



SOCIOECONOMIC VALUES OF CORRIDOR FORESTS IN THE ALBERTINE RIFT FORESTS OF THE MURCHISON-SEMLIKI LANDSCAPE

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Names: Simon Akwetaireho, Timothy Akugizibwe and Andrew Plumptre

Address: Wildlife Conservation Society
P.O Box 7487, Kampala
Uganda
Tel: +256 (0) 702509754
E-mail: aplumptre@wcs.org
Website: www.albertinerift.org

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Table of Contents

<i>Acknowledgement</i>	3
<i>Executive summary</i>	4
1 Introduction	6
1 Introduction	6
2 Objectives of the survey	7
2.1 Overall objective of the survey	7
2.2 Specific objectives of the survey	7
3 Methods	8
3.1 Study Site Description	8
3.2 Population structure	10
3.3 Methods.....	11
3.4 Data Analysis	12
4 RESULTS	12
4.1 Number of households sampled.....	12
4.2 Socio-economic and demographic household characteristics.....	13
4.3 Households use of forest goods and services.....	14
4.4 Sources of Income to a household	15
4.5 Incentives to conserve private forests	20
4.6 Socio-economic costs of corridor forests.....	23
5 Discussion	24
5.1 Contribution of northern corridor forests to rural livelihoods	24
5.2 Conservation Knowledge, Attitudes and Practices	25
6 Conclusions and Recommendations	25
References	27

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This socio-economic survey was jointly funded by WWF through the UNDP/GEF Conservation of Albertine Rift Forests Project, Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) and Jane Goodall Institute (JGI). Wildlife Conservation Society (WCS) executed the survey and provided considerable technical and administrative support. We are very grateful for the financial support provided by these organisations. Specifically, WWF funded surveys in and around corridor forests in Kibaale district while both CSWCT and JGI financed surveys in Bugoma – Budongo corridor forests in Masindi and Hoima districts. Additional financial support was provided by Darwin Initiative, UNEP, National Environment Management Authority and American Electric through these NGOs. We wish to thank National Forestry Authority and the District Local Governments of Masindi, Hoima and Kibaale for granting permission to conduct the surveys. The contribution of WCS Field Assistants towards collecting, compiling and cleaning the socio-economic data is highly recognised.



Executive summary

Over 50% of the people living adjacent to the Albertine Rift forests in the Murchison-Semliki Landscape of western Uganda have some direct dependence on the forests (WWF, 2006). Forests provide critical agricultural support and environmental services that are often poorly understood and undervalued. A regular supply of clean water and soil fertilization are major services provided by forests that are especially important to the poor, as they cannot afford alternatives such as piped water and fertilizers. This dependence and the livelihood opportunities provided by forests were not adequately recognized until recently (Bush *et al.* 2004). The linkage between poverty and the role of forests in rural livelihoods is still poorly understood by the majority of policy makers at the district and local levels in the Albertine Rift.

Given the above, Wildlife Conservation Society (WCS) was jointly subcontracted in 2010 by WWF, Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) and Jane Goodall Institute (JGI) to carry out a household survey in the districts of Hoima, Kibaale, and Masindi aimed at documenting the socio-economic values and services of the northern corridor forests in the Murchison-Semliki Landscape. Surveys under WWF contract focused on the corridor forests, south of Bugoma Forest Reserve in Kibaale district (hereafter referred to as Bugoma-Kagombe Corridor forests region) and were aimed at assessing local people's uses of forest corridor, their willingness to conserve the corridor forests and an estimate of what it might cost them to do so if given economic incentives such as REDD payments. 238 respondents were interviewed in the Bugoma – Kagombe Corridor (BKC) forest region. Building on experiences gained from WWF surveys and the methodological tools used in BKC forest region, JGI and CSWCT contracted WCS to undertake similar surveys with the same aims in Bugoma – Budongo Corridor (BBC) forests region in Hoima and Masindi districts. This would ensure adequate documentation of northern corridor forests for socio-economic and cultural values. A total of 104 respondents were interviewed in the CSWCT and JGI surveys in BBC forest region. The findings of this study are expected to inform the REDD feasibility study also being carried out by WCS on behalf of WWF, CSWCT and JGI and eventually the REDD Project Design Document to be developed by WCS in partnership with these same three organizations. The findings will also increase the understanding among local, national, regional and international stakeholders on the usefulness of corridor forests to the well-being of local communities and the rural economy.

Corridor forests contributed building materials in the form of poles, mud, thatching materials and various fibers to the construction of rural dwelling units. As with most households in Uganda, fuel wood was the most common source of energy. One household used an average 208 bundles/year of firewood from corridor forests for cooking and heating. In 2010, the average earning per household in the BBC forest region from various forest products was Ug Shs 304,864/= (US\$ 139) while in the BKC forest region the value stood at Ug.Shs. 234,404/= (US\$107). Forests were identified as contributing to agricultural production through ameliorating local climate, stabilizing soils and maintaining soil fertility. As a result of this conducive environment, corridor forests boosted agricultural productivity which in 2010 brought a gross average income of Ug. Shs. 589,965/= (US\$ 268) to each household in BBC forest region and Ug. Shs. 602,084/= (US\$ 274) to a household in BKC forest region in the same period of time. Livestock production accounted for an average gross income of Ug. Shs. 338,729/= (US\$ 154) and Ug. Shs 323,138/= (US\$ 147) in the BBC forests region and BKC forests region respectively. Other intangible forest benefits revealed by local communities are soil erosion control, soil fertility maintenance, wind breaks, seed dispersal to aid forest regeneration and influencing microclimate (rainfall attraction), tourism and recreation, mitigation of global warming and promoting conservation education.

Corridor forests also play a role in mitigating global warming through sequestration and storage of carbon dioxide as acknowledged by 47.1% of interviewees in BBC and 10.5% of interviewees in BKC forests regions. According to statistics from WCS, Carbon density for Tropical High Forest fully stocked ranged from 350 tCO₂e/ha to 838 tCO₂e/ha, for Tropical High Forest depleted from 81 to 235 tCO₂e/ha, and converted farmland from 5 to 30 tCO₂e/ha (Miguel *et al.*, 2011). The carbon price on the international market ranges from \$5 to \$10/ tCO₂e. Under a REDD incentive scheme, farmers could generate forest carbon credits that can be sold on international market. This is one of economic opportunities that farmers can seize to diversify their sources of income.

Within the perspective of REDD+, respondents were asked to state their willingness to conserve the corridor forests and also to provide an estimate of what it might cost them to do so per year i.e the opportunity cost foregone to keep their forests standing. The WTA payment was solicited from those with and without forests. Respondents without forests expressed a WTA payment to conserve the nearby smaller Central Forest Reserve and another person's forest or communally owned forest. 57.6% of interviewees with natural forests in BBC and BKC forest regions were willing to accept payments. On average the forest size owned by each respondent WTA payment was 3.1 hectares. The average Willingness to Accept payment per hectare per year was Ug. Shs 1, 387,746/= (US\$630). This compares with an estimate that REDD funding could provide about \$94 per hectare per year of forest in the corridor forests or \$281/ha/yr per average area of forest owned by a farmer (3ha). These values would be comparable to the \$100-140 obtained by households on average from these forests per year but doesn't reach the WTA values they requested.

Corridor forests not only generate positive benefits but also negative ones. They harbor crop-raiding problem animals and vermin which cause socio- economic losses to farmers. Olive baboons and Vervet Monkeys were cited as the most problematic in all three districts. It was for this reason that 5.8% of respondents in BBC and 31.9% of respondents in BKC indicated objections to creating corridor forest out of their natural forests. Because of time limitations, this study never delved in to details of monetary losses resulting from crop raiding wild animals. This should be a subject of another study.

