FIVE YEARS OF BIODIVERSITY INVESTMENT IN UGANDA

PRODUCTIVE RESOURCES INVESTMENT FOR MANAGING THE ENVIRONMENT

BIODIVERSITY MONITORING FINAL REPORT

SEPTEMBER 2008

USAID FROM THE AMERICAN PEOPLE

PRIME West

WILDLIFE CONSERVATION SOCIETY

DAI PRIME/WEST/WCS SUBCONTRACT #3827-203-05S-003
UNDER
USAID/DAI PRIME/WEST CONTRACT # 617-C-00-03-00011-00

Monitoring the Impact of PRIME/WEST activities on the environment, with specific reference to biodiversity

Productive Resources Investment for Managing the Environment (PRIME)

Wildlife Conservation Society (WCS)
and
Makerere University Institute of Environment and Natural Resources (MUIENR)

FINAL REPORT

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Executive summary

USAID/DAI/PRIME WEST/WCS subgrant #3827-203-05S-003 for US$889,609 was established to support the monitoring of the Impact of PRIME West activities on the environment, with specific reference to biodiversity. Wildlife Conservation Society (WCS) together with MUIENR Databank were subcontracted by DAI/PRIME West monitor the biodiversity and threat changes in the PRIME West working areas. The specific activities were to

1) Assist PRIME West (PW) in developing a monitoring and evaluations system which tracks changes in knowledge, attitudes and practices among key stakeholders regarding the enabling environment as a result of PRIME West assistance;
2) Monitor threats to forest/woodland and aquatic resources in selected critical buffer zone areas as a result of PRIME West interventions;
3) Monitor changes in the number of formally reported aquatic, forest and woodland ecosystem-related conflicts as a result of PRIME West interventions;
4) Monitor changes in indicator taxa in threatened (selected) forest and woodland ecosystems within normal range of population fluctuations as a result of PRIME/West interventions;
5) Monitor changes in the number of formally reported aquatic ecosystems-related conflicts as a result of PRIME West interventions;
6) Link these changes to the activities of PRIME WEST and test the assumptions inherent in PRIME West's innovative approach which addresses the wider landscape and uses a market-based approach to tackling environmental degradation as a means of learning lessons about landscape conservation and Community Based Natural Resource Management (CBNRM);
7) Measure the conservation impact of the project in selected areas on the two major threats to biodiversity loss in the Albertine Rift: (i) habitat loss, degradation and/or fragmentation; and (ii) over exploitation of species for commercial gain or subsistence.

In general, we found out that for some mammal species such as gorillas, elephants, Uganda Kob and Buffaloes, the populations were increasing while most of the primates, particularly the chimpanzees and monkeys were declining mainly due to poaching and habitat loss/degradation. Regarding the birds, the results showed an increase in bird species sightings in most of the sites. However, the bird species that are specific to wetlands, bamboo and forest habitats still face eminent danger from habitat loss. Human threats and ecosystem-related conflicts were declining in the areas that we were monitoring mainly because of law enforcement and regular presence of monitoring teams in these sites. It was noted that law enforcement is a vital ingredient for all community based natural resource management interventions. As such, there was no clear link between increasing the incomes of adjacent communities with reduction in threats to biodiversity. In reality, poor households were getting much poorer and the relatively wealthier households were getting economically better. Because poor household heavily depend on forests, they are forced to illegally harvest products. The increase in protection and regulation of community access to protected resources was increasing poverty among the poor households and in the long-run this could result in an upsurge of the exclusion costs for the management authorities.

The demand for the adjacent communities to co-manage protected areas is still premature. Local people in this region still face major constraints such as land tenure insecurity, inability to access financial capital in order to create off-farm investments, (the poor being the most vulnerable) low market prices for farm products, high crop losses and livestock predation due to wild animals and resource user groups are technically incapacitated and structurally still weak.

As a recommendation, it is considered important to develop special programs that address individual household constraints to economically prosperity and reduce their dependence on protected area resources. Provision of alternative income generating activities based on the household capacity, opportunities and the inherent resources is likely to be a more credible strategy than the community based approach if the objective is to raise household incomes. Development of the tourism sector, including community tourism supplemented by innovative off-farm activities to increase household incomes and park revenues could be considered.

Reduction of forest and wetland degradation on private land demands yet another strategy such as creating competitive economic incentives that deliver high returns to land to encourage land owners to protect the resource. Economic incentives could include carbon credit schemes, payment for ecosystem services, (e.g. watershed management), offer subsidised technical services to private forest owners to manage them as a profitable business and develop sustainable financing mechanisms for the protected areas to reduce the temptation by resource managers to increase harvesting quotas but promote afforestation and support innovations that provide alternatives to the forest products.

Elephant and lion tracking, both project activities supported by USAID grants and implemented by WCS have provided scientific evidence in the Virunga landscape that landscape approach is a viable strategy towards conserving key landscape species such as lions, elephants and flagship species mainly gorillas and chimpanzees. Maintaining connectivities between protected areas is essential for not only animal movements but also for genetic diversity. Elephants and lions require large areas, which sometimes cross political boundaries in search of food, water and mates. Any conservation initiatives that work towards increasing the protected area connectivity, will contribute immensely towards the survival of such key landscape species. The elephant and lion monitoring data can be utilised in planning for protection of core habitats and also to target interventions in areas deemed to be vulnerable to people-wildlife conflicts. Of immediate attention in this landscape is the financial support to enable the implementation of the developed QECA corridor plan, of which the immediate action is to strengthen the corridors of Kyambura WR-Kasyoha Kitomi FR used mainly by chimpanzees and elephants and Muhokya corridors to enable elephant movement to Kibale National Park.

Monitoring of biodiversity and human threats should be made an integral part of the conservation programs. Protected area authorities are under funded to measure up to this task because it requires a lot of finances and is long term. The Wetland Management Department, Fisheries department, UWA, NFA and District Forest Services need more support to able to continuously monitor the biodiversity status. Oil and Gas development is another challenge in the region whose environmental impacts are not yet known. Further training of Environmental impact monitoring staff at the local government level together with the private practitioners is highly recommended.

Specific to PRIME West design, the project framework did not provide for the sustainability of the good innovations learnt. At this stage, it is unclear whether or not the systems put in place will continue to work without external support. It is therefore recommended that environmental mainstreaming should be inherent in the project design with a deliberate inclusion of government institutions and conservation organisations with long-term commitment to the region. Also, the project targets and time frame should be realistic to deliver tangible outputs and allow the good lessons learnt for replication elsewhere. Lastly, WCS and MUIENR have been able to demonstrate the importance of using conceptual models to monitor the impacts of the projects including the use of appropriate monitoring techniques that minimise costs.

1.0 Introduction

This final report summarises project achievements in the context of contractual requirements and wider issues and perspectives, where appropriate. The subcontract was awarded on February 3, 2006 and the project field operations ceased on June 30 2008. Quarterly reports (First to Eleventh) provide details of project activities in relations to annual work plans consistent with the aim and project objectives. Annual reports (November 2006 and October 2007) provide a review of project activities up to date, and a final report gives the overall assessment of the project achievements and "lessons learned." The project sought to conserve critical habitat and species in the two landscapes that comprise the Ugandan portion of the Albertine Rift region, particularly the Greater Virunga landscape and the Murchison-Toro-Semliki landscape. The global threats to biodiversity continue to be:

1. Habitat loss/degradation/fragmentation;
2. Over exploitation of species for commercial gain, subsistence and sport;
3. The introduction of alien species; and
4. Pollution from oil and gas exploration, especially in the core biodiversity areas.

DAI/PRIME/West focused on three of these global threats - habitat loss/degradation/fragmentation, over exploitation of species, and pollution from oil and gas exploration, especially in biodiversity critical areas. The first two threats are the most predominant causes of biodiversity loss across both landscapes. Sub-threats under these two global threats addressed by the project included: a) illegal wood cutting; b) shift of arable agriculture into remaining natural forests and wetlands; c) overexploitation of heretofore commercially viable species; d) illegal hunting in protected and other areas; and e) change of land use from protected areas to agriculture or industrial expansion via political decisions (e.g. protected area degazettement and land grabbing). As such, interventions were designed targeting to reduce and/or mitigate these eminent threats to biodiversity.

Wildlife Conservation Society (WCS) was subcontracted to monitor the impacts of the project interventions on biodiversity in southwestern and western Uganda where PRIME West (PW) was operating. Originally, the subcontract to WCS had a sub tier contract to Makerere University Institute of Environment and Natural Resources (MUIENR) to support the National Biological Databank and training of Ugandans in Natural Resource Management and Conservation. However, due to technical difficulties, WCS opted for purchase order agreement to implement the project activities that had been negotiated. The subcontract as originally contracted to WCS was adjusted significantly, twice, to better meet the evolving USAID strategic needs. A refocusing of the project was requested by the USAID mission early in the implementation period (2005) but this did not affect WCS till (October 2007) when another major reconfiguration of the project took place leading to major changes in the Statement of Work (SoW). In March 2007, WCS was advised of a budget cut which was incorporated in the approved subcontract modification in April 2007. These changes are briefly discussed in the next section (1.1).

1.1 Project goal and objectives

The goal of this subcontract is to assist PRIME/West in testing two of its major development hypotheses that:

1. Providing economic alternatives to unsustainable natural resource uses will contribute to reducing environmental degradation and will help conserve critical ecosystems.

2. Establishing communal property and management regimes by defined groups in defined areas/critical ecosystems with rights of inclusion and exclusion will result in fewer threats/conflicts and increased biodiversity.

The objectives of this subcontract are fivefold:

1. Assist PRIME/West in developing a monitoring and evaluations system which tracks the following Project Intermediate Result (PIR) indicators:

PIR 1: Enabling environment for biodiversity conservation and alternative livelihoods improved
Changes in knowledge, attitudes and practices among key stakeholders regarding the enabling environment as a result of PRIME/West assistance
PIR 2: Threats to forest and woodland biological diversity decreased
Threat levels reduce to forest and woodland resources in selected critical buffer zone areas as a result of PRIME/West interventions
Change in the number of formally reported forest and woodland ecosystem-related conflicts as a result of PRIME/West interventions
Change in indicator taxa in threatened (selected) forest and woodland ecosystems within normal range of population fluctuations as a result of PRIME/West interventions
PIR 3: Threats to aquatic ecosystems (lakes and wetlands) reduced
Threat levels to aquatic resources in selected critical buffer zone areas as a result of PRIME/West interventions
Change in the number of formally reported aquatic ecosystems-related conflicts as a result of PRIME/West interventions
Change in Indicator taxa in threatened (selected) aquatic ecosystems within normal range of population fluctuations as a result of PRIME/West interventions

2. Assess changes occurring to conservation target species and indicator species,
threats to them and people's attitudes and practices with respect to conservation over the life of the project;
3. Link these changes to the activities of PRIME/WEST;
4. Test the assumptions inherent in PRIME/West's innovative approach which addresses the wider landscape and uses a market-based approach to tackling environmental degradation as a means of learning lessons about landscape conservation and Community Based Natural Resource Management (CBNRM).
5. Measure the conservation impact of the project in selected areas on the two major threats to biodiversity loss in the Albertine Rift: (i) habitat loss, degradation and/or fragmentation; and (ii) over exploitation of species for commercial gain or subsistence.

1.2 Project adjustments

In April 2007, a number of changes were made to the USAID/DAI PRIME West Project including some changes in the context within which the project was working. This automatically demanded WCS-MUIENR biodiversity monitoring programme under its sub-contract to make appropriate

revisions to the scope of work and subsequent budget adjustments to re-align with the new strategic framework for USAID Missions in the region. Previously, the project fell within USAID/Uganda Strategic Objective #7, Expanded Sustainable Economic Opportunities for Rural Sector Growth. Due to changes in the use of foreign assistance to achieve the U.S. goal of Transformational Diplomacy, USAID/Uganda was advised to develop a new strategic framework for the way it does business in Uganda, including country priority focus, budget allocation and reporting requirements.

For that reason, PRIME West had to fit within the new USAID foreign mission Operational Planning framework, complete with proposed indicators and baselines for certain indicators that have been carried over from Strategic Objective #7. As a result of the changes in the USAID/DAI contract, WCS-MUIENR monitoring activities were revisited and scaled down leading to the necessary budget adjustments. For example, direct income raising activities meant to target frontline communities were dropped and for some interventions, the operational area got reduced. Ultimately, WCS subcontract had to be modified (reference is here made to WCS Mod.1 Appendix C SOW 060407; Annual Report 2007) leading to the drop in site activities (e.g. Southern Kalinzu meant for Collaborative Forest Management; Kasangali, the Arabica coffee growing area, mid north of the Rwenzori MNP), and complete abandonment of some monitoring sites such as Ngoto and Mulehe Wetlands. However, the goal of PRIME/West project remained to conserve biodiversity by reducing threats to forest, woodland and aquatic ecosystems through increased economic opportunities and conflict reduction for rural communities in the project working areas.

In 2007, the fourth threat - pollution from oil and gas exploration, especially in biodiversity critical areas - was becoming a potential problem in Uganda. Prospecting for oil and gas exploration, and other alternative energy sources such as geo-thermal development were underway in the Albertine Rift. Reports by prospecting oil companies such as Heritage and Tullow Oil, and the Department for Energy and Petroleum Production (PEPD) under the Ministry of Energy and Mineral Resources indicated that oil discoveries were large enough to justify development and commercial exploitation. Therefore, little doubt exists that oil exploitation will continue to occur given its potential importance to Uganda's economy. It was anticipated that oil exploitation will affect wildlife, fragile ecosystems, and communities in the region and several important protected areas may suffer negative impacts. Already drilling has had negative impacts on some protected areas, with scanty attention paid to those impacts. DAI, in collaboration with the Uganda Wildlife Authority (UWA), the National Forest Authority (NFA), the National Environmental Management Authority (NEMA), the Wildlife Conservation Society (WCS), and Lake Albert Safaris Limited (LASL) initiated planning to anticipate the development of these oil resources so as to reduce and mitigate the impacts, and explore options for offsets, such as financial compensation, that could serve as a source of long-term conservation financing.

1.3 Conceptual models for PRIME West Interventions

In January 2006, a meeting was held at PRIME/west's offices in Kabale to work through the conceptual models and develop further the links between PRIME West project interventions and the impact they are thought to have on biodiversity conservation. PRIME West's approach to integrated conservation and development (ICD) took to implement the lessons learned from previous approaches where it was identified that there is a need to ensure good markets for products before trying to develop alternative sources of income for communities adjacent to protected areas. This market-oriented approach aimed to identify, and in some cases create markets for products that would either help drive a process of sustainable management of these resources or alternatively provide other sources of income and time expenditure so that people were less likely to engage in illegal activities.

The meeting resulted in the development of conceptual models that helped to show the logic between the project interventions and the impact on biodiversity conservation. This approach has been used successfully in an assessment of ICD projects around Bwindi Impenetrable National Park (Namara and McNeilage, 2006), however in this case it was a post-hoc assessment. This meeting launched the start of the WCS/MUIENR SAF project, which aimed to measure and document PRIME/west's impact on the environment. The meeting helped to identify the interventions to be monitored, detail specific sites/locations (and how widespread will the impact be) and select sites without PRIME West interventions for comparison purposes. It also helped to identify the underlying assumptions under each intervention model and prioritise linkages and assumptions to test for the conservation impact of PRIME West (i.e. potential weak links and questionable assumptions for conservation impact).

The interventions to be monitored were selected based on the following criteria:

1. ability to show impact within 2.5 years
2. practical to monitor
3. Needed to be a core focus of PRIME/west
4. an intervention taking place over a relatively large scale
5. availability of baseline data
6. hierarchy and scale of impact on conservation (where more direct impacts would be easier to monitor).

Following the discussions with DAI/PRIME West field team in the presence of USAID Environmental and Natural Resource Advisor, eight main interventions and the proposed operational sites (**Figure 1.1)** were identified namely;

1. Strategies to improve conservation of wetlands (promote community wetland management, aquaculture and reverse slope terracing);
2. Bamboo harvesting from Echuya Forest Reserve;
3. Arabica Coffee Production around Rwenzori Mountains National Park;
4. Problem animal control;
5. Corridor management in the Greater Virunga Landscape (QEPA including Kalinzu/Maramagambo and Kasyoha-Kitomi Forest Reserves);
6. Community Forest Management approaches;
7. Beach Management Unit strengthening on Lake George;
8. Fuel wood production around Queen Elizabeth National Park.

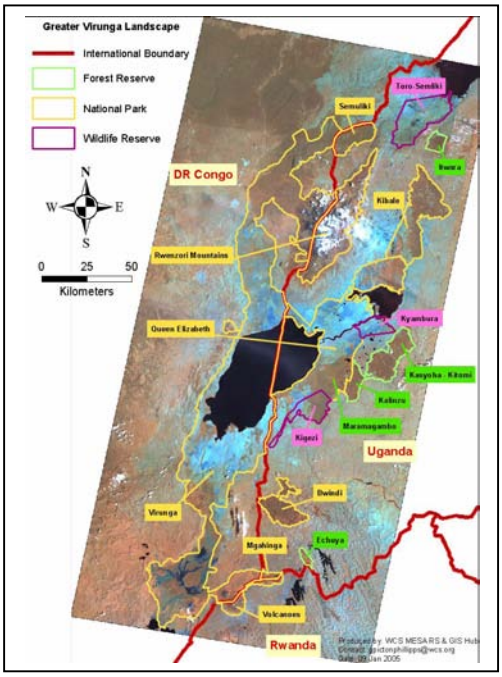


Figure 1.1 Map showing the landscape where PRIME West was working

The main intervention strategies of PRIME/West and habitat types in which they occur in western Uganda were summarised in **Table 1.1.** It was agreed that WCS/MUIENR would monitor at least seven of these:

Table 1.1 Main intervention strategies and ecosystem types in PRIME West working areas

Strategies	**Forest**	**Wetland**	**Savanna**	**Lakes**
Community Wetland Management		XX		X
- Aquaculture		XX		XX
- Reverse slope terracing		XX		
Bamboo harvesting	XX			
Arabica Coffee production	XX			
Fuel Wood production	XX		X	
Conflict management	X	X	X	X
- Problem animal management	X		X	
Corridor management	XX		X	
Community Forest Management	XX			
Beach Management Unit Strengthening				XX
Tourism	X		X	
Revenue Sharing	X		X	X

XX – main habitat of intervention; X – minor habitat affected. Those areas highlighted in yellow were decided by the group as interventions that WCS/MUIENR project would monitor.

Conceptual models were developed for each of these eight interventions and these are summarized in **Figures 1.2-1.8**. Two major assumptions cut across all the strategies, that is, 1) that there would be political will and 2) law enforcement would take place. Oval circles represent the assumptions while the green stars indicated where WCS/MUIENR aimed to test linkages and impact.

