Climate change and food security among the Batwa Pygmies of Kanungu, Uganda

By

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Abstract

Over 1 Billion people practice some form of subsistence livelihood. Climate change will impact these people to a greater extent than other groups because they have a heightened reliance on natural resources and the environment for food production. Africa is expected to be particularly impacted by climatic events such as extreme drought, increased temperatures and unpredictable precipitation. This study conducted a systematic literature review and a case study of the Batwa Pygmies in Southwestern Uganda. The systematic literature review analysed 16 peer reviewed articles. Adaptation and coping strategies were extracted from each study to determine resilience to climate exposure. The literature relayed the complexity and extent to which adaption methods are being implemented. Poverty and financial difficulties were found to reduce resilience and increase vulnerability to climate change. The case study of the Batwa examines the prevalence of food security within the Kanungu district of Uganda an adaptation of the USDA household food security survey module. A census survey was administered in January 2013 to 130 households of which 99% were categorized as food insecure. The analysis identified possible determinants of food security status but the population was homogeneously poor and little variation emerged between households.

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1. Introduction and Justification

Climate change is globally impacting health both directly and indirectly (Costello et. al. 2009; Bowen et. al. 2013; Haines et. al. 2009; Few, 2007). Food security is an area particularly at risk due to the reliance of food production on climate (Haines & Patz, 2004; Lynn et. al. 2013). Vulnerable areas are primarily located in lower income regions, where populations have less financial ability to mitigate climate stressors (Friel et. al. 2008; Apuuli et. al., 2000; Fussel, 2010). The populations most vulnerable to this increased risk include the poor, particularly the Indigenous poor (Lynn et al. 2013; Furgal, 2006). The Indigenous poor tend to be those on the fringes of low income populations. Indigenous populations have historically been ignored by governments (Lynn et al. 2013; Maldonado et. al. 2013). This vulnerability is exacerbated further by the lack of access to resources as a result of financial, social and physical constraints, which impede the ability to adapt (Berrang-Ford et al. 2012; Lynn, Mackendrick & Donoghue, 2012; Lynn et. al. 2013).

Identifying vulnerable populations and assessing their sensitivity to climate stressors are essential for informing policy and future planning in the local context (Green et al., 2010; Ford, 2012). Further, acknowledging and supporting Indigenous strategies and adaptation methods can facilitate their ability to retain traditional livelihoods (Watson et. al, 2000). Establishing a baseline and developing a research history, by compiling a corporate body of traditional local knowledge and academic research housed in a variety of oral or digital repositories, will better equip Indigenous groups to deal with future stress from both socioeconomic and climate perspectives.

1.1. Aims and Objectives

The aim of this thesis is to estimate the prevalence and characterize the determinants of food security among the Batwa of Kanungu District (Uganda) to determine the vulnerability of their food systems to future climate change. This thesis is divided into two parts. Although they can be read independently, part one will inform part two. The first part of the thesis is a realist systematic literature review of the adaptation strategies of smallholder and subsistence groups in response to climate change. A vulnerability framework is used to establish sensitivity to climate stressors. The second component of the thesis presents an analysis of food security for a study

population of Batwa pygmies in Kanungu District, Uganda. The purpose of this component is to characterize the current status of the Batwa's food security and to identify the household level determinants. Herein, this thesis has four objectives:

1) Conduct a systematic literature review of the effectiveness of adaptation and coping mechanisms employed by subsistence groups
2) Estimate the prevalence of food security in the Batwa Pygmies of the Kanungu District in Uganda
3) Identify the determinants of food security among Batwa households

Are the adaptation and coping mechanisms that subsistence groups employ in response to climate change effective?

2. Systematic literature Review

2.1 Introduction and Justification

Climate change and the rate of change is increasing; there is evidence droughts are increasing in intensity and length on the one hand while precipitation patterns are becoming more unpredictable, causing extreme floods (Nzeadibe 2012). Greenhouse gas effects are globally raising sea and air temperatures (Kotir, 2010; Nzeadibe 2012). While global climate change will impact every continent, this burden will be particularly problematic in tropical climates (Sampson et al., 2011). The areas more sensitive to change tend to be located in less developed regions in the global south and therefore have less planning and logistical capability and financial ability to cope with negative outcomes (Costello et al., 2009). Countries involved in and reliant on the production of agriculture need to prepare for the future because they rely heavily on weather and environmental conditions, and deleterious changes to both will have a greater impact on this sector than others (Molua, 2002).

Rural populations face the largest challenges as they are often ignored by governments and access to resources is restricted by social and transportation limitations. Currently there are over 1 billion people who practice some form of subsistence livelihood. Climate change will impact subsistence farmers, smallholder and Indigenous groups to a greater extent than other groups because they have a heightened reliance on natural resources and environmental factors, in their immediate location, for food production (Olsson & Jerneck, 2010). Identifying populations at risk and acknowledging successful traditional strategies and adaptation methods are essential for creating appropriate contingency policies and plans (Watson et. al, 2000).

A review by Kotir (2011) confirms the suspicion of many that the poor in Africa will experience the lion's share of the negative impacts of climate change. He suggests policy should focus on supporting smallholder farm adaptation strategies. Morten (2005) reviewed climate change impacts specifically upon subsistence/smallholder groups and concluded that Indigenous groups will face increased vulnerability as a result of both climatic and non-climatic stressors. He caveats this with the argument that Indigenous groups have been historically able to adapt

and have "resilience factors" such as diversification of livelihoods, traditional knowledge and social networks that increase their adaptation capabilities (Morten, 2005). Since Morten's (2005) paper there have been numerous studies on case-specific adaptations and coping mechanisms but none comparing and linking various groups in the global south. Many of these groups have similar climate risks and may have common adaptation and coping strategies. There is a hesitation to use findings to identify broader patterns or draw out transferable best practices and indicate ways forward as studies have been considered context-specific. This may be ignoring the commonalities of burdens and struggles that many face as well as omitting synthesis around similar adaptations used to cope with climate related impacts. How and why people have adapted in the past provides indications about their potential to cope with changing conditions in the future (Young et al., 2010).

The purpose of this review is to investigate whether subsistence groups in the developing world are adapting to climate change and explore the methods of adaptation in use. Subsistence groups in the developed world, especially those that reside in the Arctic are extensively represented in the climate adaptation literature (Berkes & Jolly 2002; Duerden 2004; Ford et. al. 2009; Ford et. al. 2007; Ford & Smit 2004; Ford et. al. 2006; Ford & Pearce, 2010). There is a significant gap in similar research on Indigenous and subsistence adaptation to climate change in developing countries. These groups, although facing very different climate impacts, share a similar burden of extreme climatic change both now and in the future. Whether it be sea ice melting or drought, these severe climatic stressors create vulnerability and hinder the resilience of traditional livelihoods.

2.1.1. Aims and Objectives

This review will synthesize the empirically based academic literature that addresses subsistence and Indigenous adaptation to climate change using a systematic search strategy and the methods of a realist review. A realist perspective on this topic challenges us to focus our attention on the mechanisms that enable adaptation to climate change in order to inform and guide sustainable, pragmatic policy as well as identify generalizable trends in adaptation strategies. Specifically, this review aims to:

1) Evaluate whether subsistence groups are employing adaptation strategies

2) Identify the mechanisms that enable and support the adoption of such strategies

3) Analyse the generalizability of adaptation strategies in the global context

2.2 Methods:

A systematic literature review follows the path of a regular review yet aims to analyse and critically appraise all relevant literature in a more structured manner. The results are therefore reproducible. Further the realist approach guides the reviewer to look further into the literature for causal mechanisms or pathways rather than focusing solely on outcomes. The goal is not to determine prevalence or the number of times an outcome occurred but to narrow in on the why and how questions (Pawson et al., 2005). When beginning a systematic literature review it may already be apparent whether or not an outcome is occurring, therefore the principle behind a realist review is to identify the mechanisms giving rise to the outcomes.

Arctic groups will be excluded from this analysis, even if classified as Indigenous or subsistence populations. The majority of Arctic populations tend to reside in very developed countries whereas the groups the review will focus on reside in the developing world (Nuttal, 1998). Within the climate change field, research regarding the north is at the forefront and many articles and reviews have covered much of that vulnerability experience. They will be used to guide and inform this review. A vulnerability framework will be used in this review based on the example of Ford & Smit's (2004) framework used to assess vulnerability to climate change in the Arctic.

2.2.1. Vulnerability Framework

Broadly vulnerability is the exposure of a system to a harmful stimulus or stimuli (Ford & Smit, 2004). There are two primary approaches in the literature; biophysical & social with some studies incorporating both (Ford et. al 2010; Turner et al. 2003). By using these two perspectives one can analyse at a local, national or international scale exposure to climatic events and key enabling factors that enable humans to cope and adapt (Ford & Smit, 2004). Socio-economics, social networks, infrastructure, environment, traditional knowledge, political context, access to resources all help create and play role in a community's adaptive capacity (Adger & Kelly, 1999; Ford & Smit, 2004). Looking at current and past adaptation will give a glimpse of a community's adaptive capacity in the future and what barriers they may encounter (Ford & Smit, 2004). First the climate event impacting each community will be extracted and classified under exposure. Second, their current adaptation strategies will be collected. Third, their sensitivity to climatic

events based on their financial, social and adaptive capacities will be collected. This will create a holistic picture of whether or not their adaptive strategies will be effective as long term adaptations.

2.2.2. Search Strategy

The first phase of the search strategy consisted of a search of Web of Knowledge, Proquest, Scopus and Ebsco online databases in November of 2012 (Fig 1). The search consisted of the following terms within the title, subject, keyword or abstract search fields: “indigenous” OR “subsistence” OR “smallholder” AND “climate change” AND “adapt*” OR “cop*”. A variety of iterations of the above terms were used in the search fields to identify subsistence groups as there is limited research that has been published on this group with a climate change focus. There was no date restriction on the results of the search. Additionally non-peer reviewed articles and those not in English were excluded. The first phase yielded 408 papers; these were reduced to 24 articles using a predetermined set of exclusion criteria (Fig 1). The abstracts of these 24 articles were read and further reduced to 14 articles. The reference lists of all 14 articles were examined and yielded and additional 2 articles. Articles found through this method were subject to the same exclusion criteria after their full texts had been read.

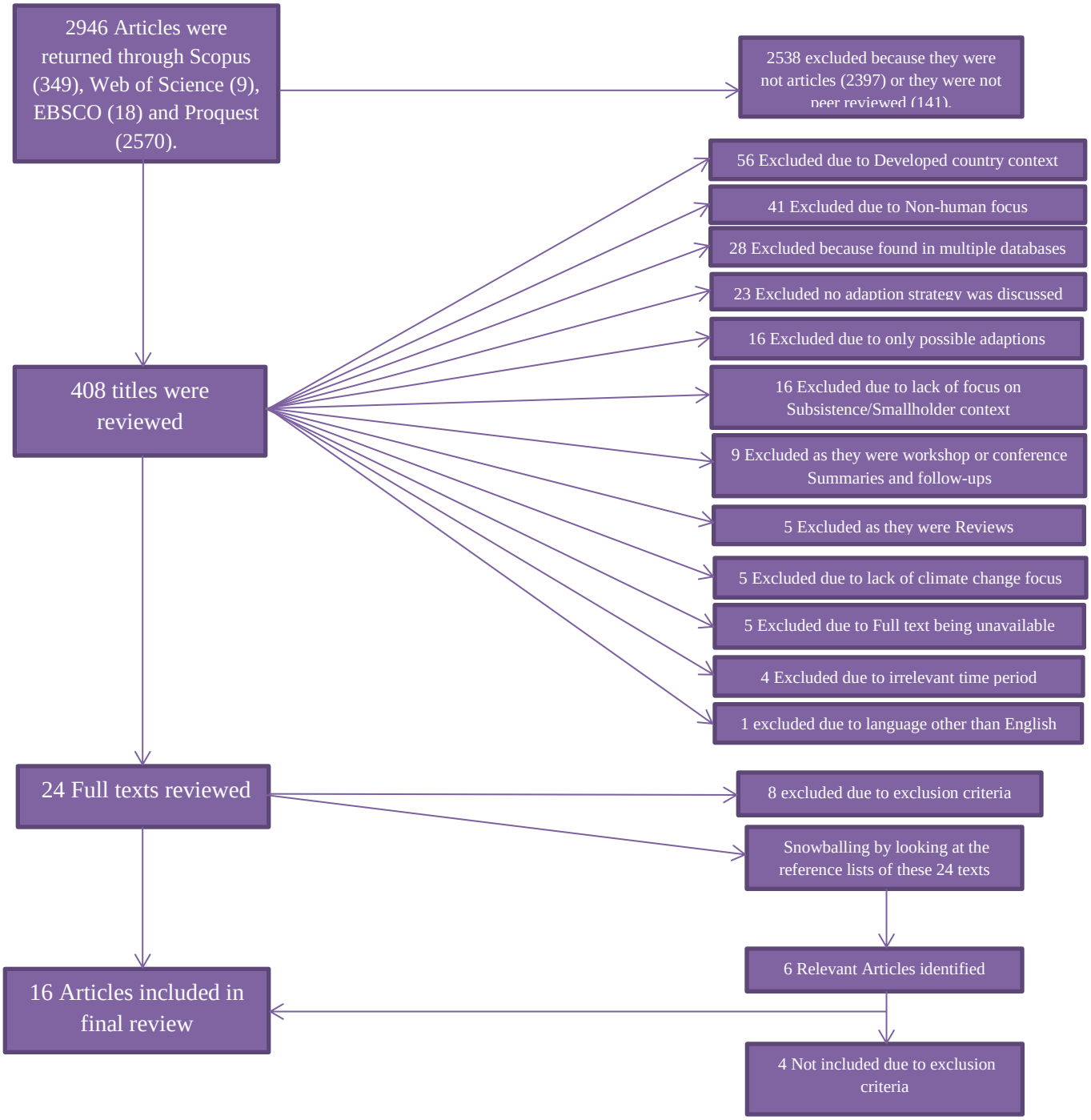

Figure 1: Methodology and Results

2.2.3. Inclusion and exclusion criteria

The criteria focused upon studies including current adaptation and coping strategies to climate change. Articles looking only at how subsistence groups will be impacted by climate change or those simply proposing strategies for the future were excluded (Table 1). Articles

focusing on subsistence groups in an artic environment were also excluded. As the study is intended to look at current adaptive capacity, articles focusing on ancient societies or on specific disaster preparation were excluded.

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Peer-Reviewed Journal Article Published up to November 24th 2012 Action in response to Climate change Currently employed adaptation strategies Subsistence, Indigenous and Small holder farmers	Non-peer reviewed Reviews Irrelevant time period Workshop or Conference Summaries and follow-ups Arctic context Non-human focus Focused only on future possibilities Short term emergency adaptation due to disaster Focus only on the impacts of climate change Not available in English

2.2.4. Data Extraction

The realist review, similar to the Cochrane method, necessitates a summation of current knowledge and theory of how subsistence groups are adapting to climate change and of empirical evidence that either contradicts this or supports such a claim (Pawson et al., 2005). Current hypotheses of causal mechanisms of effectiveness and case specific context were retrieved and will be discussed. The following information was collected from each study; research approach/study design, the population, context (location/region). A paper had to specifically articulate the adaptation strategies and not merely allude to them to be included. These will be collected in addition to the variable outlined by the vulnerability framework.

2.3. Results

The search strategy and inclusion/exclusion criteria returned 16 studies that were included in the review (Table 2). Table 2 summarizes the findings and outlines the exposure, sensitivities and adaptations of each of the case studies. The table then characterises if the adaptations were successful in reducing sensitivity to climate exposure. The studies range in publication date from 2005 to 2012. They all specifically identify adaptation and coping strategies. Coping strategies tended to be short-term mechanisms to ensure survival but may not have encompassed the ability to maintain one's livelihood (McDowell & Hess 2012; Thomas et. al. 2007; Osbahr et. al. 2010). Adaptation referred to long-term changes whereby one can continue to pursue their livelihood (Osbahr et al., 2008). Coping does not necessarily have a sustainable productive impact and often can negatively impact a household's future ability to adapt (Osbahr et al., 2010; Thomas et. al. 2007). The authors highlighted the tendency of groups to act in a reactive and responsive fashion rather than an anticipatory or proactive approach, which limited the flexibility of the groups and diminished the potential variety of avenues to pursue (Osbahr et. al. 2010; Osbahr et. al. 2008).

2.3.1. Case Studies

All of the articles could be characterized as case studies. This was not as a result of an inclusion criterion, but a reflection of the style of research pursued when researching this type of inquiry. All studies employed a household questionnaire that was central to the research. These were supplemented with focus groups, community discussions, participatory visits, key informant interviews, workshops and direct observations. Four articles conducted multiple site analysis for comparative purposes.

2.3.2. Climate Change Pressures

Within the study papers, 15 of the 16 subsistence groups were coping with the impacts of drought (Table 2). Drought is a common occurrence in southern Africa and results from a lack of moisture which then leads to the degradation of arable land (Mogotsi et al. 2012). As a result of this degradation, crops are often lost or unable to grow, the soil cannot support new crops and those who have grazing animals face a loss in herd size. This lack of moisture is often accompanied by long periods of unpredictable precipitation. Changes in precipitation patterns

were identified as a stressor in 11 of the articles reviewed. Decreases reduced crop yields and strained food production and procurement, whereas increases in precipitation cause flooding and can increase the spatial distribution and intensity of diseases (James & Washington, 2012; Christensen et. al. 2007; Conway et. al. 2005; Egeru, 2012). Additionally although the mean precipitation rate may not change higher intensity with greater temporal distribution can ruin crops or come at times that do not correspond with traditional agricultural calendars (Barbier et. al. 2008; Bewket 2012; Enete et al., 2012). Increased temperatures have been documented as leading to increased weed infestation and the heightened prevalence of crop disease as well (Egeru 2011; Eriksen 2005; Fosu-Mensah et al. 2012; Manandhar 2011; Ozor 2012).

2.3.3. Determining the adaptation strategies being implemented

The aim of most of the studies was to establish which practices (coping or adaptation) their study populations were implementing in response to climate change pressures. Fifteen of the sixteen articles reviewed focused on subsistence or smallholder farming households. The authors of all articles found it difficult to isolate sensitivity to climatic impacts versus financial and social stressors.

The strategies employed included shifting towards more resilient crops, retaining subsistence agricultural livelihoods, and liquidating all assets and/or migrating for survival. The adaptation method findings can be grouped into one of the following categories; agricultural strategies, livelihood and economic strategies, and social strategies. Adaptation methods in all categories interact with each other, however separating them provides a lens through which preferences of the population can be highlighted as well as those that are inhibitory or have negative impacts.