In general the forest goods and services generated by corridor forests contribute to human well-being through boosting agricultural productivity, which in turn contributes to household income levels as well as food security. In spite of this contribution, corridor forests continue to disappear at an alarming rate mainly due to conversion of natural forests to agricultural fields and human settlement. Urgent conservation action is needed to halt this loss. There is need to develop the capacity of local governments and local communities to manage and control vermin and problem animals in order to mitigate human-wildlife conflicts that result in destruction of forests to get rid of crop pests. There is also a need for heightening communication, education and public awareness among private forest owners, local communities and district local governments on the values of and rationale for corridor forest conservation as well as the human actions threatening these corridor forests and the life forms there in. The respondents boasted of remnant standing trees and dead logs in cultivated fields (formerly natural forests). This calls for provision of advisory services and practical training on integrating trees and crops in order to increase provision of environmental services. Related to this, on-farm forestry/agro-forestry with both indigenous trees needs to be promoted in order to provide communities with alternatives to natural forest resources. Other options that need to be explored and promoted by conservation stakeholders include a market based incentive scheme such as REDD+ funding, establishing woodlots and promoting improved agricultural practices to lessen the need to open more fertile forests for expansion of farm land.

1 Introduction

Close to 1.6 billion people – more than 25% of the world's population – rely on forest resources for their livelihoods and most of them (1.2 billion) use trees on farms to generate food and cash. Moreover, many countries in the developing world draw on fuelwood to meet as much as 90% of energy requirements (FAO, 2011). Despite the importance of these resources for the range of economic, environmental, social and cultural benefits they provide, data on such dimensions are either sketchy or not available. Therefore, the extent to which they contribute to national development, reduce poverty, and enhance food security for vulnerable populations is not well recognized or appreciated. Increasingly however, case studies and other convincing evidence are documenting the role forests and trees outside forests play in national economic growth, rural development and livelihoods. Scientific research also is improving our understanding of how forestry contributes to achieving all UN Millennium Development Goals, not only those pertaining to poverty, hunger and the environment (FAO, 2011).

There is evidence that forest products are harvested in significant quantities by a large number of households across virtually all forest types in developing countries and frameworks have been developed for analyzing and understanding different types of forest dependencies (Byron and Arnold, 1999). Research on the role and potential of forests in preventing and reducing poverty is, however, very limited and can be considered an emerging field of inquiry. Forests and other environmental resources indisputably play an important role in the livelihoods of people around the world, but significant knowledge gaps remain concerning the forest/environment-poverty nexus. Quantifying the use of forests and environment at the household level is therefore essential in order to understand their actual and potential role in preventing and reducing poverty, especially in very poor areas such as sub-Saharan Africa.

For millions of people living in poverty, forest and tree resources not only provide food, fuel for cooking and heating, medicine, shelter and clothing, but they also function as safety nets in crises or emergencies – for example, when crops fail owing to prolonged drought or when heads of households can no longer engage in productive activities because of HIV and AIDS or other devastating diseases (FAO, 2011). They can also be important during times when crops are not available for harvesting in field (the 'hungry gap') as was shown by Bush *et al.* (2004). Forest resources generate income through employment and through the sale of surplus goods and services.

In 2010 the Wildlife Conservation Society (WCS) was sub-contracted by the UNDP/GEF project managed by WWF for the *Conservation of Biodiversity in the Albertine Rift Forests of Uganda* to undertake a land cover analysis and used a GIS modeling approach to identify 27 potential wildlife corridor elements in the Murchison-Semliki Landscape for a suite of species that are thought to require connectivity to ensure long term maintenance of a viable population. These corridor forests serve as migratory and/or dispersal routes for species that occur at low densities and may need to move from one forest block to another to maintain genetic viability (Nangendo, Plumptre and Akwetaireho, 2010).

Once these corridors were identified WCS was again sub-contracted by a) the UNDP/GEF project managed by WWF for the *Conservation of Biodiversity in the Albertine Rift Forests of Uganda*, b) Chimpanzee Sanctuary and Wildlife Conservation Trust Project for *developing an experimental methodology for testing the effectiveness of payment for ecosystem services to enhance biodiversity conservation in productive landscapes in Uganda*, and c) the Jane Goodall Institute project for *Conserving Critical Chimpanzee Habitats in Western Uganda through a REDD Approach*. The aim of these joint contracts was to carry out a household survey aimed at documenting socio-economic values and services of the northern corridor forests in Murchison-Semliki Landscape. In particular the survey was planned to be linked to the ongoing REDD feasibility analysis also subcontracted to WCS under the same projects so that we could assess whether the income that might be generated by the REDD+ project would offset the benefits households obtain from access to the forests. How much would REDD have to compensate farmers in order to conserve the forests and not convert it to agricultural land?

The survey commenced in May 2010 and ended in December 2010 and was carried out at the same time as biodiversity surveys of the same forests. The corridor forests included smaller Central Forest Reserves, and private and communal natural forests between Budongo and Bugoma Central Forest Reserves in Masindi and Hoima districts (Hereafter referred as Bugoma – Budongo corridor –BBC - forests region) as well as corridor forests south and west of Bugoma CFR in Kibaale district (Hereafter referred as Bugoma – Kagombe corridor –BKC- forests region). Both JGI and CSWCT jointly funded surveys in the Bugoma – Budongo corridor forests region while the financial support from WWF covered surveys in Bugoma –Kagombe corridor forests region. The red lines in figure 1.1 below show the potential wildlife corridors in the landscape where socio-economic household surveys took place.

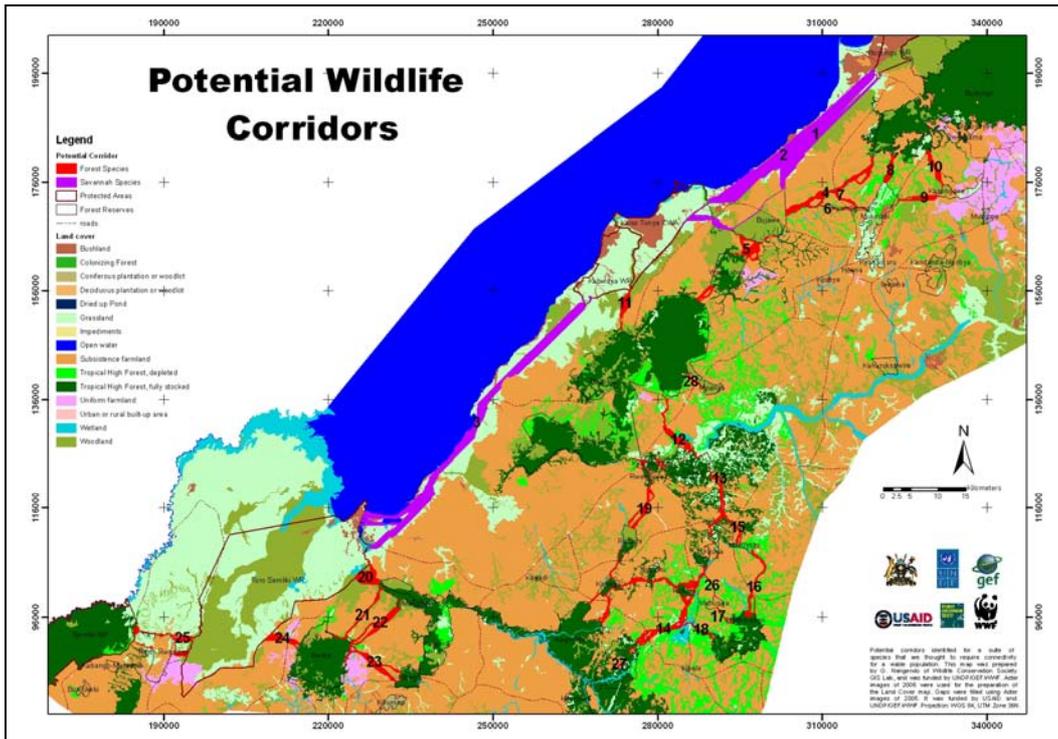


Figure 1.1 Map of the corridors identified in the Murchison-Semliki Landscape and around which the socioeconomic survey was implemented (Nagendo *et al.*, 2010). Corridors 4-10 occur in the BBC region and corridors 12-19 and 26-27 occur in the BKC region.