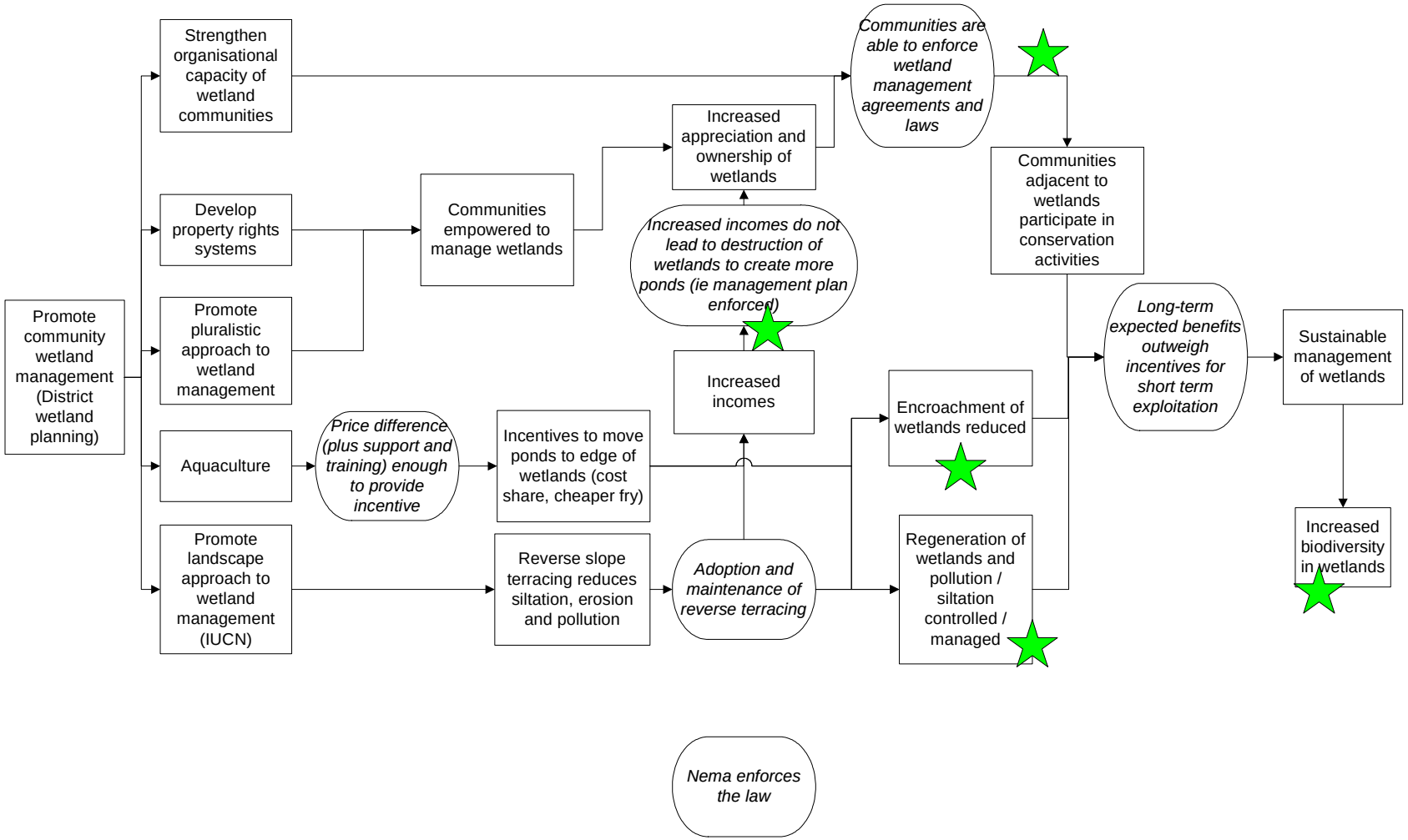


Figure 1.2 Conceptual model for improvement in wetland management

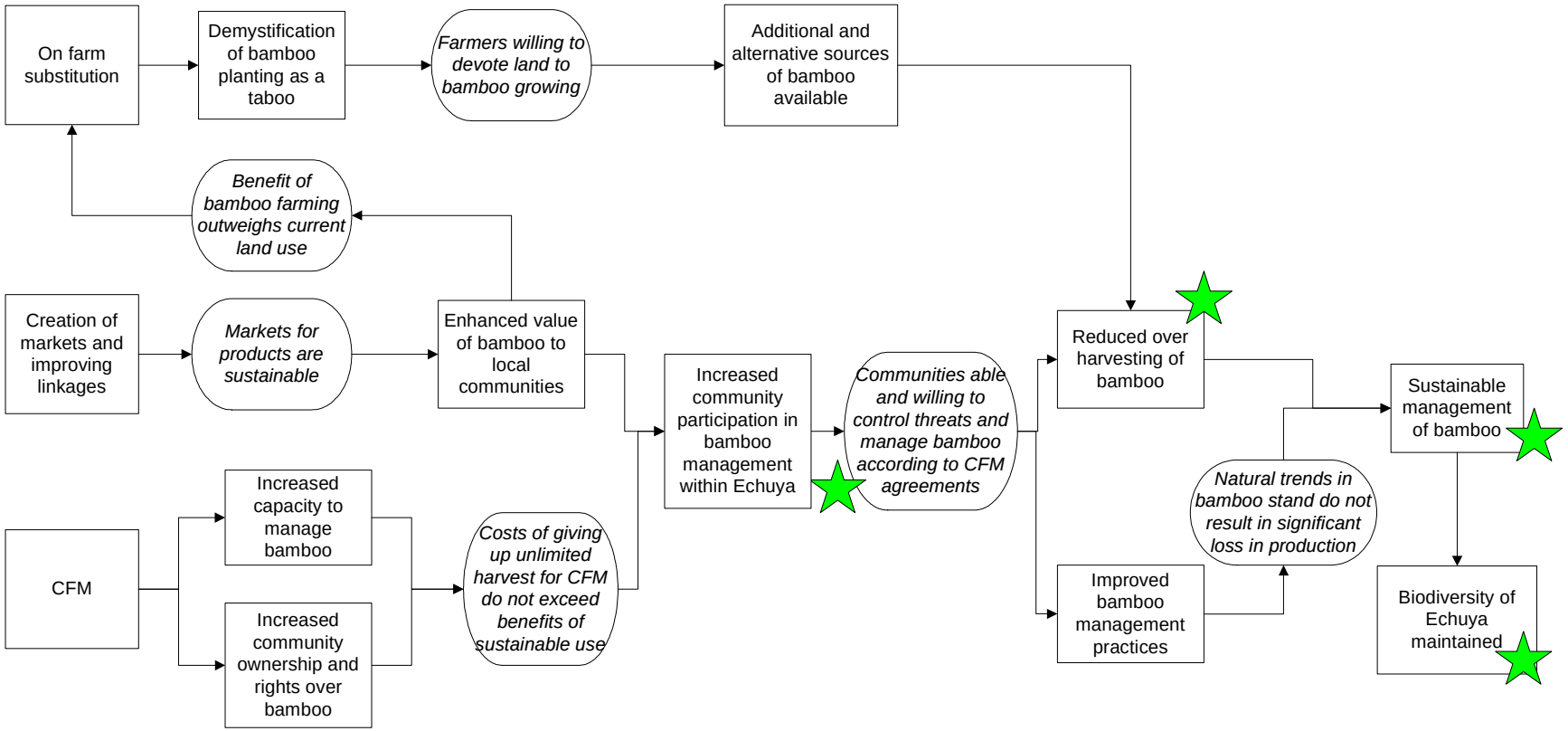


Figure 1.3 Conceptual model for bamboo management in Echuya Forest Reserve

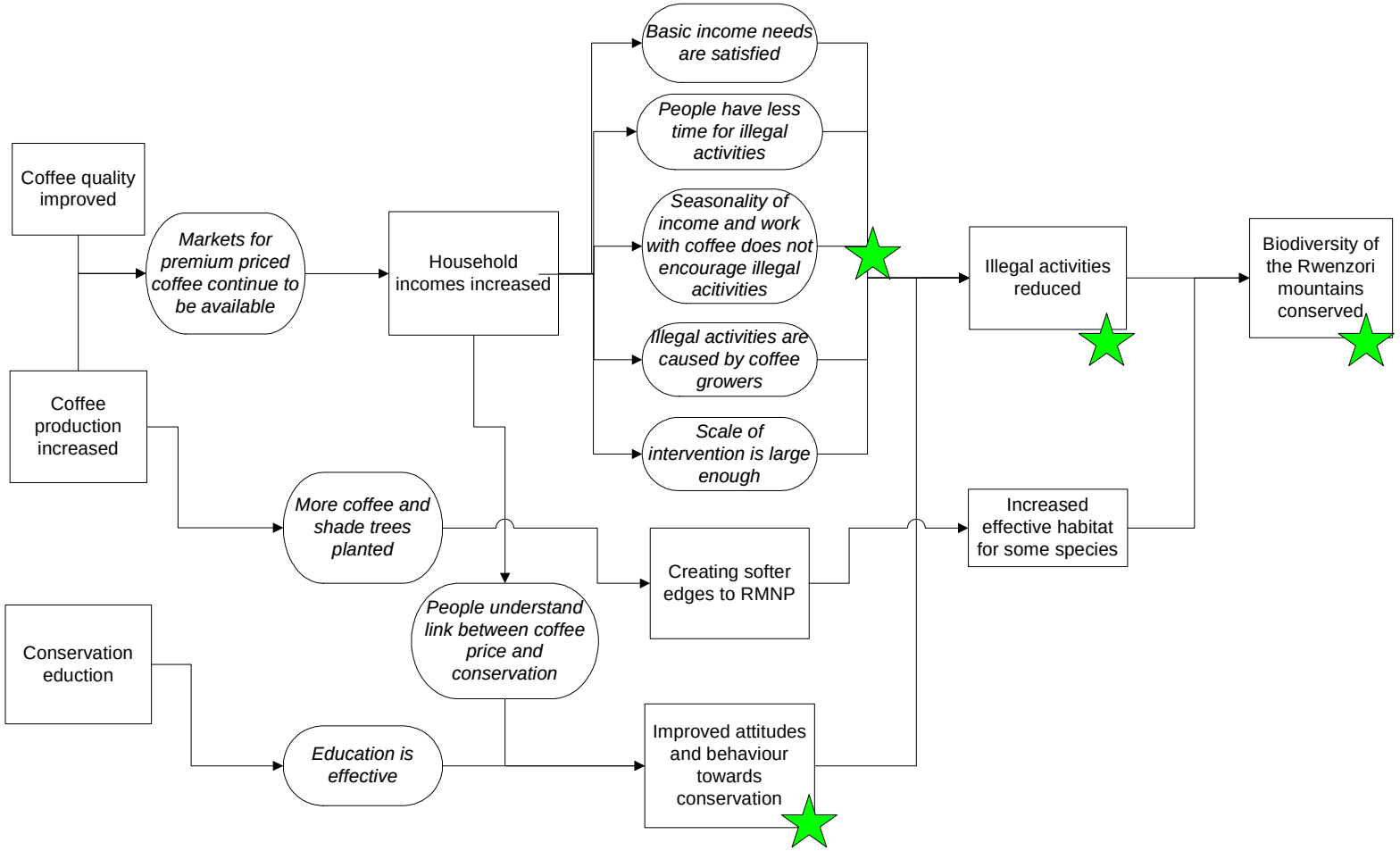


Figure 1.4 Improved Arabica coffee production around Rwenzori Mountains National park

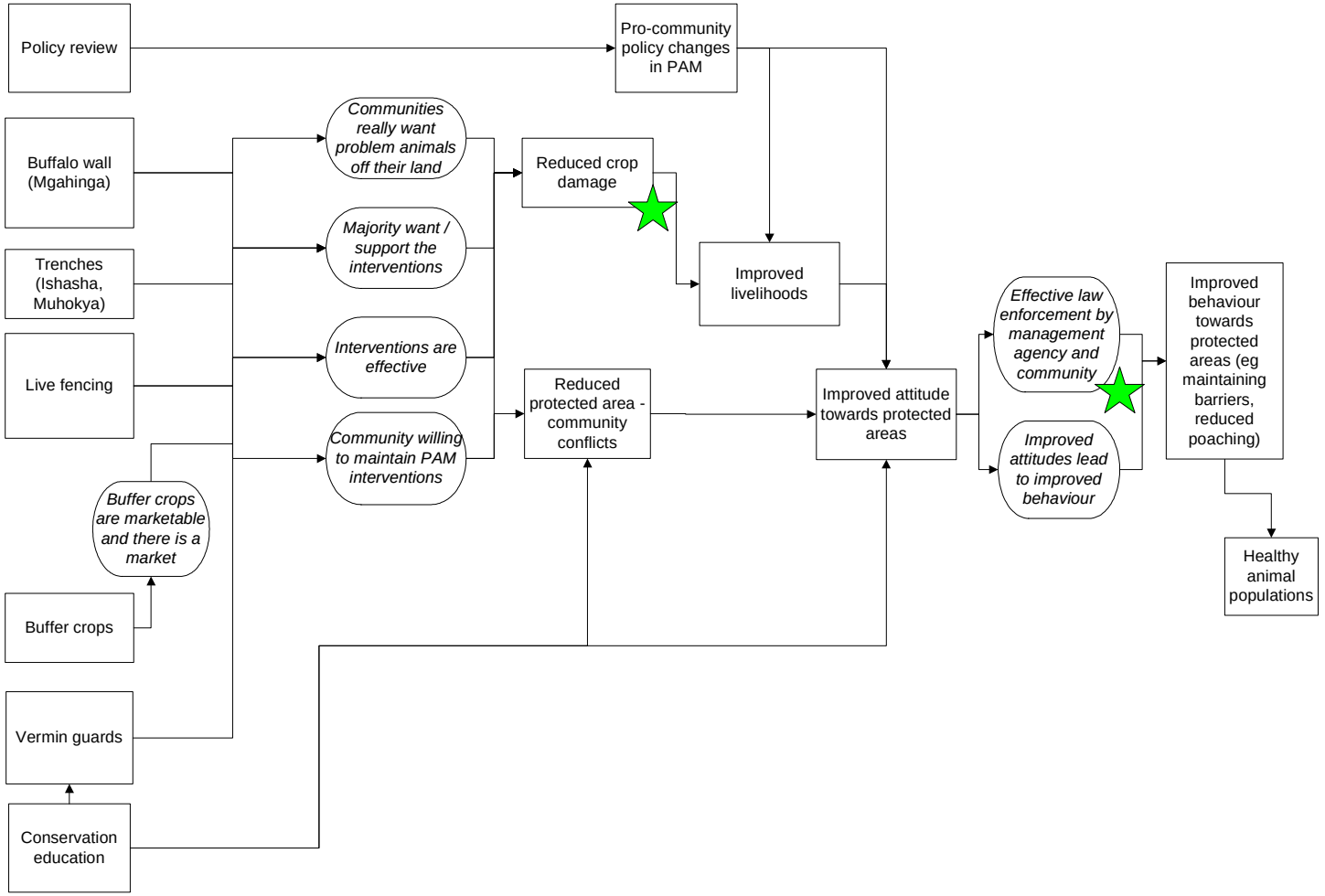


Figure 1.5 Conceptual model for Problem animal control around Queen Elizabeth Protected Area

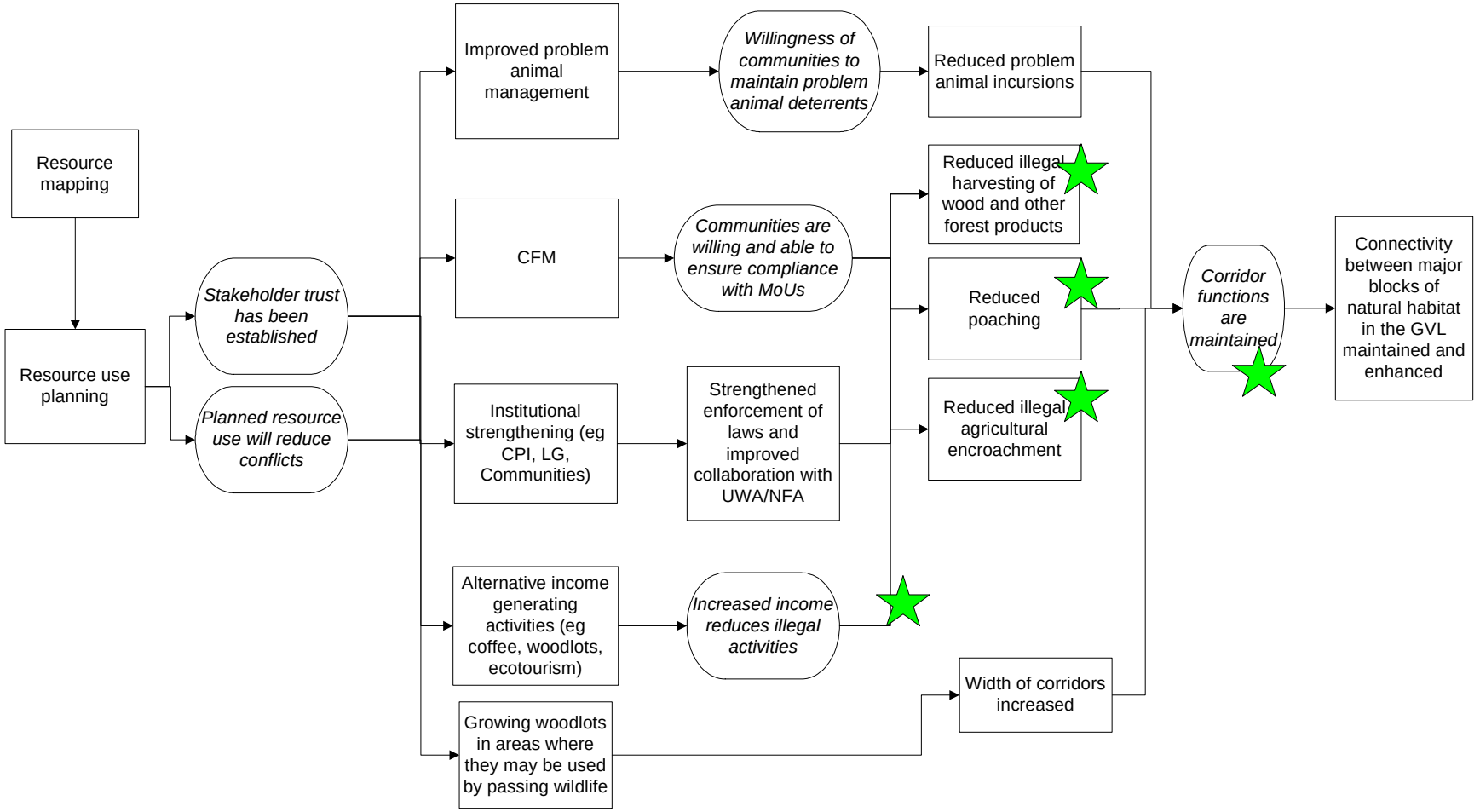


Figure 1.6 Conceptual model for the management of Queen Elizabeth Landscape corridor

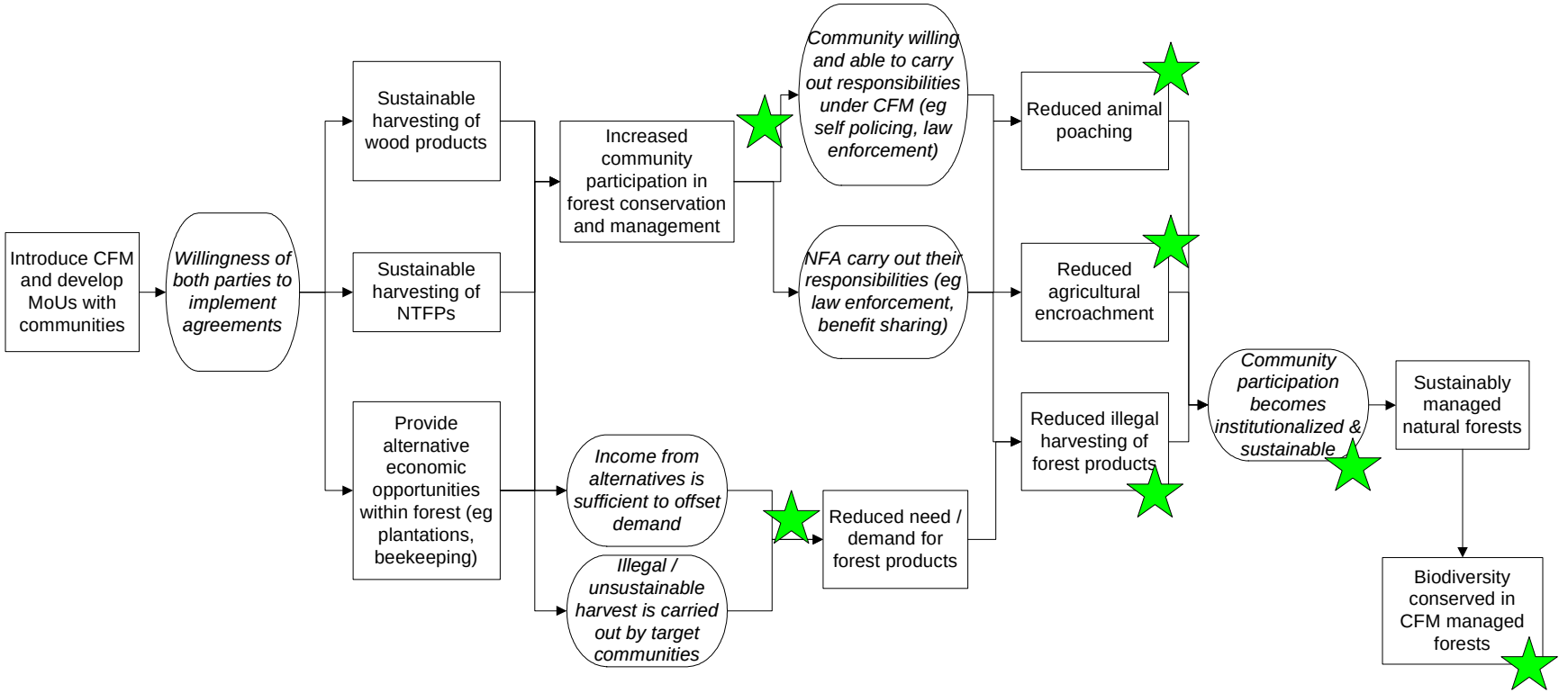


Figure 1.7 Conceptual model for Community Forest Management

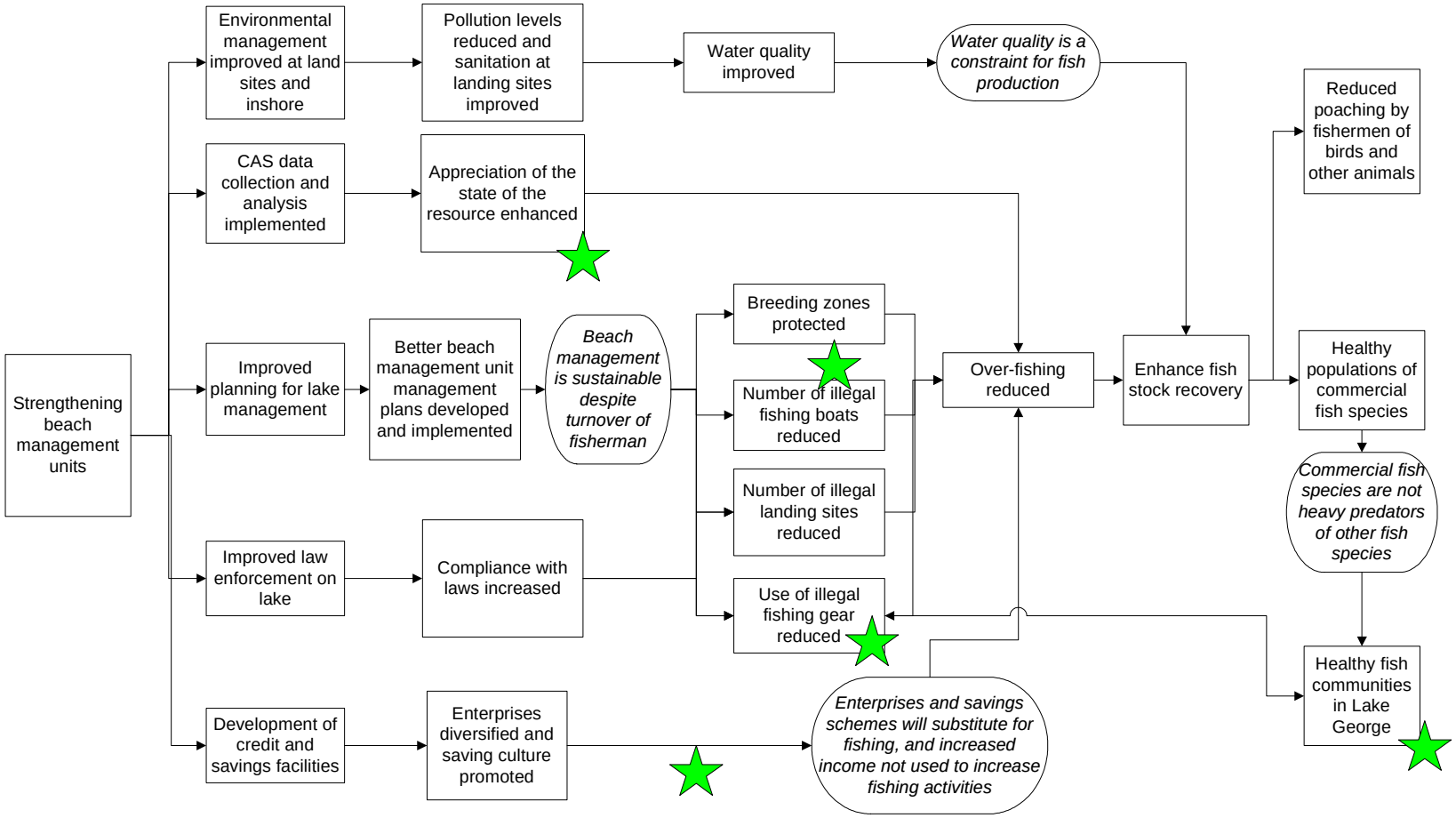


Figure 1.8 Conceptual model for Strengthening Beach Management Unit (BMU)

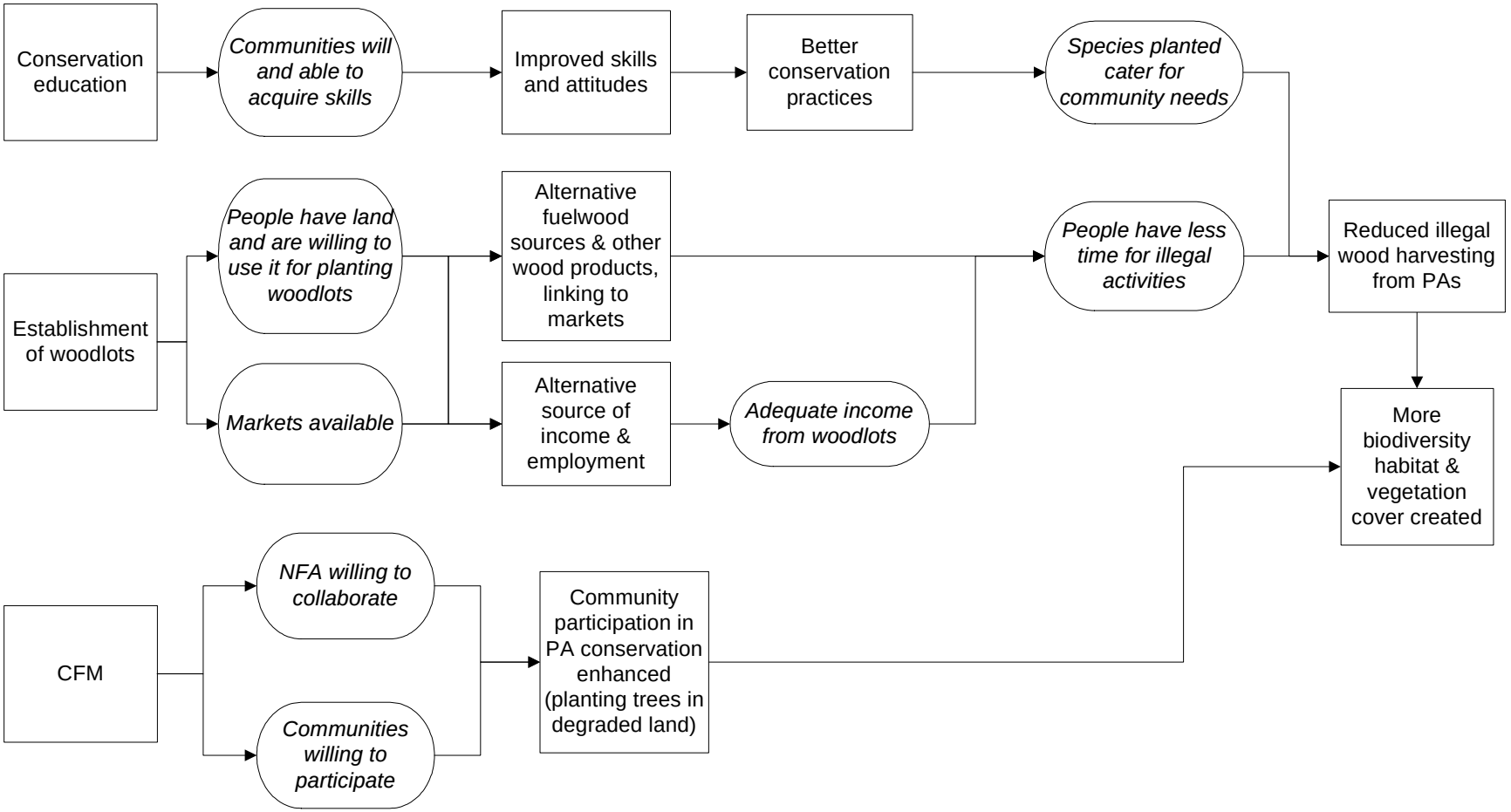


Figure 1.9 Conceptual model for Improving Fuel Wood Management around Queen Elizabeth National Park

2.0 Monitoring Indicator Results

As indicated in section one of this report, a number of monitoring indicators were selected for monitoring during the project life. The indicators selected were based on the conceptual models, these included monitoring changes in knowledge, attitudes and practices (referred to as KAP), human threats to biodiversity, household incomes focussing mainly the contribution of ecosystem-related products towards the household budgets, changes in formally reported conflicts and biophysical conditions of the ecosystems where PRIME West was intervening. In addition to the progress reports and other stand alone reports annexed to this final report, summarised results for each indicator are presented in this section. Section six provides the discussion of the results, conclusions and recommendations made.