Table 2: Summary of studies included in the review

AUTHORS	REGION	DESIGN	ADAPTATIONS	EFFECTIVE	SENSITIVITY	EXPOSURE
Barbier et al. (2008)	Tougou, Yatenga Province, Burkina Faso	Case-Study	Animal sale, reduce food, reduce meals, diversification, migration, alter grazing areas, increase fertilization, water harvesting, soil restoration, row planting, manure, increase lowland production, vegetable growth, compost, plow, use draft animals.	Yes	Financial Capital, Government Policy, Land Access	Drought, Floods

Bewket (2012)	Central Highlands of Ethiopia	Case-Study	Changes in the types of crops produced, diversification of crops and livestock, adjusting agricultural calendar, early maturing varieties for the crops, pest tolerant crops, plant fruit trees, reduce number of animals, producing livestock feed, forestation, reforestation, rainwater harvesting, construction of community ponds, stream diversions, crop rotation, stone bunds, soil bunds, grass strips, water ways, fallowing, mulching.	Insufficient	Financial Capital, government programs	Decreased and delayed precipitation, Increased temperatures
Egeru (2011)	Teso Sub-region, Easter Uganda	Case-Study	Creating food stores, harvesting wild; fruits, vegetables, termites. Early planting, fast maturing crops, saving seeds, reciprocal labour, migrating, petty trading, begging, seed storage, weeding patterns, planting modes (IK).	Yes	Education, Financial Capital	Drought, Floods
Enete et al. (2012)	Enugu and Imo States in South East Nigeria	Case-Study	Multiple/intercropping, agroforestry, afforestation, shading and shelter, mulching, expansion of cultivated land, herbicides and pesticides, water for irrigation and soil conservation practices, high-yielding, faster growing, heat-tolerant, drought-resistant crops, organic manure.	Yes	Extension services, Financial Capital	Unpredictable precipitation, land degradation, drought
Eriksen et al. (2005)	Kenya and Tanzania	Case-Study	Wage labour, charcoal burning, remittances, Indigenous fruit, sale of crafts, receiving help from neighbours and family, sale of livestock and poultry, sale of bricks, use of Indigenous plants, collecting honey.	Yes	Financial Capital	Drought
Fosu-Mensah et al. (2012)	Sekyedumase, Ghana	Case-Study	Crop diversification, changing planting dates, subsidized fertilizers, improved hybrid seeds, abandon their farms.	Somewhat	Financial Capital, Education	Decreased and delayed precipitation, Increased temperatures
Kristjanson et al. (2012)	Kenya, Tanzania, Uganda and Ethiopia	Case-Study	Changes in; crop variety, timing of planting, management (soil/land, land area, water, feed, herd composition) herd size, improved agricultural inputs, drought tolerant, shorter cycle, disease resistant varieties, intercropping, manure and/or composting, adoption of pesticides and herbicides, tree planting.	Yes	Financial Capital, Government aid	Unpredictable rainfall, drought

Malunga (2011)	Shire Valley in Southern Malawi	Case-Study	Manual weeding, adoption of chemical pest and weed control, zero tillage, surface seeding, off-farm activities, off-season vegetable production, fish farming activities, establishment of cooperatives, production and marketing channels, crop diversification.	Yes	Financial Capital, Institutional support of Indigenous practices	Uplands - Unpredictable rainfall and droughts. Lowlands - floods
Manandhar et al. (2011)	Western Nepal in Terai and Mountain regions	Case-Study	Shift from local to modern hybrid varieties, change in cropping calendar, cropping sequences, and planting methods	Somewhat	Financial Capital	Increased droughts, erratic precipitation, Cold waves
Mcdowell et al. (2012)	Bolivian Highlands	Case-Study	Later planting seasons, Restricted planting on hillsides, Intensification of cash crops, irrigation committees, Agrarian unions, Market-oriented livelihoods, Fruit trees and vegetables, Increasing livestock herds to graze on communal land, Bonfires are or straw is laid over crops to reduce frost risk. Selling livestock, Switching primarily to livestock rearing.	Somewhat	Financial Capital, social capital, land, water and labor and human capital	Decreased and delayed precipitation, Increased temperatures
Mertz et al. (2008)	Eastern Saloum, Senegal	Case-Study	Remittances, migration, older people work, new crops or crop varieties, keeping animals in stables, replacing draught horses with cattle, manure, credit schemes, revitalizing traditional solidarity measures, re-sowing, cultivate fodder, abandon fields, reforestation, use of fertilizer	Unclear	Financial Capital, Government policy	Unpredictable rainfall, severe wind
Nzeadibe et al. (2012)	Cross Rivers, Delta and Rivers State, Niger Delta	Case-Study	Conservation of water and soil, organic manure, inorganic fertilizer, minimum tillage, irrigation system/water storage, Protection of water sheds and mulching, Reclamation of wetlands/river valleys, contour bund, Draining of wetland for crop cultivation, Planting pest and disease-resistant crop, crop varieties that are well acclimated, Cover cropping, early maturing crops, preservation of seeds, windbreaks/shelter belts, herbicide, insecticide, Reforestation/Afforestation, Planting of crop with early rainfall, Reducing access to eroded and erosion prone area, Change of planting date,	Yes	Financial Capital, Government Programs, education	Drought, wind, heat waves

			Changing the timing of land preparation, Changing harvesting dates, Out migration from climate risk areas, weeding, Listening to information about climate change.			
Osbahr et al. (2008)	Mozambique	Case-Study	Reducing food consumption or expenditure to preserve assets, selling of assets, family gifts, friendship networks, sale of labour, petty trade, reciprocal or non-cash exchanges, traditional cattle and small stock breeding, temporary migration, diversification, traditional craftwork, herbal medicine construction, economic migration, collective dual land-use.	Somewhat	Government policy, Financial Capital, Market prices	Drought, increased temperatures, unpredictable rainfall
Osbahr et al. (2010)	Mozambique and South Africa	Case-Study	Selling assets, reliance on social networks, eating of wild; plants, fruits, birds, animals, petty trade, migration, turning to faith, government assistance, NGO support, agricultural experimentation, planting trees.	Yes	Financial Capital, Education	Unpredictable rainfall, drought
Ozor et al. (2012)	Southern Nigeria	Case-Study	Weeding, change cropping calendar, multiple cropping, processing crops to minimize post-harvest losses, increased use of farm inputs such as manures and seeds, crop replacement, mixed farming, use of resistant varieties, mulching/use of cover-cropping, relay cropping–planting and harvesting in succession.	No	Financial Capital, land rights	Flooding, droughts
Thomas et al. (2007)	Limpopo, North West and ZwaZulu Natal Provinces	Case-Study	Reduce investment, stop cropping, focus on livestock management, sale of vegetables and small stock, storing of fodder, cattle shelters to protect animals, increase in planting distances of crops, short-maturing varieties, stone bunds, drought-tolerant species, pig and cattle production, poultry and egg schemes, Indigenous drought resistant livestock breeds, community horticulture projects, reduce dependence on rain fed crops	Yes	Financial Capital, Institutional Capacity	Drought, Unpredictable rainfall

2.3.3.1. Agricultural Methods

Agricultural adaptations yielded the highest number of options to pursue (refer to Table 2). They reflected Indigenous, traditional and modern knowledge approaches to agriculture. The use of crop variations or multi-cropping is a traditional cultural practice for many groups but this approach seems to have increased in response to climate change (Egeru, 2011; Bewket, 2012; Thomas et al., 2007). Many have employed an altered cropping and harvesting calendar to accommodate the change in climate conditions (Egeru, 2011; Enete et al., 2012; Kristjanson et al., 2012; Malunga, 2011; Nzeadibe et al., 2012; Ozor et al., 2012). Experimentation with crop variety and planting patterns was also prevalent (Bewket, 2012; Kristjanson et al., 2012; Mertz et al., 2008; Ozor et al., 2012; Thomas et al., 2007; Fosu-Mensah et. al. 2012). Adapting agronomy practices to climate change demonstrates continuous learning and reflects a desire to keep discovering how to reduce sensitivity to impacts in the future.

Where possible, agroforestry has been implemented both as an adaptation strategy for climate change and for the benefits that shade and shelter provide for the community, herds and crops (Enete et al., 2012; Kristjanson et al., 2012; Mertz et al., 2008; Nzeadibe et al. 2012; Ozor et al., 2012). Though increased temperatures have hindered most populations, they have been advantageous to some others, allowing an increase of fruit production due to warmer climates. Growing fruit is a profitable pursuit, though only a select few have the resources to cover the start-up costs and investment (Bewket, 2012; Mcdowell & Hess, 2012).

Although many adaptation measures are implemented at a household level, Bewket (2012) describes community level interventions such as reforestation and water conservation. These measures have a positive impact on the greater community. Additionally some broader actions were supported financially by the local government, enabling the community to fully realise and sustain the projects (Bewket, 2012).

Adaptations that altered the type of livestock owned or changed herd composition were common observations (Barbier et al., 2008; Bewket, 2012; Kristjanson et al., 2012; Osbhar et al., 2008). Some producers increased their ownership of smaller livestock, like poultry, as they are cheaper to feed (Kristjanson et al., 2012; Mertz et al., 2008; Osbahr et. al, 2010). Small units can also act as a buffer in tough times, because they can be sold without impacting the larger and

immoveable asset holdings (Mertz et al., 2008). Some invested in large livestock for longevity reasons or to add value in the event they needed to sell-off entirely (Barbier et al., 2008). Sale of livestock was generally a last resort if doing so would impede their ability to persist in their livelihood in the future (Eriksen et al., 2005; Egeru, 2011).

Three studies highlight the desire to expand agricultural land to achieve economies of scale and provide more alternatives for growing a variety of crops and diversifying risk (Barbier et al. 2008, Ozor et al., 2012, Thomas et al., 2007). Where possible, this is a legitimate strategy, but for many places, personal financial realities and land scarcity in a broader context, make gaining more land unlikely.

Through the study periods, it repeatedly emerged that smallholder and subsistence farmers prefer to use technologies without external inputs or influence. In the case of Malawi the ideal irrigation methods were those that used gravity as the primary mode of water flow rather than alternatives with more inputs (Malunga, 2011). Elders prefer to use traditional seeds and crops both for familiarity and their subsequent use rather than "alien" seeds that do not last. Potatoes and cow pea leaves are both sundried traditionally in anticipation of the dry season (Egeru 2011). A preference for relying on traditional knowledge rather than "new" or "foreign" information was ubiquitous (Kristjanson et al., 2012; Osbahr et. al. 2010).

To cope with the impacts of reduced precipitation in rain-fed cropping endeavors, numerous methods of moisture conservation are employed (Barbier et al. 2008; Malunga, 2011; Nzeadibe et al., 2012). Mulching is implemented in smallholder operations in both Africa and South America. This is an effective way to reduce the impact of evaporation in times of need (Barbier et al. 2008; Kristjanson et al., 2012; Nzeadibe et al. 2012; Ozor et al., 2012). Site specific approaches such as deep hole planting, stone bunds[1], ridges, micro-catchments were noted on a smaller scale (Bewket, 2012; Nzeadibe et al., 2012; Kristjanson et al., 2012).

[1] Stone bunds are used in water conservation and elongate and cleanse the runoff of irrigation or water. Often only used in a small scale environment the stone bunds are placed along contour lines along with the planted of other vegetation to further enhance the water barrier.

2.3.3.2.Livelihood Diversification and Economic Opportunity

Diversifying livelihoods was observed as a key strategy and often essential due to other stressors impacting the population. All studies highlighted income-generating diversification where possible. As households successfully diversified income streams, risk and vulnerability were reduced (Osbhar et al., 2008). Similar to other strategies, these options favour the wealthier households as they often have excess or underutilized labour and transportation options. To gain employment off-farm, often entailed a migration of one or more family members temporarily or permanently. The lure of cash income was particularly strong, demonstrated by the number of people (mainly men) who sought outside work (Osbahr, 2010; Barbier et al. 2008; Mertz et al. 2008). Remittances[2] tended to be the most reliant form of income, especially for the subsistence groups (Barbier et al. 2008; Eriksen et al., 2005; Mertz et al., 2008). This outside influx of cash was often reinvested to grow or expand the household's farm.

Other diversification options include fishing, selling handicrafts, and casual labour etc. (Malunga, 2011; Egeru, 2011). These are more location specific as opportunities are located near markets or other natural resource features, i.e. fishing is only pursued if there is a body of water. A trend highlighted in Eriksen et al.'s (2005) study had different members of a household that would specialize in a specific activity creating a diversified household i.e. a young male would pursue casual coal labour while a woman may make baskets (Eriksen et al., 2005).

2.3.3.3. Social Networks

Peasantry literature places an emphasis on social networks and reciprocity. Within the study groups many relied on these social dynamics as they had little access to a cash economy. These relationships can be specific and reciprocal, or broad involving trading, exchanging labour, information, food, cash loans or simply support (Osbahr et al., 2010 Eriksen et al., 2005; Malunga, 2011; Mcdowell & Hess, 2012; Mertz et al., 2008; Osbahr et al., 2008; Thomas et. al. 2007). The study populations had various forms of social networks such as Osbahr et al. (2008) whereby there were 2 forms of reciprocity; one was an informal arrangement between the

[2] Often young men and women seek alternative sources of income away from home to contribute to the household's income. Remittances are financial aids that family members working abroad or away from home send back to their families as a form of support.

women in the community called Matsoni[3]. The second was called Kuvekala and involved the care of livestock in exchange for the first born animal. For social networks to work, both availability of labour and the resources to participate are needed (Osbhar et al., 2008; Mcdowell & Hess, 2012).

Collectives or associations can help reduce individual risk as well as providing greater opportunities for market involvement, for example in eMcitsheni[4] a maize group was formed. With more money to invest, better crop yields can result. The group also enabled members to overcome transport and market participation issues (Thomas et al., 2007).

2.3.4. Factors and mechanisms effecting strategy outcomes

Even though the grassroots approaches seemed to be preferable along with the melding of traditional and modern knowledge in incremental steps versus wholesale change, there are still other critical success factors and strategies beyond local control (See table 2). These enabling mechanisms are financial capital, education, social capital and government support (Egeru, 2011; Kristjanson et al., 2012). Barriers to adaptation strategies also emerge and can prevent their success. Detracting factors can be institutional barriers, economic stress or social pressure (Mcdowell & Hess, 2012; Osbahr et al., 2010; Thomas et al., 2007). The critical success factors and barriers are intertwined, for example, if one has financial capital then it is a success factor, if one does not then it is a detracting factor.

[3] *Matsoni* a traditionally informal reciprocal network shared labour, land and information while also providing social support members and the guarantee of a share of food in hard times.
[4] eMcitsheni is a rural community in the uThekula District in South Africa

2.4 Discussion

2.4.1. Critical Success Factors of Adaptation

As evidence in the literature, there were effective strategies but external sensitivities determined their success. Financial capital, education, even innovation supported the adaptation strategies pursued, Financial capital, as it emerged from the literature seems to determine whether or not many of the adaptation methods can be implemented. Those that had financial freedom were able to take advantage of the warming temperatures and plant fruit trees (Bewket, 2012). Others were able to invest in the new drought and pest resistant crops along with the appropriate chemical and technological support (Bewket 2012; Egeru 2011; Enete et. al. 2012; Fosu-Mensah et. al. 2012; Malunga, 2011; Manadhar et. al. 2011). Wealthier households are able to participate to greater extent in reciprocal relationships and can give more than they take (Osbahr et. al. 2010). Financial capital eases and enables the adaptation process.

Successful adaptations may be positively linked to education. One study by Egeru (2011), found that those who had pursued education were more likely to implement coping schemes and be aware of the phenomena of climate change. Strengthening Indigenous knowledge by fusing modern adaptation practices to traditional cultural practices and knowledge will offer greater opportunity for resilience and adaptation to changing conditions and circumstances (Egeru, 2011). Malunga (2011) found that the study population preferred localized strategies without external technologies or input. Kristjanson et al. (2012) similarly discussed the preference to implement marginal rather than "transformational" changes and the authors expressed concern about their study population's hesitance to adopt "well-tested and widely disseminated… management practices" (p.393). This is supported by change management theory whereby adapting to incremental changes and arriving at a place where change is desired is much more acceptable than absorbing wholesale or forced change (Kettinger & Grover, 1995). Fosu-Mensah et al., (2012) describes the need for awareness and increased sharing of adaptation methods through education or community programs.

One study found that more "innovative" households, as assessed by the number of successful implementations of strategies in the past two decades, had higher food security (Kristjanson et al., 2012). This is further supported by findings that indicate that ability to be

structurally and mentally flexibility reduces risk (McDowell & Hess 2012; Kristjanson et. al., 2012).

Groups that retain their ability to produce or gather their own food for their own food provisions are in a better position to deal with food insecurity and short-term climate impacts than those who are fully integrated into the monetary economy[5] (Barbier et. al. 2009; Eriksen et. al. 2005). In this context they are better able to adapt to their own needs rather than needing to satisfy the demands and volatile conditions of the market (Mertz et. al. 2009). Traditional knowledge and historical legacies of successful adaptive strategies favour these groups over those that have migrated (Barbier et. al. 2009). Many of the adaptation and coping methods observed were implemented in response to climate change along with other economic and social pressures (Thomas et al., 2007; Nzeadibe, 2012).

2.4.2. Critical Detractors to Adaptation

Farmers cited lack of knowledge, economic resources, and institutional support as principle barriers to adaptation (Egeru, 2011; Nzeadibe 2012). Yet they continue to pursue alternatives and ways forward to ensure the maintenance of their lifestyle. Their persistence reflects a commitment to their livelihoods and a tenacity that has enabled them to adapt in the past (Osbahr et al., 2010). These barriers though, can impede and prevent effective adaptive strategies unless they are addressed.

Economic pressures emerge in both obvious and in more subtle manners. Lack of financial capital to buy new crops, invest in new technologies, pay rent etc. are examples of the overt pressures (McDowell & Hess 2012; Enete et. al. 2012). Further, more vulnerable households cannot participate or take advantage of social networking because they tend to have fewer overall resources and are net 'takers' more often than 'givers' (Osbahr et. al. 2010; Osbahr, et. al. 2008). Wealthier households are able to contribute gifts, food, labour, land, loans, whereas the poorer households can usually only contribute labour. They will often use up their unofficial quota or acceptable share of aid before they can reciprocate (Osbahr et al., 2010).

[5] A monetary economy is in contrast to a bartering or self-sustaining lifestyle. All trade of products or services is done through a monetary exchange.

Because of the economic pressures, young able bodied men migrate from villages to seek alternative income, thus creating an even greater burden on both women and the elderly.

Economic and social pressures lead households to resort to cash cropping. This monoculture then harms the ability to adapt, reducing flexibility, one of the main advantages of subsistence groups (Silva et. al. 2009). Compounding pressures have been precursors to adoption of contradictory methods like cash cropping; they are contradictory in that the agronomic practice used to solve one problem is actually setting the stage for less viability and flexibility in future when combined with climate change stressors (Mcdowell & Hess, 2012). Poverty is an enormous restriction on adaptation to climate change (Ozor et al., 2012). Those that do not have access to cash income are in a very vulnerable position should crops fail or if they face an extended drought.