2 Objectives of the survey

2.1 Overall objective of the survey

To assess local people’s uses of forest corridors, assess their willingness to conserve corridor forests, and obtain an estimate of what it might cost them to do so.

2.2 Specific objectives of the survey

- To assess the contribution of corridor forests and other environmental resources to rural livelihoods
- To assess local communities Knowledge, Attitudes and Practices regarding corridor forests conservation.
- To ascertain the Willingness To Accept (WTA) payment by private forest owners and local households to conserve private forests and smaller Central Forest Reserves (CFR) if provided and motivated with economic and financial incentives, and to obtain estimates in monetary terms of what it might cost.
- To generate a baseline information on the socio-economic and livelihood status of local communities living in and around the corridor forests

3 Methods

3.1 Study Site Description

The survey focused on the northern corridor forests in northern section of the Albertine Rift in the Murchison-Semliki Landscape in Uganda. The northern section of the Albertine Rift extends from Budongo Forest Reserve (FR) to forests in the Toro-Semliki Wildlife Reserve in Masindi, Hoima, Kibaale and Kyenjojo Districts. Specifically, this study considered only corridor forests between Budongo – Bugoma CFR in Masindi and Hoima districts and those south and west of Bugoma CFR in Kibaale district as shown in Figure 1.1.

In Kibale, Hoima and Masindi districts there are still areas with woodland and forest cover (often along rivers and streams) outside gazetted forest. These ungazetted areas of woodland and natural tropical forest are either private or communal forests, which together with smaller gazetted CFRs (table 3.1) constitute corridor forests. The corridor forests provide a degree of connectivity that is of importance for species dispersal and gene flow. The extensive ungazetted private forests in the area have very important conservation values not based on their species content but on the fact that they provide linkages between other larger forests (WWF 2006). The forests are also important water catchments to regulate the flow of water in the streams and wetlands. The catchments constituted by northern corridor forests is important for domestic water supplies to the population in both rural and urban areas and make up a big contribution of the rain fed agricultural production activities.

Table 3. 1: Smaller CFRs in the corridor region where socio-economic surveys took place. These CFRs together with Local Forest Reserves and communal/private forest patches constitute corridor forests for ecological connectivity.

District	Central Forest Reserve	Area (ha)	Main	Notes
Hoima	Bujawe	4,869	Ecological	Protects Rivers Hoimo and Rwamutunga sources of water for people and animals in Buseruka and Bugambe sub-counties. The rivers feed in to Lake Albert. It is part of the corridor connecting Budongo and Bugoma CFRs and Kabwoya Wildlife Reserve.
	Mukihani	3,619	Commercial Plantation development	It is a water catchment for Rivers Nyakabale, Burara and Waki, sources of water for people and domestic animals in the areas of Kitoba, Busisi and Kigorobya Sub-counties.
	Wambabya	3,439	Ecological	Protects River Wambabya a source of water for people and domestic animals in the sub-counties of Buseruka, Bugambe and Kiziranfumbi sub-counties. It is part of a network of protected areas constituting a watershed on the Eastern Rim of Lake Albert. One of the natural forests that form the biodiversity corridor connecting Bugoma CFR, Kabwoya Wildlife Reserve Budongo CFR and Murchison Fall National Park Encroachment is a threat to the forest's ecological role.
	Mpanga	544	Commercial plantation development	Protects rivers Nyakabale, Kabaganda and Rwemiyaga which provides water for the people and domestic animals of Kabwoya and Kiziranfumbi sub-counties
	Rwengeye	329	Ecological	Protects the banks of River Pachwa which drains in to Nkuse river which in turn drains in to Muzizi River and Lake Albert. It is part of the biodiversity corridor connecting Murchison Fall Park, Budongo, Bugoma to Matiri – Itwara CFRs and Semliki NP. It is also a watershed for Nkuse River, which eventually feeds in to Lake Albert. It is a young high forest with potential for producing high value timber from natural forest.
	Kyamurangi	417	Ecological	Part of the biodiversity corridor connecting Murchison Falls, Bugoma, Matiri CFRs and eventually to Semliki National Park

Kibaale	Kasato	2,691	Ecological	The forest acts as a water catchment area for Ruzaire River which eventually drains in to Nkuse and Muzizi Rivers
	Muhunga	399	Ecological	A catchment area for River Muhunga, serving as a water source for Kibaale and Karuguuza piped water before draining in to Muzizi River
	Rukara	456	Ecological	A catchment for River Rukara which drains into River Ruzaire, a source of water for local communities for domestic and small-scale industrial processing.
	Kijuna	1,225	Ecological	The forest is encroached and the encroached part is intended to be restored
	Nakuyazo	342	Ecological	A water catchment for Nakiriba River & wetland which drain in to Nkuse River at Kikwaya
	Nyakarongo	3,535	Ecological	A young reserve protecting the banks of Mbaya river which feeds in to River Nguse draining in to Muzizi River and Lake Albert. Enable biodiversity connectivity with Semliki National Park
	Kagombe	17,751	Ecological	Protects the watershed for Rivers Kagombe and Muzizi which eventually drain in to Lake Albert. It connects to Semliki National Park via Muhangi, Kitechura, Ibambaro and Itwara CFRs. The CFR is highly encroached, threatening its ecological functions.

Source: Environmental Sensitivity Atlas for the Albertine Graben, Second edition 2010, NEMA, Uganda
N.B. There was no smaller CFR encountered in areas we surveyed in Masindi district.

Chimpanzees, *Pan troglodytes schweinfurthi*, classified as endangered under IUCN criteria, occur at low densities compared with other animals and therefore rely on these corridor forest patches to provide connectivity between breeding populations, hence reducing the risk of genetic inbreeding. Surveys carried out by WCS and JGI (Plumptre, Cox and Mugume, 2003) estimated some 4950 chimpanzees in all Uganda. Detailed surveys in eight forests showed that most forests contain less than 500 animals. The results for the chimpanzee census showed the CFRs (large forest blocks) of the Murchison-Semliki Landscape to be containing a population size of 1,550 chimpanzees, 35% of the national total (Table 3.2). Population biology suggests that for a population to be viable in the long term it should have at least 500 individual animals. This landscape contains relatively large populations of chimpanzees in Budongo and Bugoma Forest Reserves but they are borderline viable (around 500 individuals at each site) and linking forests may be important for gene flow in chimpanzee communities.

Table 3.2. Chimpanzee densities and population estimates in Forest Reserves in the Murchison-Semliki landscape (Plumptre *et al* 2003).

Forest	Density per sq km	Population estimate	95% confidence limits
Budongo	1.36	584	356-723
Bugoma	1.90	570	424-769
Kagombe	0.71	80	29-218
Itwara	1.35	120	67-215
Estimated Total	-	1550	-

in 2010 WCS undertook chimpanzee surveys in Bugoma and Kagombe CFRs, Under the WWF/UNDP/GEF project for the Conservation of Biodiversity in the Albertine Rift Forests of Uganda, aimed at assessing changes in chimp numbers since the previous census period of 1999 and helping forest managers and other conservation NGOs assess whether their conservation actions are truly working to conserve chimp and other key mammal species. The survey estimated the density of individual chimpanzee in Bugoma CFR at 1.24 individuals per km² in 2010 as compared to an individual density of 1.87 per km² in 1999 (Plumptre *et al*. 2010)

3.2 Population structure

Overall, the study was undertaken in 25 parishes located in 15 Sub-counties with the total of 208,800 people (see table 3.3)

Table 3.3: Human population estimates by parish in the sub-counties around the corridor forests where the socio-economic surveys took place. These estimates were obtained from Sub-national projections report (2008-2012) for the Western Region as compiled by Uganda Bureau of Statistics.

