and digital data capture tools consultant	O778798945
5	Naluwagga Flavia	Research Assistant-Surveillance/rappattoire	O703120527
6	Tubihemukama Methodius	Statisitic and data handling	O750681822
Bundibugyo District Focal Persons &			
1	Bwambale Robert	OHDREAM Team	O773981298
2	Rusamba Johnson Ndyanabo	OHDREAM Team	O772528123
3	Samson Ndyanabaisi	District Veterinary Officer. Bundibugyo	O774681995
4	Muhindo David Kasumba	District Surveillance Focal Person	O784844103
5	Kabasinguzi Kuluthum	Environmental Officer.	O772966096
6	Kule Charles	Surveillance focal person Bughendera sub county.	O775677566
7	Muhindo Samuel	Parish Admin Burondo. Bundibugyo	O779557136
8	Tham Anzire Bwambale	Parish Admin Ntandi. Bundibugyo	O779784341
9	Christopher Maate	Parish Admin Harugale	O788248831
Monitoring agents			
1	Masika Justin	Harugale subcounty	786427942
2	Mbusa Daniel	Harugale subcounty	789147319
3	Mercy Orine	Harugale subcounty	777538177
4	Masereka Lugard	Harugale subcounty	778524652
5	Bwambale Josam	Harugale subcounty	787500507
6	Mbambu Yones	Ntandi Town Council	782283017
7	Asiimwe Gloria	Ntandi Town Council	774985883
8	Sekalombi Alex	Ntandi Town Council	770863976
9	Baluku Edson	Ntandi Town Council	774392140
10	Muhindo Sadam	Ntandi Town Council	783974809
11	Muhindo Nyahoma Joram	Burondo Subcounty	773086545
12	Thembo Edson	Burondo Subcounty	785735878
13	Bwambale David	Burondo Subcounty	762599548
14	Muzima Juliet	Burondo Subcounty	776121712
15	Masika Ellen	Burondo Subcounty	762599548