Institutional pressures at the local scale i.e. weak leadership or poor village organization; negatively impact the success of adaptation in rural communities (Barbier et al., 2008; Osbahr et al., 2010). On a large scale, governments often ignore rural groups or implement policy and programs without consulting with them. In developing countries in particular, climate change and coping strategies have either not been identified and planned or are weakly implemented. To implement sustainable or broader geographical adaptation strategies government support is needed. Planned agricultural initiatives (formalized versions of reciprocity)[6] supported by government, community and NGO's have been very effective (Barbier et al., 2008). Government support, through the provision of incentives to private companies to partner with smallholders, furthers a cooperative and sustainable approach (Osbhar et al., 2008). Respect of a community and its traditions and current cultural practices is vital when attempting to implement a new program. This may seem intuitive but is often overlooked; consequentially many groups cling very closely to historical patterns and will not alter methods based solely on outside suggestions and imposed implementation (Manandhar et. al. 2011; Osbahr et al., 2010; Nzeadibe et al., 2012; Egeru, 2012; Barbier et al., 2008).

[6] This would entail communal grain storage, group agriculture and cropping etc.

2.4.3. Segment Variation within the Population

Youth will be the cohort that will face the increased burden of climate change and yet they feel, and are in reality, removed from many of the power structures. This is as a result of community leaders preventing dialogue with the young from occurring and a historical pattern of elder authority (Osbahr, et al., 2010). One study mentioned the possibility that farming may be a viable option for youth in response to the large unemployment rates in developing countries (Enete et. al. 2012). Though, this view was unsupported by the remaining 15 studies.

Women, as a sub-population, face barriers and opportunities – women are most dependent on reciprocal relationships (Osbhar et al., 2008; Osbhar et al., 2010). Female-headed households tend to be the most reliant on reciprocal arrangements compared to those headed by men. However, women cannot contribute to the reciprocal arrangements in terms of sufficient reciprocal labour, cash loans or shared food as they often have the least amount of resources in a community (Osbahr et. al. 2010; Osbahr et. al. 2008; Mertz et. al. 2009). During high stress times, men have more mobility and opportunity to support their family than women (McDowell & Hess; 2012; Mertz et. al., 2009; Eriksen et. al., 2005). The women have many household responsibilities and family care responsibilities and face a large barrier to enter the wage market (Eriksen et al., 2005; Osbahr et. al. 2008).

2.4.4. Government and Adaptation

Poorer farmers or those with lower quality soils are unable to take advantage of adaptation measures such as drought resistant or hybrid crops. This is due to the lack of access to credit, access to extension services[7], the fertility status of their soil, and land tenure[8] (Barbier et al., 2008; Fosu-Mensah et al., 2012). This can be ameliorated through government policy and programs enabling farmers to employ approaches implementing new crop varieties or low–cost sustainable technologies so that they can remain self-reliant (Manandhar et al., 2011).

[7] Extension services traditionally relay best farming practices within the community and through shared collaborations. Governments have adopted this technique to help farmers improve their practices but many of these services do not reach the rural poor.

[8] Many poor lack the ability to own land or have it recognized by the state. Implementing new farming practices such as irrigation on land that may be taken away often proves to be too great of a risk.

Some studies found that aid programs were in place; however the authors observed that there are some practical and more cost effective solutions to the aid that is currently being dispersed. Cash injections as opposed to food aid, indexed insurance[9] and the opportunity for land tenure all help farmers in a more efficient fashion than current programs (Barbier et al., 2008; Ouma et. al., 2010).Government support and partnerships between different institutional levels can support many of these small holder pursuits and can reinforce efforts by communities to cope and adapt (Barbier et al. 2008; Fosu-Mensah et al., 2012; Nzeadibe et al., 2012; Osbhar, 2008).

2.4.5. Future research and the need for context specific analysis

Although many regions and areas cited similar strategies, context specific approaches remain a necessity i.e. irrigation versus rain-fed dependent crop operations require different options. Identifying the mechanisms and resources that subsistence populations need to adapt to stressors should be the focus. Although much research has been done and models have been developed for future climate change impacts there are a variety of outcomes to prepare for and having access to the tools that aid adaptation creates a flexible context in which populations can adjust regardless of the impact (Mcdowell & Hess, 2012; Mertz et. al. 2009).

Future research should focus on which adaptation measures are successful with NGO or government support and analyse the long term sustainability of these strategies. For planning and policy to be affective on the ground there must be place-based population specific research and community involvement.

[9] Many farmers cited the difficulty in getting insurance, as most did not have enough money or were not given the opportunity due to the small nature of their farms.

2.5. Conclusion

As the impacts of climate change become more pronounced and prevalent both coping and adaptation strategies will need to be implemented. Those in the most vulnerable positions face a daunting task but this review demonstrates that there are options to pursue. In many cases economic resources are a key determinant in the ability to implement these alternative avenues. Programs and policy will need to support these groups in an enabling manner. Rather than implementing policy upon groups, participant involvement and community consultation is key. Many subsistence populations have an extensive history of successful adaptation, and as presented in this review, have already developed coping and adaptation strategies to the current impacts of climate change. This view was a prominent theme brought up in the literature with Ozor (2012) calling for "… a systems approach involving all stakeholders to work together in turning the challenges posed by climate change into opportunities."(p.250) (Nzeadibe et al., 2012).

As some of the articles mentioned, access to land tenure and rights can be essential for survival as well as short-term government support to aid in the diversification or implementation of improved crop varieties. Rather than government aid and migration, keeping groups in the places they call home and having the ability to pursue livelihoods with which they have traditional knowledge leads to more sustainable outcomes.

Many successful NGO and government implemented programs revolve around a grassroots and local knowledge management approach. Although smaller scale programs require more logistical support, both financial and physical capital can be saved through a more efficient and effective project implementation.

Food Security of Batwa Pygmies in Kanungu, Uganda

3.1 Introduction

Negligible peer-reviewed research is available to describe the health of the Batwa Pygmies of Uganda. Authors of various reports consistently cite the poor health status and heightened risk that this population faces in relation to climate change (Berrang-Ford et. al 2012; Dingle 2011; Namara, 2007; Balenger et. al 2005; Tumushabe & Musiime, 2006; Jackson 2003; Warrilow 2008; Zaninka 2001). Previous research has stated that poor nutrition and low food security status are expected in the Batwa but there has been no focused research on the Batwa food systems or food security status (Jackson, 2003; UOBDU 2010; Balenger et. al; 2005, Dingle, 2011). The Minority Rights Group (2008) warns that the Batwa may face extinction as a result of their small numbers, high malnutrition, extreme poverty and the disintegration of social cohesion.

The Batwa face more urgent risks and difficulties than climate change, notably extreme poverty, food insecurity, marginalization and health outcomes. The Batwa are therefore very vulnerable to climate exposure, due to these heightened levels of sensitivity. The Batwa's main food sources are from their own land, remuneration in exchange for manual labour, from other farms or from the market (Dingle, 2012). Climate change will directly impact the availability and quality of food from their land and the farms in the area. Indirectly, market products will likely go up in price and further reduce access that the Batwa have to acquire food (Berazneva & Lee, 2013; Sassi, 2013). Due to lack of cash wealth at present in these communities, buying market products is rare (Namara, 2007). Increased food prices may inhibit the Batwa entirely from accessing market food sources. Here, an analysis of food security within a case-study population of 130 Batwa households in Kanungu District of Southwestern Uganda is presented.

Objectives:

1) Estimate the prevalence of food security in the Batwa Pygmies of the Kanungu District in Uganda
2) Identify the determinants of food security within the Batwa
3) Identify implications of vulnerability of Batwa food systems to climate change

3.1.1 Batwa Pygmy Community

The Batwa Pygmies are an Indigenous group and the most eastern group of Central Africa's pygmy population (Jackson, 2005). Originally the sole inhabitants of the equatorial forests of the Great Lakes Region in central Africa, the Batwa now live primarily in Rwanda, Burundi, the Democratic Republic of Congo and Uganda with a combined population of 70,000 (Hamilton et. al. 1986; Lewis 2000). Current estimates put the Batwa numbers in Uganda at 6,700, or about 0.02% of the Ugandan population. They live in the rural districts of Kanungu, Kabale and Kisoro.

Traditionally the Batwa were forest hunter-gatherers and had a nomadic lifestyle. Temporary grass shelters were built for housing and for sleeping, and water was accessed through natural streams and creeks. Firewood and wild honey were sourced within the forest. In particular, the Batwa were active as collectors and cultivators of honey, which was used for both dietary consumption as well as medicinal purposes (Kajobe, 2007; Kajobe & Roubik, 2006). Their mobile lifestyle was instrumental in facilitating a relocation when food sources dwindled, consequentially reducing issues of sanitation, contamination and conflict (Lewis, 2000). Given the limited amount of research conducted and a limited body of knowledge related to this period of forest inhabitance, not a lot is known about Batwa health outcomes before their departure from the forest (Berrang-Ford et al., 2012).

In 1930 with the establishment of forest reserves, the Batwa were forced to the fringes of their traditional forest territory (Kidd & Zaninka, 2009). These initial restrictions were created with the intention and justification of protecting the forest from agriculturists. Their agronomy had been encroaching into forested land. Although the Batwa, in theory, retained some access to the forests for hunting and gathering, their activities and movement were in practice limited, with reduced forest access (Zaninka, 2001).

During the turbulent rule of Idi Amin in Uganda, conservation was neglected and deforestation and logging were allowed to proceed unrestrained. Farmers near the forests took advantage of this time to increase their land holdings and develop more fields (Turyahabwe & Banana, 2008). Other groups began using the forest reserves for hunting as an additional form of income, which caused the number of mammals in the forest to decrease. Much of this damage

was blamed on the Batwa (Baker, 2001). During the surge in African conservation movements and the establishment of Bwindi National Park in 1991, the Batwa were completely displaced from their forest homes, which resulted in a termination of all livelihood activities to which they were accustomed (Bitariho et. al. 2006). Because of their mobile nature and their lack of familiarity with and integration into formal land tenure or ownership practices, the Batwa were considered landless migrants and squatters. Some were given limited compensation but those deemed to have no official land were given nothing (UOBDU, 2006). Those that received cash compensation, in many cases, lacked the skills and experience with a cash economy to invest and spend this compensation effectively (Zaninka, 2001).

Eviction from the forest created adaptation challenges and cultural adjustments. The forest not only represents the ancestral home of the Batwa but has significant spiritual and cultural meaning for the pygmy population (Klieman, 2003). Their burial grounds and sacred sites are all located within a forest that they find themselves without legal rights to access. The Batwa have since adopted an agricultural and sedentary lifestyle (Balenger et. al. 2005). Many of the displaced Batwa currently live in settlements or land trusts donated and supported by NGO's and private donors. Others live as squatters or take part in migrant labor to support their families (Kenrick & Lewis, 2004). Initially through one of the trust organizations, land was purchased for Batwa settlements and agriculture. While successful during the early years of support when seed was provided, seed stocks soon ran out and the Batwa could not afford to buy their own (Balenger et. al. 2005). The Batwa have thus engaged in low paying manual labor, working as porters, diggers, tea collectors, brick makers or tourist craftsmen. The income per capita is 97$ or 0.88$ a day, substantially less than the Ugandan national per capita income of 366$ (Namara, 2007; World Bank 2012).

The Ugandan constitution identifies those residing within Ugandan borders prior to 1926 as Indigenous (Kidd, 2008; Republic of Uganda 1995). As a result, they did not receive a unique Indigenous status that recognized their particular circumstances and culture that would help ensure the provision of essential services. Dingle (2010) found that the Batwa living in Kanungu district had an adult literacy rate of less than 10%, compared to 75.5% (women) and 77.7% (men) in the Southwestern Province (UBOS/Macro Intl., 2012). The large difference demonstrates the level of inequality of education accessibility in the region. In schools the Batwa

often face discrimination from both students and teachers alike (Warrilow, 2008). 'Mutwa' (plural: Batwa) is often used in a derogatory sense by outsiders to imply lazy, different, or bad.

Women face a double burden, including both discrimination from those outside the Batwa community as well as discrimination by their male counterparts within their community (Jackson, 2003). Along with disrespect, some people outside the community hold mystical or magical beliefs surrounding the Batwa. HIV is believed to be cured by sleeping with a Batwa woman (Ohenjo et al., 2006; Tumushabe and Musiime 2006; Ramsay 2010; Warrilow 2008). This leads to physical and sexual abuse at the hands of 'outsiders' (Ramsay, 2012; Tumushabe & Musiime, 2006; Warrilow, 2008). Batwa women also face domestic violence. The numbers of both spousal sexual and physical abuse are high according to the 2009 Minority Rights Group International report on violence against women in Batwa communities. Batwa women have poorer health outcomes than men both physically and mentally (Jackson, 2006; Harper, 2012).

Batwa health indicators are some of the lowest in the country and this people group has been highlighted as one of the world's most vulnerable populations (Harper, 2012). The average life expectancy for the Batwa is 28(BDP, 2011), whereas for Ugandan it is 54 (UNICEF, 2010). Maternal health, child mortality, infant mortality are all manifested more negatively in the Batwa than in neighboring populations and in the Ugandan averages (Jackson, 2006; Harper, 2012; Namara, 2007). The Batwa live predominantly in rural areas and according to the 2011 Uganda demographic and health survey, rural children are more likely to be malnourished than their urban counterparts (UBOS/Macro Intl., 2012). No food security analysis has been conducted of the Ugandan Batwa, but an impact assessment conducted by the Green Environment Facility Evaluation Office[10] found that "no Batwa communities have attained a level of food self-sufficiency" (p.11) (Namara, 2007). Similar situations are reflected in much of East Africa with Batwa facing lack of food in Rwanda, Burundi, Congo, DRC (Lewis, 2000; Warrilow, 2008; Jackson, 2003). For example in Burundi several religious organizations have implemented food security interventions such as seeds, fertilizers and the procurement of goats due to the severity of hunger in the Batwa communities (Harvest for Christ, 2013).

[10] The Green Environment Facility (GEF) Evaluation Office is conducting impact assessments on projects they have funded to both determine environmental and social impacts. Bwindi Impenetrable National Park was given money by the GEF, and this assessment specifically focused on how the Batwa have adjusted since their eviction from park land in 1991 (Namara, 2007).

3.1.2. Food systems

Food systems cover the workflow of the production, processing, distribution, preparation and consumption of food (Gregory et. al. 2005). The different components of the food system are impacted by human and environmental processes. When a food system is stressed[11], food may become unavailable, poor in quality or restricted in access, resulting in food insecurity. The FAO defines food security as "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Food security entails the ability to have regular and consistent access to nutritious and adequate food resources. Food insecurity is the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways (Andersen 1990). For example, one may be able to steal food, sift through garbage or beg, but there is a social stigma that surrounds these methods. When a group is food insecure, their access to, quality of, or quantity of food resources may be lacking (Gregory et. al. 2005). *Access* to food is the ability to access sufficient resources to secure enough food to maintain a healthy diet (Campbell 1999; WHO, 2013; Bickel et. al. 2000; FAO 2006; Schmidhuber & Tubiello 2007). Food *quality* refers to the access of both the appropriate nutritional and traditional food (Campbell 1999; WHO, 2013; Bickel et. al. 2000; FAO 2006; Schmidhuber & Tubiello 2007). Food *quantity* reflects the amount of food available within the food system and if it is enough to meet the demand (Campbell 1999; WHO, 2013; Bickel et. al. 2000; FAO 2006; Schmidhuber & Tubiello 2007). Food insecurity in itself is a negative outcome, but it can also indirectly lead to other negative health outcomes. Those who are food insecure have higher rates of under-nutrition, malnutrition, stunting, wasting, mental stress, greater risk of infection and higher rates of chronic illness (Hamelin et. al. 1999, Lambden et al. 2006, McIntyre & Tarasuk 2004).

Many developing countries have food insecure populations. An estimated 850 million people are undernourished in the developing world with Sub-Saharan Africa having one of the highest rates of malnutrition (FAO 2012). According to Misselhorn (2005), food insecurity in

[11] Food systems can become stressed by a number of factors; climate (drought, flooding), economic (price or demand increases, food shortages), conflict (supply routes destroyed, decreased safety). All these lead to increased difficulty in securing food for the household or self.

southern Africa is driven by poverty, environmental conditions, access to property rights and land, unemployment, insufficient distribution networks and inadequate access to markets.

3.1.3. Climate change

Sub-Saharan Africa has been identified as one of the most vulnerable regions in the world to the risks and threats of climate change on its food security. (Davidson et al., 2003; Ramin & Mcmichael, 2009; Sokona & Denton, 2001; Tschakert, 2007; Apuuli, Wright, Elias & Burton, 2000; Confalonieri et al. 2007; Fussel, 2010). Predictions of climate change in Uganda include increased and unpredictable rainfall, raising temperatures, and higher occurrences of extreme weather (Christensen et al, 2007; Hepworth, 2010; Magrath, 2008). Rain fed agriculture is practiced by the majority of the Ugandan population; changes in climate will impact their food production practices and crop successes and in turn their food security.

The Kanungu district falls within Uganda's southwestern highlands and includes the Bwindi Impenetrable Forest National Park. The forest creates a unique micro-climate with lower temperatures and higher rainfall than the rest of the district and Uganda (Oluput, 2009). Little is known about how climate change will manifest locally due to the lack of monitoring and data collection, however models and community-based research predict that the area will face rising temperatures, an increase in extreme weather and a change in precipitation (Berrang-Ford et. al. 2012; Christensen et. al. 2007; Magrath, 2008, Hepworth, 2010; Anderson & Gabrielsson, 2012).

3.2. Methods

3.2.1. Population census

The study was conducted in the Kanungu district of Southwestern Uganda. As of 2009, there were approximately 900 Batwa living in Kanungu District, scattered throughout 10 settlements. An attempt at a full census of Batwa residing in Kanungu District, including children took place in January 2013. These communities are currently participating as partners in an ongoing research project, Indigenous Health Adaptation to Climate Change (IHACC, www.ihacc.ca). IHACC is conducting a global comparative study of the impacts that climate change will have on the health of remote Indigenous communities in the Canadian Arctic, Peru and Uganda. As part of ongoing research, IHACC is conducting a two-year longitudinal health survey (2011-13). The data and research presented here represents an analysis of food security data of one cross-sectional survey from the Ugandan component of the IHACC project (January 2013).

IHACC outlined a 450 individual minimum sample size for each of their 3 study regions in the Arctic, Peru and Uganda. Due to the small size of the Batwa population, a census survey was selected. This ensured the collection of even the most vulnerable households, which can be missed in sampling design. The study communities were selected after pilot research was conducted in 2010 by the IHACC team. Partnerships with these 10 communities are facilitated by local IHACC collaborators.

3.2.2. Data

Data were collected in 129 households using a household head survey (see Appendix I) and food security survey (see Appendix II). The first was administered to those who self-identified as the household head, or in their absence, their spouse or eldest child. The food security survey was administered to those who self-identified as the head of household food preparation by IHACC and community researchers in January 2013; if that member of the household was unavailable, other suitable candidates were sought out (i.e. a household member highly familiar with, and involved in, food preparation). Questionnaires were conducted orally with participants directly in the local language of Rukiga, with responses recorded on a paper questionnaire.