District	Sub-County	Parish	Males	Females	Total no. of people
Hoima	Bugambe	Katanga	7400	6000	13400
	Buseruka	Kabale	7900	8000	15900
	Kabwoya	Bubogo	4800	4500	9300
		Igwanjura	8000	7500	15500
	Kitoba	Birungu	4100	4200	8300
		Kibanjwa	3100	3200	6300
	Kizirafumbi	Bulimya	6700	6700	13400
		Kidoma	3800	3700	7500
		Munteme	5000	5100	10200
	Kibaale	Bwamiramira	Bukonda	2700	2500
Rwamagando			1800	1900	3700
Bwikara		Nyamasa	3800	3800	7600
Kagadi		Busirabo	2200	2500	4700
Kakindo		Kikwaya	2400	2600	5000
		Rukunyu	5000	5300	10300
Kiryanga		Kicucura	3900	3900	7800
		Kiryanga	3400	3300	6700
		Paacwa	3600	3700	7300
Kyebando		Kicunda	3600	3700	7300
		Kisojo	4100	4200	8300
Matale		Karangara	2900	3200	6100
		Kitaba	3500	3500	7000
Mugarama		Kezimbira	2900	2800	5700
Muhoro		Nyamacumu	4700	5100	9800
Masindi	Budongo	Kasenene	3400	3100	6500
Grand total population					208,800

3.3 Methods

The method chosen involved: collection of primary data through administration of a household questionnaire, review of existing relevant literature on the region and personal field observations during village visits. The methods are explained below in detail.

3.3.1 Household questionnaire survey

The household survey focused on corridor forests linking Budongo and Bugoma CFRs in Masindi and Hoima districts and all corridor forests in Kibaale district south of Bugoma CFR. The survey lasted for 3 months in Kibaale district i.e. May – July 2010 while in Hoima and Masindi districts the duration was one month i.e. 19th November to 19th December 2010. Only households in villages located within and around corridor forests were randomly selected for interviews. The sample unit of the study was a household. Simple random sampling was used to identify the households with the help of a local council one (LC 1) register such that every household had an equal chance of being selected. The household heads were picked from the village register book where all members of the village and households are listed, a method which has proved useful in other studies. LC 1s are the local government administrative units established at village level. To identify LC1s to visit, the enumerators worked in the villages near the biodiversity survey points that were used to survey carbon biomass, and mammal and bird diversity. The interviewers were guided every day to the households to visit by the LC1 chairpersons or any Councilor in the absence of the chairperson.

Both open-ended and closed questions were used to interview heads of households. Data were collected on aspects such as demographic characteristics of the household, socio-economic issues such as education and income levels from agriculture and other business, resources collected from forests, land tenure, impacts of crop raiding wild animals, and knowledge, awareness and practices of households. Prior to the full-scale surveys, a pilot household survey was made under the WWF/UNDP sub-grant in December 2009 in the corridor forests of Kiryanga sub-county, Kibaale district to pre-test the questionnaire. This allowed the opportunity to correct omissions, or ambiguous questions and to discover where the meaning of questions was not clear to interviewees or enumerators. Three enumerators/interviewers conducted this household survey with supervision and guidance provided by Simon Akwetaireho and Andrew Plumtre. Two of these enumerators had participated in similar socio-economic surveys performed by WCS under the USAID funded PRIME West project in the Murchison–Semliki Landscape. The Knowledge, Attitude and Practices (KAP) component of this survey in BKC forest region generated also data for baseline awareness survey conducted by WWF independently (which was supposed to incorporate results from WCS). WWF staff (Ms. Hellena Nambogwe) participated in KAP surveys in BKC forests region.

The distribution of respondents in the study villages are shown in Table 4.1 and 4.2 respectively. A total of 342 respondents were interviewed in both the Bugoma-Budongo corridor (BBC) forests region and the Bugoma-Kagombe corridor (BKC) forests region in Kibaale district.

3.3.2 Contingent Valuation survey

As part of the general household survey, a contingent valuation survey was carried out to elicit and gauge the Willingness to Accept (WTA) payment in monetary terms to conserve private forests and small CFRs for carbon sequestration and storage values, biodiversity conservation, and protection of other ecosystem services and goods. A hypothetical market scenario was created and then each respondent asked how much money s/he would want to be paid per year as a compensation to protect and conserve the corridor forests (private forests and small CFRs). A payment card with open bids was presented to each respondent and then each asked to pick an amount of compensation per year in Uganda Shillings for not converting the forest to other land uses i.e. compensatory payments to keep their forests standing. These values were compared with income values in 2010 farmers obtained by harvesting forest products and from crop and livestock production on their lands.

3.3.3 Field observations by researchers

To supplement the household survey, interviewers made observations about various community and household activities, crops grown, nature of housing, livestock reared, land use types and the nature forest resource utilization as well as capturing photographs of different forms of forest use by local communities.

3.3.4 Secondary data collection

A literature review was carried out by consulting relevant secondary sources available at the WCS digital library, reviewing the project proposal document for UNDP/GEF Albertine Rift Forest Project and having one-on-one discussion with key WCS staff knowledgeable on socio-economic issues surrounding natural resource management and biodiversity in Murchison-Semliki Landscape as well as reviewing the socio-economic studies previously made by other conservation NGOs in the study area. Relevant online sources were also consulted.

3.4 Data Analysis

The quantitative and qualitative information collected through the questionnaire survey were coded and entered into the MS-excel computer programme (MS excel worksheets) and then analysed. Using pivot tables, the incomes per study sites, problem animals and other simple computations were calculated.

4 RESULTS

4.1 Number of households sampled

As indicated in tables 4.1 and 4.2 below, a total of 342 respondents were interviewed in villages found in Bugoma-Budongo corridor forests region and Bugoma-Kagombe corridor forest region. The respondents interviewed were only household heads or their representatives encountered at home during survey time. The survey respondents numbered 104 for BBC and 238 for BKC. 29 villages were visited in BBC 41 villages were visited in BKC. These households represented 2,474 people or about a 1.2% sample. The number of households interviewed per parish depended on the size of the parish, and on the availability and extent of forest coverage. The sampling intensity was higher in areas that were heavily forested than those with little or no forest cover.

Table 4.1 Number of households, Villages and Parishes surveyed in Bugoma-Budongo corridor (BBC) forests region in Hoima and Masindi district

District	Sub-County	Parish	Village	No. Households Interviewed
Hoima	Bugambe	Katanga	Kakora, Rwamutunga, Rwenkobe	13
	Buseruka	Kabale	Kijumba	5
	Kabwoya	Bubogo	Ikoba A, Kabango, Kabira, Kihenda, Kihooko, Kisonsome, Kitoole, Nyakabale, Rwabuhuka	28
			Igwanjura	Maya B, Rusona
	Kitoba	Birungu	Kitesekula	6
		Kibanjwa	Bukerenge	6
	Kizirafumbi	Bulimya	Kyarwensambya	5
		Kidoma	Kyakatamba, Rwamusaga	12
		Munteme	Kajoga, Mugwoma, Nyansorooro, Rwooma	8
Masindi	Budongo	Kasenene	Abangi, Biyasiku, Kibale, Ogadra, Onieni	14
Total number households				104

Table 4.2. Number of households, Villages and Parishes surveyed in Bugoma-Kagombe corridor (BKC) forests region in Kibaale district

Kibaale district	Bwamiramira	Bukonda	Bujogoro, Kigoro, Kyabasita, Nyabusajo	11
		Rwamagando	Ngerebwe	9
	Bwikara	Nyamasa	Kamukole	8
	Kagadi	Busirabo	Rwamabale A, Rwamabale B	6
	Kakindo	Kikwaya	Kagezi, Rwanjare, Kagezi, Rutooma	10
		Rukunyu	Kisaige, Marongo	12
	Kiryanga	Kicucura	Kiryanga, Kitemba	6
		Kiryanga	Kiryanga, Kisegu, Kiduma, Kikonda, Kyakatebe, Rugaga	88
		Paacwa	Irobe , Nyaisamba	20
	Kyebando	Kicunda	Bweyale , Kicunda, Kyebando	7
		Kisojo	Bigaaga, Kamuhoko, Kasenyi, Kisalizi, Muhunga, Wantema	28
		Kiwanda	Bweyale , Kyebando	8
	Matale	Karangara	Nguse	5
		Kitaba	Kaisekenkere	7
	Mugarama	Kezimbira	Kyarubalo	2
	Muhororo	Nyamacumu	Kambogo, Kasoga, Kyakajwiga	11
Total sample size				238

4.2 Socio-economic and demographic household characteristics

Table 4.3 below summarizes information on demographic and socio-economic characteristics percentage of respondents interviewed, average household size, household age structure, average age of household occupants, respondent occupation and education of households in BBC and BKC respectively. Male and female respondents were 77% and 23% respectively in BBC while in BKC male respondents were 64% and female respondents 36%. In terms of household occupation, farming is the most predominant form of employment. In BBC, 84.4% of the households depend on farming as opposed to 92.6% of the households in BKC. Regarding literacy levels, 59.8 of the respondents in BBC and 58.2% in BKC had attained primary level education.