2.1. Changes in household incomes, knowledge, attitudes and practices (KAP)

Estimating natural resource values and deriving the household incomes from the use of these resources is a key step towards understanding the role of forests/wetlands and savanna woodlands in rural livelihoods and but also how their decisions, behaviours and practices are influenced. In valuing the benefits of forests, parks and wetlands resources to the adjacent communities, we did not include the ecological benefits and services because of the methodological and technical complications associated with valuing environmental services. Our focus was mainly on tangible consumptive products harvested either for commercial (e.g. timber, fish, wild fruits, animals, charcoal, fibres and robes) or domestic purposes such as firewood, water, medicinal plants, sand and other products. All income calculations were made with respect to the prevailing local commodity prices and prices of other inputs of production (e.g. fertilizer, pesticides, labour). Because of the seasonality effect in crop production, there were considerable differences in the quantities produced but these were smoothened by the prices, that is, during the lean season, prices were slightly higher than in the peak season. Incomes were also adjusted for inflation, economies of scale and adult equivalencies to make them comparable across households and sites.

In order to test the assumption that increasing household incomes of the protected area adjacent rural poor communities would gun support for community conservation of wildlife, we conducted two surveys during the project. A baseline household survey was conducted in May to September 2006 and a repeat survey of the same households was conducted in 2008 from March to May. The main objective was to measure the contribution of forests/parks/wetlands and fisheries resources to the overall annual household budget. As such, a socioeconomic survey questionnaire was developed to capture all the household income streams (agriculture, non agricultural income sources, forest/park/wetland products, regular income, remittances, NGO or in kind support). Other indicators such as people's attitudes, knowledge and practices, including the level of participation in community based natural resource management activities based on user group records (e.g. committee meeting attendance lists, time spent) and contributions to the project were captured during the survey. An attempt was made to retrace the same households that were surveyed in 2006 (panel data) in order to achieve effective comparison. It should be noted that because of in-and-outward migrations coupled with natural causes such as death, we did not manage to retrace all our respondents. With regard to the wetland households, dropping Mulehe and Ngoto, and the reduction in activities around Echuya (bamboo domestication and CFM), our survey design was relatively affected. The results of household incomes and changes in knowledge and attitudes for each ecosystem are presented below.

2.1.1 Household Incomes for BMU households interacting with QENP

Overall, the socioeconomic survey results revealed a decline in household incomes across all ecosystems (wetlands, fisheries, forests and parks) in the project area. Considering the households involved in fishing on Lake George and the Kazinga channel, the mean proportion (%) of park income (PAI) to the mean adjusted total household income (TAI) reduced. The proportion of income from the park (PAI) to the mean total annual income (TAI) for Hamukungu BMU households declined from 6.86% to 4.93% and overall un adjusted total household income reduced from UGX 2,234,262 recorded in 2006 to UGX 1,376,397 (2008) (**Table 2.1**). The Average total annual income (TAI) was UGX 1,376,397 and UGX 414,925 when adjusted for household size, economies of scale and inflation in (**Table 2.1**). The total park income per annum (PAI) was UGX 31,841 and UGX7,351, when similar adjustments were performed. The total mean annual household income for those households exclusively involved in fish related businesses was UGX307,375 and the adjusted income was UGX84,631. Although Katunguru-Kasese and Kazinga BMUs, showed a slight increase in the mean annual household income, a Kruskal Wallis test for any statistical differences, revealed that there were no significant differences (χ^2 = 0.012, df =1, P-value =0.913, N = 58) among the BMUs surveyed. When intervention was used as the grouping variable, the Kruskal Wallis test, showed that there was no significant difference (χ^2 = 3.635, df =3; P-value =0.304, N = 58) between BMUs that received PRIME West support and those that did not. This indicates that the BMUs are homogeneous in general income terms.

Table 2.1 Total mean annual household income and proportion of Park contribution to the BMU fishing communities on Lake George

2008 BMU	**N**	**Mean total annual income (TAI) UGX**	**Mean total Park income (PAI) UGX**	**Mean adjusted total income (TAI) UGX**	**Mean adjusted Park income (PAI) UGX**	**Mean proportion PAI (%)**	**Mean proportion of TAI (%) 2006**
Kahendero	13	1,425,100	23,167	477,565	4,363	0.91	3.15
Hamukungu	15	2,176,643	117917	512,318	25,259	4.93	6.86
Katunguru-Kasese (NPW)	15	3,135,300	94000	785,516	26,845	3.41	2.72
Kazinga (NPW)	15	603,578	88000	239,041	1,715	2.45	1.9
ALL	58	1,376,397	31,841	414,925	7,351	1.77	3.66

The incomes are adjusted for household economies of scale, adult equivalencies and average underlying inflation of 7.8% (Minister of Finance, Budget Speech for FY2008/9). Average household composition was recorded to be six members.

2.1.2 Household Incomes for Wetland adjacent communities

Results of the household survey showed a decline in incomes derived from wetland resources from 4.3% (2006) to 2.7% recorded in 2008 (**Table 2.2**). In order to ensure reasonable comparison between the baseline and the repeat income results of 2008, the overall household income was computed exclusive of Kandekye wetland (N=104). In absolute terms, the mean total wetland income was slightly higher (UGX28,627) compared to UGX22,385 but the mean proportion (%) of wetland income remained the same (2.7%). At

the individual wetlands, households adjacent to Nyamurilo recorded an increase in the incomes by 1.24% while those for Mulehe recorded relatively high decline (3% to 0.7%) in incomes derived from the wetland. It should be noted that Irish potato growing in Nyamurilo wetland contributed 38% of the total agricultural income recorded by the households in 2008. This probably explains the increase in wetland-related incomes for Nyamurilo adjacent households as opposed to Mulehe dependants.

Table 2.2 Household Income by wetland (repeat survey 2008) where PW was working

Wetland Area	N	Mean total annual income (TAI) UGX	Mean total wetland income (TWI) UGX	Mean adjusted total income (ATI) UGX	Mean adjusted wetland income (AWI) UGX	Mean proportion AWI of ATI (%)	Mean proportion AWI of ATI (%) in 2006
Mulehe	30	1,042,942	3,750	265,719	1,813	0.68	2.99
Nyamuliro	74	802,914	20,096	155,385	5,696	3.67	2.43
*Kadenkye	29	1,068,466	47,503	276,062	8,710	3.15	**
All	133	914,958	22,385	206,585	5,477	2.65	4.30

* Kandekye wetland (Bushenyi) was selected in 2007 as a replacement for Ngoto (Kanungu) due to changes in the project but also because of the wetland- related enterprises that had been supported were in advanced stages. ** was not considered during the baseline survey

2.1.3 Household Incomes for Forest/park adjacent communities

There was a sharp decline in both the annual total income (TAI) and the proportion of Adjusted Forest Income (AFI) to the mean adjusted total income (ATI) across forests. In income terms at least they are fairly homogeneous. The average adjusted forest income (AFI) over all villages was UGX 4,063 p.a (**Table 2.3**). As a proportion of ATI, AFI over all the villages decreased from 8.5% (2006) to 1.4 % (2008). The Kruskal Wallis test showed no significant differences (χ^2=0.095, df. =1, p-Value 0.758, N=481) in AFI between PW working areas and non PW areas. Households living adjacent to forests managed by NFA derived more annual forest/park incomes (AFI) compared to those in the park neighbourhood managed by UWA revealed by the significant difference (χ^2=16.64, d.f. = 4, p-Value 0.002).

Table 2.3 Total annual and adjusted forest/park income derived by households disaggregated by natural habitat type

Forest/park	N	Mean total annual income (TAI) UGX	Mean total forest income (TFI) UGX	Mean adjusted annual total income (ATI) UGX	Mean adjusted forest income (AFI) UGX	Mean proportion AFI of ATI (%) in 2008	Mean proportion AFI of ATI (%) in 2006
Kasyoha Kitomi/ Kyambura WR	104	1,221,014	6,892	290,025	1,715	0.6	6.23
Kalinzu	162	1,467,409	19,645	359,347	5,295	1.0	4.50
Echuya	119	1,071,034	33,463	266,595	7,715	1.0	16.12
QENP	33	817,294	0	182,037	0.1	0	12.55
Rwenzori NP	63	1,078,648	0	227,102	0	0	2.02
Total	481	1,220,549	16,385	291,926	4,063	1.4	8.50

By comparing the household incomes in 2006 and 2008, the Wilcoxon signed ranked test showed that the difference was highly significantly (Z = -10.928; P<0.01). Crop production contributed 47% and livestock raising (16.4%) towards the mean annual total household income. Of the agricultural income, Arabica coffee contributed 12% of the mean annual income for households adjacent to Rwenzori Mountains National Park. Around QENP, livestock raising contributed UGX 247,939 (12%) to the total annual household income (TAI). Although the park adjacent households interviewed suggested not to be deriving any income from QENP (**Table 2.3**), in the recent past, cattle keepers depended heavily on the park for grazing. Because of the technical problems associated with valuing livestock grazing in protected areas, these results do not include cattle grazing costs and benefits in the park. PRIME West together with UWA, offered support to ex poachers (formerly poachers but handed in their hunting gears and denounced poaching) in 2007 by providing wet processing machines for them to access high price value for coffee marketed to Good African Coffee (buyer). As a specific resource user group, during the repeat survey in 2008, we asked them to compare the income they are getting now and before they abandoned poaching. Only 22% (n=63) reported an increase in income, same (22%), less (14%) and the rest of the members (42%) in the ex-poacher groups had never been involved in poaching although they were members to the poacher groups. The most important result of this intervention (offering support to poachers to wet process their coffee) was that it acted as an incentive for other poacher groups to surrender to UWA. By the end of the project, the ex poacher groups that declared their weapons had grown to 300.

2.1.4 Attitudes, Knowledge and Practices

Attitudes of Beach Management Unit members

Respondents were asked as to whether or not they knew the reason(s) why PW was supporting them. The purpose of this question was to assess whether or not households made a link between PW interventions with biodiversity conservation. A total of 60 households were surveyed in both PW and Non PW supported BMU in equal proportions. However, the results presented below only apply to PW supported BMU of Kahendero and Hamukungu on Lake George. Of the 28 respondents surveyed in Kahendero and Hamukungu BMUs, 20% reported that PW was helping them to achieve economic development. In this context, the project was understood to be promoting economic development aimed at improving their livelihoods by reducing poverty at the household level and not different from any other poverty reduction programmes. 42.5% considered PW project to be promoting the sustainable use of natural resources by providing alternative sources of income and reducing the dependency on protected area resources to achieve sustained wildlife conservation (**Table 2.3**). Unlike the 2006, during which 26.7% of the respondents understood the project as a contribution to biodiversity conservation, in 2008, people's knowledge of the purpose of the project increased. The percentage of the respondents who did not know the project purpose decreased from 43.3% to 37.5% and only 20% still viewed it as poverty reduction program.

Table 2.4 Percentage of respondents and reasons given why PW was helping them (N = 28)

Reason for support	**2008 % of respondents**	**% of respondents in 2006**
Promote economic development	20.0	30.0
Promote sustainable use of NR/alternative source of income/conservation of protected areas	42.5	26.7
Don't the reason for supporting me (us)	37.5	43.3
	100	100

The respondents were asked whether the park should be converted to agricultural land or maintain the area under wildlife management. Majority (76%) of respondents disagreed with the idea of converting the park to agricultural land use. This result was interesting because in 2006, 68.3% supported the idea and the main reason was to acquire more agricultural land (31.7%). This change in the attitude could be explained by the responses given for another question that was asked, whether the projects in the areas were helping them to improve the relations with the park and fisheries authorities. 74% (N=58) of the respondents indicated that the projects mainly PRIME/West project (29.4%) CARE Rights Equity and Protected Area (REPA) project (23.5%) and Kyamughema Rural development association (6%) played a big role in improving their relations with the protected area managers through information provision, education and negotiations for increased access to park resources. Those respondents who still support the idea of converting the park to agricultural land use, of the reasons given, the need for agricultural, including livestock grazing was the most reported (58%) followed by the need to access the resources and get money (21%) and reduction in people-wildlife conflicts (5%). Interestingly, the problem of both crop raiding and livestock predation animals was not mentioned by many respondents (5%) as we had anticipated.

Attitudes of communities adjacent to Wetlands

A total of 133 households were surveyed in both PW and Non PW working areas. Of these, 85 were drawn in PW working areas adjacent to the selected wetlands. On the overall, 27% of the respondents living in villages around the three wetlands surveyed were able to link PW interventions to biodiversity conservation (**Table 2.5**). The results showed an increase in knowledge about wetland protection and were actively participating in community wetland restoration or enterprise related projects.

Table 2.5 Percentage of respondents and reasons given why PW was helping them (N = 133)

	WETLAND			Total %	2006 Total %
Reasons	**Mulehe (%)**	**Nyamuliro (%)**	**Kandekye (%)**		
Promote development	0	1.7	12.0	3.1	1.9
Promote sustainable use of NR/alternative source of income /conservation of protected areas	17.7	28.3	18	26.6	14.3
Don't the reason for supporting us	80.0	70.0	70	70.3	83.8
Total	30	74	29		100.0

At the individual wetland scale, communities adjacent to Nyamurilo were noted to be more involved in community wetland management than Mulehe adjacent communities. This was probably because of the persuasive or in-kind approach that Nature Uganda, the implementing partner used to engage the communities. It could also be explained by the reasonable benefits that the people around the wetland enjoyed mainly Irish potato growing. The stream buffer strip played a great role in coalescing the community, as in this activity was highly linked to property ownership and rights. Households that had landholdings in the wetland needed to secure their plots to avoid eviction and ensure that the boundaries were clear and uncontested. Fifty five percent of the respondents reported that the projects working in the area helped a lot in improving the relations between wetland managers and

the communities. The project cited to play such important role included Nature Uganda's Community wetland project, PRIME West, Africare and ADRA safe water project.

The main reasons for using the wetland were income generation from marketing of wetland products (21%), fuelwood harvesting (17.6%), farming to ensure household food security (16.6%) because wetlands are known to be productive throughout the year and Water (13.7%) for domestic use. When the households were asked whether they would support the idea to declare the wetland an agricultural land, majority (85%) disagreed with the idea because they appreciate the functional and ecological roles the wetland plays in the area. Of those respondents who supported the idea, 95% reported the need for agriculture land and the other 5% reported that it was a source of diseases and crop pests.

Attitudes of communities adjacent to parks and forest reserves

A total of 481 households from both PW and Non PW working areas were surveyed. Of these 259 households were drawn from PW working areas. Forty percent of the respondents were able to link PW interventions to biodiversity conservation. Households adjacent to QENP (mainly ex poacher groups) and Rwenzori NP were more knowledgeable about the PW support for biodiversity conservation than the rest of the respondents surveyed. It is not surprising because these respondents were purposively drawn from the Arabica coffee producer groups who received support from PW, UWA and Good African Coffee during the project. Around Echuya, Kalinzu and Kasyoha Kitomi Forest Reserves (FR), most of the planned activities suffered major set backs due to project reconfiguration.

Table 2.6 The percent of respondents when asked to give reasons why PW was supporting them (n = 481)

	KK FR/ Kyambura WR	Kalinzu FR	Echuya FR	QENP	Rwenzori NP	Total %	2006 Total %
Promote economic development	7.0	10.0	0	15.6	15.3	26.3	36.2
Sustainably use our natural resources	1.8	0	20	6.3	5.1	13.0	5.4
Provide alternative/improved income sources to reduce use of PAs	5.3	6	0	53.1	11.1	18.3	17.6
Promote conservation of the PA	19.3	19	17.4	9.4	5.1	8.4	3.8
Don't know	54.4	65	62.6	15.6	54.4	34	37
Total	104	162	119	33	63	100	100

Among the forest/park products that communities reported to be the most important, firewood dominated the list. It was also reported by majority (87%) respondents to have declined. As a response to firewood decline, only 3% (N=481) planted some woodlots averaging 0.26±0.66 ha. Of the households interviewed around Echuya, only 9% (N=119) had planted some bamboo trees (average of 6±4.02 plants) on their farmland to cater for their future needs. Because of limited land, a large number of households are unable to plant trees. Majority respondents (66%) reported a reduction in access to park resources. The respondents reported that projects were very helpful towards improving their relations with forest/park authorities. Around Echuya, projects such as CFM supported by NatureUganda (16%),

PRIME/West project (28.2%), Africa Network 2000 project (2%) and Africare project (4%) were regarded important for playing this role.

2.2 Changes in biological indicator taxa (large mammals, birds and fish)

2.2.1 Ground surveys of large mammal

We established random sample plots in the sites that we selected for monitoring ranging from 25-50 plots per site. The sites were selected based on the ecosystem where PRIME West was to intervene with due consideration of the conceptual models developed for each intervention. The main plot measured 40m in radius, where the search for human signs was done and four sub plots each measuring 5 m by 10 m located in the four compass directions (i.e. West, East, South and North) specifically for mammal dung sightings as sign of presence or absence of mammals. The plots were resurveyed every after six months and both new and old human signs recorded. The total area searched for mammal dung presence or absence is provided in **Table 2.7** below. Apart from Echuya bamboo forest and Rwenzori forest, there was a general increase in mammal sightings for all the other sites surveyed. There was a gradual increase in elephant, Uganda Kob and buffalo sightings in Queen Elizabeth woodlands and a decline in mammals in Echuya FR and Rwenzori forest (**Figure 2.1**). The detailed encounter rates for all mammal species recorded in the sites are provided in **Appendix 1**.

Table 2.7 Sites monitored for large mammal presence and total area covered over 2.5 years

	Area (hectares)				
Survey number (every after six months)	1	2	3	4	5
Monitoring Site					
ECHUYA (bamboo mixed forest)	0.765	0.745	0.740	0.750	0.720
ISHASHA NON PW (savanna woodland)	0.480	0.490	0.500	0.480	0.480
ISHASHA PW (savanna woodland)	0.460	0.480	0.500	0.460	0.460
Kasyoha Kitomi –Kalinzu FR (KK-K) NOPW	0.600	0.520	0.560	0.540	0.480
KK-K PW	0.520	0.575	0.500	0.480	0.520
Kyambura WR-Kasyoha Kitomi FR NOPW	0.790	0.800	0.780	0.800	0.795
KWR-KKFR PW	0.610	0.600	0.600	0.595	0.580
Queen Elizabeth NP NOPW (savanna woodland)	0.520	0.460	0.505	0.500	0.440
QE WOOD PW (savanna woodland)	0.340	0.365	0.360	0.320	0.300
*Rwenzori KASANGALI (Afromontane forest)	0.565	0.540			
Rwenzori NSENYI	0.415	0.560	0.560	0.560	0.560
*Southern Kalinzu FR NOPW	0.510	0.475			
*Southern Kalinzu PW	0.680	0.655			

* Site dropped in 2007 due to project modification

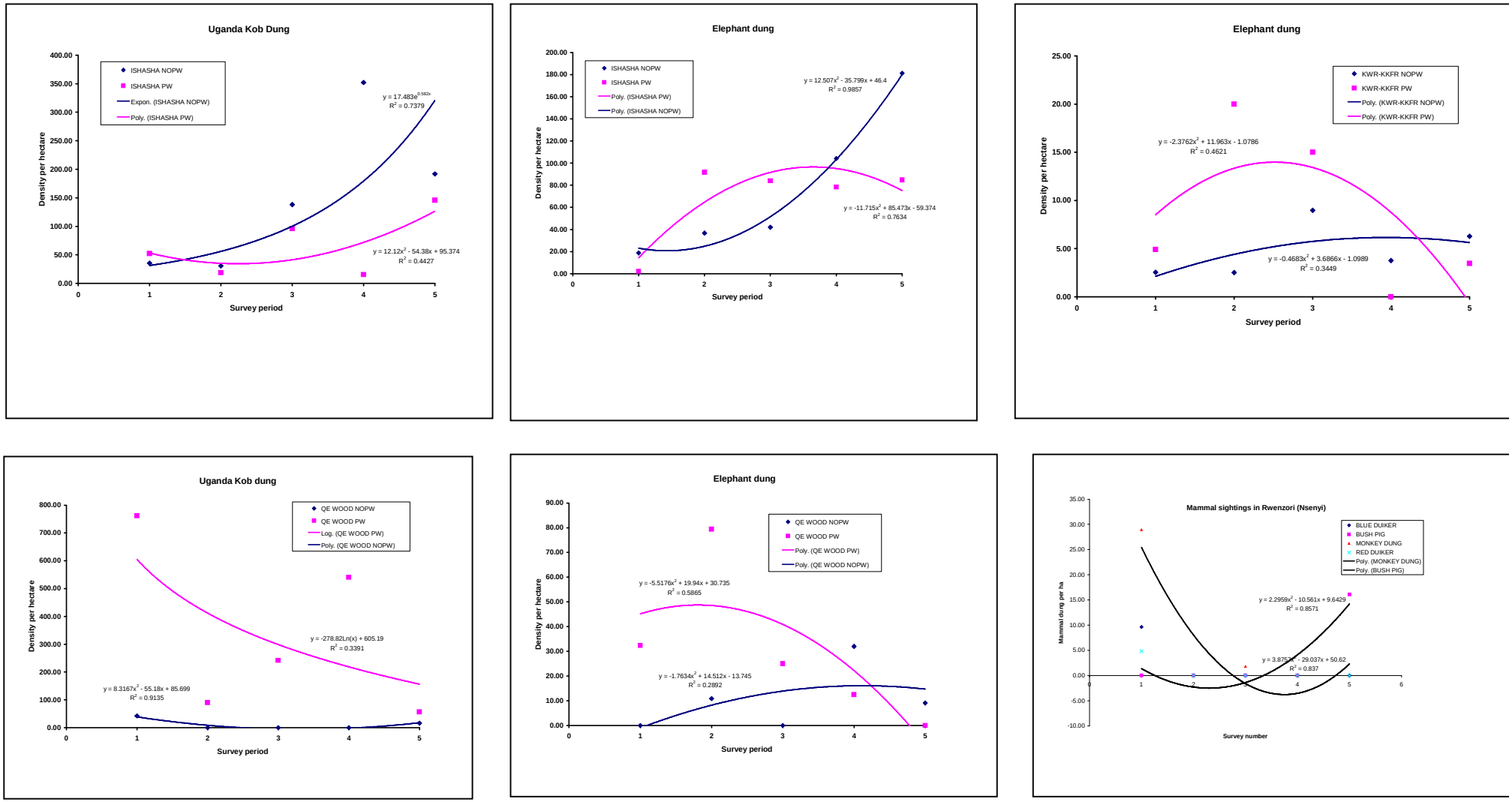


Figure 2.1 Large mammal (e.g. elephants, Kob, Duikers and monkeys) sightings in selected sites where PRIME West was working

The results from the Aerial census of large mammals in Queen Elizabeth Protected Area (QEPA) showed a similar trend as observed from the ground survey results (**Table 2.8**). In late June 2006, UWA Census unit undertook an aerial reconnaissance survey of large mammals in Queen Elizabeth National Park and the Kibale Game Corridor with Prime/West and WCS support. Results showed a general increase in large mammal populations since 2000/3 (**Table 2.8**). There has been a relative increase in the numbers of some mammals such as the buffaloes from 6,807 (2002) to 14,858, elephants increased from 998 (2002) to 2,959, topi, 157 (2002) to 1521 and the Warthog, 2423 (2000) to 1,388 and the declines were registered in the Water buck from 4,666 (2000) to 3,548. However, this good response was severely affected by the settlement of cattle keepers from DR Congo in the northern sector of QENP. The increase in elephant numbers could be attributed to the movement of some elephants from DR Congo (where there has been lots of insecurity and human disturbance) to QEPA. Also an increase in law enforcement as a result of PRIME West support to UWA and the coffee enterprise scheme that targeted mainly the ex-poachers around QENP and Rwenzori Mountains National Park (RMNP) could have played in a key role in reducing poaching of elephants.