Ethics approval was obtained from the McGill Research Ethics Board on research involving human subjects. All sections and questions were voluntary, with options to skip or end the survey at any time. To ensure confidentiality, all data analyzed has been de-identified and individual and household ID's have been assigned to facilitate temporal analysis in the future. No payment was provided for participation; as per IHACC practice, the communities were provided with a nutritious lunch following surveys; participating in a questionnaire was not mandatory to receive a meal.

The household head survey aimed to identify a household's characteristics; size, assets, wealth and health indicators such as mosquito net use, access to clean water and sanitation facilities. To determine a household's wealth profile, the questions addressing the following assets were asked: ownership of animals, radios, cell phones, electricity, bicycles, car or truck, other vehicles for transportation, house construction materials, hand washing facilities, size of household, remittances, method of water treatment, type of toilet, privacy of toilet. Further, questions regarding involvement in these practices were asked: fishing, agro-labour, tending crops, tending animals, hunting and collection of medicinal plants.

The food security survey was based upon the U.S. Department of Agriculture's (USDA) food security survey module (FSSM). It aims to establish the extent and occurrence of food insecurity in the Batwa Pygmy community during October 2012-January 2013. The USDA's module is used around the world to assess food security. The version of the FSSM used examined the conditions, experiences and behaviors that characterize ranges of food insecurity and hunger severity experienced over the previous 3 months (Ford & Ford 2009). The survey has 3 sections and contained 34 questions. The first section captured the demographics of the respondent. The second section contained 12 questions concerning the food security of the household's adults, including access, quality and quantity available. The final section had 7 questions and focused on the food security of the household's children.

Questions ranged from those relating to concerns about food insecurity, experiences of being food insecure and well as frequency and season during which these occurred.

The 12 questions concerning adult food security include three questions that reflect uncertainty about having enough food, the experience of running out of food, and not being able

to attain healthy food. Then the respondents are asked to describe their typical daily diet, using 24 hour recall and then confirming that what the respondent typically eats. The remaining seven questions are arranged in increasing order of severity and concern changes in diet and food intake as a result of constrained food availability, accessibility, and/or quality, finishing with the most severe conditions of food insecurity: losing weight and not being able to eat for a whole day due to lack of food.

3.2.3. Data processing

Survey results were inputted in both Excel 2010 and StataSe ll. Basic descriptive statistics were calculated. Data for the frequency questions within the food security questionnaire were found to be inconsistent and deemed invalid (q.20b, q25b & q.29b). The question was asked to the respondents based on a 3-month scale; however the answers reflect a far shorter time period and are likely indicative of a mismatch between the length of recall and Batwa non-linear conceptualization of time and history[12] (Kidd, 2008). Based on this observation, the imputation model outlined in the USDA FSSM manual (See Figure II) was used to impute the values as is if they were missing.

Once all the data had been cleaned, sections two and three of the survey were converted, as per the following, to facilitate the calculation of food security status. The FSSM was designed to have positive answers (yes, 1 or often, 1 & sometimes, 2) result in food insecurity and negative answers (never, 3 & no, 0) result in a food secure outcome. These were converted to 1 (positive) & 0 (negative) respectively.

[12] Kidd conducted research in 2002 and recorded that both he and NGO's found that the Batwa were constricted by questions and would negotiate the question and answer in a non-linear fashion.

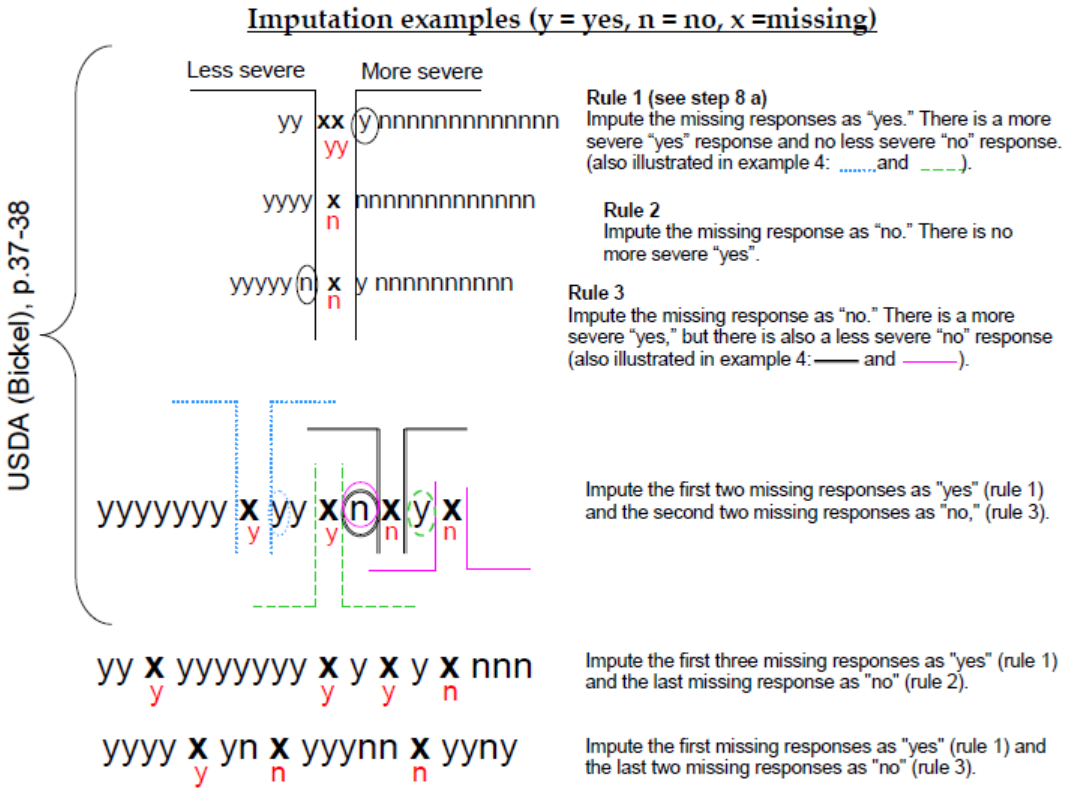

Figure II: Imputation Model © Catherine Huet, 2013.

Food security status was formulated by analyzing families with children and those without children separately. Families without children were assessed against a maximum score of 10, and those with children were had a maximum score of 18. Food security was categorized in the following manner: a status of 'food secure' resulted with less than 3 positive responses to the food security questionnaire and 'food insecure' if they gave 3 or more positive responses. The food insecure respondents were further separated into three categories: food insecure without hunger, food insecure with hunger (moderate) and food insecure with hunger (severe). Table III outlines the classification differences between families with children and those without (adapted from Bickel et. al. 2000).

Table 3: Classification Guide: households with complete responses, food security scale values and status levels corresponding to number of affirmative responses

Number of Affirmative Responses		Food Security Status Level	
Households With Children (Out of a maximum possible total of 18)	**Households Without Children(Out of a maximum possible total of 10)**	**Code**	**Category**
0 1 2	0 1 2	0	Food Secure
3 4 5 6 7	3 4 5	1	Food Insecure Without Hunger
8 9 10 11 12	6 7 8	2	Food Insecure With Hunger, Moderate
13 14 15 16 17 18	9 10	3	Food Insecure With Hunger, Severe

Food secure – denotes a household with no concerns or observed occurrences of food security. *Food Insecure without hunger* – Food security is a concern but reductions in food intake have not been recorded. *Food insecure with hunger (moderate)* – at this stage households are struggling to feed their own members, with adults reducing food intake and experiencing hunger. *Food insecure with hunger (severe)* – All members of the household are forced to reduce food intake, loss of weight is observed and longer periods of not eating can be observed. At this stage a household's children will be eating less and experiencing hunger (Bickel et. al. 2000).

3.2.4. Analysis

To identify possible determinants of food security among Batwa households, the following tests were conducted using a 95% significance level: chi², Fisher's exact; Wilcoxon and t-tests. The four categories of food security were collapsed in two, with food secure to food insecure with hunger (moderate) in one and food insecure with hunger (severe) in the second. This binary categorization reflected the high prevalence of severe food insecurity; categorization with food secure versus food insecurity would have resulted in too few households in the food secure category to provide sufficient variation for predictive analyses. Households that are classified in the most severe category reflect both adult and child food insecurity in a household. In the less severe categories, coping and adaption strategies exist to prevent children from being impacted. However at the most severe stage a household can no longer protect children and children will be forced to eat smaller amounts, skip meals and not eat for whole days.

3.3. Results

The average Batwa household in the Kanungu district of south western Uganda was headed by a male (53%), was dependent on firewood for cooking fuel, has a dirt floor, and has 5 members. There was little occurrence of cell phones or radios and no households had electricity. Two (of a total of 129) households owned a bicycle, but no households owned any type of motor vehicle. Less than one fifth of households owned animals. Those that did had goats (12%), pigs (8%), chickens (7%), dogs (2%) and rabbits (1%). The preferred sources of water came from rainwater harvesting or from a cistern, unprotected springs and a protected well. The majority of household deemed their water to be very poor or poor and more than half do not treat their water. Households that did treat their water used boiling, some filtering and ultra-violate radiation. Most households used covered pit latrines, with less than a quarter using uncovered pit latrines. The majority of respondents had private toilet facilities and one fifth used semi private facilities (shared with only a few other households).

Most Batwa earn negligible income or have inconsistent cash earnings. Less than 20% had remittances through cash or gifts. Seventy-nine percent received no outside income through remittances or gifts (See Appendix III). Nearly every household had members that tilled or tended animals for money or to provide food for their families. Few families participated in fishing or hunting.

The Batwa are food insecure (Table 4). One (1%) out of 129 households was food secure, 10 (8%) households were food insecure without hunger, 47 (36%) were food insecure with hunger (moderate) and 71 (55%) were food insecure with hunger (severe). Just over 99% of the households surveyed were classified as food insecure, with 91% of households being food insecure with hunger. There was no significant variation between villages, demonstrating the uniformity of food insecurity in the Batwa population.

Table 4: Food Security of the Batwa

Food Security Status	Number	%
Food Secure	1	0.775194
Food Insecure without hunger	10	7.751938
Food Insecure with hunger, moderate	47	36.43411
Food Insecure with hunger, severe	71	55.03876
	129	100

With the questionnaires designed to sequentially reflect increasing severity of food insecurity, the frequency of affirmative responses is expected to decrease; this was indeed observed in the survey results (Table 5). Ninety-three percent of households were worried about food running out, 96% of households had run out of food within the last 3 months, 89% were unable to eat a varied diet, 73% had to cut or skip meals and 84% had to eat less than they should. For the two questions reflecting the most sever indicators of food insecurity within the adults of the household, 77% had lost weight within the last 3 months and 61% had gone more than half the days in the month without eating.

Table 5: Survey Response Statistics

Food Security Questions	Total responses (%)	Often	Sometimes	Never	Yes	No
Worried Food about food running out	129 (100)	57 (44)	63 (49)	9 (7)	-	-
Food didn't last	129 (100)	63 (49)	61 (47)	5 (4)	-	-
Lack of varied diet	128 (100)	41 (32)	73 (57)	14 (11)	-	-
Had to cut the size or skip	124 (100)	-	-	-	91 (73)	33 (27)
Cut or skipped meals more than half the days in the month*	124 (100)	-	-	-	85 (69)	39 (31)
Ate less than they should	129 (100)	-	-	-	109 (84)	20 (16)
Went Hungry	129 (100)	-	-	-	91 (71)	38 (29)
Lost Weight	127 (100)	-	-	-	98 (77)	29 (23)
Didn't eat for a whole day	126 (100)	-	-	-	91 (72)	35 (28)
Did not eat for a full day more than half the days in a month*	127 (100)	-	-	-	77 (61)	50 (39)
Had to give children less expensive food	112 (100)	47 (42)	54 (48)	11 (10)	-	-
Couldn't feed children a varied diet	111 (100)	44(40)	57 (51)	10 (9)	-	-
Unable to feed children enough	113 (100)	41(36)	59 (52)	13 (12)		
Had to reduce children's meal size	113 (100)	53(47)	51 (45)	9 (8)	-	-
Children had to skip meals	101 (100)	-	-	-	68 (67)	33 (33)
Children had to skip meals more than half the days in the month*	101 (100)	-	-	-	46 (46)	55 (54)
Children went hungry	113 (100)	-	-	-	64 (57)	49 (43)
Children did not eat for a full day	112 (100)	-	-	-	56 (50)	56 (50)

*Data imputed.

Notably, food insecurity levels were also very high amongst children. Forty-six percent of children within these communities were skipping meals more than half the days in a month. Over half the households responded that their children went hungry and did not eat for full days. The questions related to whole days without food and going hungry indicate the utmost severity of 'food insecurity with hunger' and half the community reflected this status.

Table 6 displays the variables that were found to be significantly associated with food insecurity[13] (the grouping of the three statuses of food secure through food insecure with hunger (moderate) versus food insecure hunger (severe)). The number of people per household and food security status was significant. The more members a household had, the more likely they were to be more food insecure if there was not a corresponding increase in the number of key providers. This was not surprising, as the more people there are the less food there is to go around. Both the number of rooms in a house and the number of rooms used for sleeping were significant indicators of food insecurity. Houses with more rooms reflected a larger household size.

[13] Technically one respondent of the 129 was food secure, but has been grouped with the two other light and moderate food insecure categories as described by using the binary approach Section 3.2.4. It is recognized that not 100% of the respondents in the less severe food insecure category were in fact insecure. It was not thought that the removal of the one food secure respondent would significantly change results and that it was illustrative to include this respondent in analysis.

Table 6: Significant determinants of Food Security

	Number (%)	Mean	Food secure to Food insecure with hunger (moderate) (%)	Food Insecure with hunger (severe) (%)	P-value	Stats Test
Community	126 (100)	-			0.359	Chi²
Household Size	124 (100)	4.79			0.0005	t-test
Number of rooms	127 (100)	2.842			0.0051	t-test
Owns pigs	28 (100)	-			0.006	Fishers
Yes	10 (36)		7 (60)	3 (30)		
No	18 (64)		3 (12)	14 (82)		
Owns goats	29 (100)	-			0.035	Fishers
Yes	15 (52)		2 (18)	13(76)		
No	14 (48)		9 (82)	4 (24)		
Toilet facilities	123 (100)	-			0.016	Chi²
Private	95 (77)		35 (66)	56 (85)		
Semi-Private	28 (23)		18 (34)	10 (15)		
Exposed to pigs	20 (100)	-			0.005	Fishers
Yes	8 (40)		7 (78)	1(10)		
No	12 (60)		2 (22)	9 (90)		
Exposed to dogs	19 (100)	-			0.070	Fishers
Yes	4 (21)		1 (12)	3 (30)		
No	15 (79)		7 (88)	7 (70)		
Exposed to goats	20 (100)	-			0.070	Fishers
Yes	11 (55)		3 (33)	8 (80)		
No	9 (45)		6 (66)	2 (20)		
Animals come inside the house	20 (100)	-			0.033	Fishers
Yes	16 (80)		5 (56)	10 (100)		
No	4 (20)		4 (44)	0 (0)		
Household does not fish	130 (100)	-			0.096	Chi²
Yes	103 (79)		49 (86)	51 (74)		
No	27 (21)		8 (14)	18 (26)		
Fishes to provide food	130 (100)	-			0.096	Chi²
Yes	27 (22)		8 (14)	18 (26)		
No	103 (79)		49 (86)	51 (74)		
Sells fish	130 (100)	-			0.095	Chi²
Yes	10 (8)		2 (4)	8 (12)		
No	120 (92)		55 (96)	61 (88)		
Tills land to sell for income	130 (100)	-			0.053	Chi²
Yes	36 (28)		11(19)	24 (35)		
No	94 (72)		46 (81)	45 (65)		
Collects plants for medicinal purposes	130 (100)	-			0.097	Chi²
Yes	33 (25)		19 (33)	14 (20)		
No	97 (75)		38 (67)	55 (80)		

Owning animals was not a significant predictor of food security, which was surprising as typically this would indicate a level of wealth that would increase food security. Owning *specific* animals was significant, however. Of the households that owned animals, owning pigs was associated with higher food security. Overall only 37% of respondents owned pigs, but 70% of food secure to moderate food insecurity owned pigs (Table 7). Households that owned goats on the other hand were associated with lower food security. Fifty-four percent of those that owned animals had goats; 76% of food insecure households with hunger (severe) had goats compared to 18% of food secure to insecure households with hunger moderate who owned them (Table 8).

Table 7: Relationship between owning pigs and food insecurity

	Owns Pigs		
Food Security status	No (%)	Yes (%)	Total (%)
Food secure to food insecure with hunger (moderate)	3 (30)	7 (70)	10 (100)
Food insecure with hunger (severe)	14 (82)	3 (12)	17 (100)
Total	17 (63)	10 (29)	27 (100)

Table 8: Relationship between owning goats and food insecurity

	Owns Goats		
Food Security status	No (%)	Yes (%)	Total (%)
Food secure to food insecure with hunger (moderate)	9 (81)	2(18)	11(100)
Food insecure with hunger (severe)	4(24)	13(76)	17(100)
Total	13(46)	15(54)	28(100)

Fishing for food was significantly associated with severe food insecurity. Fishing most likely takes place as a direct effort to feed the family rather than to sell the goods or earn a wage. Those that sold fish had an even higher chance of being severely food insecure. Hunting was not found to be significant. Being away from the forests presents less opportunity to pursue this method of acquiring food for the household. Only nine (7%) households had members who hunted, with seven using it as a food source and two households trading or selling their game. Tilling of land to sell for income was associated with food insecurity. Finally, collecting medicinal plants was associated with heightened food security (p=0.097).

The most food secure village was Kitariro: only 25% of its households were severely insecure (Figure 4). Kitahuria had the highest percentage of severely food insecure households

(78%). The only food secure household was in Mukongoro. All households in Buhoma suffered from food insecurity. However since the numbers are so small the variance between communities is negligible and not significant.