Table 4.3. Household socio-economic and demographic characteristics

Household characteristics	Bugoma – Budongo corridor forests region	Bugoma-Kagombe corridor forests region
Respondent interviewed		
Male (%)	77	64
Female (%)	23	36
Average household size	8.4	6.8
Household age structure – male		
0 – 30	79.7	79
31 – 60	17.2	18
>=61	3.1	3
Average age	18.7	18.8
Household age structure- female		
0 – 30	80.3	78.6
31 – 60	17.4	19.7
>=61	2.3	1.7
Average age	18.8	19.2
Occupation of respondent		
Farming	84.4	92.6
Retail trading	8.8	1.3
Occasional contract job	4.9	1.7
Permanent job	1.9	4.2
Education of respondent		
No formal education	20.6	24.5
Primary	59.8	58.2
Secondary	12.7	12.7
College/University	6.9	4.6

4.2.1. Residency time in the village

The majority of respondents had resided in BBC and BKC for more than 10 years. 8.7% of the respondents had lived in BBC for 6 to 10 years while in BKC it was 12.7% for the same duration of time (table 4.4) Both BBC and BKC registered the lowest percentage of respondents residing for less than one year.

Table 4.4 The percentage of respondents who had lived at that site for different numbers of years.

No. of village residence years	Bugoma-Budongo Corridor forests region	Bugoma-Kagombe Corridor region
Less < 1	1.0	2.0
1 to 5	4.8	10.9
6 to10	8.7	12.7
> 10	85.5	72.7
Did not know	0.0	1.7
Total percentage	100	100

4.3 Households use of forest goods and services

4.3.1 House materials for main dwelling

In both BBC and BKC forest regions, the predominant materials for constructing walls were mud and poles followed by burnt bricks. The predominant roofing material was iron sheeting. 26% of respondents in BBC had grass thatched roof structures while BKC had 17.6% with

thatched roofs. The importance of poles and thatch indicates that corridor forests and woodland play a vital role of providing building materials to construct rural dwelling units.

Table 4.5 The percentage of households per corridor region with houses constructed of different wall and roof materials

<i>Wall</i>	BBC forest region	BKC forest region
Timber	0	0
Bricks	16.3	15.6
Mud & poles	83.7	84.4
Iron	0	0
Plastic sheeting	0	0
<i>Roof</i>		
Grass thatch	26	17.6
Tiles	0	0
Iron sheets	74	82.4
Plastic sheeting	0	0

4.3.2 Fuelwood and other plant material biomass for cooking

As illustrated in table 4.6, households interviewed use either firewood, charcoal, grass or remains of agricultural production (maize stems, grass, banana leaves and sorghum stems) for cooking, heating and lighting. As with most households in Uganda, fuel wood is the major form of energy used by households from corridor forests. All respondents in BBC and BKC said that they obtain firewood from corridor forests to meet the daily household energy demands

Table 4.6 Number of households that used various sources of fuels in BBC and BKC

	Fuel type	No. of households	Unit(s)	Average quantity per household per year
BBC forest region	Firewood	104	Bundles	316
	Charcoal	3	Sacks	35
	Paraffin	104	Litres	62
BKC forest region	Firewood	236	Bundles	164
	Charcoal	5	Sacks	31
	Paraffin	211	Litres	6
	Crop residues	1	Bundles	104
	Grass	69	Bundles	119

Households engaged in small scale enterprises also utilize fuelwood for brick burning and tobacco curing. The fuelwood is collected in billets or bundles, with the size varying among households. The size of the billet depends on the ability to carry it, the availability and the distance from home to the forest. Fuel wood is largely collected for domestic consumption and rarely for commercial purposes (i.e. selling). The average price of one billet on the local market in the village is Ug. Shs. 1000/= . Grass is only utilized by respondents in BKC forest region at the peak of tobacco season when it is needed for curing tobacco.

4.4 Sources of Income to a household

4.4.1 Annual net household income of household heads

Respondents were asked to estimate the amount of money they earn per year after tax deductions. On average a respondent in BBC forests region earned an annual income of Ug Shs 2,830,693/= (\$1,287 USD) compared to an average of Ug Shs 2,024,401/= (\$920 USD)

earned by a respondent in BKC forests region (Table 4.9). This income may be from different sources e.g gifts, casual labour wages and sale of agricultural produce.

Table 4.9 The average, minimum and maximum annual net income estimated by a household head in 2010

Corridor forest region	Average	Min.	Max.	StdDev.	No. of respondents
BBC forests region	2,830,693	300,000	20,000,000	3,211,969	101
BKC forests region	2,024,401	80,000	160,000,000 (extreme value is for one respondent only)	10,472,824	234

Regarding the net annual income level categories for each respondent/household head, In BBC and BKC forest regions, the majority of respondents earn in the range of Ug Shs 0 – 2,999,000/= per year save for only one outstanding respondent in BKC with an very large income of Shs 160,000,000/= per annum which was reportedly earned from timber extraction (Table 4.10).

Table 4.10 Net annual income categories in Uganda Shillings earned by each household head after tax deductions. Numbers are the percentage of respondents

Annual Household head income levels in UGX (000')	BBC forest region	BKC forest region
0 – 2,999	55.8	87.4
3,000 – 5,999	32.7	8
6,000 – 8,999	4.8	2.1
9,000 – 11,999	1.9	0.4
12,000 – 14,999	0	0
15,000 – 17,999	0	0
18,000 – 20,999	1.9	0
≥ 23,999	0	0.4
Do not know	2.9	1.7
Total percentage of respondents	100	100

N.B. By the time of this study in 2010, \$1 was traded on Uganda foreign exchange market for Uganda Shillings (UGX) 2,200/=

4.4.2. Income from Agriculture and forestry goods

As well as asking respondents to estimate their annual income we also made an effort to calculate it by asking them about their incomes from agricultural production, livestock production and from the forests.

Income from Agricultural crop production

Interviewees were asked to name various crops they sell to earn household income as well as those they harvest for household consumption. They also stated the total annual crop harvest in a local unit for quantifying the volume of crops and the local price per unit sold. Interviewees were asked to only concentrate on recalling events from the past 12 months. Respondents revealed a variety of crops harvested for commercial purposes (Table 4.11) Respondents cited among others the following types of food crops: maize, rice, bananas, sugar cane, sweet potatoes, finger millet, tomatoes, legumes, soya, sunflowers, cassava, groundnuts and a range of green vegetables. The cash crops most valuable to the communities were tobacco, sugarcane and cocoa

Table 4.11 Average income from crops sold and consumed in Ug. Shs derived by household heads from diverse agricultural products cultivated and harvested in and around the corridor forests. The average income is for only those household heads/respondents who that grew that crop.