Table 2.8 UWA aerial census of large mammals in QEPA in June'06

Species	Mweya – Kasenyi			Ishasha			Total	
	Population Estimate	SE	95% Confidence Limit	Population Estimate	SE	95% Confidence Limit	2006	2000 Population estimates
Buffalo	5,940			8,918			14,858	10,674
Bush pig	22						22	
Bushbuck	29	15	33				29	
Elephant	1,824	648	1,425	1,135	384	844	2,959	1,086
Hippo	4,329	720	1,583	695	288	633	5,024	3,400
Reedbuck	7	7	15				7	
Topi				1,521	833	1,833	1521	94
Uganda Kob	14,679	5,484	12,065	6,293	1,831	4,028	20,971	32,245
Warthog	1,179	300	661	208	70	153	1,388	2,423
Waterbuck	2,630	655	1,440	919	290	639	3,548	4,666

2.2.2 Chimpanzee census and other large mammals in the central forest reserves in the Greater Virunga landscape

The Forest Reserves of the Greater Virunga Landscape

This report summarises the results of censuses of three Forest Reserves within the GVL: Kasyoha-Kitomi, Kalinzu and Maramagambo (both north and south). A detailed report is provided in **Annex 1** of this report. Two of these reserves, Kasyoha-Kitomi and Kalinzu are situated at the edge of the escarpment above the western Rift Valley while Maramagambo Forest is situated in the valley within Queen Elizabeth National Park. The forests can be briefly summarized as follows:

1. ***Kasyoha-Kitomi Forest Reserve***: 399 km^2 of forest lying between 975 and 2,136 metres altitude a.s.l. with most of the forest between 1,250-1500m a.s.l. The vegetation is classified as medium altitude moist evergreen forest in the south west and medium altitude moist semi-deciduous forest in the north east (Howard 1991). Parts of the forest have been pitsawn and encroached for agriculture in the past (Howard, 1991; Plumptre et al. 2002).

2. ***Kalinzu Forest Reserve***: 137 km^2 of forest lying between 1,100-1,750 metres a.s.l. The vegetation is classified as medium altitude moist evergreen forest. Much of the reserve has been affected by commercial logging, pitsawing and fabrication of charcoal.
3. ***Maramagambo Forest Reserve***: This reserve is divided into two management areas; north (291 km^2) and south (152 km^2). Most of the reserve lies between 915-1,200 metres a.s.l. Much of the vegetation is classified as medium altitude moist semi-deciduous forest and moist thicket. The forest has expanded into the surrounding grasslands with the decline in elephants in Queen Elizabeth National Park since the late 1970s.

2.2.2.1 Survey design

DISTANCE 5.0 (Laake et al. 1994) was used to design where transects would be located within each of the forest blocks. As Kalinzu and Maramagambo are contiguous forests they were treated as one block but transects within each forest reserve analysed separately. DISTANCE 5.0 allows an assessment of coverage probability by various transect design layouts and can be used to try and maximize the chances that every portion of the forest has an equal chance of being sampled. A total of 41 three kilometer long transects were established using a 'Systematic Segmented Trackline Sampling' method in Kasyoha-Kitomi Forest (**Figure 2.2**) and a further 46 three kilometer long transects in Maramagambo-Kalinzu forest block (36 in Maramagambo and 10 in Kalinzu).

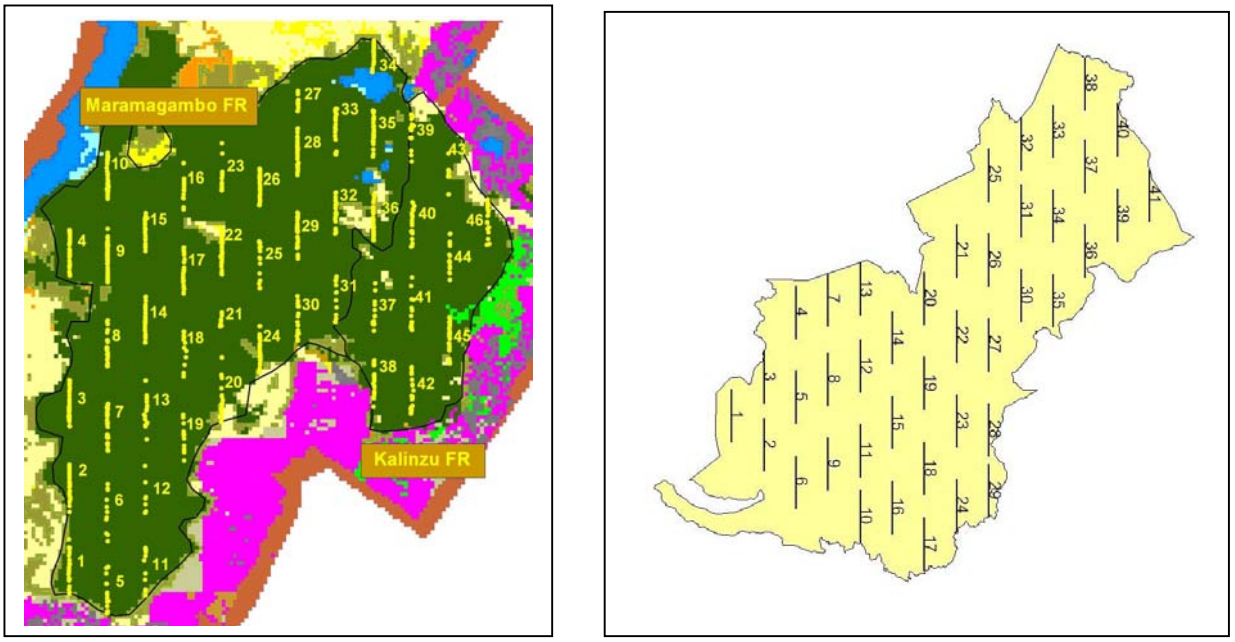


Figure 2.2 Location of transects in Maramagambo-Kalinzu (left) and Kasyoha-Kitomi (right).

The coordinates of the start and end points of the transects were calculated by DISTANCE and are given in Appendix 1 for both forest blocks. This should allow future surveys to find the same points in the forest and repeat surveys along the same lines, thereby allowing more robust comparisons of differences between population estimates (see full description of the methods and results in the census report annexed to this report).

2.2.2.2 Results

Encounter rates

Encounter rates (number of sightings per km walked) were calculated for all animals seen, animal signs (nest/dung) as well as signs of human activity. Human activity signs were combined (by summation) into encounter rates of signs concerned with poaching, logging and total human signs. These encounter rates were mapped for each transect to obtain a measure of relative abundance of species across the different forest blocks (**Figure 2.3 to 2.6**).

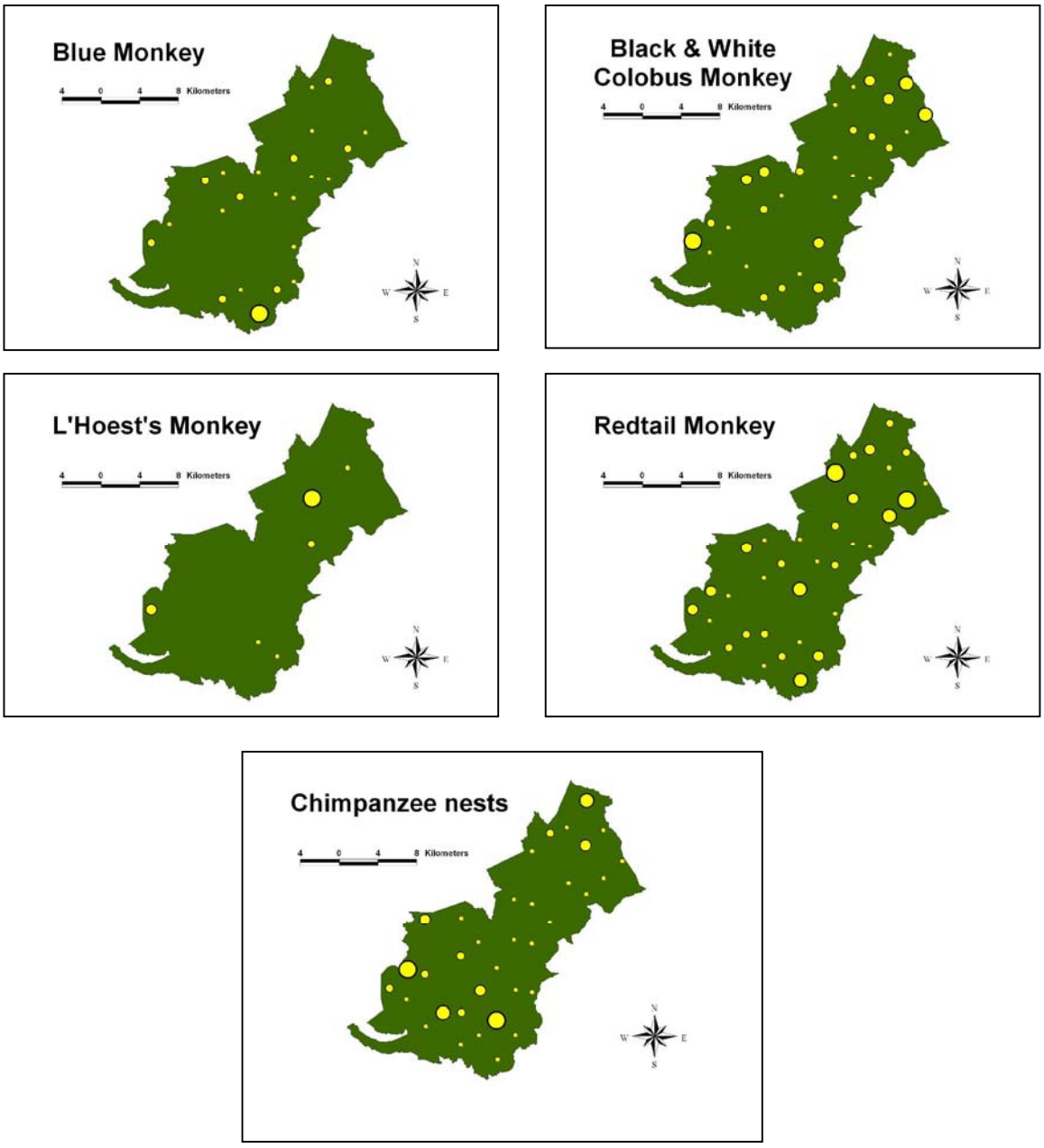


Figure 2.3 Relative densities of primates in Kasyoha-Kitomi Forest Reserve

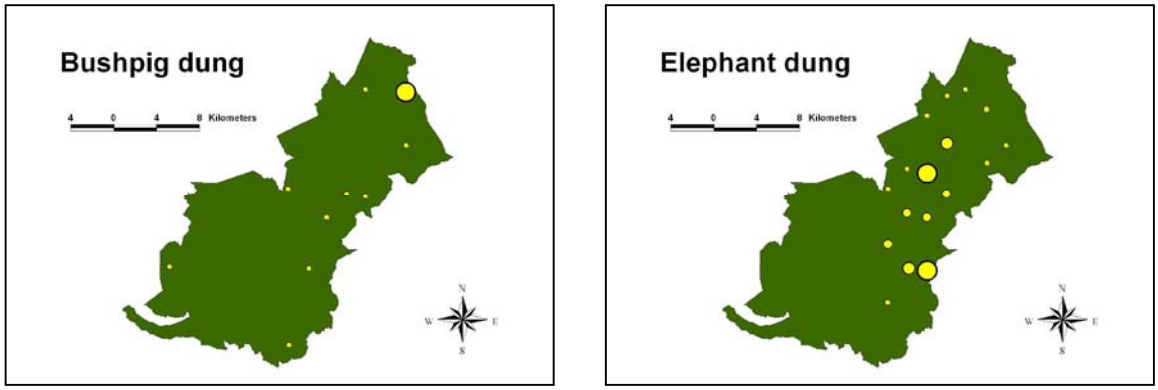
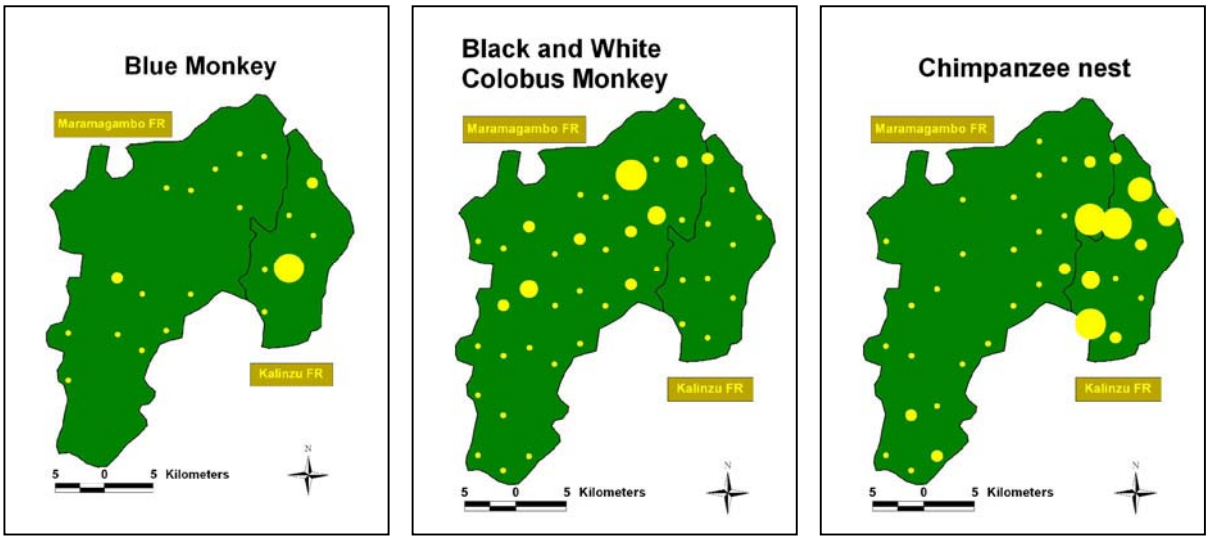


Figure 2.4 Relative abundance of bushpig and elephant dung in Kasyoha-Kitomi Forest Reserve.



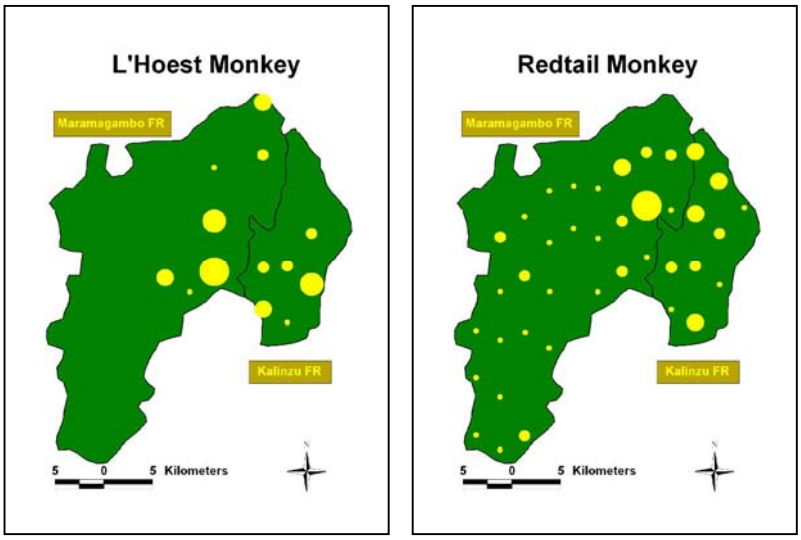


Figure 2.5 The relative abundance of primates in the Maramagambo-Kalinzu Forest block.

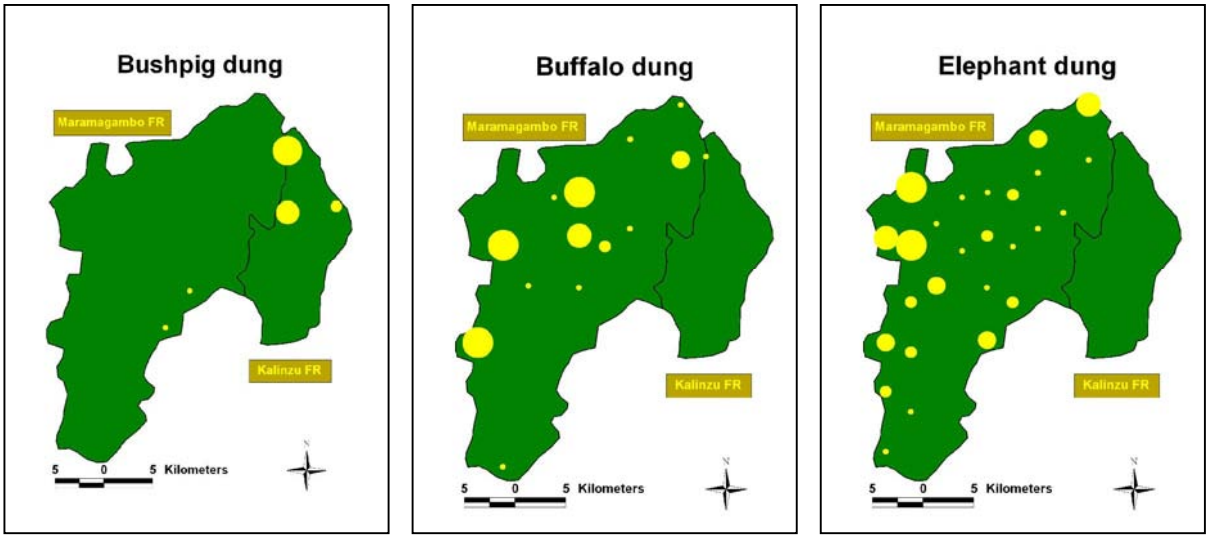


Figure 2.6 The relative abundance of ungulate dung in the Maramagambo-Kalinzu Forest block**.**

Density Estimates

Density estimates were made for animal species where reasonably sufficient data were obtained from the transects (at least 40 sightings). Where sightings were less than 30 for any forest reserve then the data for different forests was combined to estimate the decline in visibility with distance from the transect and fit a curve to the data, but density estimates were calculated separately for each forest. This assumes a similar probability of sighting animals/sign with distance from the transect in the different forests. This was not necessary for the chimpanzee nests however. The density estimates for the three forests are given in **Tables 2.9-2.11**

Table 2.9 Density estimates of animals in Kasyoha-Kitomi Forest Reserve. Comparisons with 2001 census estimates are marked with * where they have changed significantly at P<0.05.

Species	Density	SE	Lower	Upper	Population in forest	Density in 2001
Blue monkey	5.84	1.55	3.48	9.80	2,330	16.7*
Redtail monkey	23.5	4.20	16.6	33.4	9,380	87.7*
Black and white colobus	21.6	3.70	15.4	30.3	8,620	48.4*
L'Hoest monkey	1.6	0.7	0.7	3.7	654	5.3 *
Chimpanzees	1.07	0.2	0.74	1.54	425	1.0
Elephant	0.16	0.09	0.06	0.44	65	0.02

Table 2.10 Density estimates of animals in Kalinzu Forest Reserve. Comparisons with 2001 census estimates are marked with * where they have changed significantly.

Species	Density	SE	Lower	Upper	Population in forest	Density in 2001
Blue monkey	6.8	2.8	2.9	16.0	934	15.7*
Redtail monkey	45.8	12.9	26.1	80.4	6,275	36.4
Black and white colobus	31.2	11.4	14.8	65.6	4,274	19.8
L'Hoest monkey	9.9	3.8	4.4	22.0	1,349	4.5
Chimpanzees	3.2	0.8	1.9	5.5	445	1.7

Table 2.11 Density estimates of animals in Maramagambo Forest Reserve.

Species	Density	SE	Lower	Upper	Population in forest	Estimated density in 2001
Blue monkey	5.0	1.6	2.7	9.4	2,215	
Redtail monkey	22.5	4.1	15.7	32.2	9,968	
Black and white colobus	58.8	10.6	41.0	84.2	26,048	
Chimpanzees	0.6	0.2	0.3	1.2	270	0.51
Elephant	0.7	0.3	0.3	1.7	319	

No censuses of chimpanzees have been carried out using transect methods in Maramagambo Forest but we estimated chimpanzee density from a correlation between encounter rates and density that had been calculated from data from several forests in Uganda (Plumptre and Cox, 2005). It is reassuring that the density calculated here from transect data gives a similar figure to the estimate using this equation and further supports the use of the equation in predicting chimpanzee density (**Table 2.11**).

Monkey densities seem to have significantly declined in Kasyoha-Kitomi Forest Reserve (KK FR) since the 2001 surveys but it is not clear why this would have occurred. The field assistants involved in the surveys indicated that there was some evidence of people hunting primates for meat around the forest but this was not common. Whether there has been some form of disease that has affected their populations we can't be sure but nobody has noticed many carcasses in the forest. A colobus monkey was eaten by local people north of Kasyoha-Kitomi in mid 2007, however which had Marburg's virus, a virus that causes hemorrhagic fever and which monkeys are known to die from. So it is possible that monkeys in this forest may have contracted something like this but we can't know for sure. The households that we interviewed around KK FR and Kyambura WR during the socioeconomic survey, 46% (n =60) reported that declines in monkeys was due to excessive hunting and degradation of the forest forcing them to move to other places. Only 3% reported that monkeys got killed because of raiding crops and 5% reported the cause to be killing by illegal timber harvesters. Some respondents (5.4%) reported death due to disease infection being one of the reasons for the decline in monkeys. The bush meat study funded by this project and conducted by Olupot et al., 2008 p21 showed that there was a lot of hunting going on around Queen Elizabeth Landscape and chimpanzees and other primates were reported to be some of the victims of this activity. It would be good for further research to look at what is happening in around this forest, particularly to assess whether these declines are due to human causes or purely natural processes.