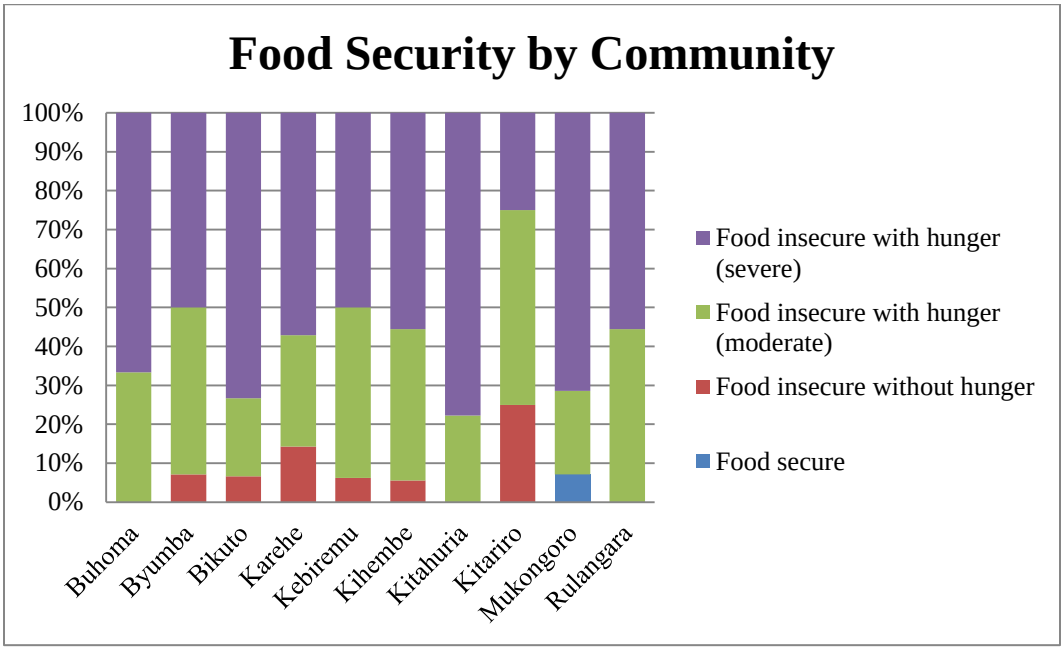

Figure 4: Food security by community

Having a balanced and healthy diet is an important aspect of both food security and nutrition. Having a variety of carbohydrates, fats, vitamins and proteins is essential to maintain a healthy body (Schmidhuber & Tubiello, 2007). The survey asked what household members ate the previous day, with a follow-up question asking if this was what the family typically ate. The respondents listed each item that had been eaten in their household (Figure 5). The majority of people reported consuming beans (62%), posho[14] (42%), millet[15] (37%) and matoke[16] (34%). Only ten (8%) reported eating meat, likely due to financial constraints; those eating meat added that this was not typical. The majority of households reported eating no meat. When asked about their diet and referring to a lack of meat, community members responded with "it's [the beans and carbohydrate based components] the cheapest food affordable", "Not enough money to buy them [the meat]", "financial difficulty", "no money to buy it" and "lack of money".

[14] Posho or ugali is boiled corn flour and served as a side to vegetables or meat.
[15] In the Batwa community it is most often prepared as a porridge
[16] Matoke is a type of green banana similar to a plantain and is a national dish in Uganda. Respondents interchanged banana, plantain and matoke.

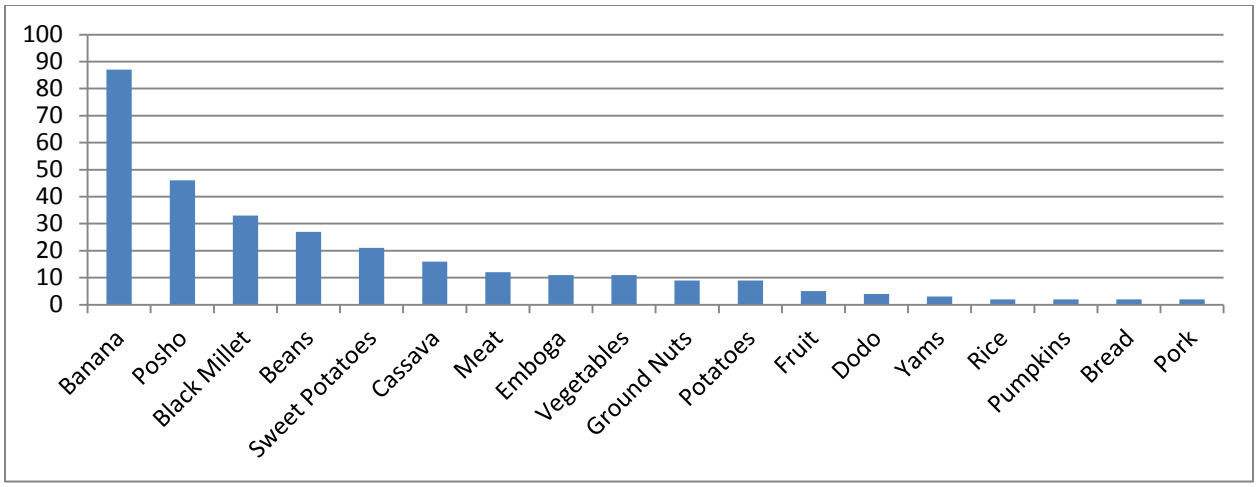

Figure 5: Typical food intake

Only one (of 129) households was categorized as food secure. This household differed substantively from the profile of the average Batwa household, notably in that it comprised of a single male with no children who received money from other family members through remittances and gifts. There were no indications of particular wealth or employment to otherwise differentiate this household.

3.4 Discussion

3.4.1. Batwa Vulnerability

The Batwa population in the Kanungu district of south western Uganda have one of the highest levels of food insecurity recorded in the world. Ninety nine percent of households were found to be food insecure. Reduction in food intake was found to be prevalent at higher rates for in adults than children. This would imply that households are protecting children from hunger, with adults taking on a higher burden, which reflects the literature wherein adults buffer children's experience with food insecurity (McIntyre et al. 2003; Oldewage-Theron et al. 2006; Hadley et al. 2008; Leonard 1991). Only one study in India using the HFIAS[17] survey, had higher severe food security (60%) than the Batwa (55%) (Chatterjee et. al. 2012). However 24% of the Indian study population was food secure compared to <1% of the Batwa, implying less variation and more homogeneity of food insecurity among Batwa compared to high inequality of food security in the Indian population studied. Regassa et al.'s (2012) study in Ethiopia also had results similar to the Batwa with 48% as severely food insecure. Studies in Nigeria, Eastern Africa, South America, and the Middle East have all found levels of varied food security; however none reach rates as high as 99% (Fakayode et. al. 2009; Usfar et. al. 2007; Mohammadi et. al. 2012). Even within Uganda the rate of severe food insecurity has never been reported this high; Alcaraz & Zeller (2008) (34.64%), FAO report (2008) (27.6%). This questionnaire validates the predictions by those that have studied the Batwa; they have extremely low food security and subsequently are highly sensitive to any stressors like climate change or conflict (Berrang-Ford et al. 2012; Jackson, 2003; UOBDU 2010; Balenger et. al; 2005, Dingle, 2011).

3.4.2. Predictors and a homogenous population

There were few predictors that emerged from the data, as a result of the Batwa being a homogenously food insecure population. After a comparison between 'food secure' to 'food insecurity with hunger (moderate)'and 'food insecurity with hunger (severe)', some hypotheses emerged. First, larger households were more likely to be food insecure with hunger (severe). This observation is similar to other case studies of highly food insecure populations (Amaza et

[17] Household Food Insecurity Access Scale developed by the Food and Nutrition Technical Assistance Project (FANTA), in response to improve the USDA FSSM for global use.

al. 2008; Bashir et al. 2012; Bogale, 2012; Sulaiman et al. 2013; Maharjan & Joshi 2011; Omeumu et. al., 2012). In Bashir et al.'s (2012) analysis of the rural and landless households in the Punjab province of Pakistan, size of household was the strongest determinant of food insecurity. Larger households have more mouths to feed, and the Batwa do not have sufficient wealth and assets to ensure adequate food for each member. Education and family planning resources have been a policy strategy to help reduce the burden of family size in vulnerable communities (Amaza et al. 2008; Bogale et al 2012; Wahlqvist et al. 2012; Jansen et al. 2006).

Owning livestock is typically a protective mechanism against food insecurity (Chenyambuga et al. 2012; Devendra & Chantalakhana, 2002; Demeke et al. 2011). For the Batwa though, owning animals was not significantly associated with food security. Of those who owned animals, pigs were a significant indicator of lower food insecurity; goats in contrast were associated with higher food insecurity. The relationship between food security and pigs was further supported by the significant result of pig exposure and lower food insecurity. Similarly with goats, exposure was a predictor of higher food insecurity. This could reflect the cost and benefits of the two types of livestock. Goats maybe cheaper to rear but result in lower returns (low quality; milk, meat) versus pigs that may need more inputs but produce higher yields (high sale price) (Lebbie 2004).

Lack of variance in both food security outcomes and measured predictors constrained analysis and identification of the determinants of food insecurity among the Batwa. The Batwa were 99% food insecure and there were only subtle determinants of this status or wealth. Rose (2000) discussed this trouble of looking within a population to find outliers and defining normal as the average within the local population. Within the Batwa context exposure does not vary: all Batwa report difficulty accessing sufficient food. Few have animals or financial resources to ensure a consistent food source. The real variance Rose (2000) argues can be seen between populations. When Batwa are compared to the national average or even the district average both are far lower than the 99% food insecure as is reported here for Batwa. As mentioned earlier, the Batwa have higher rates of food insecurity than anywhere else in the world. Yet if we simply looked at this population in isolation, it would seem that severe food insecurity is the norm.

The population was divided into two groups: food secure to food insecure with hunger (moderate) and food insecure with hunger (severe). The division was made to analyse what was

different about the most severely food insecure group. What emerged were small indications of variance but nothing significant to indicate food security. Through the survey the most food insecure households were fairly indistinguishable from each other.

Owning animals, having employed members of the household, remittances, and covered toilets were all expected to indicate wealth within the Batwa population and therein be predictive of increased food security. The only household with high food security had remittances, covered and private toilet facilities, but had no animals. This household only compromised of one male who lived alone. These results demonstrate the lack of significance in owning animals or having remittance money. This raises the question as to what determines variation in food security among Batwa households in Kanungu.

Firstly, social networks and sharing networks may explain the absence of variation in food security outcomes, as well as the poor predictive capacity of wealth measures. Social networks were not explicitly addressed in these surveys. Social and reciprocal relationships are often found in Indigenous groups globally and may help explain how households are able to acquire food if not through typical sources of wealth i.e. owning animals or having a wage employment (Osbahr et. al. 2010; Osbahr et. al. 2008; Mertz et. al. 2009; Egeru, 2011). During difficult times community members will share or support more vulnerable members until the time of stress ends. Participation in networking groups can be effective however; a household must maintain its ability to contribute to continue participating (Osbahr et. al. 2010; Osbahr et. al. 2008; Mertz et. al. 2009). Households that are better off can contribute the most but a household that is a net "taker" can develop a negative reputation and may be excluded or marginalized in the future (Osbahr et al., 2010; Osbahr, et. al. 2008).

Secondly, the variables used as proxies of wealth in our survey may not be accurately reflecting appropriate indicators of wealth within a Batwa cultural context. The household head survey was designed to capture indicators and determinants of wealth within the Batwa community. This was then meant to be used to analyse food security status and health outcomes within the population. During the analysis of food security, animal ownership, remittances, wage labour (wealth indicators) did not alter a household's food security.

For a typical developing country, the wealth assets of a rural population usually center around wage labour, owning animals, radios, cellphones, transportation and remittances (Knueppel et al., Filmer & Pritchett, 2001; Échevin, 2013; Antwi-Agyei et al. 2013). Remittances, rather than being a reflection of wealth, may actually demonstrate desperate need for outside financial aid and only result in sufficient financial assets to maintain survival (Mabogunje, 2007). With limited job opportunities in the area, family members may leave in an effort to keep their family fed at the most basic of levels.

The Batwa maybe so poor that relative wealth variations within the community may not explain the variance in food security. A study done in 1999 found that the 3 biggest national indicators of household food security were unpredictable precipitation (either inadequate or excessive), pests and disease (Bahiigwa, 1999). Eighty percent of Uganda's population depends on agriculture. Owning land or tending your own crops may be better indicators of food security within the Ugandan context for the Batwa population. Qualitative research might help to identify and characterize Batwa conceptualizations and interpretations of wealth as it pertains to accessing food sources.

3.4.3. Validity of the Survey

While cleaning data from previous surveys it was noted that answers by respondents did not reflect understanding of the questions being asked. This was ameliorated during the January 2013 implementation of the survey with more intensive interviewer training. However discrepancies and oddities in the data revealed that questions were still unclear to the interviewees. This suggests a shortcoming in the administration and appropriateness of the survey. The FSSM by the USDA may not be the appropriate method to measure food security in extremely vulnerable and Indigenous populations. Questions that were particularly difficult involved memory recall with a three month time reference. Many respondents appeared to be answering 3-month recall questions with a weekly or daily time frame. Indigenous populations often do not have linear perceptions of time (Janca & Bullen, 2003). Perception of time relates to seasons or events and not necessarily days or months that do not hold traditional significance (Janca & Bullen, 2003; Gell, 1992).

Several studies have outlined the weaknesses of memory recall and the cultural comprehension of time (Beegle et al. 2012; Bouis; 1994). Some reviews have established that 7-14 day food intake recall is more appropriate to understand what communities are eating (Hoddinott, 1999). Respondents generally are more likely to accurately answer questions with a shorter recall period (Keenan et. al. 2001). However because this survey was designed to be consistent with internationally standardized applications, recall periods were longer to ensure that hard times were captured (Bickel, 2000; Keenan et. al. 2001). Within severely food insecure populations the longer recall periods are not as essential. However, one of the key advantages of the memory recall approach is to uncover the perceptions of food security that the population holds (IFPRI, 2012; Bickel et. al. 2000).

Questions in the survey appear repetitive given the particular situation of the Batwa, i.e. asking about skipped meals and not eating for a whole day. Some impatience was noted through feedback from our interviews relaying complaints by the respondents of having to answer the same question twice. While in English there were subtle differences, translations seemed to be unable to relay these subtleties accurately. Additionally words like “varied” and healthy are very subjective and for this particular population they did not accurately reflect the North American meaning (IFPRI 2012). While in the field words were simplified to ensure comprehension of the respondents. For example the most relatable concept for varied was eating lots of different foods, which was uncommon (see Fig. 5).

3.4.4. Development of a Batwa Baseline

Other issues arose in assessing meal and food intake reductions. There was no baseline established to determine if the “normal” intake was sufficient, but visual observations suggest that normal would qualify on the survey scale as deficient. The Batwa have a very different diet style than the western context for which this survey was designed. The Batwa typically eat one meal per day, rather than the survey’s assumption that a typical household has 3 meals a day. When respondents answered the question, 'have you skipped any meals', the responses were surprisingly low for this population given the severity indicated by answers to the rest of the survey and in-field observations. In the research done by Dingle (2011) 65% of households said they were unable to secure enough food to eat sufficiently on a daily basis. A quarter of

households mentioned they never skip meals, in the context of the survey though the Batwa are skipping 2 meals per day. For the Batwa skipping a meal would mean not eating the whole day.

While this survey is useful for global comparison studies it does not adequately portray the variance in food insecure groups. Once the threshold is passed to qualify as food insecure with hunger (severe) there is no additional categorization. For example two families may declare they are forced to skip meals and state a frequency of this event. If they skip meals more than half the days in a month then they are food insecure for that question. The way the survey is set up, a family could go for a month without eating at all and have the same ranking as a family who only skipped meals half the days in a month. For extremely poor and food insecure populations the survey fails to indicate the severity of their situations. The survey is designed for a normal distribution which may occur in a more developed context but for these communities their normal is in the most severe category and the USDA FSSM, like other food security questionnaires, are unable to distinguish between families within the bottom category (Webb et. al. 2006; Bickel, 2000). Some of these limitations have been addressed by Bickel et al. (2000), they state the survey was developed within a U.S. context and may not adequately capture very poor populations (Bickel et. al. 2000).

4. Conclusion

Identifying the baselines of access, quality and quantity of food sources within the Batwa people could better direct research and interventions in the future as well as inform similar studies of highly vulnerable and severely food insecure populations. Although using the internationally validated USDA module is effective for comparison between populations on a global scale, being able to adapt the questions for cultural variants[18] or subtleties of the population would enable researchers to more appropriately define food security within the Batwa population. Considering the severity of Batwa food security status, intervention and adaptation strategies need to be implemented to avoid further deterioration of health, culture and livelihoods.

4.1 Climate change, vulnerability and food security

Populations that are highly vulnerable and have little resilience to current climate impacts will face the greatest burdens when faced with future climate change. The systematic literature review highlighted ways that subsistence and vulnerable groups are trying to cope and adapt to the impacts of climate change. The most prevalent area of stress was the impact of weather on agriculture, which subsequently impacted food security. Climate exposure can often result in a decrease of quality and yields from crops. Climate impacts like drought, increased temperature and unpredictable precipitation are expected to increase the risk of hunger and malnutrition (Parry et. al. 2005). The Batwa, who are already severely food insecure and highly vulnerable to climate change, will be particularly at risk because of their reliance on agriculture for food and income.

4.2 Moving Forward

Establishment of seasonal patterns and a temporal analysis of annual change would help develop a short-term prediction model of food-security and climate. This would be informative for both planning and adaptation implementation for the Batwa. Further qualitative research should be conducted to identify; an appropriate wealth and asset profile, determinants of food insecurity, the role of social networks and traditional knowledge of coping strategies. A modified

[18] For example the Batwa traditionally only eat one meal per day.

locally appropriate food-security questionnaire would further strengthen the understanding of the Batwa food systems. Although the research suggested here is context specific, the results would be valuable for guiding similar studies in vulnerable populations. Additionally, a comparative analysis between the Batwa and their Bakiga neighbours could clarify the role of climate impacts versus sensitivities due to inequalities and underdevelopment.

Possible avenues to pursue improved food security in these communities would be to strengthen extension services, agricultural workshops to enhance current practices and develop new skills and low tech or low input interventions (i.e. stone bunds or drip irrigation). The Batwa have adapted in the past from a nomadic hunting to a sedentary agricultural lifestyle. This illustrates their resilience when change is imposed upon them and may reflect their ability to adapt in the future.

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Appendix I – Household Head Questionnaire

IHACC

EBIBUUZO BYA MUKURU W'EKA | HOUSEHOLD HEAD QUESTIONNAIRE			
EKICWEKA A: EBIRI KUKWATA AHA KYARO/OMUNTO OGWO ORIKUBUUZIBWA	**EBIBUUZO IKUMI NA BISHATU**	**PART A:** Demographics	**13 questions**
EKICWEKA C: EBIRIKURETAHO EBIZIBU, ENDWARA N'AMAGARA MABI	**EBIBUUZO ABIRI NA MUSHANJU**	**PART C:** Risk factors	**27 questions**
EBIBUUZO EBIRI KUHENDERA EKIGAANIIRO	**EBIBUUZO BIBIRI EBY'OKUHENDERA**	**Completion Questions**	**2 questions**
BYOONA HAMWE		**Total:**	**42 questions**

EKICWEKA A - EBIRIKUKWATA AHA KYARO/EIHANGA/OMUNTU OGWO ORIKUBUUZIBWA

PART A – Demographics

ORIKUBUZA: EIJUKA EBI!

- ☐ SHOBORORA NGU EBIMULA-BAMBEHO NEBYANYU, TIHARITTO'NDIJJO ORABIMANYE
- ☐ BUZA KUBARABEBINE EBIBUZO BYONA OTAKATANDICHIRE

Interviewer: Remember this!
☐ Explain the answers are confidential
☐ Ask the respondent if they have any questions before you begin.