Corridor forest region	No. of respondents in BBC	Average annual crop income in BBC	No. of respondents in BKC	Average annual crop income in BKC
Banana	60	1,016,067	60	1,390,343
Beans (dry)	97	526,313	193	421,268
Cabbage	10	390,400	10	204,120
Cassava	94	485,717	115	1,164,837
Cassava leaves	6	58,933	0	0
Citrus	0	0	1	60,900
Cocoa	1	78,000	2	2,150,000
Coffee	34	209,941	65	224,703
Curry	1	516,000	0	0
Dodo (<i>Amaranthus hybridus</i>)	95	84,345	25	46,196
Egg plant	63	192,829	29	191,931
Green pepper	6	570,833	1	20,800
Ground nuts	80	979,545	62	919,187
Guava fruits	12	155,567	4	61,000
Irish Potatoes	29	860,069	39	464,483
Jack fruit	86	239,344	72	181,646
Lemon	0	0	3	107,900
Maize	97	302,932	209	328,975
Mangoes	63	282,781	19	142,316
Millet	29	314,869	10	549,580
Nakati (<i>Solanum Aethiopicum</i>)	79	78,023	13	49,138
Onions	9	150,889	5	81,360
Orange	6	54,167	3	37,873
Passion fruit	11	120,052	11	76,609
Pawpaw	64	239,606	31	133,923
Pigeon peas	1	46,800	0	0
Pineapple	24	311,017	20	156,840
Pumpkin	23	135,843	0	0
Pumpkin leaves	8	65,000	0	0
Rice	90	1,735,833	57	1,190,739
Simsim	1	734,400	0	0
Sorghum	14	179,843	1	150,000
Sugarcane	34	3,451,324	22	585,345
Sukumawiki (tall cabbage plant)	2	41,600	0	0
Sweet Potatoes	97	599,124	93	535,044
Tobacco	39	2,081,967	52	2,631,846
Tomatoes	13	157,785	11	356,291
Avocado	33	265,139	49	161,914

Waragi (local potent gin)	0	0	1	120,000
Yams	19	256,926	19	306,567
Household average income		589,965		602,545

Income from livestock

Livestock farming is also one of the economic activities practiced by respondents on a small scale. Respondents owned cattle, chicken, goats, pigs and sheep (table 4.12). Respondents earned substantial amounts of money from selling cow milk. Sheep rearing is the least practiced form of animal husbandry in BBC.

Table 4.12 Average income in Uganda Shillings obtained from consumed and sold livestock/livestock products by a household head in 2010 in the corridor forests. The average income is for only interviewees that reared a particular animal or that sold the animal product

Corridor forest region	No. of respondents in BBC	Average annual income in BBC	No. of respondents in BKC	Annual average income in BKC
Cattle	13	1,081,538	12	866,667
Chicken	84	289,018	18	169,833
Eggs	57	103,889	10	150,175
Goats	38	386,974	19	179,474
Milk	7	935,914	7	457,136
Pigs	27	444,333	26	313,846
Sheep	4	98,750	0	0
Household average income		338,729 (\$154 USD)		319,663 (\$145 USD)

Income from corridor forest products

Interviewees were asked whether they collected forest products and if so what they collected, how often and whether they sold or consumed forest products. Many respondents admitted to harvesting forest products (table 4.13). The forest products obtained varied from wild foods, biomass fuels, timber for house building and carpentry works, house thatching materials and medicinal products. Timber and the associated carpentry items were the leading contributors of forest income.

Table 4.13 Varied forest products and the corresponding average income in Ug Shs derived by household heads from sale of assorted forest products in 2010. The average income is for only respondents that harvested and sold or consumed a forest product

Corridor forest products extracted	No. of respondents in BBC	Annual average forest income in BBC	No. of respondents in BKC	Annual average forest income in BKC
Afromomum	34	64,853	21	41,230
Bamboo shoot	2	390,000	2	17,000
Wooden beds	1	2,000,000	0	0
Big antelope	0	0	1	40,000
Building poles from forest	66	60,521	58	107,243
Charcoal	7	260,429	3	2,077,333
Clay	0	0	1	10,000
Wooden doors/windows	2	150,000	0	0

Socioeconomic values of corridor forests in the Murchison-Semliki Landscape

Duiker	0	0	6	24,083
Fibers (Ropes for construction)	10	9,700	0	0
Fire wood	89	227,090	99	179,415
Francolin	9	71,129	19	879,899
Grass for thatching	1	40,000	82	16,324
Greens	1	10,400	0	0
Guinea fowl	9	24,222	26	23,972
Handicrafts/panniers	8	19,563	12	32,750
Hoe handle	3	19,167	0	0
Carpentry items e.g. wooden furniture	3	3,303,000	2	55,000
Mats/woven goods	9	29,222	10	27,600
Medicinal plants	16	137,263	64	3,852
Mushrooms	66	102,395	91	19,254
Porcupine	0	0	3	14,000
Edible rats	10	13,432	1	8,000
Rattan cane	0	0	5	16,000
Sand	5	314,000	16	277,375
Stone	1	250,000	2	237,500
Wooden tables	1	250,000	0	0
Timber from forest	26	2,917,308	29	1,232,586
Standing trees for timber from farm	6	400,000	1	3,360,000
Wild coffee	1	40,000	4	34,750
Wild honey	11	52,455	44	43,513
Wild pig	0	0	1	100,000
Yams(wild)	21	33,738	65	31,191
Household average income		303,416 (\$138 USD)		234,404 (\$107 USD)

In summary crop production was the leading earner of income to households, followed by livestock production and lastly income from various forest products (table 4.14). Crop farming was undertaken by the majority respondents, followed by respondents gathering forest products and a minority of respondents rearing livestock.

Table 4.14: Summary of average income in Uganda Shillings derived by households in 2010 from selling and consuming various agricultural crops, forest products and livestock/livestock products

Type of good	Average income from goods in BBC	Average income from goods in BKC
Income derived from goods sold		
Agricultural crops	293,711	363,109
Forest products	197,755	157,274
Livestock & products	198,528	277,513
Income from goods consumed		
Agricultural crops	296,254	239,437
Forest products	105,660	77,139
Livestock & products	140,200	42,151

4.5 Incentives to conserve private forests

4.5.1. Private and communal forest ownership

There exist discrete forest patches (ungazetted forests) on private land and a few patches on public land. So during the survey, respondents were asked if they owned private forests and if possible the size of the forest patch owned. 64 respondents in BBC owned private forests totaling 194.2 ha compared to 155 respondents in BKC owning a total of 464.6 ha of corridor forests (table 4.15). The average size of forest per household held in BBC and BKC was 3ha.

Table 4.15 The number of respondents owning private forests in a given range of hectares

Range of forest hectares owned	BBC forests region	BKC forests region
≤ 0.5	12	31
0.6 -2.4	39	77
2.5 – 4.3	3	21
4.4 – 6.2	1	9
6.3 – 8.1	4	3
8.2 - 10.0	0	7
10.1 - 11.9	0	0.
12.0 - 13.8	3	1
> 13.8	2	6
Total respondents	64	155

4.5.2 Indirect environmental values provided by private forest patches

Respondents were asked if it was a good idea to encourage private forest owners to retain forests on their lands for forest corridor connectivity. 94.2% of BBC and 68.1% BKC respondents said 'yes'. Objections ('no' answer) to wildlife corridor conservation idea were as follows: BBC (5.8% of respondents) and BKC (31.9% of respondents). The objection was largely attributed to corridor forests being reservoirs of vermin and problem animals raiding crops hence leading to economic losses in agricultural production and also to the need for more arable land for food production to feed families.

If 'yes', respondents were asked to explain why it is a good thing to keep their forests for conservation corridor connectivity, to which they revealed a number of conservation benefits that are likely to enjoy as a result of keeping their private forest patches.

Respondents gave the following reasons for keeping forest patches on their lands

- Movement of wild animals would aid dispersal of seeds which eventually would lead to regeneration of the forests and ultimately ensuring continued provision of vital ecosystem services.
- Forests influence microclimate (e.g. local rainfall pattern) that supports agriculture
- It would generally promote environmental conservation as well as conserving chimpanzees and their habitats
- Presence of corridor animals would lead to promotion of tourism and offer education opportunities to the present and future generation in the area
- Maintaining the natural heritage
- Guaranteeing continuous flow of ecosystem services for the benefit of local people.
- Increasing presence and movement of wild animals for bush meat in the area

Others accepted the corridor conservation idea on condition that it would not escalate human-wildlife conflicts and that adequate compensation is offered to offset the opportunity costs foregone such as farming.