2.2.3 Mountain Gorilla Census in Bwindi Impenetrable National Park

A census of the Bwindi gorilla population was carried out between April and June 2006 to determine the total population size and structure for the Bwindi mountain gorillas, their distribution across Bwindi and the potential impact of human disturbance on the population. This activity was carried out jointly by Institute of Tropical Forest Conservation (ITFC) and Uganda Wildlife Authority funded by USAID/PRIME West and Wildlife Conservation Society.

2.2.3.1 Introduction

Periodic censuses of endangered populations of high-profile species help us to understand their population dynamics, to assess the success of conservation programmes aimed at ensuring their survival, and to ensure that they receive continued attention from the global conservation community. Mountain gorillas (*Gorilla beringei beringei)* are highly endangered, with just two small populations in Bwindi Impenetrable National Park in SW Uganda, and the nearby Virunga Volcanoes on the borders with Rwanda and the Democratic Republic of Congo. A survey of the Bwindi population was carried out in 2002, and results showed that the population had increased since the previous census in 1997 by approximately 7 %, to 320 individuals (McNeilage et al., 2006). The Virunga population currently numbers around 380 gorillas (Gray et al., 2006). The new gorilla census now provides us with park-wide information spanning nine years.

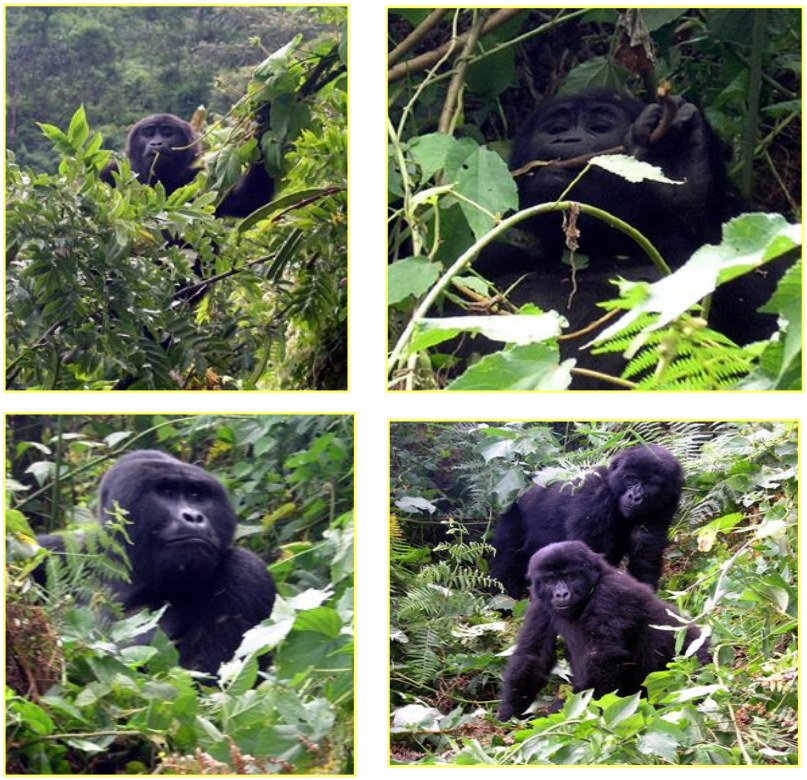
To estimate the total population size for the gorillas, the park is intensively surveyed by teams with the goal to locate every gorilla group of the population. This method normally allows us to ensure that groups are not counted twice by different teams. However, during this census, several gorilla groups were found in close proximity to each other in one area of forest, such that we were unable to distinguish each on the basis of trails and nest counts alone. In previous census, we have generally been able to distinguish groups on the basis of trails and nest sites, but we were unlucky this time in having so many groups in a relatively small area of forest. Therefore to ascertain that we were not double-counting groups, and to ensure that we were able to distinguish and identify each group, we used genetic analysis of fecal samples to create genotypes, or unique genetic identifications, of the gorillas in each group. Fecal samples of all groups were collected for genetic analysis, and this work was carried out at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Individuals from the groups for which identifications were not clear from the field data on nest sites and trails were treated as priorities. DNA analysis was done allowing us to establish a final total and other population parameters from this census.

2.2.3.2 Methods

The census team used the same methods as in the previous exercises. The park was divided into small sectors, centered around campsites and access points. Teams of trackers, rangers, and researchers traversed the park systematically sector by sector. One team was assigned to census each sector, proceeding such that no more than three days were left between the completion of work in one sector and the beginning of work in the next contiguous sector. Each sector was searched by walking an irregular network of reconnaissance routes across the area. The actual route walked was determined largely by the terrain and the availability of existing trails, while ensuring that the routes were sufficiently dense so that no area was missed which could be large enough for a gorilla group to spend more than one week in it. Gorillas construct a fresh nest each night to sleep in, and when recent gorilla trail (less than 5-7 days old) was found, it was followed until nest sites were located. Using the topographic maps, along with GPS readings every after 250m, compass and altimeter readings, each census team mapped as accurately as possible all paths taken

and gorilla trails followed. By covering the area in this way, mapping and dating all gorilla trails and nest sites, and by marking nest sites once they had been counted, it was possible to ensure that all groups are found and that none were counted twice, and to distinguish similar sized but distinct gorilla groups found close to each other. At each nest site, nests were counted and measurements of dung size were made and, along with the presence of silver hairs, used to establish the age-sex composition of the group. Teams aimed to find at least three nest sites for each group to confirm the composition of each group, since individual nests or dung could be missed at one nest site.

The irregular network of trails walked while looking for gorilla trail during a census covers a large portion of the park and provides an excellent opportunity as reconnaissance routes to collect data on other mammals, as well as signs of human use. While walking these trails signs of other large mammals and signs of human disturbance were recorded and the distance walked on each trail measured using hip-chains. Analysis of large mammal and human disturbance data is underway.



2.2.3.3 Results

The five habituated groups in Bwindi contained a total of 76 individuals at the time of the census. In addition to these, 25 unhabituated groups were found, containing 227 individuals along with 11 lone silverback males, giving a total uncorrected population count of 314 individuals. Experience shows that approximately one in three infants is not found from nest counts. A total of 40 infants were counted in the unhabituated groups, so that we predicted that another 20 would have been missed because they were too young for their dung to be visible in the nests. This brings the corrected total to 334 individuals, and as with the previous census in Bwindi, we round this figure up to 340 as our best estimate of the population size, since experience shows that a small number of small groups or lone silverbacks can be missed with these methods. The distribution of groups found during the census is shown in **Figure 2.7**. A complete list of the groups found during the census is provided at the end of this section.

A summary of the gorilla population size and structure found during this census is shown below, in comparison with previous censuses in 1997 and 2002. While the total population size has increased slightly, the other population parameters, group size and percentage of immatures (infants plus juveniles) in the population are comparable with those found in 1997 and 2002 (**Table 2.12**). The current age composition of the population (**Figure 2.8**) indicates healthy distribution of individuals in the adult and immature age classes. While the number

of lone silverback males found during 2002 and 2006 seems to be higher than in 1997, lone silverbacks are more difficult to locate and to identify using these methods, so this may simply reflect sampling errors. The proportion of the groups that are multimale has declined from approximately 45% in the previous two censuses to 23%. This may be a result of normal dispersal patterns of males (some remain in their natal group and others emigrate) or it may be a result in sampling error in estimating the presence of silverbacks from nests. Regardless, this fluctuation in multimale groups is normal and has been observed similarly in the Virunga Volcano population (Gray et al., 2006).

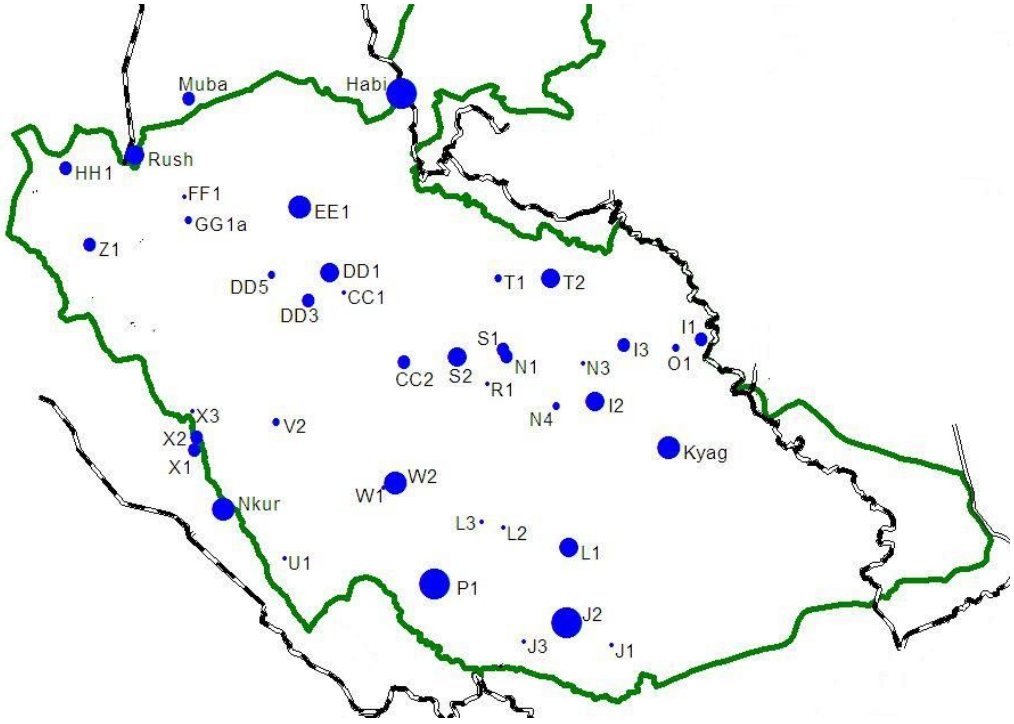


Figure 2.7 Distribution of gorilla groups in found during the Bwindi 2006 gorilla census. Each circle represents one group, with the size of the circle proportional to the size of the group.

The number above the circle is the group size in each case, and the code below is a unique identifier for each group, as given in **Table 2.12** Kyag, Muba, Habi, Rush, and Nkur are the habituated groups.

Table 2.12 Comparison of population size and structure across censuses

Population parameter	1997	2002	2006
Total population estimate	300	320	340
Number of groups	28	27	30
Number of solitary males	7	10	11
Mean group size	10.2	11.3	10.8
Range	2 to 23	3 to 25	3 to 28
Proportion immatures	37%	36%	36%
Proprotion Multimale Groups	46%	44%	23%
Number of habituated groups	3	5	5
Individuals in habituated groups	52	72	76
Proportion of population habituated	17.3%	22.5%	22.4%

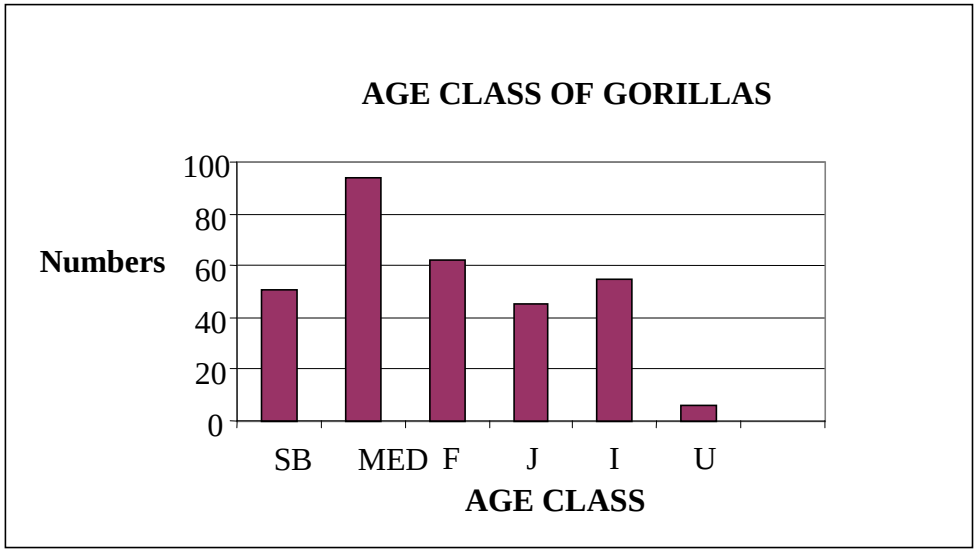


Figure 2.8 Age composition of the population. SB- Silverback male, MED-Medium size (adult female or black back male), F- Adult Female, J- Juvenile, I-Infants, U-unknown.

2.2.3.4 Discussion and Conclusions

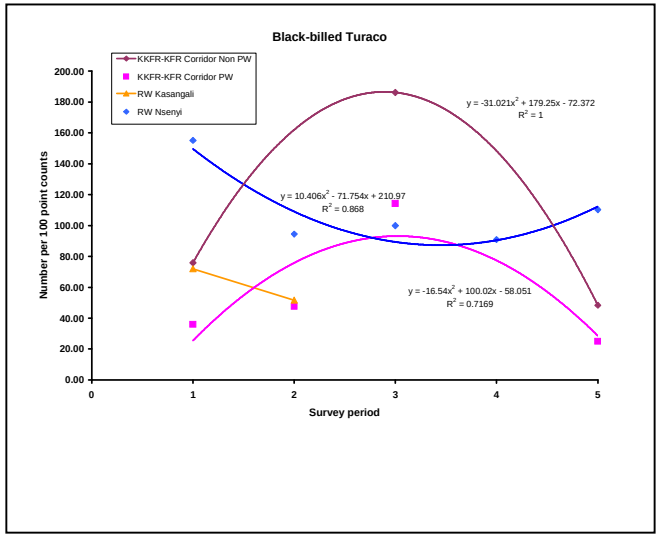
These results show a continued steady increase in the population of mountain gorillas in Bwindi Impenetrable National Park, Uganda. The increase to 340 gorillas represents a 6% increase in total population size since 2002 and a 12% increase since 1997. Overall the gorilla population has been increasing at an approximately 1% annual growth rate. While research in the Virunga Volcanoes has shown that gorilla populations are capable of growing at a higher rate than this, a 1% annual growth rate over nearly a decade is still indicative of a reasonably healthy and well protected population. More in-depth analysis of the spatial and temporal trends in the population will be carried out. The change in population size results will be compared with life history data from the monitored groups to better understand how birth and mortality rates are influencing population dynamics. An additional point to note is that the habituated groups have not increased much in size over the past four years.

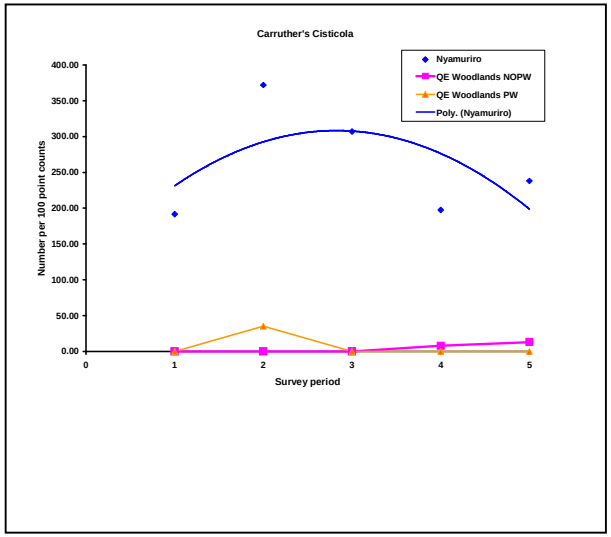
Further investigation of the group compositions is necessary to determine if this is due to few surviving births or because of natural emigration out of the groups or a combination of the two. Further population distribution analyses will be done relative to habitat types and human disturbance, and compared over time. However, a number of important points can be noted already. Firstly, there is still no indication of gorillas using the eastern part of the park (**Figure 2.7)**. Work is currently underway to assess the suitability of this habitat for gorillas. Secondly, gorillas are expanding their use of the park in other areas, notably by moving into the area known as 'the neck' and the southern portion of the northern sector (Habinyanja group). Therefore further work should be done to assess the suitability of the entire northern sector for gorillas. Both the eastern and northern sections of the park have had high levels of human disturbance in the past, and this must be taken into account in assessing their potential as gorilla habitat.

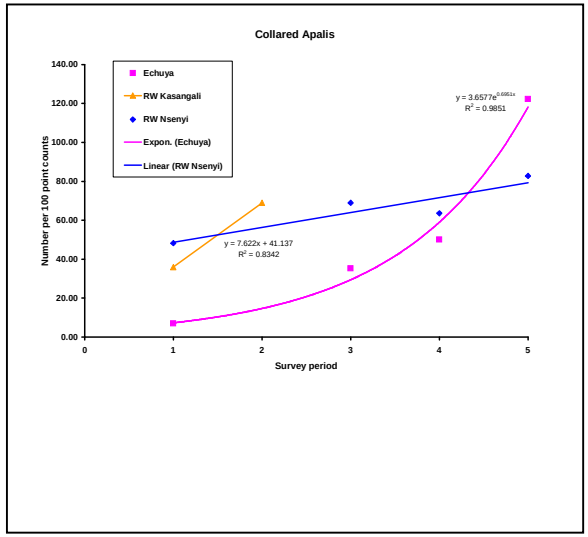
2.3.3.5 Bird surveys

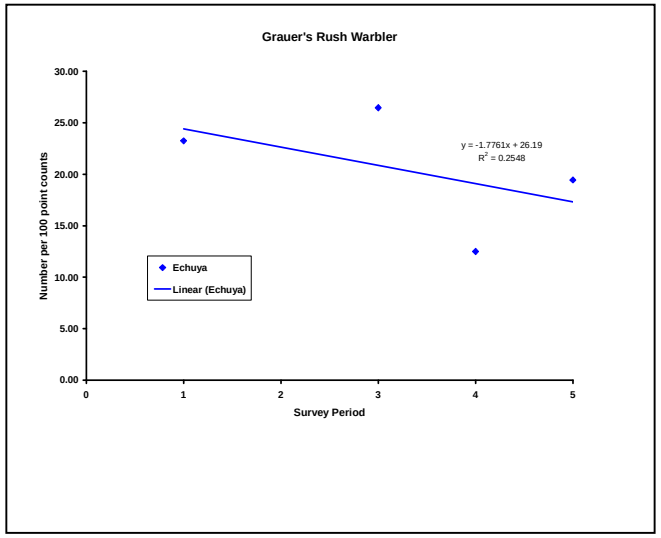
Birds are a good indicator of ecosystem health and because they occur widely and are well know (terms of identification) were selected as an important taxa for monitoring.

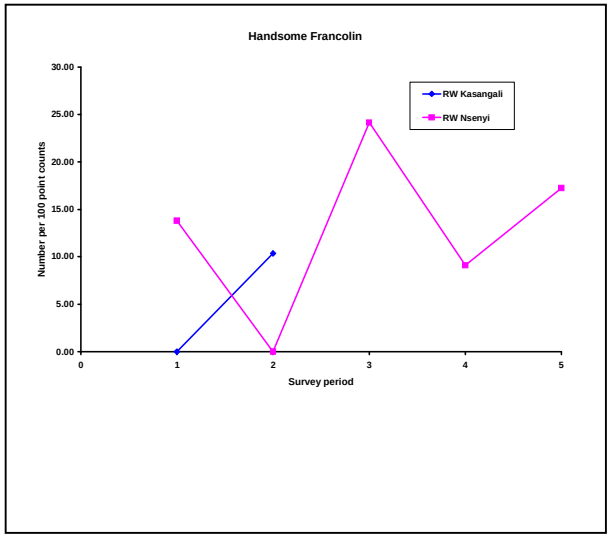
The following are the key bird species that we selected to monitor in relation to the different habitat where they are know to specifically occur but also respond drastically to ecosystem change; Black-billed Turaco, Carruther's Cisticola, Collared Apalis, Grauer's Rush Warbler, Handsome Francolin, Mountain Greenbul, Mountain Illadopsis, Mountain Oriole, Narina's Trogon, Papyrus Gonolek, Red Faced Woodland Warbler, Red-tailed Greenbul, White-winged Warbler (**Figures 2.9-2.10**). The sighting of these bird species has been increasing a positive sign for improved ecosystem health. The encounter rate of all bird species per site calculated for every 100 counts are provided in **Appendix II**











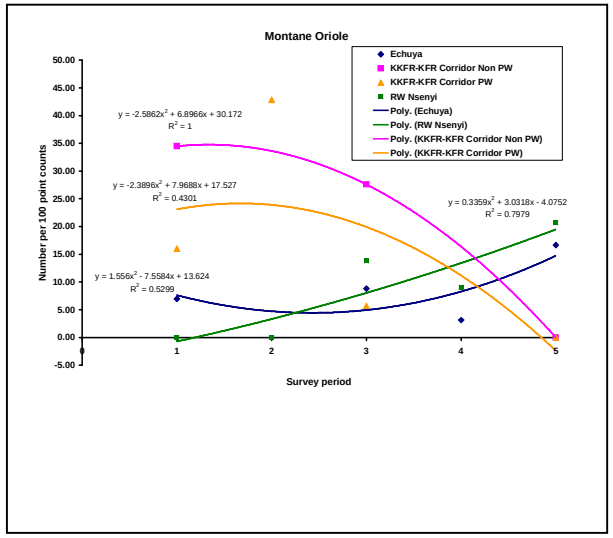
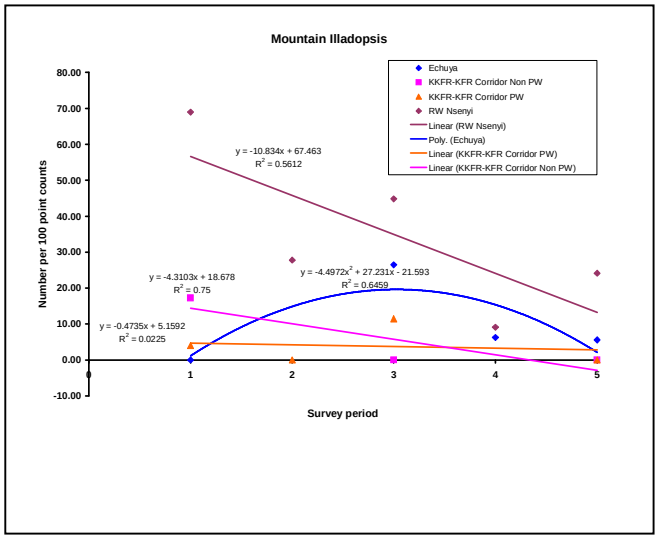
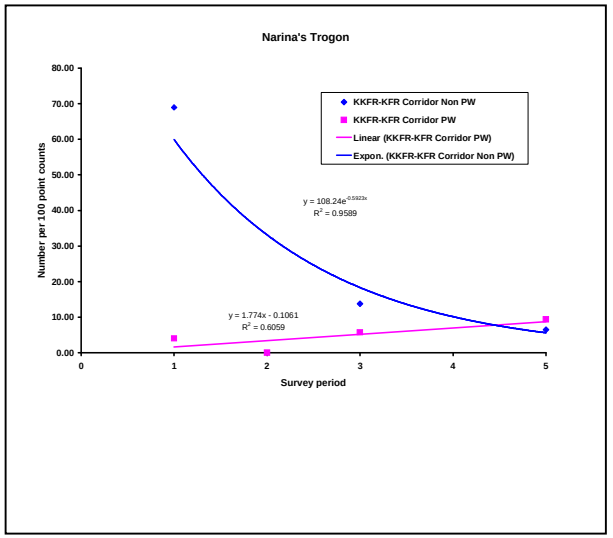
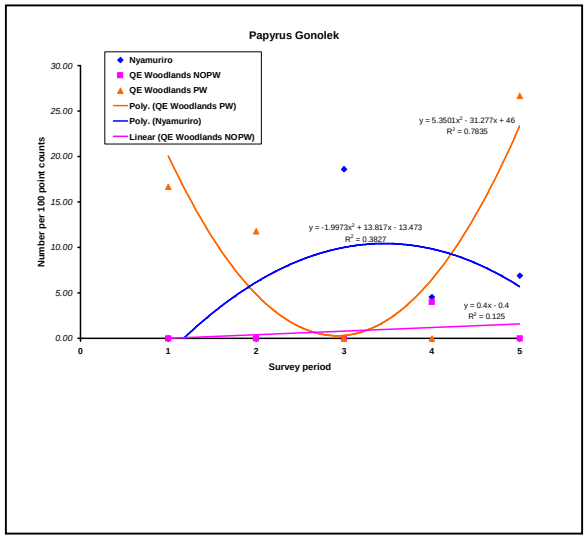
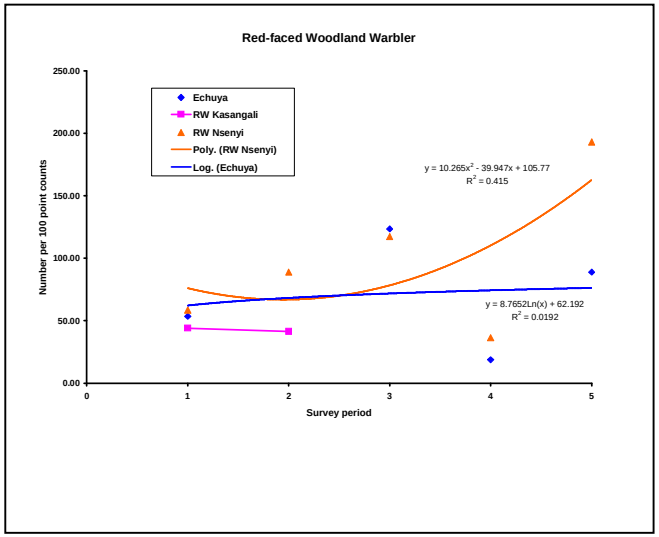