1. ORIKUBUUZIBWA YAIKIRIZA:
   - ☐ YAIKIRIZA KUBUUZIBWA
   - ☐ TIYAIKIRIZA KUBUUZIBWA

Informed consent:
☐ Respondent agrees to be interviewed
☐ Respondent does not agree to be interviewed

2. EIHANGA:
   - ☐ Canada
   - ☐ Peru
   - ☐ Uganda

Country:
☐ Canada
☐ Peru
☐ Uganda

3. EKICWEKA (EKYARO/OMWANYA OGU):_____

Location (i.e. settlement):

4. EBIRO BY'OKWEEZI:_____ (dd; mm; yr)

Today's Date:
(dd; mm; yr)

5. IZIINA RY'OGWO ORI KUBUUZA EBIBUUZO EBI: _____

Interviewer name:

6. OBUHANGWA BW'OMUNTU:
   - ☐ MUSHAIJA
   - ☐ MUKAZI

Sex:
☐ Male
☐ Female

7. OINE EMYAKA ENGAHI? _____

What is your age? _____

YAABA ATARIKUMANYA MYAKA YE, GYERANISIZA AHA RURENGO ORU

- ☐ AHANNSI Y'OMWAKA GUMWE
- ☐ OMWAKA GUMWE KUHIKA AHA MYAKA ETAANO
- ☐ EMYAKA MUKAAGA KUHIKA AHA MYAKA IKUMI N'EBIRI
- ☐ EMYAKA IKUMI N'ESHATU KUHIKA AHA MYAKA ABIRI N'ESHATU
- ☐ EMYAKA ABIRI N'ENA KUHIKA AHA MYAKA ASHATU N'ETAANO
- ☐ EMYAKA ASHATU NA MUKAAGA KUHIKA AHA MYAKA ANA NA MUSHANJU
- ☐ EMYAKA ANA NA MUNAANA KUHIKA AHA MYAKA ATAANO NA MWENDA
- ☐ EMYAKA NKAAGA, NINGA AHAIGURU
- ☐ INGAAHA

If unknown, estimate age range:
☐ *< 1 year*
☐ *1-5 years*
☐ *6-12 years*
☐ *13-23 years*
☐ *24-35 years*
☐ *36-47 years*
☐ *48-59 years*
☐ *≥60 years*
☐ *No response*

8. EKIGAANIIRO KYATANDIIKA SHAAHA: _____

Time started: _____

9. EIZIINA RY'ORIKUBUUZIBWA*:* _____

Participant name:_____

10. AKAMANYISO K'OMUNTU ORIKUBUUZIBWA:_____

Individual ID:_____

11. AKAMANYISO K'AMAKA*:*_____

Household ID: _____

12. ORI MUKURU W'EKA EGI?
    - ☐ EEGO
    - ☐ INGAAHA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Are you the household head?
- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ No response

EKICWEKA C - EBIRIKURETAHO EBIZIBU, ENDWARA N'AMAGARA MABI

PART C Risk factors

ORI KUBUUZA EBIBUUZO EBI: EBIBUUZO OMU KICWEKA EKI NOOBAASA KUGARUKAMU KURUGIRIRA AHARI EBY'O EBI ORI KUREEBA, BAITU WAABA NOOKIBAASA.

Interviewer: The following questions may be completed by the interviewer, if appropriate and possible.

13. NIMUKOZESA KI KUTEEKA EBY'OKURYA? (*RONDA KIMWE KYOKNA*).
    - ☐ PARAFIINI
    - ☐ AMAKARA
    - ☐ ENKU
    - ☐ EBINDI, SHOBORORA: _____
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

What type of fuel does your household mainly use for cooking? Select one.
- ☐ *Kerosene*
- ☐ *Charcoal*
- ☐ *Firewood/ straw*
- ☐ *Other (specify): _____*
- ☐ *Unsure*
- ☐ *No response*

14. OMUNJU, AHAANSI; HATIINDIISE KI? *RONDAHO KIMWE.*
    - ☐ EITAKA/OBUDONGO
    - ☐ AMASHA
    - ☐ AMAKOOKO G'EMITI
    - ☐ SIMINTI
    - ☐ EKIRAGO/KAPETI
    - ☐ EBINDI, SHOBORORA: _____
    - ☐ TARIKUHAMYA KURUNGI
    - ☐ YAAHUNAMA

What is the main material of the floor? Select one.
- ☐ *Natural earth/ sand*
- ☐ *Dung*
- ☐ *Cement*
- ☐ *Carpet*
- ☐ *Other (specify): _____*
- ☐ *Unsure*
- ☐ *No response*

15. AMADIRISA OMUNJU? TOORANA BYOONA EBIRI KUKWATWAHO.
    - ☐ TIGAITSIRWE
    - ☐ GAITISE EMICINGO
    - ☐ TIHARIMU MADIRISA
    - ☐ EBINDI, SHOBORORA: _____
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Are windows in your house? Select all that apply.
- ☐ *Uncovered*
- ☐ *Covered with screens*
- ☐ *There are no windows in my house*
- ☐ *Other (specify): _____*
- ☐ *Unsure*
- ☐ *No response*

16. OINE AMAIZI G'OKUNAABA OMU NGARO HAIHI N'ENJU?
    - ☐ EEGO
    - ☐ INGAAHA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Are there hand washing facilities near the house?
- ☐ *Yes*
- ☐ *No*
- ☐ *Unsure*
- ☐ *No response*

17. *KU ARARE YAAGIRA NGU EEGO OMU KIBUUZO 17,* HARIHO ESAABUNI AHA MWANYA OGUKOZIRWE KUNAABIRWAMU ENGARO?
    - ☐ EEGO
    - ☐ INGAAHA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

If yes to question 17, Is there soap at the washing facility near the house?
- ☐ *Yes*
- ☐ *No*
- ☐ *Unsure*
- ☐ *No response*

ORIKUBUUZA EBIBUUZO: BUUZA KANDI OTUNGYE EBIGARUKWAMU	Please ask the participants the following questions.

18. OMU NJU NIMUTUURAMU ABANTU BANGAHI MWENA HAMWE, OGAITSIRE NA BAANA BOONA?
    - ☐ OMUHENDO GW'ABANTU MWEENA OMU NJU EGI: _____ ABANTU MWEENA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

How many people, including yourself, live with you in your household now, including children?
- ☐ Specify: _____people
- ☐ Unsure
- ☐ No response

19. ENJU ERIMU EBISHENGYE BINGAHI?
    - ☐ OMUHENDO GW'EBISHENGYE: _____
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

How many rooms are there in your house?
- ☐ Specify: _____rooms
- ☐ Unsure
- ☐ No response

20. NI EBISHENGYE BINGAHI AHARI EBYO EBIRIKURAARWAMU ABANTU?
    - ☐ OMUHENDO: _____ EBISHENGYE BYOONA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

How many of these rooms are used for sleeping?
- ☐ Specify: _____rooms
- ☐ Unsure
- ☐ No response

21. OINE BIMWE AHA BINTU EBI NK'EBYAWE AHA BWAWE? *RONDAHO BYOONA EBIRIKUBASIKA.*
    - ☐ ESIMU Y'OMUNGARO
    - ☐ REEDIYO
    - ☐ AMASHANYARAZI
    - ☐ TINYINE KINTU NA KIMWE AHARI EBYO EBYASHOMWA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Does your household own? *Select all that apply.*
- ☐ Mobile/cellular telephone
- ☐ Radio
- ☐ Electricity
- ☐ None of the above
- ☐ Unsure
- ☐ No response

22. HARIHO OMUNTU N'OBUYAKUBA OMUNTU OMWE OMUKA EGI OINE EBINTU EBI NK'EBYE AHABWE? *RONDAHO BYOONA EBIRIKUBASIKA.*
    - ☐ EGAARI
    - ☐ PIKIPIKI
    - ☐ EMOTOKA
    - ☐ ENDIIJO NTAMBURA, SHOBORORA: _____
    - ☐ TIHARIHO OINE KIMWE AHIRI EBYO EBYASHOMWA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Does any member of your household own? *Select all that apply.*
- ☐ A bicycle
- ☐ A motorcycle or motor scooter
- ☐ A car or truck
- ☐ Other vehicle/mode of transportation (specify): _
- ☐ None of the above
- ☐ Unsure
- ☐ No response

23. OINE AMATUUNGO GOONA, ENYAMAISHWA? YAAGIRA NGU INGAAHA, GYENDA AHA KIBUUZO 26.
    - ☐ EEGO
    - ☐ INGAAHA *[GYENDA AHA KIBUUZO 26]*
    - ☐ TARIKUKIHAMYA KURUNGI *[GYENDA AHA KIBUUZO 26]*
    - ☐ YAAHUNAMA *[GYENDA AHA KIBUUZO 26]*

Does your household currently own any animals? *If no, skip to question 26.*
- ☐ Yes
- ☐ No *[Skip to Q26]*
- ☐ Unsure *[Skip to Q26]*
- ☐ No response *[Skip to Q26]*

24. *YAAGIRA NGU EEGO OMU KIBUUZO 24:* OMUHENDO GW'AMATUNGO GAAWE:
    - ☐ OMUHENDO GW'ENKOKO N'EBINDI BINYONYI _____
    - ☐ OMUHENDO GW'EMPUNU _____
    - ☐ OMUHENDO GW'EMBUZI _____
    - ☐ OMUHENDO GW'ENTE _____
    - ☐ OMUHENDO GW'EMBWA _____
    - ☐ EBINDI, SHOBORORA/ OYOREKYE OMUHENDO: _____
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

If yes to question 24: Please list the number of animals you currently own:
- ☐ Number of Chickens or other birds _____
- ☐ Number of Pigs ____
- ☐ Number of Goats or sheep
- ☐ Number of Cattle ____
- ☐ Number of Dogs ___
- ☐ Other (specify type and number): _____
- ☐ Unsure
- ☐ No response

25. EKA YAAWE EINE ABANYARUGANDA, ABANYWANI, AB'EMIKAGO ABIRI KUKORERA OMU BICWEKA EBINDI NINGA OMU NSI YA HEERU ABARI KUBATWEKYERA ESENTE NINGA EBINTU BUTOOSHA?
    - ☐ EEGO
    - ☐ INGAAHA
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

Does your household have family members or friends working in another town or country who regularly send money or products home to you?
- ☐ *Yes*
- ☐ *No*
- ☐ *Unsure*
- ☐ *No response*

26. OMUNDA Y'ENJU EGI HABEIRE HAFUHIRIRWEMU N'OMUBAZI GW'ENSIRI OMU MYEEZI NKA IKUMI N'EBIRI EHWEIRE? *YAAGIRA NGU INGAAHA, GYENDA AHA KIBUUZO 29.*
    - ☐ EEGO
    - ☐ INGAAHA [*GYENDA AHA KIBUUZO 29]*
    - ☐ TARIKUKIHAMYA KURUNGI *[GYENDA AHA KIBUUZO 29]*
    - ☐ YAAHUNAMA *[GYENDA AHA KIBUUZO 29]*

At any time in the past 12 months, has anyone sprayed the interior walls of your dwelling against mosquitoes? *If no, skip to question 29.*
- ☐ Yes
- ☐ No *[Skip to Q29]*
- ☐ Unsure *[Skip to Q29]*
- ☐ No response *[Skip to Q29]*

27. *YAAGIRA NGU EEGO OMU KIBUUZO 27*, ENJU EFUHIRIRWE, HATI HARABIREHO EMYEEZI ENGAHI?
    - ☐ EMYEEZI ERABIREHO BWANYIMA YAFUHIRIRWA: _____ EMYEEZI
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

If yes to question 27, how many months ago was the house sprayed?
- ☐ Specify: _____months
- ☐ Unsure
- ☐ No response

28. OMU KA EGI, OINEMU OBUTIIMBA BW'ENSIRI OBURI KUBAASA KURARWAMU ABAUNTU? *YAAGIRA NGU INGAAHA, GYENDA AHA KIBUUZO 32.*
    - ☐ EEGO
    - ☐ INGAAHA *[GYENDA AHA KIBUUZO 32]*
    - ☐ TARIKUKIHAMYA KURUNGI *[GYENDA AHA KIBUUZO 32]*
    - ☐ YAAHUNAMA *[GYENDA AHA KIBUUZO 32]*

Does your household have any mosquito nets that can be used while sleeping? *If no, skip to question 32.*
- ☐ Yes
- ☐ No *[Skip to Q32]*
- ☐ Unsure *[Skip to Q32]*
- ☐ No response *[Skip to Q32]*

29. *YAAGIRA NGU EEGO OMU KIBUUZO 29:* OINEIBUTIIMBA BW'ENSIRI BUNGAHI BWONA HAMWE KANDI OMAZIRE NABWO BWIRECHI? ORIKUBUUZA EBIBUUZO: KYEBERA KANDI AHAMYE EKYO, N'OMUHENDO GWABWE.
    - ☐ OMUHENDO GW'OBUTIIMBA BW'ENSIRI: _____ OBUTIMA BW'ENSIRI
    - ☐ OMAZIRE NABWO BWIRECHI? _____
    - ☐ TARIKUKIHAMYA KURUNGI
    - ☐ YAAHUNAMA

If yes to question 29: How many mosquito nets does your household have and how long have you had them?
Interviewer: Please observe the number of mosquito nets to confirm number.
- ☐ Specify: ___ mosquito nets
- ☐ How long have you had them? _____(years)
- ☐ Unsure
- ☐ No response

30. *YAAGIRA NGU EEGO OMU KIBUUZO 29: NISHABA KWONGYERA KWETEGYEREZA BIKYE EBIRIKUKWATA AHA BUTIIMBA BW'ENSIRI.* KYEBERA BYONA EBIRI KUKWATWAHO.

If yes to question 29: We would like to know more about each of your mosquito nets. *Select all that apply.*

	OBU WAATUNGA, NINGA OBU WAAGURA AKATIIMBA AKA, KAKABA KARIMU OMUBAZI GW'AKO? *When you got the net, was it already factory treated with an insecticide to kill or repel mosquitoes?*				AKATIIMBA KATEIRWEMU OMUBAZI GWAKO BWANYIMA? *Has the mosquito net been soaked or dipped in a liquid to repel mosquitoes or bugs in the past 12 months?*				AKATIIMBA KAKOZESEIBWE OMU KIRO? *Was the net hanging last night?*			
	EEGO *Yes*	INGAAHA *No*	TARIKUHAMYA *Unsure*	YAAHUNAMA *No response*	EEGO *Yes*	INGAAHA *No*	TARIKUHAMYA *Unsure*	YAAHUNAMA *No response*	EEGO *Yes*	INGAAHA *No*	TARIKUHAMYA *Unsure*	YAAHUNAMA *No response*
AKATIIMBA 1 Net 1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
AKATIIMBA 2 Net 2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
AKATIIMBA 3 Net 3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
AKATIIMBA 4 Net 4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
AKATIIMBA 5 Net 5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

31. AMAIZI G'OKUNYWA AHA BW'ABANTU OMU KA EGI NIMUKIRA KUGAIHA/KUGATAHA NKAHI? *ORI KUBUUZA EBIBUUZO: OTASHOMA EBIGARUKWAMU EBI. KURUGIRIRA AHARI EBYO EBI YAAGAMBA, TOORANA ENSHONGA EISHATU OMU BUKURU BWAZO HAZA OZIHANDIIKYE; OTI: HANDIIKA "1" OMWANY A OMUKURU OGURI KWIHWAMU AMAIZI G'OKUNYWA, "2" OMWANYA OGURI KUGARUKA AHA GW'OKUBANZA, "3" OMWANYA GW'AKASHATU GUBE OGWO OGURI KUKOZESEBWA EMYANYA ENKURU YAABA ETARIHO. KOZESA EBY'OKUREEBERAHO BYABA NIBYETAAGISA.*

_____ TAAPU AHEERU Y'ENJU
_____ PAIPU/TAAPU YA BOONA
_____ NAYIKONDO
_____ EIZIBA ERIREEBERIRWE
_____ EIZIBA ERITAREEBERIRWE
_____ OMUDUMO/OMURINDI OGUREEBERIRWE
_____ OMUDUMO/OMURINDI OGUTAREEBERIRWE
_____ KUTANGISIRIZA AMAIZI G'ENJURA
_____ OMUGYERA/ENYANJA/OMURINDI
_____ AMAIZI G'OMU CUPA
_____ EBINDI, SHOBORORA: _____

☐ TARIKUKIHAMYA KURUNGI *[GYENDA AHA KIBUUZO 35]*
☐ YAAHUNAMA *[GYENDA AHA KIBUUZO 35]*

What are the main sources of drinking water for members of your household?
*Interviewer: **Do not** read out options. Based on participant answers, select up to three sources, using numbers to rank importance.*
Private standpipe or outdoor tap, Public standpipe or tap, Tube well or borehole, Dug well (protected), Dug well (unprotected), Water from protected spring, Water from unprotected spring, Rainwater harvesting or cistern, Surface water (river, lake, stream)
Bottled water,
Other (specify): ____
☐ Unsure *[Skip to Q35]*
☐ No response

32. OMUTIINDO GW'AMAIZI GAANYU AG'OKUNYWA NOOGUREEBA OTA?
- ☐ OMUTIINDO GURI AHANSI MUNONGA
- ☐ MUBI
- ☐ HAKIRI
- ☐ NI MURUNGI
- ☐ NI MURUNGI MUNONGA
- ☐ TARIKUKIHAMYA KURUNGI
- ☐ YAAHUNAMA

How would you rate the overall quality of your drinking water?
- ☐ Very poor
- ☐ Poor
- ☐ Fair
- ☐ Good
- ☐ Very good
- ☐ Unsure
- ☐ No response

33. NOOSHEMEZA OTA AMAIZI G'OKUNYWA? *TOORANA BYONA EBIRI KUKWATWAHO.*
- ☐ TINDI KUSHEMEZA MAIZI NA KAKYE
- ☐ NINGATEEKA
- ☐ NINGAGYEGYENA
- ☐ AMAANI G'EIZOOBA N'OMUSHANA
- ☐ NINKOZESA OMUBAZI NKA "WATER GUARD"
- ☐ NINGURA AMAIZI AG'OMU CUPA
- ☐ EBINDI, SHOBORORA: _____
- ☐ TARIKUKIHAMYA KURUNGI
- ☐ YAAHUNAMA

Do you treat your drinking water? *Select all that apply.*
- ☐ Do not treat the water
- ☐ Boiling
- ☐ Filtering
- ☐ Ultraviolet irradiation (i.e. sunlight)
- ☐ Chemical treatments (e.g. "Water Guard" Tablets)
- ☐ Purchase purified water
- ☐ Other (specify): ____
- ☐ Unsure
- ☐ No response

34. EKA YAAWE EINE KIGO KI?
ORI KUBUUZA EBIBUUZO: OTASHOMA EBIGARUKWAMU EBI. KYABA NIKYETENGESA, YONGYERA OBUUZE OTI: HARIHO EMYANYA ENDIIJO? KOZESA EBY'OKUREEBERAHO.
- ☐ EKIHORONI, KYOMBOKIRWE
- ☐ EKIHORONI, KITOMBEKIRWE
- ☐ EKISHAKA
- ☐ EBINDI, SHOBORORA: _____
- ☐ TARIKUKIHAMYA
- ☐ YAAHUNAMA