Table 4.16 Site based indirect values accruing from corridor forests as identified by respondents supporting the corridor conservation idea

Indirect values	BBC forests region (responses out of 104 households)	BKC forest region (responses out of 238 households)
Carbon sequestration and storage	47.1	10.5
Influencing microclimate (rainfall attraction)	69.2	63.4
Biodiversity conservation and management	52	8.8
Forests act as wind breakers	0	5.5
Soil erosion prevention		1.7
Animals are seed dispersers/aid forest regeneration	2.9	10.1
Habitat for wild animals	3.8	7.6
Drought prevention	1.9	0.4
Soil fertility maintenance		7.1
Tourism and recreation	3.8	1.7
Environmental education	0	0.4
Source of building materials	0	1.3
Source of bush meat	0	5.5

4.5.3 Elicitation of Willingness to Accept (WTA) payment by forest owners and local communities

Rationale

There is a widespread perception amongst the rural people in Uganda that natural forests in themselves yield little or no value in economic terms. Indeed, alternative land-uses such as agriculture are currently more financially profitable, as are their by-products in the form of charcoal and fuel wood which provide crucial short-to medium term income, particularly to the poor (MLWE, 2002). Forest owners tend to see themselves as owning bushy land which at some point in the future, is to be converted to agriculture. It is not common for such forest owners to encourage, or at least not to discourage, gradual clearance of forests by adjacent communities. Natural forests are also cleared to remove the habitat of insect pests and disease vectors, which cause human and animal disease, as well as problem animals, which raid crops and kill livestock.

The National Forest Plan (2002) proposes the development of economic incentives that will include possibilities of compensation for forest conservation in form of carbon storage, the marketing of non-wood forest products through access to market information and markets, and the encouragement of high value added tree-based crops. Market-based incentives are being developed to potentially provide an incentive to conserve forests, for example through carbon sequestration and REDD, however these projects are not in place yet.

Willingness to enter in to a contract agreement for an incentive scheme

Within the above context, respondents were asked to state their willingness to conserve private forests in return for financial incentives. Respondents were asked as follows: "suppose there is a conservation NGO willing to give you financial assistance (carbon finance) for the conservation and management of your private forest, would you be willing to enter in an agreement"? 96.2% of interviewees in BBC said 'yes' against 3.8% who said 'no'. 85.3% of respondents in BKC expressed willingness to accept payment as opposed to 14.7% who said 'no'.

Those who said 'yes' were then asked to state the duration in years of finance agreement they would be willing to sign with the finance provider. The percentage responses are as indicated in table 4.17 below. 93% of respondents in BBC opted for payments to be effected on yearly basis during the life time of the payment scheme compared to 41.1% (majority) in BKC

Table 4.17 Percentage of respondents and the duration of contract agreement they were willing to sign in order to obtain monetary incentives to protect corridor forests

Duration of contract agreement	BBC forests region	BKC forests region
1 year	93.0	41.9
2 years	3.0	14.3
5 years	2.0	19.7
10 years	2.0	10.3
20 years	0	2.0
Not more than 20 years	0	6.4
Don't know	0	3.9
Monthly	0	1.5
Total percentage of respondents	100	100

Elicitation of Willingness to Accept payment

Respondents were asked to state the amount of money they would be willing to be paid per year as an incentive to keep natural forests standing on their land or to desist from activities that destruct another person's private forest or a small CFR. An open ended offer with open bids was presented to each respondent and asked to choose the most suitable amount of money. The WTA payment was elicited from households with natural forests.

93.3% of the interviewees (with and without private forests) in BBC indicated a WTA payment while 6.7% did not or declined any offer. BKC had 85.3% of respondents willing to accept against unwilling 14.7%. The WTA payment was solicited from those with or without forests. Those without forests expressed WTA payments for protecting the neighbour's private forest or the nearby small Central Forest Reserve.

Out of the interviewees WTA payments, 57.6% of them possessed private or community natural forests and owned on average 3.1 ha. Tables 4.18 show the number of respondents with natural forests and their associated WTA monetary levels/ranges in Uganda shillings.

Table 4.18 Number of respondents who owned private forests and were willing to accept compensation per year for not cutting down their forests. The numbers of respondents are indicated against WTA levels in Uganda Shillings

WTA payment intervals in UGX (000')	BBC forests region	BKC forests region
0 – 1,999	10	60
2,000 – 3,999	18	46
4,000 – 5,999	25	9
6,000 – 7,999	8	12
8,000 – 9,999	0	1
10,000 – 11,999	1	2
12,000 – 13,999	1	2
>14,000	0	8
Total no. of respondents	63	140
Size of forest owned	193.8ha	426.8ha
Average size of private forest owned	3.1ha	3.1ha
Average WTA payment/household head/year	4,274,206/=	4,228,286/=
Average WTA/year/hectare	1,389,448/=	1,386,973/=

BBC had one forest owner (0.4ha) who expressed no WTA payment while BKC had 5 private forest owners (37.8ha) who declining to accept the idea of compensation.

8.2% of the respondents in BBC and BKC who declined to indicate WTA payment or did not know the value to offer had the following reasons to give:

- The forest is communally owned, so there is need to seek consensus among members on the WTA value.

- Compensatory payments can't cater for all the forest goods and services derived from the forest
- The forest is a reservoir for vermin and problem animals acting as pests to crops in gardens
- The forest being reserved for other future land uses such as clay and sand mining, timber cutting and bee-keeping to cater for the need of future generation
- Squatters on the forests land and female respondents needed first to consult land owners and husbands respectively.

4.6 Socio-economic costs of corridor forests

Local communities living in and around corridor forests suffer economic costs due to problem animals and vermin (wild animals) damaging agricultural crops and/or injuring human beings. This has contributed to the clearance of private forests in order to get rid of crop pests and crop raiding wild animals. In this light, households were asked about crop-raiding to determine the percentage that suffer loss of crops to animals coming from the forest, to determine which species crop raid most frequently and to obtain information on measures they have used to control crop raiding.

Interviewees were asked if they face problems from crop raiding animals coming from corridor forests. 88.5% of respondents in BBC experienced human-wildlife conflicts compared to 11.5% who did not suffer from crop raiding animals. In BKC forest region, 85.7% of interviewees experienced problems from crop raiding animals while 14.3% did not. Generally, a high percentage of respondents stated that they lose crops to animals from the forest (table 4.19). Baboons and Vervet monkeys were cited by respondents as the most problematic crop raiding wild animals (table 4.20).

Table 4.19 The number of respondents that suffer crop losses due to crop raiding wild animals

Forest region	Chimpanzees	Vervet Monkeys	Baboons	Porcupines	Wild pigs	Forest duikers
BBC	13	75	66	1	3	2
BKC	7	192	140	2	15	1

Table 4.20 The number of respondents who were asked to name the most problematic crop raiding wild animals

Corridor forest region	Baboons	Vervet monkeys
BBC	49	34
BKC	107	81

Problem animal prevention techniques

People manage crop raiding problems differently but common to all is guarding of crop fields (Table 4.21)

Table 4.21 Number of respondents using control techniques to deter problem animal and vermin emanating from corridor forests

Methods of prevention	BBC forests region	BKC forest region
Guarding the garden	98	147
Raising alarm	1	2
Throwing stones	0	1
Chasing using dogs	0	2
Gun shooting by vermin guard (employed by District Local Government)	0	5

5 Discussion

5.1 Contribution of northern corridor forests to rural livelihoods

This study found out that 83.7% of the households in BBC and 84.7% of those in BKC derived poles, mud, reeds and fibres from corridor forests for construction of house walls. House thatching materials were also derived from these forests as evidenced by 26% of respondents having grass-thatched structures in BBC compared to 17.6% of interviewees in BKC with similar structures. The type of materials used in construction of roof, wall and floor of a house are good indicators of how-well off households are in terms of housing (UBOS 2003). The 2002 Housing and Population Census reported that only 17% of the houses in Uganda were made of permanent roof, floor and wall materials and about 59% of houses in urban areas were permanent compared to 10% in rural areas. The implication is that even now most houses, especially rural ones, are constructed of natural resources materials and scarcities of these (poles, grass for thatch, etc.) adversely affect housing conditions (NEMA 2004).