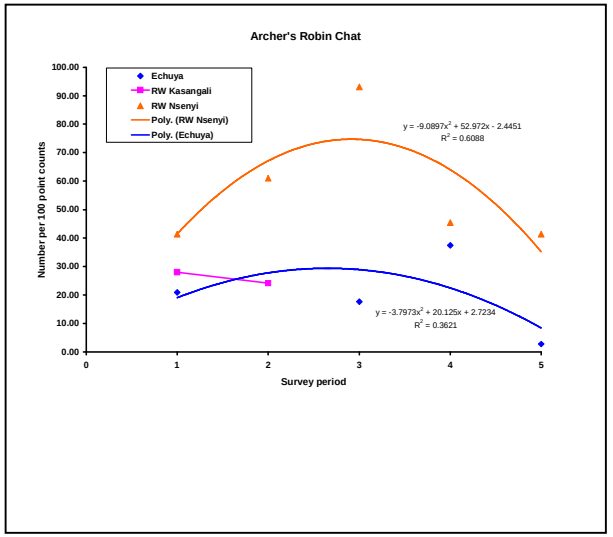
Figure 2.9 Key bird species encounter rates over 2.5 years of monitoring











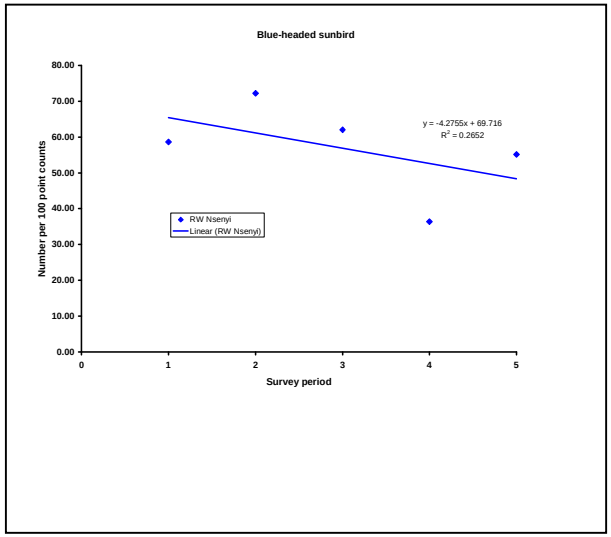


Figure 2.10 Key bird species encounter rate for every 100 point counts

2.3.3.6 Bird surveys in the Arabica coffee gardens around the RMNP

PRIME West undertook the initiative of linking communities to the resources by designing alternative sources of income and increasing economic opportunities for the people with the aim of reducing dependency on protected areas resources. Of the areas of intervention, Arabica coffee around the Rwenzori Mountains National park locally grown by farmers was selected as a subsector enterprise for support. Farmers were provided with wet processing machines through a joint arrangement with African Good Coffee (as marketers) and trainers of farmers in appropriate coffee production technologies. The intention was that by increasing the acreage of coffee around the park and the availability of markets for coffee farmers would earn more money and reduce the illegal resource harvesting from the Rwenzori forest.

The study was conducted by Richard Ssemmanda and Perpetra Akite with the direct supervision of Professor Derek Pomeroy all of MUIENR and WCS staff. The study addressed itself mainly with birds in coffee-growing areas and the adjacent natural forest relating the improvement in habitat to the anticipated reduction in human threats to biodiversity within selected sites in and outside Rwenzori Mountains National Park during the project life. It partly designed to test the assumptions made in the Arabica coffee conceptual model that by providing economic alternatives to unsustainable natural resource use by adjacent communities, would contribute to reducing environmental degradation and thus help conserve critical ecosystems?' Birds are arguably the best known, conspicuous and easily studied inhabitants of tropical forests. They occur in broad geographical range and in large numbers of habitats with some specializing within narrow habitat bands and thus sensitive to habitat change. Two monitoring sites were selected around RMNP where adjacent communities were supported to wet process Arabica coffee. In this study, we compared the birds, as surrogates for biodiversity, in two areas, Nsenyi (located to the South of Kasese District and Kasangali to the north of Kasese district. The study focused on re-sampling birds in coffee-growing areas and the adjacent natural forest. The PW interventions began in 2005, and birds were surveyed in 2006 and again in 2008. A total of 40 forest points, 50 coffee points and 10 non-coffee points were surveyed, using the point count method. Observations were made at each point using an 8 x 30 binocular. At each point, 10 minutes was spent recording birds that were either seen or heard and their distance from the point also estimated but for well-positioned birds, a range finder was used to measure actual distance. A two minute time lag was allowed on reaching the point to allow birds to settle after arrival at point (Bibby *et al*., 1998).

The results of bird surveys in the forest and Arabica coffee gardens in both Kansangali and Nsenyi monitoring sites should no major differences in bird species assemblages between 2006 and 2008. A number of new species were recorded in 2008 and some species previously recorded were not present in the 2008 surveys. However, this is probably too short a time to be able to detect significant changes. Forest specialist birds were the most dominant group recorded in the forest and rarely sighted in coffee gardens including the tree shaded coffee during the study period. There were no significant changes in bird diversity and species richness in the Rwenzori forest in Nsenyi site in 2006 and 2008 survey. However, significant variations between bird diversity and species richness with increased diversity over the two-year period in the Rwenzori forest in Kasangali site. Analysis of the bird data collected showed that species diversity and richness in coffee gardens in Nsenyi site were higher in 2006 compared to 2008, while in Kasangali site coffee gardens showed more species diversity and richness in 2008 compared to 2006 (**Table 2.13**). On the other hand, the results of 2006 for areas without coffee gardens in Nsenyi recorded more species diversity and low species richness compared to Kasangali which exhibited same results in species numbers for both 2006 and 2008 counts but less in diversity recorded in 2008.

Table 2.13 Summery of bird diversity within the different ecosystems for surveys conducted in 2006 and 2008

Site	Shannon's index (H)		Species richness (J)		Birds by forest category					
	2006	2008	2006	2008	2006			2008		
					FF	F	f	FF	F	F
Nsenyi forest	3.85	3.92	0.83	0.89	41	41	8	29	31	3
Kasangali forest	3.27	3.97	0.69	0.84	33	43	13	32	28	9
Nsenyi with coffee	3.96	3.76	0.77	0.72	0	14	22	0	5	15
Kasangali with coffee	3.91	4.09	0.76	0.79	0	12	28	0	9	27
Nsenyi without coffee gardens	2.92	2.78	0.53	0.62	0	4	16	0	1	5
Kasangali without coffee	3.06	2.14	0.57	2.14	0	5	19	0	6	15

Kasangali had less mature coffee gardens during the 2006 survey with more young coffee gardens, which had attained some level of growth over the two years providing extra habitat to the birds for both feeding and roosting since most of these gardens had shade trees. Nsenyi had mostly mature coffee trees in 2006, some of which had been pruned to reinvigorate the old stumps and improve yields. It was however noted that such an action compromised the habitat quality for birds because frugivore species benefit a lot from large amounts of biomass. Measures such as the tongya system were also devised in 2006 as a management tool to resolve boundary conflicts and improve relations between park authorities and the community in Kasangali as a pilot site. Forest specialists (FF) were specifically recorded in forested areas in both Nsenyi and Kasangali stressing the importance of the forest ecosystem. The forest visitors were occasionally sighted out of forest ecosystem but in relatively small numbers while forest visitors were very few within the shaded coffee. This observation highlighted the importance of shade trees if coffee farmlands were to benefit the conservation of birds and other biodiversity.

In terms of the conceptual model assumptions that wet processing and marketing of Arabica coffee was labour intensive, much more paying hence it would constrain local people's time to engage in illegal actives and an increase in income would trigger off a reciprocal effect for them to support conservation were noted to be false. In Nsenyi, local people were noted to be involved in poaching and illegal resource harvesting. Equally, in Kasangali, threat monitoring surveys should a declining trend in numbers of illegal activities, particularly snare encounter, it was isolate the exact people involved. As such, it was not clear whether or not the illegal harvesters were from distant communities or members of the adjacent community. A detailed report produced by Richard Semmanda and Perpetra Akite provided in **Annex II**

2.1.3.6 Fish diversity monitoring on Lake George and the Kazinga channel

Fish assemblage composition and seasonal patterns of species were studied in Lake George and Kazinga Channel by David Bainomugisha with technical assistance of the National Fisheries Resources Research Institute staff. Abundance and size distribution of fish populations was assessed in 10 sites by sampling in the wet and dry seasons between July 2006 and February 2007 using standard multifilament gill-nets, seine net and minnow traps in areas open to fishing and reserved areas that are protected from fishing activities(Full report is provided in **Annex III**.

Sampling was done on fish species occurring in Lake George and Kazinga Channel that has faced varying degrees of human disturbance (**Figure 2.11)**. The ultimate goal was to examine the diversity of fish species in terms of species richness, distribution and relative abundance in the protected areas and open fishing areas of Lake George and Kazinga Channel. Representative samples from both Lake George and Kazinga Channel were obtained with the help of experimental fishing and my data was analyzed.

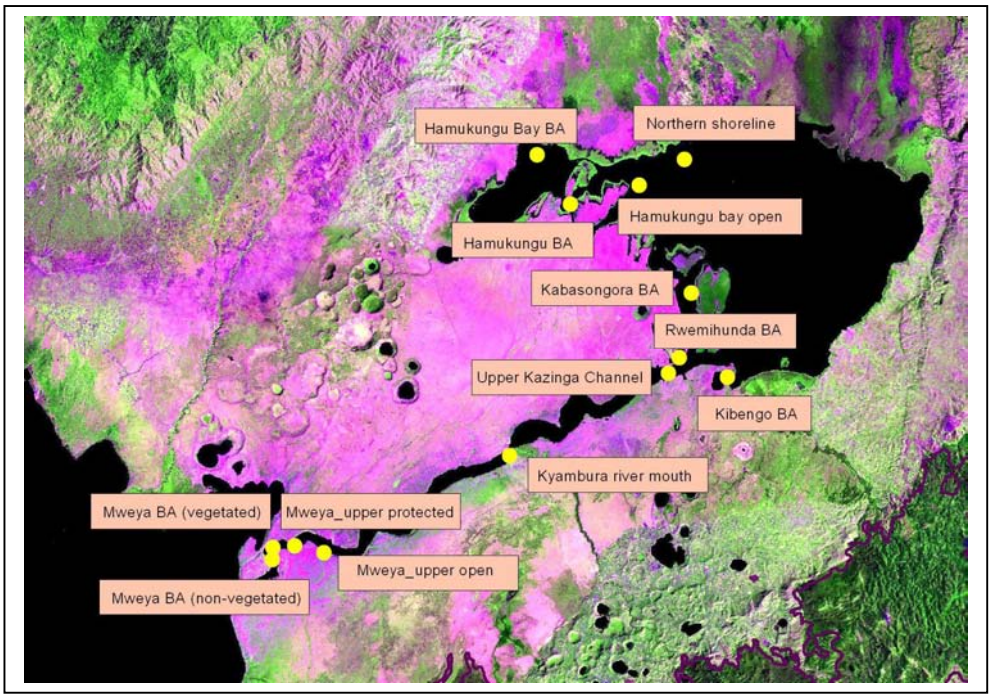


Figure 2.11 Fish species sampling sites on Lake George and the Kazinga Channel

Overall, 32 fish species belonging to 21 genera and seven families were captured. Kazinga Channel was found to be more diverse in abundance than Lake George but with no significant difference among fish species diversity. Results provided no evidence of major seasonal changes in fish abundance. The comparison between open fishing and protected areas showed that there was a reduction in mean length and number of commercial fish species in the open fishing areas. There was a higher abundance of non-commercial species in the open fishing areas. It was also revealed that *Enterochromis nigripinnis* Regan, 1921 was the most abundant species both in number and weight and was present in all habitats sampled in the study sites. Non-commercial species such as *Enterochromis nigripinnis* Regan, 1921, *Harpagochromis squamipinnis* Regan, 1921, *Barbus altianalis* Boulenger, 1900 and other smaller species were more abundant in the open fishing areas than at the river mouth or shorelines. This was attributed to the nature of the fishing industry on the lake where the permitted commercial large mesh-sized gill-net can not catch these tiny fishes. The haprochromine species were the most abundant in terms of numbers and have the

potential for commercial exploitation. They are not exploited because of their low market value and also their size demands the use of smaller mesh gill nets which are not legally permitted by the Fisheries Department.

Fish diversity was higher in Lake George (log series α = 3.5) than Kazinga channel (α = 3.4), although there were no significant differences (Kruskal-Wallis test; X^2 = 7.81, p> 0.05 between the two fish habitats. Fish diversity in protected areas (log series α =3.7) was also higher than in open fishing habitats (α = 2.7). Overall, species evenness in the Kazinga Channel was high (Shannon evenness index, J′ =0.63) and has a better intra-species population distribution compared to Lake George.

Cichlids still dominate the Lake George-Kazinga fishery with a relative abundance of 90%. Of this abundance, the Haprochromine cichlids contributed 83.6% for the entire lake fish population. Protected areas showed high fish biomass (**Figure 2.12)** than open fishing areas although they may have similar relative abundances by number. Protected areas and river mouth habitats have high fish species diversity than open fishing areas due to less human disturbance.

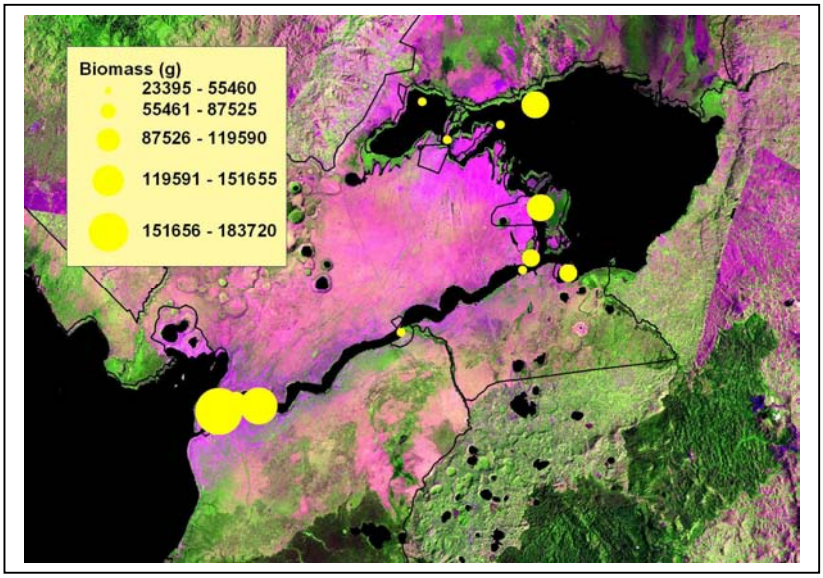


Figure 2.12 Fish biomass measured from Lake George and Kazinga Channel sampling sites

Seasonal changes show variation in the Lake George-Kazinga channel fish relative abundances with the wet season having higher abundance than dry season. During the study, we did not attempt to identify phonological processes as a disturbance or stress to local fishes involves, which required measuring environmental properties over a sufficiently long time to gain an estimate of actual system variance. As such, a more detailed study addressing the ability of fish to survive, or accomplish basic life/reproductive functions and behaviour under controlled conditions need to be undertaken. It will help greatly to understand the response of fishes in Lake George and Kazinga Channel to changing levels of disturbance and stressful effects.

2.4 Changes in human threats to biodiversity (human signs in PAs, BMU, water quality assessments in wetlands, biophysical conditions)

Any sign of human use of the forests/park was recorded also both in the circular plots (40 m radius) and during the reconnaissance walk (at every 250m distance walked with average rece length of 2000m). The total area for sample plots and site areas surveyed is provided in **Table 2.14**.

Monitoring the impacts of USAID/DAI/PRIME West project interventions on biodiversity

Field data recording was based on the following template:
1. Pitsaw sites – the number of pits are counted
2. Huts (for poachers or pitsawyers) - number
3. Shambas - fields in the forest - estimate area for group size
4. Snares - number
5. Pit fall traps - number
6. Beehives - number
7. Paths that were obviously made by humans – presence=1
8. Cut trees for timber - number
9. Firewood cutting – number of piles
10. Cut poles – number cut
11. Cut rattan – number of bundles
12. Fireplaces - number
13. Poachers seen - number
14. Porters seen in the forest – number
15. Other – specify

The human signs were subjectively aged as follows:
1. Fresh = occurred within the last 24hrs
2. New = occurred within the last 2-3 weeks
3. Old = occurred a month ago
4. Very Old = more than 6months

Table 2.14 Monitoring sites, total area per site and sample area selected for regular monitoring based on the circular sample plots (40 m radius)

Survey number		**1**	**2**	**3**	**4**	**5**
Sites	Area of selected monitoring zone	**Plots Area (Ha)**				
ECHUYA FR	2983	19.60	19.10	18.10	19.10	17.59
ISHASHA NOPW	769	11.04	12.57	12.57	12.06	12.06
ISHASHA PW	797	11.56	12.06	12.57	12.06	11.56
KK-K NOPW	147	14.58	13.57	13.57	13.07	17.09
KK-K PW	1758	12.06	14.58	12.06	10.05	11.06
KWR-KKFR NOPW	205	18.60	20.11	19.10	20.11	7.54
KWR-KKFR PW	172	14.07	15.08	15.08	15.08	14.07
QENP WOOD NOPW	3525.6	11.06	11.06	12.06	12.57	7.04
QENP WOOD PW	2350.4	8.04	8.55	9.05	8.04	10.05
RW KASANGALI	1446	11.56	13.07	0.00	0.00	0.00
RW NSENYI	1089	13.07	13.07	14.07	8.55	13.57
STH KFR NOPW	717	9.55	12.06	0.00	0.00	0.00
STH KFR PW	806	16.09	18.60	0.00	0.00	0.00
Total area (ha)	16,765					

NB. Area per survey round is calculated based on the number of plots surveyed per site per survey round (inaccessibility due to river flooding, fires and presence of large herds of elephants and buffaloes hindered regular surveys of all plots established per site)

The number of illegal human activities has been on the decline for most part of the areas (i.e. both PRIME West and none working areas) that we selected to monitor (**Table 2.15**). Most of the illegal activities recorded were mainly harvesting of Non Timber Forest Products (NTFPs) such as pole, stakes, grass, fibres, firewood and charcoal. Timber harvesting was recorded to be the least activity in most protected areas. However, where it occurred, it had very severe negative impacts on the habitat. Other illegal activities included poaching for bush

meat and trophies mainly inside forested areas under NFA and to a high degree in northern part of Ishasha sector under UWA management.

Table 2.15 Summary of total human sightings (illegal activities) in the monitored sites over 2.5 years period

	Encounter rate of all human signs per ha				
Site	**Baseline**	**2**	**3**	**4**	**5**
ECHUYA	457.88	108.58	202.43	89.16	90.78
ISHASHA NOPW	1.18	0.08	0.00	0.00	0.00
ISHASHA PW	0.61	0.00	2.47	1.74	0.95
KK-K NOPW	15.50	8.11	1.55	15.84	9.48
KK-K PW	27.52	8.44	1.82	9.85	53.62
KWR-KKFR NOPW	81.84	14.77	38.06	37.70	3.71
KWR-KKFR PW	25.72	5.31	10.61	0.40	1.49
QENP WOOD NOPW	19.53	22.52	6.05	0.48	5.26
QENP WOOD PW	18.90	12.40	137.49	11.44	14.72
RW KASANGALI	4.93	1.22			
RW NSENYI	6.66	0.92	0.07	0.35	0.07
STH KFR NOPW	45.76	22.96			
STH KFR PW	63.04	6.99			

NB. There was a slight increase in human activities recorded during survey round three in QENP woodlands due to the settlement of cattle keepers in the park and it also coincided with the Commonwealth heads of government meeting (CHOGM) where all security organs, including UWA rangers where deployed to provide security to the delegates leaving the protected areas less manned. In the Echuya, the increase could be attributed to increased access to the bamboo by organised harvesters as a resulted of Collaborative Forest Management (CFM).

The trends in illegal harvesting of selected products in the central forest reserves and savanna parks is provided in **Figures 2.13-2.16**.