What kind of toilet facilities does your household use?
- ☐ Pit latrine (covered)
- ☐ Pit latrine (uncovered)
- ☐ No facilities/ bush/ field
- ☐ Other (specify): ____
- ☐ Unsure
- ☐ No response

35. EKIHORONI/EKIGO N'EKYAWE N'EKA YAAWE MWENKA NINGA NIMUKIKOZESA NA BANDI BANTU?
- ☐ EKA YANGYE TWENKA
- ☐ NITUKIKOZESA N'AMAKA MAKYE AGANDI
- ☐ EKYARO KYOONA
- ☐ TARIKUKIHAMYA
- ☐ YAAHUNAMA

Are the toilet facilities you use private, semi-private, or communal?
- ☐ Private
- ☐ Semi-private (shared with a few other households only)
- ☐ Communal
- ☐ Unsure
- ☐ No response

36. AB'OMUKA YAAWE BABEIREHO HAIHI MUNONGA N'ENYAMAISHWA OMU SAANDE NK'IBIRI EZIHINGWIREHO? KWONGYERE KUKYENGYESA ORI KUBUUZIBWA*: OHIKIREHO HAIHI MUNONGA N'ENYAMAISHWA NK'EMBWA N'EZINDI NYAMAISHWA OMU BWIRE OBWO? EMBYZI, ENTE, ENTARMA, ENKOKO, EMPUMU, YAAGIRA NGU INGAAHA, GYENDA AHA KIBUUZO 41.*
- ☐ EEGO
- ☐ INGAAHA *[GYENDA AHA KIBUUZO 41]*
- ☐ TARIKUKIHAMYA KURUNGI *[GYENDA AHA KIBUUZO 41]*
- ☐ YAAHUNAMA *[GYENDA AHA KIBUUZO 41]*

Have the members of your household been exposed to animals within the last 2 weeks? *Possible clarification: Have you had physical contact or been within one metre of an animal within the last 2 weeks?*
- ☐ Yes
- ☐ No *[Skip to Q41]*
- ☐ Unsure *[Skip to Q41]*
- ☐ No response *[Skip to Q41]*

37. *YAAGIRA NGU EEGO OMU KIBUUZO 37:* TOORANA ZOONA EZIRIKUKWATWAHO. *RONDAHO BYOONA EBIRIKUBASIKA.*
- ☐ EMPUNU Z'OMUKA
- ☐ ENTE
- ☐ EMBWA
- ☐ ENYONYI Z'OMUKA (i.e. NK'ENKOKO)
- ☐ EMBUZI/ENTAAMA
- ☐ ENYAMAISHWA EZINDI (SHOBORORA): _____
- ☐ ENKIMA/ENKYENDE
- ☐ EMBEBA
- ☐ ENYAMAISHWA EZINDI EZ'OMUKISHAKA: _____
- ☐ TARIKUKIHAMYA
- ☐ YAAHAUNAMA

If yes to question 37: What animals was your household exposed to? *Select all that apply.*
- ☐ Domestic pigs
- ☐ Domestic cattle
- ☐ Dogs (domestic or feral)
- ☐ Domestic birds (i.e. chickens)
- ☐ Goats or sheep
- ☐ Other domestic animal (specify): _____
- ☐ Monkeys
- ☐ Rodents
- ☐ Other wildlife (specify): _____
- ☐ Unsure
- ☐ No response

38. *YAAGIRA NGU EEGO OMU KIBUUZO 37: HARIHO OBU ENYAMAISHWA ZAAWE ZIRIKUTAAHA OMU NJU?*
- ☐ EEGO
- ☐ INGAAHA
- ☐ TARIKUKIHAMYA
- ☐ YAAHUNAMA

If yes to question 37: Do your animals ever come inside your house?
- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ No response

39. *YAAGIRA NGU EEGO OMU KIBUUZO 37:* ENYAMAISHWA ZEINE ENJU YAAZO HANGAHARI/ ZONKA?
- ☐ EEGO
- ☐ INGAAHA
- ☐ TARIKUKIHAMYA
- ☐ YAAHUNAMA

If yes to question 37: Do you have a separate shelter for your animals?
- ☐ Yes
- ☐ No
- ☐ Unsure
- ☐ No response

40. NITWENDA KUMANYA AB'OMUKA YAAWE BAABA NIBEEJUMBA OMU MIRIMO ERI KURUGA AHA MIRUNDI ESHATU OMU SAANDE N'OKUKIRAHO? *TOORANA BYONA EBIRI KUKWATWAHO.*

We are interested in whether any members of your household participate in the following activities 3 or more times a week, and for what purpose? *Select all that apply.*

	TIBARI KWEJUMBAMU	KURONDA EBY'OKURYA	KURONDA EKY'OKUTUNDAMU SENTE	KURONDA EKY'OKUHANISAMU EBINTU EBI NTAINE KURUGA OMU BANDI	KURONDAMU EMIBAZI Y'OKURAGURA	EBINDI, SHOBOROR A	TARIKUKI HAMYA	YAAHUN AMA
	Do not participate in this activity	*To provide food for my family*	*To sell for income*	*To give as gifts or non-monetary trading with family or friends*	*For spiritual or medicinal purposes*	*Other (specify):*	*Unsure*	*No respons e*
KUSHOHA EBY'ENYANJA Fishing	☐	☐	☐	☐	☐		☐	☐
KUHINGA Agriculture - tilling land/ agrolabour	☐	☐	☐	☐	☐		☐	☐
KURIISA Agriculture - tending animals	☐	☐	☐	☐	☐		☐	☐
KUKORA OMU MISIRI Agriculture - tending crops	☐	☐	☐	☐	☐		☐	☐
KUHIGA Hunting	☐	☐	☐	☐	☐		☐	☐
KUCWA EMIBAZI Collection of medicinal plants	☐	☐	☐	☐	☐		☐	☐

EKYI NIKYO KIBUUZO KYAHA MUHERU ***That was my last question***

41. OINE EKINDI KIBUUZO EKI ORIKWENDA KUMBUUZA NINGA EKINDI KINTU EKI ORI KWENDA KUNSHOBORE RAHO? *ORI KUBUUZA EBIBUUZO? HANDIIKA EBYO BYONKA EBI EBIRI KUKWATA AHA NSHONGA EZI.*

Do you have any other questions or comments? *Interviewer: type any additional comments the respondent has said that are relevant*

SHOBORORA:

Comments:

_____

_____

_____

YEBARE MUNONGA. EBIGARUKWAMU EBI WAAHAYO NIBAIJA KUTEERANWA N'EBYA BANDI BANTU ABAABUZIBWA OMU KUCOONDOOZA OKU. BWANYIMA HARUGYEMU AMAKURU AHA MAGARA GA BANTU OMU KICWEKA EKI. EBYO EBIRAYEGWE AHA MAGARA GA BANTU, NIBIIJA KUGUMA BIRI EBYEKIHAMA KANDI TIHARIHO EIZIINA RY'OMUNTU N'OMWE ERIRAMANYWE ABANDI BANTU NINGA GAVUMENTI. YEBARA MUNONGA KUKWATANISA NAITWE.

With all other participants to give us information about the health of people throughout the community. The information you provided is strictly confidential and no names will be released to the community or government. Thank you again for your time and cooperation.

Appendix II – Household Food Security Questionnaire

IHACC

EBIBUUZO EBIRIKUKWATA AHA NTEBEKANISA/ENTEEKA Y'EBY'OKURYA OMU MAKA | HOUSEHOLD FOOD PREPARATION HEAD QUESTIONNAIRE

EBIBUUZO EBI N'EBYO'GWO OMUNTU AINE OMWOOGA GW'OKUTEEKA N'OKUTEBEKANISA EBY'OKURYA OMU MAKA	**THESE QUESTIONS ARE FOR THE PERSON GENERALLY IN CHARGE OF FOOD PREPARATION**

EKICWEKA A: EBIRI KUKWATA AHA KYARO/OMUNTO OGWO ORIKUBUUZIBWA	**EBIBUUZO IKUMI NA BISHATU**	**PART A:** Demographics	**12 questions**
EKICWEKA D: ENTEEKATEEKA Y'EBY'OKURYA OMU MAKA	**EBIBUUZO IKUMI NA MWENDA**	**PART E:** Food security	**17 questions**
EBIBUUZO EBIRI KUHENDERA EKIGAANIIRO	**EBIBUUZO BIBIRI EBY'OKUHENDERA EKIGAANIRO**	**Completion Questions**	**2 questions**
EBIBUUZO BYOONA HAMWE/ OMUHENDO	**EBIBUUZO ASHATU NA BINA**	**Total:**	**31 questions**

EKICWEKA A - EBIRIKUKWATA AHA KYARO/EIHANGA/OMUNTU OGWO ORIKUBUUZIBWA

PART A – Demographics

ORIKUBUZA: EIJUKA EBI!

- ☐ SHOBORORA NGU EBIMULA-BAMBEHO NEBYANYU, TIHARITTO'NDIJJO ORABIMANYE
- ☐ BUZA KUBARABEBINE EBIBUZO BYONA OTAKATANDICHIRE

Interviewer: Remember this!

- ☐ Explain the answers are confidential
- ☐ Ask the respondent if they have any questions before you begin.

42. ORIKUBUUZIBWA YAIKIRIZA?
    - ☐ YAIKIRIZA KUBUUZIBWA
    - ☐ TIYAIKIRIZA KUBUUZIBWA

Informed consent:

- ☐ Respondent agrees to be interviewed
- ☐ Respondent does not agree to be interviewed

43. EIHANGA (KUBUUZIBWA AHA KUHANDIIKWA HONKA):
    - ☐ Canada
    - ☐ Peru
    - ☐ Uganda

Country

- ☐ Canada
- ☐ Peru
- ☐ Uganda

44. EKICWEKA (EKYARO/OMWANYA OGU): _____

Location (i.e. settlement): _____

45. EBIRO BY'OKWEEZI: _____ (dd; mm; yr)

Today's Date: ____ (dd; mm; yr)

46. IZIINA RY'OGWO ORI KUBUUZA EBIBUUZO EBI: _____

Interviewer name: _____

47. OBUHANGWA BW'OMUNTU *(KUBUUZIBWA AHA KUHANDIIKWA HONKA)*:
    - ☐ MUSHAIJA
    - ☐ MUKAZI

Sex:

- ☐ Male
- ☐ Female

48. OINE EMYAKA ENGAHI? _____
    YAABA ATARIKUMANYA MYAKA YE, GYERANISIZA AHA RURENGO ORU
    - ☐ AHANNSI Y'OMWAKA GUMWE
    - ☐ OMWAKA GUMWE KUHIKA AHA MYAKA ETAANO
    - ☐ EMYAKA MUKAAGA KUHIKA AHA MYAKA IKUMI N'EBIRI
    - ☐ EMYAKA IKUMI N'ESHATU KUHIKA AHA MYAKA ABIRI N'ESHATU
    - ☐ EMYAKA ABIRI N'ENA KUHIKA AHA MYAKA ASHATU N'ETAANO
    - ☐ EMYAKA ASHATU NA MUKAAGA KUHIKA AHA MYAKA ANA NA MUSHANJU
    - ☐ EMYAKA ANA NA MUNAANA KUHIKA AHA MYAKA ATAANO NA MWENDA
    - ☐ EMYAKA NKAAGA, NINGA AHAIGURU
    - ☐ INGAAHA

What is your age: _____

If unknown, estimate age range:

- ☐ *< 1 year*
- ☐ *1-5 years*
- ☐ *6-12 years*
- ☐ *13-23 years*
- ☐ *24-35 years*
- ☐ *36-47 years*
- ☐ *48-59 years*
- ☐ *≥60 years*
- ☐ *No response*

49. EKIGAANIIRO KYATANDIIKA SHAAHA: _____

Time started: _____

50. EIZIINA RY'ORIKUBUUZIBWA *:* _____

Participant name:_____

51. AKAMANYISO K’OMUNTU ORIKUBUUZIBWA*:* _____
52. AKAMANYISO K’AMAKA*:*_____

Individual ID*:*_____
Household ID: _____

EKICWEKA D - ENTEEKATEEKA Y'EBY'OKURYA OMU MAKA

PART D – Food Security

53. OINE EMYAKA IKUMI NA MUNAANA N'OKWEYONGERAYO AHAIGURU?
    - ☐ EEGO *[GUMIZAMAU]*
    - ☐ INGAAHA *[*HEZA,/HENDERA EKIGAANIIRO*]*

Are you 18 years old or older?
- ☐ Yes [Continue]
- ☐ No [End of the Food Security Food Questionnaire]

OMU KICWEKA EKIRIKUGARUKAHO, NOOSHABWA KUGARUKAMU EBIBUUZO BIKYE EBIRIKUKWATA AHA BUREMEEZI BW'OKWEHISYAHO EBY'OKURYA BIRIKUMARA OMUKA. BIMWE AHA BIBUUZO EBI TIBYOROBI KANDI NOOBAASA KUGUMIRWA OMU KUBIGARUKAMU. KWONKA EBIBUUZO EBI NI BIKURU OMU KWETEGYEREZA EBIZIBU BY'AMAKA OMU KICWEKA EKI N'OMUKUTAHO OBURYO BW'OKUYAMBA EKICWEKA KUTUNGUURA OBWINGI N'ENTEEKATEEKA Y'EBY'OKURYA. BYONA EBI ORATEISE, EBITEEKATEEKO BYAWE AHA NSHONGA EZI NINBYIJA KUKUMWA NKEKIHAMA. TIHARIHO EIZIINA RY'OMUNTU WEENA OBUUZIBWE ERIRIKWIJA KUMANYWA ABEEBEMBEZI NINGA GAVUMENTI. OINE ORUSA KWIKIRIZA KUGARUKAMU NINGA KWANGA KUGARUKAMU EKIBUUZO EKYAKUHA OBUREMEEZI BWINGI.

The next section asks questions about being able to afford food for your household. Some of the questions are very personal and may be difficult for you to answer. However, this information will help researchers, as well as community and health leaders to have a better understanding of problems facing families in this community and to design better programs to improve food security. Like the rest of the questionnaire, this information is strictly confidential and no names will be released to the community or government. You are free to refuse to answer any question.

EKICWEKA 1

AHABIBUZO EBI (15-17), NGAMBIRA KUKIRABE KIRIKUCHIRA KUBAHO, KUBAHO RINIWE NARIME NINGA KITAKABAGAHO OMUKA YAWE OMUMYEZI ESHATU EHINGWIRE.

EBIBUZO EBI NEBYO'MUNTU ORIKUTEBEKANISA EBYOKURYA.

SECTION 1

FOR EACH OF THESE QUESTIONS, PLEASE TELL ME HOW MANY DAYS THE FOLLOWING IS TRUE FOR YOUR HOUSEHOLD IN THE LAST THREE MONTHS.
THESE QUESTIONS ARE FOR THE PERSON GENERALLY IN CHARGE OF FOOD PREPARATION

54. OMU MYEZI ESHATU EHWEIRE, OBAIRE WAATUNGIREHO OKWERARIKIRIRA NGU EBY'OKURYA AHABW'AWE NA BANTU B'OMUKA YAAWE BYAZA KUHWAHO OTAKATUNGIRE AHO KWIHA EBINDI?
    - ☐ NIKIRA KUBAHO
    - ☐ RIMWE NA RIMWE
    - ☐ INGAAHA
    - ☐ TINDIKUMANYA
    - ☐ YAAHUNAMA

In the last 3 months, did you ever worry whether the food for you and your family would run out before you could get more?
- ☐ Often
- ☐ Sometimes
- ☐ Never
- ☐ Don't know
- ☐ No response

55. OMU MYEZI ESHATU EHWEIRE, KIKABAHO NGU EBY'OKURYA EBI WAABIRE OINE/OGUZIRE TIBIRABAMARIRE BWIRE OBU WAABIRE NOOTEEKETEEKA HAZA WAYESHANGA OTARIKUBAASA KUTUNGA/KUGURA EBINDI?
    - ☐ NIKIRA KUBAHO
    - ☐ RIMWE NA RIMWE
    - ☐ INGAAHA

In the last 3 months, did it happen that the food you Bought/obtained didn't last enough time and you couldn't buy/obtain more?
- ☐ Often
- ☐ Sometimes
- ☐ Never

☐ TINDIKUMANYA
☐ YAAHUNAMA

☐ Don't know
☐ No response

56. OMU MYEZI ESHATU EHWEIRE OBIRE NOKIRA KURYA EBYOKURYA BY'EMIRENGO MINGI?
☐ NIKIRA KUBAHO
☐ RIMWE NA RIMWE
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

In the last 3 months, did you not have enough varied meals to eat?
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ No response

57. EKA YAAWE: MURAIRE KI NYOMWABAZYO? IJUKA KUBUUZA "HARIHO EKINDI EKI MURAIRE; OMU MIRINGO Y'EBY'OKURYA NK'ENYAMA, AMATE, EBIJUMA, EMBOGA. HANDIIKA EMIRINGO Y'EBY'OKURYA EYAYOREKWA

_____ _____ _____
_____ _____ _____
_____ _____ _____

What did your family eat yesterday?
Interviewer Prompt: prompt the participant by asking "And what else did your family eat yesterday?" Also prompt on food groups such as meat, dairy, fruit, and vegetables.