As is the case with most rural and urban households in Uganda, fuel wood for cooking and heating remained one of the most sought after goods from corridor forests. The annual average fuelwood consumption per household in and around the corridor forests stood at 206 bundles or billets. Wood fuel was complimented by grass biomass that is mostly used in curing tobacco at the peak of tobacco harvesting season. Fuel wood energy is the major source of energy for domestic cooking, heating and lighting in Uganda (MLWE, 2002). Over 90% of Ugandans use fuel wood as the main or only source of energy, consuming 16 million tonnes each year as domestic firewood and 4 million tonnes as charcoal (MLWE, 2002)

52.7% of the respondents cited corridor forests as the main source of water for their domestic use. The annual average water utilized per household was 29,200 litres. Forests provide a wealth of indirect environmental benefits as well as direct use benefits for many of the people surrounding them (Bush *et al* 2004) and beyond. The loss of forested areas upsets soil-water relations, creates soil erosion, and lowers water quality that, in turn, has an associated effect on human health (Bush *et al* 2004). Tropical High Forests (THF) protect watersheds, river valleys and lakeshores. Their "sponge" effect soaks up the water that would otherwise run off and get lost and release it slowly to the streams and wells thereby guaranteeing all-year-round flow. In the Murchison-Semliki Landscape, corridor forests protect the sources of underground water that re-charges springs and wells ensures more constant flow of the Muzizi, Nguse, Wambabya and Waki rivers into Lake Albert. The smaller CFRs in Hoima, Kibale and Masindi districts perform watershed functions as re-affirmed by table 3.1.

As revealed by table 4.3, BBC had 84.4% of respondents engaged in farming activity as compared to 92.6% of respondents in BKC. In 2010 a respondent in BBC and BKC earned on average an income of Ug. Shs. 589,965/= and Ug. Shs. 602,084/= respectively from crop production. In the same period of time, a respondent in BBC obtained an average income of Ug. Shs. 338,729/= from livestock production as opposed to Ug. Shs. 323,138 a respondent on average earned in BKC. These average income values are reflected in tables 4.11 and 4.12 respectively. Agriculture is the major economic activity and the backbone of Uganda's economy. It largely depends on rainfall and fertile soils. Corridor forests make a significant contribution indirectly to agricultural productivity in the Murchison-Semliki landscape through promoting soil and water conservation, preventing soil erosion, increasing water infiltration, maintaining soil fertility, providing crop pollinators and attracting rain. Forests and trees protect and improve soils and substantially increase crop yield.

The study also found that in 2010, corridor forests provided a variety of forest goods and services for rural livelihood promotion. As summarised in table 4.13, the goods ranged from wild foods, medicinal materials, house building materials, carpentry items, bush meat and handcraft materials. These forest goods and services generated an average income of Ug. Shs 304,864/= and Ug. Shs 234,400/= to household heads in BBC and BKC forests regions

respectively. The average forestry income included the monetary value of forest goods that were harvested for household consumption as well as sale. Other studies have shown that poor households in forested areas earn up to Ushs 130,000 per year from the sale of forest products such as bush meat, medicines, rattan, bamboo, craft materials and food (MWLE, 2002). Bush et al (2004) estimated mean forest income for a household south of Bugoma was around Ug.Shs. 320,000/= of which 82% was consumed in the home and only 57,000/= raised as cash income for the household from sales of forest products. It is clear from this study that sales of forest products in the region have increased significantly or that prices per item have increased.

5.2 Conservation Knowledge, Attitudes and Practices

Corridor forests provided not only direct forest goods and services but also indirect ones i.e non-consumptive goods. 47.1% of interviewees in BBC and 10.5% of those in BKC (table 4.16) were aware of the role their private forests play in mitigating global warming by way of carbon sequestration and storage. Forests stabilize climate, through absorbing the carbon dioxide from the atmosphere. Forests mitigate climate change through absorbing and storing carbon dioxide i.e. providing a natural reservoir for these GHGs –said this above When they are destroyed or degraded, they release large quantities of carbon-dioxide and other GHGs, and become a significant or primary source of GHG emissions and a contributor to climate.

Within the framework of REDD+ (REDD or REDD+ - the discussion has so far been about REDD where payment is made for standing carbon; the overwhelming majority of respondents in BBC and BKC were willing to accept forest carbon finance as a means of compensating them for the opportunity costs foregone while protecting private forests for (biodiversity conservation) purposes. Respondents from BBC forest region exhibited 96.2% Willingness to Accept for REDD carbon payments vis-a-vis 85.3% of the respondents in BKC forests region. 57.6 % of interviewees in BBC and BKC forest regions who were willing to accept REDD payments owned collectively an estimated size of 659 hectares i.e. on average 3.1 ha of private forests. The average Willingness to Accept payment per hectare per year was Ug. Shs 1, 387,746/= (or \$631 USD). Estimates of what could be generated from REDD+ funding for the whole corridor region suggest that \$94/ha/yr could be generated from REDD+ or \$281/ha/yr for the average size of forest on farmers land (3ha). From this some funds would need to go to monitoring, verification and management of the funds but it indicates that REDD+ funding could perhaps compensate for the value of what farmers obtain from forests currently (\$130-140/household/yr) but would not meet WTA payment expectations.

There is a perception among local communities that corridor forests are reservoirs of wild animal species that are crop raiding. This is one of the main reasons as to why 5.8% of respondents in BBC as well as 31.9% of respondents in BKC rejected the idea of putting aside their private forests for ecological corridor connectivity purposes. This issue could be a major concern for any REDD project and it should be factored in and addressed in the design of the project.

6 Conclusions and Recommendations

The survey has shown that corridor forests provide forest goods and services which are vital for sustenance of local livelihoods and promotion of local economy. The varied forest products commonly provided range from house building materials for dwelling, fuel woods to domestic water supply and forest foods. In addition to this, the accruing intangible values are: carbon storage and sequestration, soil erosion control, wind breaking, aiding forest regeneration through seed dispersal, soil fertility maintenance, influencing local microclimate through rainfall attraction and drought prevention. In general the forest goods and services mainly contribute to human well-being through boosting agricultural productivity, which in turn contributes to household income levels, nutrition as well as food security. Despite contributing significantly to local livelihoods, these corridor forests are disappearing at a terrifying rate, mainly due to conversion of more natural forests to agricultural fields and human settlement. Urgent conservation action is needed to halt this state of affairs. Options that need to be explored and promoted to halt this include, among others, market based incentive schemes

such as REDD+ funding, promoting agro-forestry, establishing woodlots and promoting improved agricultural practices to lessen the need to open more fertile forests for farm land. If given economic incentives it is likely that farmers will adopt conservation friendly practices. Interviewees generally and private forest owners demonstrated a strong willingness and desire to keep their forests standing for the purposes of conserving biodiversity, combating global warming and ensuring continuous flow of forest goods and services.

The corridor forests possess a diversity of tree species, birds and mammals which have tourism potential. As one of the ways of diversifying local economic activities, private forest owners can be helped to develop and implement community based eco-tourism enterprises that will generate additional income and hence maintaining the motivation of private forest owners to protect their forests.

The most common form of land ownership in the corridor forest is informal tenure or customary tenure system where private forest owners do not possess land titles. There is insecurity of tenure which is associated with this type of land ownership, resulting in to open access use (common pool resources) of the corridor forests and ultimately leading to loss of biodiversity, promotion of soil erosion and reduction in soil productivity. To avert this, there is need to help private forest owners register their forests with the District Land Boards and where possible help them acquire land titles that will legalize ownership of forests, hence guaranteeing formal ownership of the forestry resource. Related to this, there is need to mobilize private forest owners in a forest association/network with the aim of providing a common platform to voice their concerns and also soliciting support. If a REDD+ project is to be developed issues of land tenure need to be resolved.

This study shows though that a REDD+ project could provide sufficient incentive for farmers to seriously consider conserving forest on their land as it can offset their current revenue from forests.

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