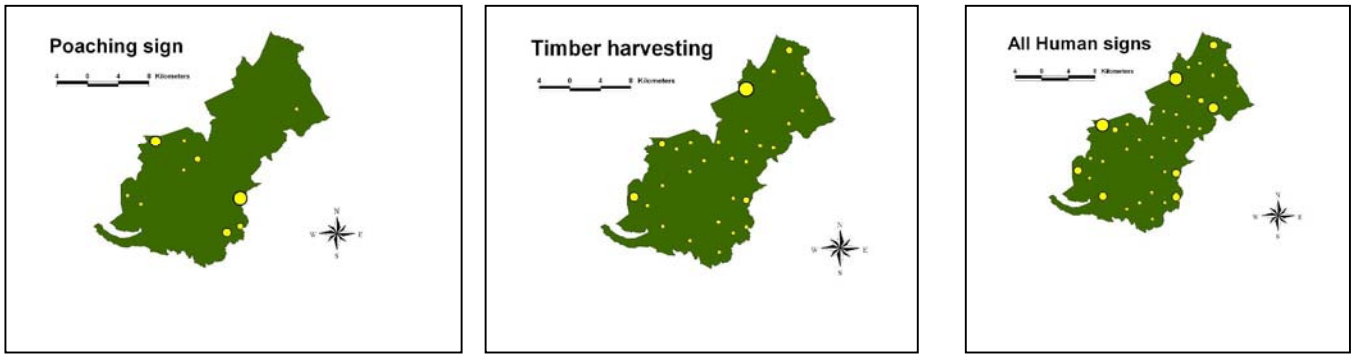


Figure 2.13 Relative abundance of human sign in the Kasyoha-Kitomi Forest Reserve

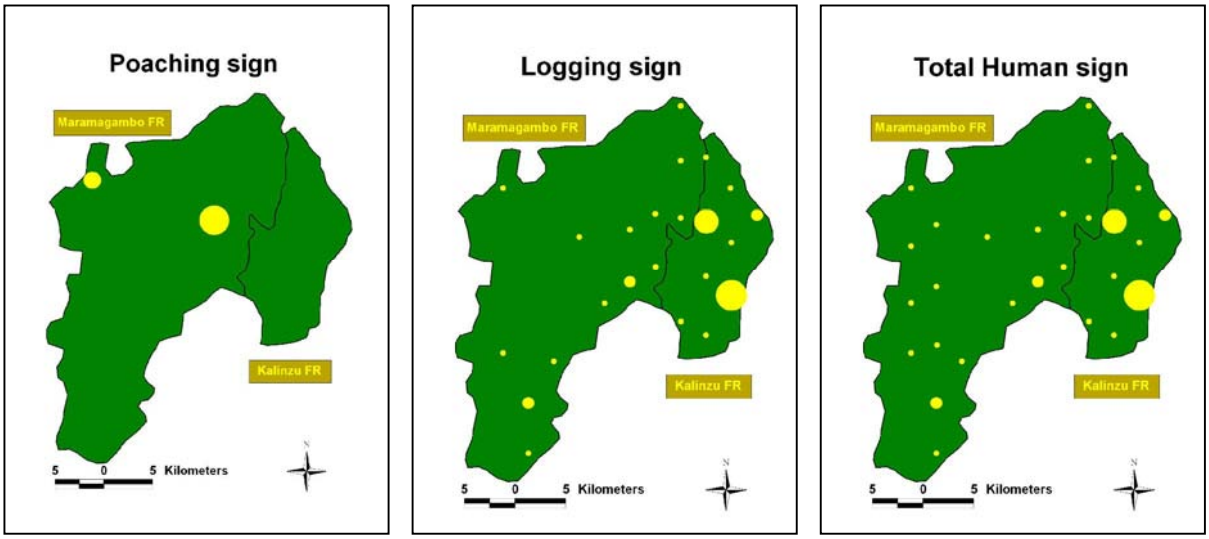


Figure 2.14 Relative abundance of signs of human impact in the Maramagambo-Kalinzu Forest block.

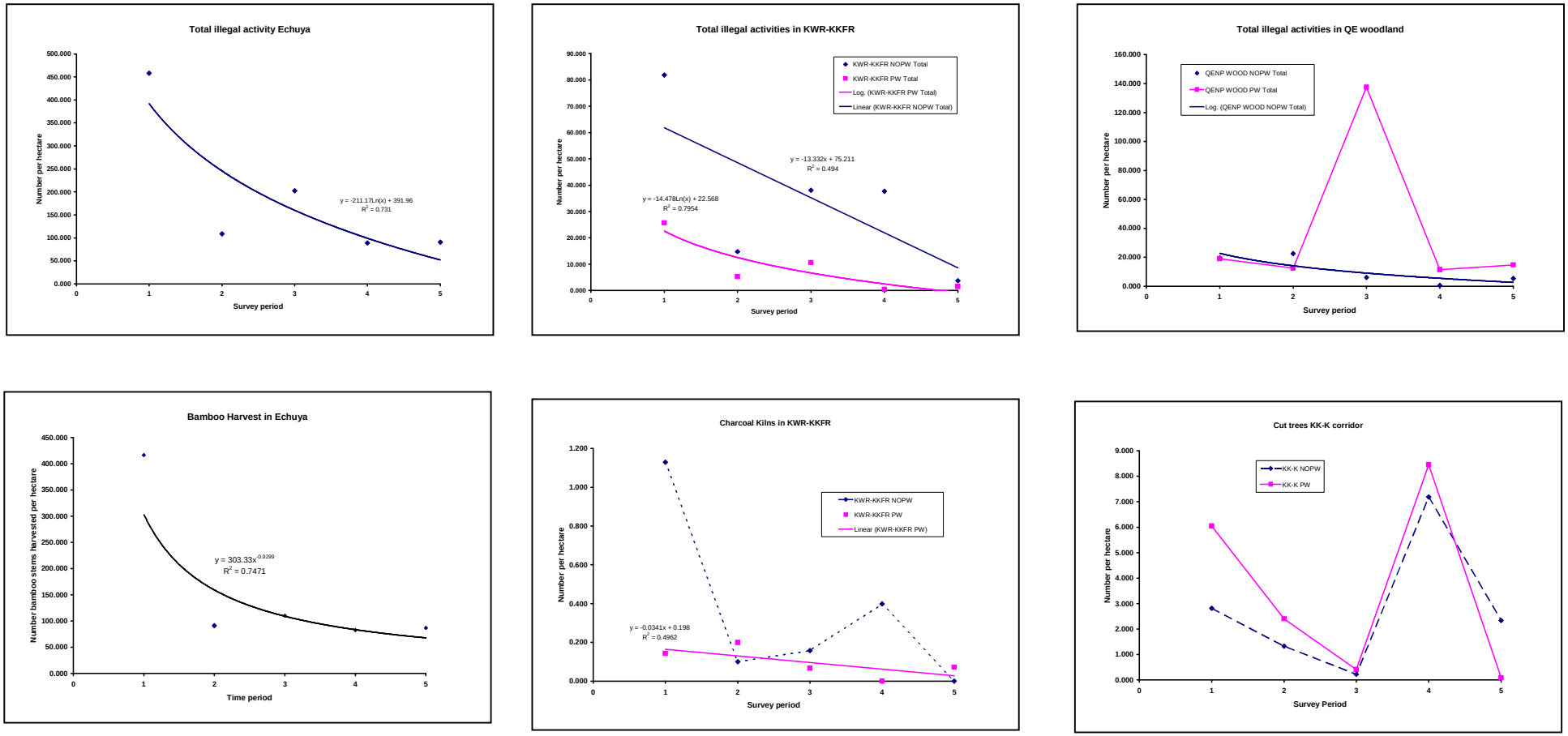


Figure 2.15 Trends in illegal human activities in the selected monitoring sites over the last 2.5 years

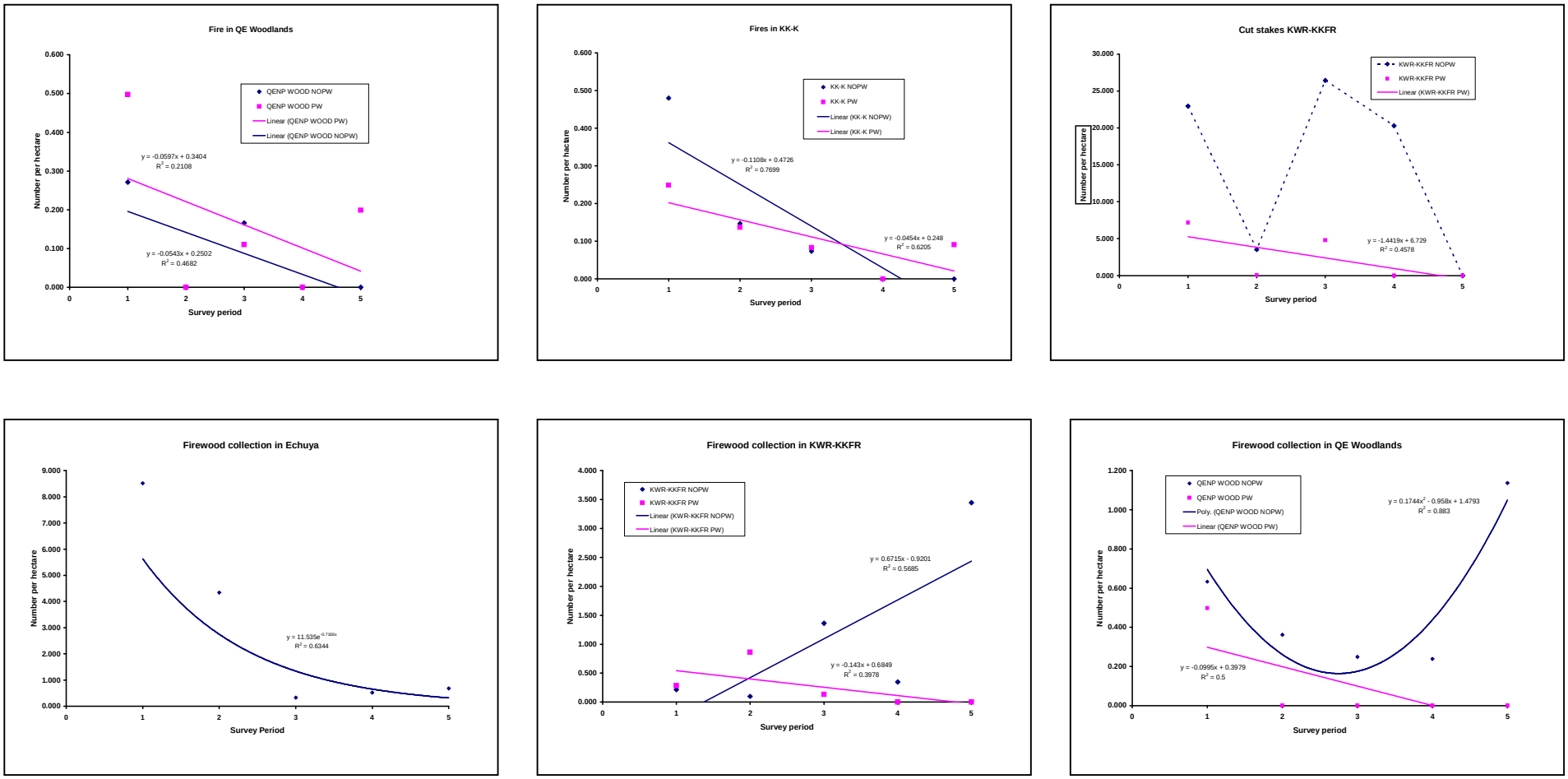


Figure 2.16 Trends of selected illegal forest/park use activities by the adjacent communities

2.4.1 Wetland monitoring

In the last two decades, there has been growing awareness of the ecological and economic importance of wetland systems and the need to conserve them in Uganda. The increasing demand for natural resources, however, has forced the nation, particularly the Wetland Management Department (formerly Wetland Inspection Division) to shift from exclusive protectionism to assess how best to balance economic development and natural resource conservation and sustainable utilisation while ensuring environmental quality. It was noted during the USAID/DAI/PRIME West project that the wetlands in southwestern Uganda were experience severe loss or degradation which negatively affected the biodiversity, including migratory birds and numerous fish species, amphibians and invertebrates. In addition, it was evident that human threats such as agricultural expansion, unsustainable wetland resource harvesting, point and non point source pollution and mining of resources were the key drivers of wetland loss. In its undertaking, the project sought to improve the management and quality of selected wetlands in the landscape namely Nyamurilo (Kabale), Ngoto (Kanungu), Kandekye (Bushenyi) and Mulehe in Kisoro among others. WCS set out to monitor the impacts of the project interventions on biodiversity focusing on key indicator taxa mainly birds and herptofauna, economic and domestic utilisation of resources and water quality monitoring.

Mapping of the wetland change indicated that Nyamurilo slightly over 2200ha (of the 21.4km^2 farmed land) had been restored or at least protected from human disturbance resulting from the project activities implemented by NatureUganda. On the other hand, Mulehe wetland recorded in a decline in the buffer zone around the lake by 12.2ha. The change detection was conducted by collecting georeferenced points in the field using a Global Positioning System (GPS) and later compared with the original wetland maps from WMD in a GIS Laboratory. This method had some technical limitations since the area and extent of wetland maps provided by WMD were done in the early 1990s. As such, there were problems of inaccuracies in providing the quantitative measure of the extent of wetland area in relation to the current gain or loss. It is therefore important that future, intensive analysis using remotely sensed data in combination with fieldwork to determine changes in wetland area be used to capture both quality and quantity. The WMD needs to adopt wetland monitoring as a periodic tool as opposed to inventories which are very expensive and can only be done after long interval period. In terms of water quality, Nyamurilo wetland, where ITFC together with WCS staff were monitoring, showed a slow but steady improvement in water quality. It was very difficult to eliminate noises due to seasonal variation, flooding regimes and annual variations in amounts of precipitation during the project life.

2.4.2 Illegal activities and BMU performance monitoring on Lake George and the Kazinga Channel

The motor boat engines were extended to four Beach management units operating on Lake George and the Kazinga channel by PRIME West in October 2006. Since then, we have been monitoring the level of illegal activities, particularly the number of boats operation on the lake, number of gill nets and hooks per boat and monitoring the compliance of BMUs with fishing standards and regulations. The strengthening of community capacity to police themselves is key to the success of CBNRM. With support from PRIME West, BMUs have been able to reduce the level of illegal fishing activities on Lake George and the Kazinga Channel. After the issuance of boat engines in October 2007, the number of gill nets and hooks per boat reduced from 96.8±8.0 to 69.8±5.3 and 1063±60 to 1014±31.6 respectively; in 2008, we recorded an average of 70 gill nets and 1015 hooks per boat (slightly above the recommended 60 gill nets & 1000 hooks).

(1) BMU capacity

Meetings are frequently (four times in three months) held and follow normal meeting procedures, that is, announcement and invitation of committee members for the meeting is given including the agenda. Hamukungu recorded the highest number (10 in three months) of BMU meetings. During the meeting, minutes are recorded and filed by the secretary to the committee for most of the BMUs except Kahendero which had conducted only one BMU meeting in the last six months. We

were able to look at the minutes and found them well recorded in BMUs minute books. The minutes detail issues discussed, reports on illegal activities, attendance, updated fishing gear register, BMU members register, proposed interventions/actions to be taken and a reporting period. Of high interest to the monitoring team were the conservation issues discussed. These included 1) fisheries law compliance and enforcement (e.g. fishing gears used, size of fish caught, respect of prohibited fishing areas), protection of breeding sites, regulation of fishing effort by gear type and size, fishing methods, number of licensed boats and regulation of BMU membership; 2) landing site sanitation and water pollution management (e.g. collection of fish waste, plastic bottles, used dry cells and disposal of human waste on landing sites); and 3) fisheries data collection, analysis and utilization to improvement fisheries resources management. For most BMUs, recording keeping was quite good, which is a sign of transparency, good management and commitment to collaborative lake and fisheries management.

(2) Monitoring, surveillance and control activities

Most BMUs conduct patrols regularly particularly now that the patrol equipment is on station. PRIME West intervention is strongly appreciated because before the provision of the motor boat engines, it was very difficult to patrol the entire lake. In all six people participate in a single patrol activity constituted by four BMU committee members and two police men. Sometimes the team comprises of BMU members, UWA rangers/police and Barias. A single patrol activity averagely costs UGX 90,000 and this activity is mainly financed from fines levied on illegal users. However, this source of income is very unreliable and affects the patrol plans. As such, only two patrols are conducted in a month yet the most appropriate and effective patrol schedule would be once a week. At the time, the entire lake system had only two sets of patrol boats and life saving jackets which made it difficult to serve all the 13 BMUs. As such, whenever the equipment was brought to a particular BMU, everyone would be aware of the enforcement and try to comply but immediately it headed for another BMU then compliance would cease. The situation was even more complicated whenever, the equipment broke down or there was lack of fuel, free riding was the order of the day. According to the BMU chairperson Kashaka landing site, “most of the illegal and hidden boats would be resurrected on the lake”. Apparently, it is easy to monitor the entire lake and the channel including the breeding areas and any incidences of illegal fishing are recorded and exhibits kept in the BMU stores particularly illegal boats and undersized nets.

It was noted that most of the culprits involved in illegal fishing are mainly the Barias (persons that cast the nets and land the fish) and illegal boat owners. This is not a surprise because fishing is done at night and the Barias and illegal boat owners retrieve and anchor the illegal boats on islands often far from the landing site. From the discussions with the BMU committee members, most cases were handled at BMU level, only one incidence at Hamukungu where the case was reported to Kasese central police station. This particular case involved illegal fishing and fighting on water (illegal fishermen fighting with BMU law enforcement team). The BMU feel that by handling the culprits themselves, it helps to build confidence in the team, reduce prosecution costs and offers an opportunity to monitor the culprit and crack down the network. The punishments vary from warnings by the committee, fines and commitment of suspects to courts of law.

Comparison of the level of law enforcement before and after PRIME/West support shows that the provision of patrol equipment has eased enforcement and made it more effective. This is because it helped to reduce on the patrol time (it takes on average eight hours to patrol the entire lake as opposed to 2-3 days with a canoe. It can be conducted anytime whenever information is received about poor fishing activity on the lake. Compliance had gradually improved but recently retarded by elections of new BMU committees. At least by the end of November, the situation was getting to normal as a result of committee members getting to understand their responsibilities and an increase in awareness raising. As a result fish catches are improving both in fish quantity (numbers) and quality (size). On the other hand, the demand for Ambatch (*Aeschynomene elaphroxylon*) trees to provide gill net floaters is on the increase. Fishermen have to a large extent resorted to using plastic jerricans and stones as floaters and anchors respectively. The major concern with plastic containers is possible water contamination since these jerricans are not thoroughly cleaned.

2.4.3 Changes in formal conflicts in forest/woodlands/aquatic ecosystems

Ecosystem-related conflicts monitoring

Information regarding conflicts reported to the formal courts mainly at the subcounty level and police in relation to unauthorised or prohibited use of forests, savanna woodlands, wetlands, lakes and rivers, and fisheries resources were collected over a period of five years. Because the conflicts we examined were related to different ecosystems and dependent on the management approaches employed by the resource managers (e.g. UWA for parks and wildlife reserves, forests – NFA, Wetlands – WMD and fisheries resources – Fisheries department), we used documents and archive analyses together with interviewees with legal/formal court clerks and resource managers. We analysed the data from magistrate court case returns and collaborated this information with formal reports from UWA, NFA, WMD and fisheries and later validated the information being collected by conducting direct interviewees with selected court magistrates and resource managers. In this report we have been able to present only court returns mainly for the QECA, as reported to Kasese (Katwe), Kanungu (Kihihi) and Bushenyi (Kichwamba, Rheru and Katerera) and only Kabale (Muko) district sub counties for region further south. Records from NFA and Wetland Management Department are still scanty because NFA and Wetland officials do not keep records. It was reported by the staff in Bushenyi that because they don't have prosecutors and normally take the suspects to police and are constrained by resources to make a follow up. At the same time, the police posts where these cases are reported only get registered if settlement out of the police station is not reached. As such, police records are also wanting for forest and wetland related offences.

The formal cases recorded in QECA over a period of four years (2004-2007) were noted to be 280 (**Table 2.16**). There was an increasing decline in the number of formally reported cases from 2004 (34.2%) to 2006 (12.7%) and a slight an increase by the end of 2007 (**Table 2.17)**.

Table 2.16 Conflict/case returns for Queen Elizabeth Conservation Area

Year	District	Forest	LAKE	National Park	Wetland	Total number of cases	% of total cases
2004	Bushenyi	9	4	0	1	14	
	Kasese	0	0	65	0	65	
	Kanungu	2	0	13	0	15	
	Kabale	1	0	0	0	1	
2004 Total		12	4	78	1	95	34.2
2005	Bushenyi	2	0	0	0	2	
	Kasese	0	6	63	0	69	
	Kanungu	0	0	13	0	13	
	Kabale	4					
2005 Total		6	6	76	0	88	30.5
2006	Bushenyi	0	0	0	2	2	
	Kasese	0	0	26	0	26	
	Kanungu	0	0	7	0	7	
	Kabale	0	0	0	0	0	
2006 Total		0	0	33	2	35	12.7
2007	Bushenyi	1	1	0	0	2	
	Kasese	0	0	55	0	55	
	Kanungu	0	0	5	0	5	
	Kabale	0	0	0	0	0	
2007 Total		1	1	60	0	62	22.5
Grand Total		19	11	247	3	280	

During the period between March 2006 and October 2007 alone, 60% (59 cases out of 97 recorded between 2006 and 2007) cases were committed. This period also corresponds well with the settlement of the Basongola cattle keepers in QENP.

Table 2.17 Percentage distribution of Conflict charges awarded by the legal courts for different ecosystems in QECA

Conflict/Case/section of law contravened	Ecosystem					
	Forest	**LAKE**	**National Park**	**Wetland**	**Total number of cases**	**%**
Illegal entry	1	6	207		214	62.4
Possession of dangerous weapon/device			45		45	13.1
Disturbing the peace of wild plants			17		17	5.0
Fishing in prohibited area including breeding zones			9		9	2.6
Starting & maintaining fire in a PA			6		6	0.0
Hunting of game meat/trophies			16		16	4.7
Conveying domestic animals in the PA			2		2	0.6
Use of illegal/un permitted fishing gears/vessels		5	3		8	2.3
Possession of wildlife specimen without permission	4		5		9	2.6
Fishing immature fish			3		3	0.9
Selling/buying/accepting to authorised wildlife specimen transfer an			4		4	1.2
Conspiracy to commit a felony					1	0.0
Abuse of office					1	0.0
Preparing land in a PA (agric encroachment)	1				1	0.3
Unlawful shooting in PA			4		4	1.2
Draining a wetland				2	2	0.6
Hindering and obstructing environmental inspection				1	1	0.3
Illegal charcoal burning in the PA	3				3	0.9
Illegal tree/timber harvesting/pitsawying	5				5	1.5
Grand Total	14	11	315	3	*343 (351)	

*most cases attracted more than one count (i.e. 1-3)

Magistrate court performance in executing reported cases

Although the magistrate courts (sub county courts) are overwhelmed with criminal cases, the level of execution of protected area related cases is relatively faster compared to land related conflicts handled by the same courts in the region. Of the four districts that we were monitoring, Kasese recorded the slowest legal prosecution of criminals followed by Kanungu. Following the survey results, it was also noted that Kasese district recorded the highest number of cases compared to other districts. This could be attributed to the presence of very many protected areas overlapping the district, which increases access to protected area resources illegally. In addition, it is culturally known that the ethnic groups living in Kasese district enjoy bush meat a lot (Olupot *et al*., 2008). However, such results also emphases the high level of community dependency on protected area resources for survival. **Table 2.18** provides a summary of the total number of cases handled (completed or pending) in various courts in the districts of Kanungu, Kasese and Bushenyi from 2004 -2007. Most of the cases reported have been executed to the last conclusion and

punishments awarded to the culprits. However, it was noted that in some cases, the police officers tend to frustrate the efforts of arresting authorities by releasing suspects under unknown circumstances. Although UWA and NFA officers are empowered to arrest suspects, they lack their own prosecutors to present cases before courts of law. In areas where UWA and NFA are not represented, police prosecutors mishandle cases by collaborating with suspects through bribery and forms of inducements (gifts in form of livestock and money). They also coach suspects to state otherwise hence misdirecting facts and evidence leading to dismissal of such cases for want of more incriminating evidence; granting suspects' police bond in prejudice to 'constitutional powers vested in them' and in the long run, such suspects don't turn up nor does the police officers follow them up for jumping bond and bring for further prosecution. This has been a very big set back considering the resources the authorities invest to apprehend these suspects, particularly the logistics, manpower and time spent in order to have these suspects brought to justice.

Table 2.18 Handling of cases by magistrate courts in the QEPA overlapping districts.