58. EBI NIBYO BY'OKURYA EBI MURIKURYA BUTOOSHA?
☐ EEGO
☐ INGAAHA (YOREKA ENSHONGA AHANKI OBUNDI EBY'OKURYA NIBIHINDUKA): _____
☐ TINDIKUMANYA
☐ YAAHUNAMA

Is this what your family typically eats in a day?
☐ Yes
☐ No (specify the reason why):
☐ Don't know
☐ No response

59. OMU MYEZI ESHATU EHWEIRE, IWE NINGA ABANTU ABAKURU OMUKA MUBAIRE MWAHARIRIZIBWE KUKYENDEEZA AHA BUHANGO BW'EKIHURO AHA SOHAANI NINGA KUGURUKAMU EBIHURO AHABW'OKUGIRA NGU EBY'OKURYA BIKABA BITARIKUMARA?
☐ EEGO (AMAZOOBA AGU EKYO KIBAIREHO): _____
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

In the last 3 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough food at home?
☐ Yes (specify number of days this happened): _____
☐ No
☐ Don't know
☐ No response

60. OMU MYEZI ESHATU EHWEIRE, IWE NINGA ABANTU ABAKURU OMUKA MUBAIRE NIMURYAHO KAKYE KURUGA AHA KUMURYA BURIIJO AHABW'OKUGIRA NGU EBY'OKURYA TIBIRI KUMARA?
☐ EEGO
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

In the last 3 months, did you or other adults in your household ever eat less than you felt you should because there wasn't enough food at home?
☐ Yes
☐ No
☐ Don't know
☐ No response

61. OMU MYEZI ESHATU EHWEIRE, IWE NINGA ABANTU ABANDI ABAKURU OMU KA EGI MUKASIBAKWE/MUKARARAKWE MUKEESIIBYAKWO AHABW'OKUBA HAKABA HATARIHO BY'OKURYA BIRI KUMARA OMUKA?
☐ EEGO
☐ INGAAHA

In the last 3 months, were you or other adults in your household ever hungry but didn't eat because there wasn't enough food at home?
☐ Yes
☐ No

☐ TINDIKUMANYA
☐ YAAHUNAMA

☐ Don't know
☐ No response

62. OMU MYEZI ESHATU EHWEIRE, IWE NINGA ABANTU ABANDI ABAKURU OMU KA EGI MUHURURUKIRE AHABW'OBUTAGIRA SENTE ZIRIKUMARA KUGURA EBY'OKURYA?
    ☐ EEGO
    ☐ INGAAHA
    ☐ TINDIKUMANYA
    ☐ YAAHUNAMA

In the last 3 months, did you or other adults in your household lose weight because you didn't have enough money for food?
☐ Yes
☐ No
☐ Don't know
☐ No response

63. OMU MYEZI ESHATU EHWEIRE, IWE NINGA OMUNTU ONDIIJO OMUKURU MUKASIBAUWE/MUKARARNAKWE AHABW'OKUGIRA NGU OMUKA HAKABA HATARIMU BY'OKURYA BIRI KUMARA?
    ☐ EEGO (AMAZOOBA AGU EKYO KIBAIREHO): _____
    ☐ INGAAHA
    ☐ TINDIKUMANYA
    ☐ YAAHUNAMA

In the last 3 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough food in the home?
☐ Yes (specify number of days this happened): _____
☐ No
☐ Don't know
☐ No response

EKICWEKA 4

EBIBUUZO EBIRI KUGARUKAHO NIBIKWATA AHA BAANA OMU KA EGI ABARI AHANSI Y'EMYAKA IKUMI NA MUNAANA Y'OBUKURU

AMAKA AGATIINE BAANA OMU MYAKA EGYO, NINGA AGIINE ABAANA BAKURU ABARI KUHINGUZA OMURI IKUMI NA MUNAANA, HEZA,/HENDERA EKIGAANIIRO

SECTION 4
THE NEXT QUESTIONS ARE ABOUT PERSONS LIVING IN THE HOUSEHOLD WHO ARE UNDER 18 YEARS OF AGE

HOUSEHOLDS WITH NO CHILDREN UNDER 18, END QUESTIONNAIRE

64. OMU MYEZI ESHATU EHWEIRE, HARIHO OBU OHARIRIZIBWE KURIISA ABAANA BAAWE EBY'OKURYA BY'OMUTIINDO GWA HANSI AHABW'OKUBA EBYO NIBYO BY'OKURYA EBI OBAIRE NOOBAASA KUBAHEREZA?
    ☐ NIKIRA KUBAHO
    ☐ RIMWE NA RIMWE
    ☐ INGAAHA
    ☐ TINDIKUMANYA
    ☐ YAAHUNAMA

In the last 3 months, were there times when you could only feed your children less expensive/ lower quality foods because food ran out at home and it was difficult to buy/obtain higher quality food?
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ No response

65. OMU MYEZI ESHATU EHWEIRE, HAINE OBU OBAIRE OTAINE BY'OKURYA BY'EMIRINGO MIINGI NAHABW'EKYO ABAANA BAAWE TIBAABAASA KURYA BY'OKURYA EBY'O?
    ☐ NIKIRA KUBAHO
    ☐ RIMWE NA RIMWE
    ☐ INGAAHA
    ☐ TINDIKUMANYA
    ☐ YAAHUNAMA

In the last 3 months, were there times when you did not have enough to feed your children with varied, balanced and healthy meals?
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ No response

66. OMU MYEZI ESHATU EHWEIRE, HARIHO AMAZOOBA OBU ABAANA BAAWE BABAIRE BATARIKUTUNGA EBY'OKURYA BIRIKUBAMARA AHABW'OKUBA NAIWE OKABA OTARIKUTUNGA BIRIKUMARA?

In the last 3 months, where there times when your children were not eating enough because you just couldn't buy/obtain enough food?

☐ NIKIRA KUBAHO
☐ RIMWE NA RIMWE
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ No response

67. OMU MYEZI ESHATU EHWEIRE OHARIRIZIIBWE KUKYENDEEZA AHA MUGABO/OBWINGI BW'EBY'OKURYA EBI OBAIRE NOOGABURIRA ABAANA BAAWE AHABW'OKUBA EBY'OKURYA BIBAIRE BITARIKUMARA?
☐ NIKIRA KUBAHO
☐ RIMWE NA RIMWE
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

In the last 3 months, did you have to reduce your children's food portions because there wasn't enough food at home?
☐ Often
☐ Sometimes
☐ Never
☐ Don't know
☐ No response

68. OMU MYEZI ESHATU EHWEIRE, ABAANA BAAWE BABAIRE BAGURUKIREHO EKIIHURO/EBY'OKURYA AHABW'OBUTABA NA BY'OKURYA OMUKA?
☐ EEGO (EMIRUNDI EI EKYO KIBAIREHO): _____
☐ INGAAHA
☐ TINDIKUMANYA
☐ YAAHUNAMA

In the last 3 months, did any of your children have to skip meals because there was not enough food at home?
☐ Yes (specify number of days this happened): _____
☐ No
☐ Don't know
☐ No response

69. OMU MYEZI ESHATU EHWEIRE, ABAANA BAAWE BABAIRE BASIBIREKWE AHABW'OBUTAGIRA BY'OKURYA OMUKA?
☐ EEGO
☐ INGAAHA
☐ TINDI KUMANYA
☐ YAAHUNAMA

In the last 3 months, did any of your children ever go hungry because there was no food at home?
☐ Yes
☐ No
☐ Don't know
☐ No response

70. OMU MYEZI ESHATU EHWEIRE, ABAANA BAAWE BABAIRE BASIBIREKWE KUMARA EIZOOBA RYONA AHABW'OBUTABAHO BY'OKURYA OMUKA?
☐ EEGO
☐ INGAAHA
☐ TINDI KUMANYA
☐ YAAHUNAMA

In the last 3 months, did any of your children not eat for a whole day because there was no food at home?
☐ Yes
☐ No
☐ Don't know
☐ No response

EKYI NIKYO KIBUUZO KYAHA MUHERU ***That was my last question***

71. OINE EKINDI KIBUUZO EKI ORIKWENDA KUMBUUZA NINGA EKINDI KINTU EKI ORI KWENDA KUNSHOBORE RAHO? *ORI KUBUUZA EBIBUUZO? HANDIIKA EBYO BYONKA EBI EBIRI KUKWATA AHA NSHONGA EZI*

Do you have any other questions or comments? *Interviewer: type any additional comments the respondent has said that are relevant*

SHOBORORA

Comments:

_____

_____

_____
_____
_____
_____

YEBARE MUNONGA. EBIGARUKWAMU EBI WAAHAYO NIBAIJA KUTEERANWA N'EBYA BANDI BANTU ABAABUZIBWA OMU KUCOONDOOZA OKU. BWANYIMA HARUGYEMU AMAKURU AHA MAGARA GA BANTU OMU KICWEKA EKI. EBYO EBIRAYEGWE AHA MAGARA GA BANTU, NIBIIJA KUGUMA BIRI EBYEKIHAMA KANDI TIHARIHO EIZIINA RY'OMUNTU N'OMWE ERIRAMANYWE ABANDI BANTU NINGA GAVUMENTI.	**With all other participants to give us information about the health of people throughout the community. The information you provided is strictly confidential and no names will be released to the community or government.**
YEBARA MUNONGA KUKWATANISA NAITWE	***Thank you again for your time and cooperation.***
72. EKIGAANIIRO KYAHWA SHHAHA: _____	Time finished: _____

Appendix III – Extended Results Table

	Number (%)	Mean	P-value	Stats Test	Relationship
Age	**129 (100)**	**40.43**	**0.1162**	**Willcoxon**	**N/A**
Food Security Status	**129 (100)**	**2.457**	**N/A**		**N/A**
High Food Security	1 (0.77)	-			
Moderate Food Security	10 (7.69)	-			
Low Food Security	47 (36.43)	-			
Very Low food Security	71 (55.03)	-			
Type of fuel used	**130 (100)**	**-**	**0.203**	**Fishers**	**N/A**
Kerosene	0 (0)	-			
Charcoal	2 (1.5)	-			
Firewood	124 (95.3)	-			
Floor Material	**128 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Natural Earth/sand	120 (93.75)	-			
Dung	4 (3.12)	-			
Cement	0 (0)	-			
Carpet	1 (0.7)	-			
Window type	**129 (100)**	**-**	**0.338**	**Chi²**	**N/A**
Uncovered	18 (13.9)	-			
Covered with Screens	59 (45.73)	-			
No windows	21 (16.27)	-			
Furniture/Wooden Frame	27 (20.93)	-			
Access to hand washing facility	**129 (100)**	**-**	**0.196**	**Chi²**	**N/A**
Yes	48 (37.2)	-			
No	77 (59.68)	-			
Own Soap	**50 (100)**	**-**	**0.153**	**Chi²**	**N/A**
Yes	32 (64)	-			
No	16 (32)	-			
Number of People	**124 (100)**	**4.79**	**0.0005**	**t-test**	**-**
Number of Rooms	**124 (100)**	**2.842**	**0.0053**	**t-test**	**-**
Number of Sleeping Rooms	**129 (100)**	**1.775**	**0.0179**	**t-test**	**-**
Owns Cell	**129(100)**	**-**	**0.694**	**Chi²**	**N/A**
Yes	17 (13.17)	-			
No	108 (83.72)	-			
Owns Radio	**130 (100)**	**-**	**0.245**	**Chi²**	**N/A**
Yes	58 (44.61)	-			
No	68 (52.30)	-			
Has electricity	**130 (100)**	**-**	**N/A**		**N/A**
Yes	0 (0)	-			
No	126 (100)	-			
Owns bicycle	**130 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	2 (1.53)	-			
No	124 (95.38)	-			
Owns motorcycle	**130 (100)**	**-**	**N/A**		**N/A**
Yes	0 (0)	-			
No	124 (100)	-			
Owns Car	**129 (100)**	**-**	**N/A**		**N/A**
Yes	0 (0)	-			
No	125 (100)	-			

Owns other transportation	**130 (100)**	**-**	**N/A**		**N/A**
Yes	0 (0)	-			
No	126 (100)	-			
Owns Animals	**130 (100)**	**-**	**0.596**	**Chi²**	**N/A**
Yes	26 (20.96)	-			
No	98 (79.03)	-			
Owns Chickens	**29 (100)**	**-**	**0.231**	**Fishers**	**N/A**
Yes	9 (31.03)	-			
No	20 (68.96)	-			
Owns Pigs	**28 (100)**	**-**	**0.006**	**Fishers**	**+**
Yes	10 (35.71)	-			
No	18 (64.28)	-			
Owns Goats	**29 (100)**	**-**	**0.035**	**Fishers**	**-**
Yes	15 (51.72)	-			
No	14 (48.27)	-			
Owns Cattle	**29 (100)**	**-**	**N/A**		**N/A**
Yes	0 (0)	-			
No	29 (100)	-			
Owns Dogs	**28 (100)**	**-**	**0.690**	**Fishers**	**N/A**
Yes	3 (10.71)	-			
No	25 (89.28)	-			
Owns other animals	**29 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	1 (3.44)	-			
No	28 (96.55)	-			
Has financial support	**130 (100)**	**-**	**0.557**	**Chi²**	**N/A**
Yes	27 (20.76)	-			
No	103 (79.23)	-			
House sprayed for mosquitos	**129 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	4 (3.10)	-			
No	125 (96.89)	-			
Owns a mosquito net	**130(100)**	**-**	**0.599**	**Chi²**	**N/A**
Yes	90 (69.23)	-			
No	40 (30.76)	-			
Number of nets owned	**90 (100)**	**2.022**	**0.3162**	**t-test**	**N/A**
Water quality	**128 (100)**	**-**	**0.662**	**Fishers**	**N/A**
Very poor	6 (4.68)	-			
Poor	52 (40.62)	-			
Fair	24 (18.75)	-			
Good	42 (32.81)	-			
Very Good	4 (3.12)	-			
Treat their water	**128 (100)**	**-**	**0.557**	**Chi²**	**N/A**
Yes	71 (55.46)	-			
No	57 (44.53)	-			
Boil their water	**127 (100)**	**-**	**0.737**	**Chi²**	**N/A**
Yes	44 (34.64)	-			
No	83 (65.35)	-			
Filter their water	**128 (100)**	**-**	**0.477**	**Chi²**	**N/A**
Yes	20 (15.62)	-			
No	108 (84.37)	-			
Type of toilet	**129 (100)**	**-**	**0.375**	**Fishers**	**N/A**

Pit Latrine (covered)	93 (72.09)	-			
Pit Latrine (uncovered)	32 (24.80)	-			
No Facilities/bush	4 (3.10)	-			
Privacy of Toilet	**123 (100)**	**-**	**0.016**	**Chi²**	**-**
Private	95 (77.23)	-			
Semi-Private	28 (22.76)	-			
Communal	0 (0)	-			
Exposed to animals	**128 (100)**	**-**	**0.771**	**Chi²**	**N/A**
Yes	20 (15.62)	-			
No	108 (84.37)	-			
Exposed to pigs	**20 (100)**	**-**	**0.005**	**Fishers**	**+**
Yes	8 (40.00)	-			
No	12 (60.00)	-			
Exposed to dogs	**19 (100)**	**-**	**0.070**	**Fishers**	**+**
Yes	4 (21.05)	-			
No	15 (78.94)	-			
Exposed to chickens	**20 (100)**	**-**	**0.628**	**Fishers**	**N/A**
Yes	6 (30.00)	-			
No	14 (70.00)	-			
Exposed to goats	**20 (100)**	**-**	**0.070**	**Fishers**	**-**
Yes	11 (55.00)	-			
No	9 (45.00)	-			
Exposed to other animals	**20 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	1 (5.00)	-			
No	19 (95.00)	-			
Exposed to monkeys	**20 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	1 (5.00)	-			
No	19 (95.00)	-			
Exposed to rodents	**20 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	3 (15.00)	-			
No	17 (85.00)	-			
Let animals in the house	**20 (100)**	**-**	**0.033**	**Fishers**	**-**
Yes	16 (80.00)	-			
No	4 (20.00)	-			
Own a shelter for animals	**21 (100)**	**-**	**0.642**	**Fishers**	**N/A**
Yes	7 (33.33)	-			
No	14 (66.66)	-			
Do not fish	**130 (100)**	**-**	**0.096**	**Chi²**	**+**
Yes	103 (79.23)	-			
No	27 (20.76)	-			
Fish for food	**130 (100)**	**-**	**0.096**	**Chi²**	**-**
Yes	27 (20.76)	-			
No	103 (79.23)	-			
Fish to sell or for income	**130 (100)**	**-**	**0.095**	**Chi²**	**-**
Yes	10 (7.69)	-			
No	120 (92.30)	-			
Fish to trade	**130 (100)**	**-**	**1.00**	**Fisher**	**-**
Yes	1 (0.76)	-			
No	129 (99.23)	-			
Fish for medicinal purposes	**130 (100)**	**-**	**0.501**	**Fisher**	**-**

Yes	2 (1.53)	-			
No	128 (98.46)	-			
Do not participate in tilling	**130 (100)**	**-**	**0.152**	**Chi²**	**N/A**
Yes	8 (6.15)	-			
No	122 (93.84)	-			
Tilling for food	**130 (100)**	**-**	**0.409**	**Fisher**	**N/A**
Yes	123 (94.61)	-			
No	7 (5.38)	-			
Tilling to sell or for income	**130 (100)**	**-**	**0.053**	**Chi²**	**-**
Yes	36 (27.69)	-			
No	94 (72.30)	-			
Tilling for trade	**130 (100)**	**-**	**0.626**	**Fisher**	**N/A**
Yes	4 (3.07)	-			
No	126 (96.92)	-			
Tilling for other purposes	**129 (100)**	**-**	**0.203**	**Fisher**	**N/A**
Yes	2 (1.55)	-			
No	127 (98.44)	-			
Do not tend animals	**130 (100)**	**-**	**0.148**	**Chi²**	**N/A**
Yes	110 (84.61)	-			
No	20 (15.38)	-			
Tend animals for food	**130 (100)**	**-**	**0.516**	**Chi²**	**N/A**
Yes	11 (8.46)	-			
No	119 (91.53)	-			
Tend animals to sell or for income	**130(100)**	**-**	**0.988**	**Fishers**	**-**
Yes	11 (8.46)	-			
No	119 (91.53)	-			
Tend animals for trade	**130 (100)**	**-**	**0.501**	**Fisher**	**N/A**
Yes	2 (1.53)	-			
No	128 (98.46)	-			
Do not tend crops	**130 (100)**	**-**	**0.362**	**Chi²**	**N/A**
Yes	8 (6.15)	-			
No	122 (93.84)	-			
Tend crops for food	**130 (100)**	**-**	**0.602**	**Chi²**	**N/A**
Yes	104 (80)	-			
No	26 (20)	-			
Tend crops to sell or for income	**130 (100)**	**-**	**0.889**	**Chi²**	**N/A**
Yes	52 (40)	-			
No	78 (60)	-			
Tend crops for trade	**130 (100)**	**-**	**0.126**	**Fishers**	**N/A**
Yes	7 (5.38)	-			
No	123 (94.61)	-			
Tend crops for other purposes	**127 (100)**	**-**	**0.447**	**Fishers**	**N/A**
Yes	1 (.78)	-			
No	126 (99.21)	-			
Do not participate in hunting	**130 (100)**	**-**	**0.456**	**Chi²**	**N/A**
Yes	121 (93.07)	-			
No	9 (6.92)	-			
Hunt for food	**130 (100)**	**-**	**0.362**	**Chi²**	**N/A**
Yes	7 (5.38)	-			

No	123 (94.61)	-			
Hunt to sell or for income	**130 (100)**	**-**	**0.501**	**Fishers**	**N/A**
Yes	2 (1.53)	-			
No	128 (98.46)	-			
Hunt for medicinal purposes	**130 (100)**	**-**	**0.452**	**Fisher**	**N/A**
Yes	1 (0.7)	-			
No	129 (99.23)	-			
Does not collect plants	**130 (100)**	**-**	**0.255**	**Chi²**	**N/A**
Yes	87 (66.92)	-			
No	43 (33.07)	-			
Collect plants for food	**130 (100)**	**-**	**1.000**	**Fishers**	**N/A**
Yes	5 (3.84)	-			
No	125 (96.15)	-			
Collect plants to sell or for income	**130 (100)**	**-**	**0.658**	**Fishers**	**N/A**
Yes	6 (4.61)	-			
No	124 (95.38)	-			
Collect plants for medicinal purposes	**130 (100)**	**-**	**0.097**	**Chi²**	**+**
Yes	33 (25.38)	-			
No	97 (74.61)	-			