District	Year	Number of cases completed	Number of cases pending
KASESE	2004	42	66
	2005	63	43
	2006	33	41
	2007	87	37
SUB TOTAL		**225**	**187**
KANUNGU	2004	15	0
	2005	13	0
	2006	7	0
	2007	2	3
SUB TOTAL		**37**	**3**
BUSHENYI	2004	14	0
	2005	2	0
	2006	2	0
	2007	1	0
SUBTOTAL		**19**	**1**

2.4.4 Improved Biohysical conditions of ecosystems in PRIME West working area

Results of areas of biological significance showing improved biophysical conditions of marine/wetland, and terrestrial/forest and woodland as a result of PRIME/West assistance was done by putting together all contributions from PRIME West implementing partners towards this indicator. The analyses where based on reduction in illegal activities for the selected sites from May 2006 (baseline year) to May 2008 where WCS chose to monitor, mapping of restored wetland and formally degraded forest areas and coniferous tree planting on private land. Six sites with a total area of 13,796 ha was selected and mapped for regular monitoring of birds, mammals and threats to biodiversity conservation. Of the six sites selected, a representative number of random sample plots (256) each measuring 0.5ha and a total area of 133 ha was monitored for 2.5 years (**Table 2.19**). The plots were searched for human activity signs at intervals of six months and the encounter rates computed. Analyses of the results have showed a decline in illegal human activities in almost all sites with some 'noises' created in 2007 due to the settlement of cattle keepers in QEPA causing a slight increase in illegal activities, and later gradually declining. Equally the analyses of the formally reported conflicts for QEPA discussed in the previous section above exhibited the same trend. This information was supposed to be collaborated with the UWA MIST data results from QEPA and Rwenzori MNP for gap analysis but it was not possible due to technical problems with the MIST data (poor entry of records, inconsistence in data collection

techniques and formatting). As such, UWA is still cleaning their datasets and hopefully this will be completed by the end of August 2008 just after the project life.

Nonetheless, a reduction in human activities in the ecosystems that we were monitoring together with an increase in birds and large mammal sightings is a surrogate indicator for an improvement in the ecosystem health. In addition, the decline in illegal activities in the protected areas is indicative of the increased support to UWA and NFA management by PRIME West mainly in law enforcement, support to collaborative forest and wetland management and offering of economic alternatives through the enterprise support to the communities, in particular to the ex-poachers. These results of this particular parameter should be interpreted cautiously as a reduction in illegal activities could be attributed to other causes beyond this study such as incremental and cumulative effects from other projects, changes in the climate, political and economic opportunities. It is hard to attribute all the changes to PRIME West in such a short time. It is also important to note that some of the long term positive impacts (qualitative) will be felt after some time and not ease to capture during the project life. 2) Mapping of fish breeding zones on Lake George and the Kazinga channel where improvement in protection status and management has occurred using Aster satellite images, which are both aerial and ground-truthed. This particular parameter was handled directly by PRIME West core team; (3) Analysis of the forest cover change in Murchison Falls National Park – Semliki Landscape to show any increases in forest cover in the landscape attributed to increase in law enforcement and afforestation by our partners ECOTRUST and JGI. This imagery analysis will be both aerial and ground-truthed focusing on areas of uncertainty for the key drivers of this change. Following the Aster satellite imagery analyses of MF-Semliki landscape for the period from 2000-2006, results only showed an increase in forest cover in Murchison fall NP of 236.6ha and the rest of the areas both NFA forest estates and private forests showed tremendous declines in forest cover. It is important to note that the satellite imagery does not cover any interventions/impacts that occurred after 2006. As such, it is advisable that you contact other implementing partners such as ECOTRUST and JGI for their actual contribution to forest restoration and afforestation reports.

Table 2.19 Number of hectares per ecosystem that has showed an improvement in biophysical conditions based on declines in human illegal activities and wetland mapping of improved areas

Site	Ecosystem type	Baseline 2006 (ha)	2008 (ha)	Actual increment For LOP (ha)
Rwenzori Forest	Afromontane forest		1,089.0	
Queen Elizabeth Northern sector	savanna woodlands		5,876.0	
Ishasha sector	savanna woodlands		1,566.0	
Echuya	Mixed bamboo forest		2,983.0	
Kasyoha Kitomi -Kyambura WR	Mixed forest and woodlands		377.0	
Kasyoha Kitomi -Kalinzu FR	Tropical High Forest		1,905.0	
Murchison - Semliki Landscape	Mixed forest and woodlands			236.6
Sub total			**13,796.0**	
****Wetland mapping (ha)**				
Nyamuriro		455.5	617.1	161.6
Mulehe		372.6	360.4	-12.2
*Fish breeding zones on Lake George			4000	
Total area (ha)				**18,194.2**

*Mapping of BMU was conducted by PRIME Core team together with consultant
**Wetland mapping was done in 2006 and 2008, the figures presented show the change in area
WCS could not assign baseline values because it was not directly implementing the project interventions and the results presented here are just a surrogate measure of the ecosystem health.

3.0 Landscape analyses

3.1 Greater Virunga Landscape corridors

Mr. Polycarp Mwima Musimami, a PhD student on the project together with WCS and MUIENR academic supervisors assessed the value of the Greater Virunga corridors focusing mainly on the importance of corridors in animal movements between protected areas, the threats to these corridors and human-wildlife conflicts resulting from the presence of animals that use these corridors. His results showed that animals such as elephants, chimpanzees, monkeys and hippos use the most of the forest corridors (**Figure 3.1**). Elephants do cross back and forth to DR Congo and on their way, they occasionally raid people's crops.

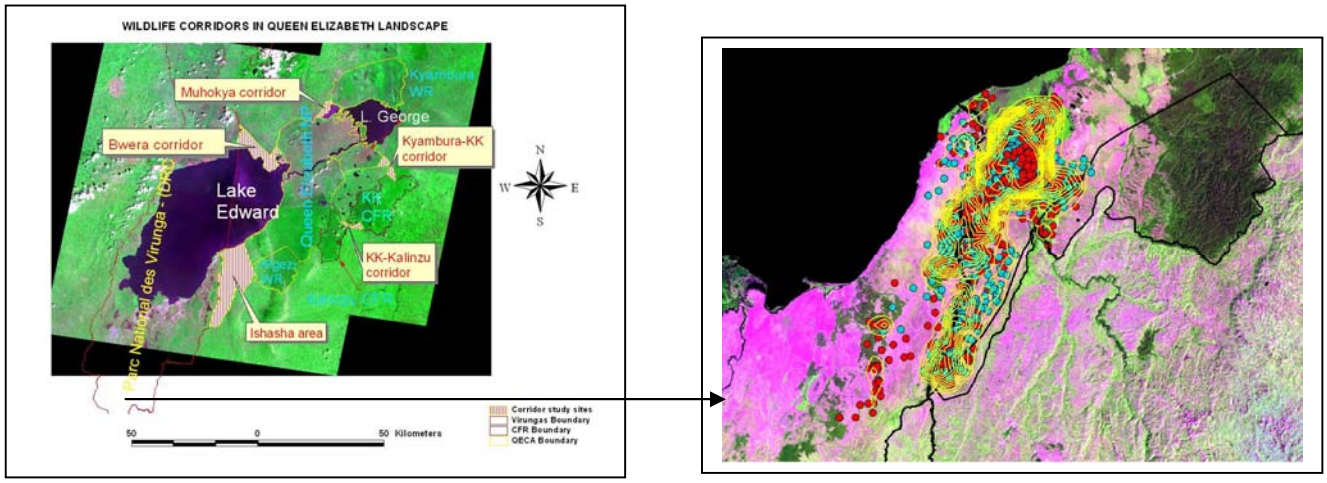


Figure 3.1 Greater Virunga landscape corridors and the movement of cow three that was collared in Ishasha

Excavation of a trench in Ishaha has helped to reduce crop losses and the relations between UWA and the community was improving. Muhokya corridor is still a big challenge for the elephants to cross to Kibale. Because of the productivity of the area, throughout the year, the area is farmed and whenever elephants attempt to cross, they repulsed by farmers. The Mauritius thorn hedge that was established by CARE and further supported by PW got burnt by fires and some parts just dried up due to prolonged dry spell. A detailed report of the study is provided in **Annex IV**

3.2 Strategic corridor plans

A strategic corridor plan for Greater Virunga landscape corridor was developed with facilitation from the Nairobi based consultancy firm, Conservation Development Centre (CDC) through a consultative process of all concerned stakeholders mainly the government agencies, local government leadership, conservation organisations and community based organisations. A Corridor plan is provided in **Annex VI**.

3.3 Satellite imagery analyses of Murchison Falls _ Semliki Landscape

The aim of this project was to develop a map of the existing natural habitat (2004-6) in the Murchison-Semliki landscape and also show the forest cover change over the same period.

3.3.1 Land cover/use changes (2006)

The land cover change map includes fully stocked forest, depleted forest, woodland, grassland, swamp or wetland habitat, lakes, built up areas and farmland as habitats. The major areas of interest were the forest reserves, conservation areas and the privately owned remnant forests. It was also important to differentiate between uniform and subsistence farmland because this would be used as a guide in determining which areas would be most suitable for animal corridors.

Results

A classified land use/cover map of the area from Murchison to Semliki was completed (**Figure 3.1**) and validation of the classification map was done. From the classification map, it can be noted that there has been a lot of forest cover loss with most of the forests getting completely degraded such as Kagombe, Kitechura, Matiri in the south and Nyakarongo and Nyabigoye FRs in the northeast of Lake Albert. Most of these forest reserves are being cut down for subsistence farming to plant crops such as maize, bananas, cassava. There has been considerable sugarcane growing expansion by Kinyara Sugar Works leading to the conversion of most of the forest patches around Budongo FR. A combination of subsistence farming (mainly slash and burn practice) and commercial farming, particularly tobacco around Budongo and Bugoma forest reserves, has accelerated the rate/level of forest cover loss. We are beginning to see some small islands of colonizing forests in previously degraded area but now abandoned.

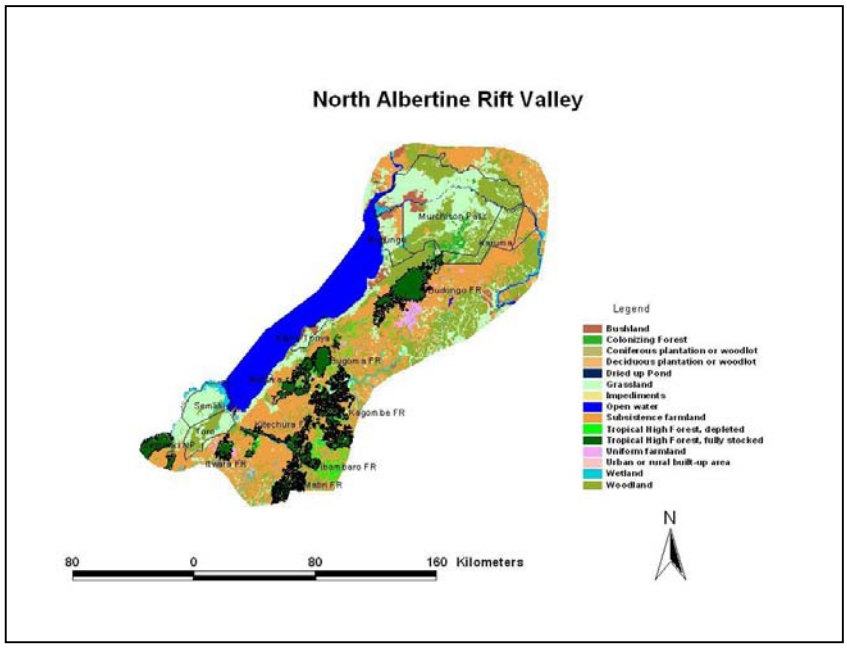


Figure 3.2 Land cover/use map based on 2006 Aster images and the 2003 Land use/cover map produced by the Biomass department of NFA.

3.3.2 Forest cover change (2000-2006)

Introduction

Murchison Falls –Semliki Landscape supports a large array of forest types ranging from tropical high forests (e.g. Budongo, Bugoma, Matiri), savannah woodlands (large sections of MFNP), riverine forests (e.g. Wambabya & Waki) to plantation forests (e.g. Katugo and Oruha). Biodiversity arises not only from this complexity but also because westward flowing rivers such as Wambabya, Waki, semliki, and Muzizi contribute to species diversity that otherwise would be restricted to higher altitude areas. Of specific importance to large forest cover presence are the large mammals (e.g. elephants) chimpanzees and monkeys, reptiles, birds to plants, some of which are endemic to the region (Plumptre, *et al*; 2003) . At the same time, forests are strongly influenced by human activities, in part because they occur in areas with large community settlements due to proximity to water sources, agriculturally productive soils (nutrient-rich), livestock grazing areas and a home to both timber and Non Timber Forest Products. A large proportion of the forests occur on private land, managed and controlled by individual owners. The other proportion of forests is protected by government and managed by national government institutions such as National Forestry Authority (in charge of central forest reserves), Uganda Wildlife Authority (in charge of forests inside parks and wildlife reserves) and local governments (district –sub county level) in charge of local forest reserves.

The greatest threat to the biodiversity and forests are the result of conflicting land uses such as conversion of forested areas to agricultural farmlands, human settlements, infrastructure development (social service facilities and roads), and mineral extraction including now oil and gas production schemes. In response to these growing threats, DAI/PRIME West supported WCS and the WHRC to assess and evaluate the forest cover change and provide an understanding of what the important drivers of forest loss are in order to develop appropriate management responses to the underlying causes. Our approach to the forest cover change analyses involved two components, that is, the forest change map generated from remotely sensed data conducted greatly by Woods Hole Research Centre (WHRC), which based in the USA and the socio economic survey and analysis to establish the drivers of forest cover change lead by Wildlife Conservation Society, Uganda office. It should be noted that both techniques complemented each other and provided input before fieldwork or during the lab analyses to help generate accurate forest change maps for the landscape.

Methods

Remotely sensed data have been extensively used for monitoring natural resources over large areas. In this study we used remotely sensed data from the Landsat GeoCover data set (Tucker et al., 2003), and Gap filled SLC OFF Landsat images with a spatial resolution of 28.5 meters. A combination of multispectral transforms of brightness, greenness, wetness (Crist and Cicone, 1984) for the year 2000 and change in brightness, greenness and wetness (Collins and Woodcock, 2003) between 2000 and 2005 data served as input to a supervised neural network classifier to map land cover and land cover changes (**Figure 3.2**). A total of eight dates Landsat scenes were individually classified to identify land cover and forest change. For each of the scenes a representative set of training sites was visually identified for each of the land cover and land cover change classes and used to train a neural network classification algorithm (Carpenter et al. 1997). The neural network assigns a land cover or land cover change class to each pixel in the dataset. These per-pixel classification results were then aggregated in polygons via image segmentation (Woodcock and Harward, 1992). The segmentation processing groups neighboring pixels into regions (or polygons) on the basis of their spatial location and spectral similarity. A minimum mapping unit of approximately one hectare (11 pixels) was used. The goal of using a minimum mapping unit larger than the spatial resolution of the data is to minimize confusion in the identification of land cover change resulting from minor mis-registration of the two dates of imagery. The final results were visually inspected and edited to remove some of the errors in the forest change class. The methods used in this analysis closely follow those outlined in detail in (Woodcock et al, 2001).

Landsat data used in the study

172_58

T1 - 11/29/2005 (Gap filled by USGS with images 12/15/2005, 12/31/2005,
2/20/2007; residual fill 2/6/2002)
T2 - 9/12/2000 (Orthorectified/Geo-Cover product)
172_59

T1 - 11/29/2005 (Gap filled by USGS with images 12/15/2005, 12/31/2005,
2/20/2007; residual fill 2/6/2002)
T2 - 5/23/2000 (Orthorectified/Geo-Cover product)
172_60

T1 - 11/29/2005 (Gap filled by USGS with images 12/15/2005, 12/31/2005,
2/20/2007; residual fill 2/6/2002)
T2 - 01/02/2001 (geometrically corrected to 12/31/1999
Orthorectified/Geo-Cover product)
173_59

T1 - 01/23/2006 (Gap filled by USGS with images 1/10/2007, 2/21/2005, 2/5/2005; residual fill 1/9/2001)
T2 - 01/09/2001 (Orthorectified/Geo-Cover product)

All T1 images (from above) were geometrically corrected using ERDAS Imagine to the orthorectified images from T2. The resultant map is shown in **Figure 3.2** below.

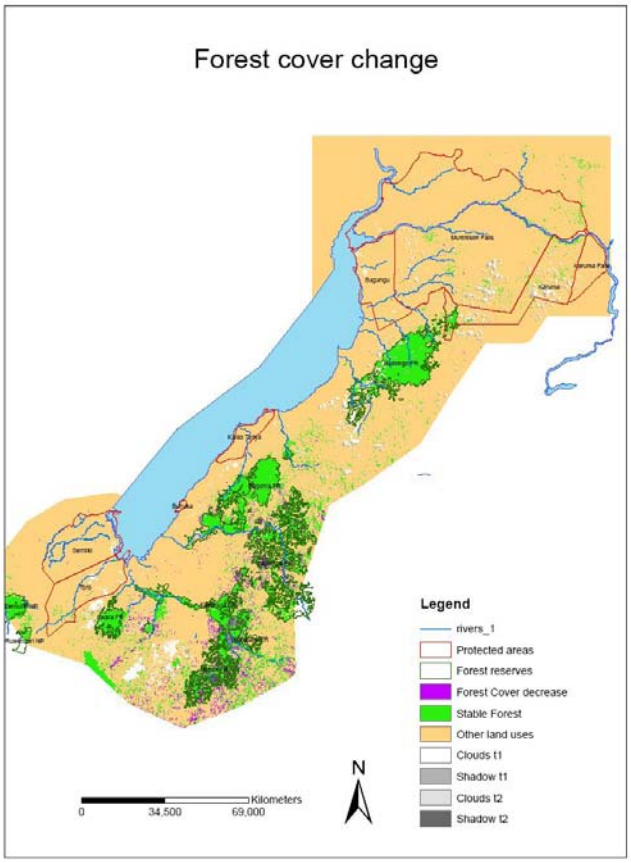


Figure 3.3 The forest cover change map indicating areas that decreased in forest cover

Whereas there has been forest cover change within the forest reserves under NFA, most forest decrease was in areas managed by the local government. Considering the large forests, most of the forest loss was recorded around the forest boundaries. The southern part of Bugoma forest registered high forest loss. Much of Matiri and Ibambaro forest reserves have been depleted. Considering areas outside the large closed forests, the southern part of the Murchison-Semliki landscape registered higher forest loss than the northern areas. The districts of Kibaale and Kyenjojo registered the highiest forest loss. Forest cover increase was mainly observed in the southern sector of the Murchison Falls Conservation area. A total of 236.6 Ha of vegetation cover had changed from Woodland to colonizing forest. This is probably due to increased control of fire use, as a management strategy, and the presence of the ecotourism activities at the Kaniyo-Pabidi ecotourism camp. Other areas of forest increase, which may have occurred during the Prime West period could not be detected during the Land cover classification or the forest cover change analysis because of two major reasons;

1. The woodlots were in most cases smaller than the minimum area acceptable for mapping.

2. Most of the PRIME West supported tree planting initiatives had just started (2006) when the images for vegetation cover mapping and for the second date of the forest cover change were obtained. Forest increase resulting from tree planting initiatives can therefore only be obtained from reports of the supported organizations.

Whereas the forest change map provides an overview of the forest cover changes taking place in the Murchison-Semliki landscape, the results presented here should be taken with caution. The map is not yet validated. So there could be minor errors of omission and commission in some of the areas. We however, used the map to identify sites for the socioeconomic survey and all areas that were indicated as having lost forest cover on the map were actually found to be cleared in the recent past. This provided a reasonable confidence in the results generated.

At district level, Kyenjojo registered the highest forest loss of 7.2% (17,000 Ha), followed by Kibaale with 4.2% (10,199 Ha) and Hoima with 1.0% (3,644 Ha) of their land area (**Table 3.1)**. In Kyenjojo district, the parishes that registered the highest forest loss were Mugongwe, Kijaguzo and Rwibale with 30.5%, 22.3% and 19.7% respectively. Twelve parishes in Kyenjojo registered forest loss of equal to or more than 10% of their land size. In Kibaale district, the parishes that registered the highest forest loss were Igayaza (14%), Kabamba (13.4%), Kibogo (12.5%) and Kicura (12%) loss. Seven (7) of the parishes in Kibaale district registered forest loss >=10%. In Hoima district, the parishes that registered the highest forest loss were Igwanjura with 8.2%, Bubogo with 5.2% and Kyangwali with 4.4% loss of their land area. Although Igwanjura registered only 8.2%, in absolute terms this equates to 1,337 hectares. Considering the individual forests (both under NFA and Local government), Oruha forest (south of Itwara forest), Kikumiro and Kehara forests registered the highest forest loss of 36.7%, 25.5% and 23.5% respectively of their land area. In terms of number of hectares, Matiri, Ibambaro, Kagombe and Bugoma forests lost the highest number of hectares that is, 844 Ha, 538 Ha, 534 Ha and 353 Ha respectively of their land area. The variation in the identified forests when using the two measures is influenced by the initial size of the forests. Larger forests seem to have lost little in terms of percentage coverage yet the number of hectares is high. For example, Matiri forest had an overall area of 3,924 Ha and lost 844 Ha, which is equivalent to only 15.4% of the total forest area. Oruha forest on the other hand, had a total area of 334 ha and lost 127 ha equivalent to 36.7%.

Table 3.1 The forest cover change per area of the districts in PRIME West working areas

District Name	AREA (Ha)-PW Area	% Change	Change (Ha)	Stable Forest (Ha)	Stable NonForest (Ha)	No data/Clouds (Ha)
Kyenjojo	236,673.3	7.2	17,000.2	40,210.8	165,062.1	6,138.5
Kamwenge	1,618.4	5.6	90.5	22.0	1,486.1	0.0
Bundibugyo	140,203.7	0.0	54.3	4,913.0	133,381.2	1,853.1
Kabarole	46,421.3	0.6	280.1	4,654.1	37,283.3	4,214.7
Kibale	244,354.2	4.2	10,198.9	43,442.0	189,705.7	977.5
Buliisa	123,025.9	0.0	18.0	12,711.6	105,974.4	4,315.6
Masindi	413,571.5	0.1	244.0	39,186.1	356,676.0	17,491.3
Hoima	360,859.0	1.0	3,643.5	54,895.0	288,264.0	14,047.6

3.3.3 Socioeconomic survey results

The survey was carried out in the districts of Masindi, Hoima, Kibaale and Kyenjojo to identify the drivers of forest cover change. Discussions with the district and parish officials, and the NFA personnel in charge of the different forests provided us with the general overview of the main drivers of forest cover change. Most of the views were confirmed by making field observations during the household interviews with the local communities.

3.3.3.1 Formal meetings with the District, Parish and NFA officials in the areas surveyed

The factors contributing to forest cover change include the increase in population leading to increasing demand for land for cultivation, intensification of sugarcane and tea growing, availability of market for timber (especially in southern Sudan) for construction and housing and the need to generate local revenue for running the districts. Other identified causes of forest cover reduction

were the 2003 forest law that lead to the restructuring of the Forest Department and creation of three units i.e. National Forest Authority (NFA), District Forest Service (DFS) and Forest Inspectorate Division (FID). Management of local/private forest was handed over to the DFS, which was already technically weak. This has accelerated forest loss on communal lands including riverine forests. Although the law is explicit about how private forest owners should manage their forest estates and is clear about the role of DFS on providing technical guidance to private forest owners, enforcement is still a challenge mainly due to understaffing and lack of operational funds.
A few specific sights were also singled out. For example in the Nyabyeya (I & II) parishes, the major causes of forest reduction is sugarcane growing, increase in population, local people renting out most of their arable land to rich sugarcane out growers. The households are left with very little and unproductive pieces of land for agriculture and housing units. This in turn, forces them to encroach on the marginal lands such as the river banks. Most of the places around Budongo Forest Reserve, forest patches were initially devoid of standing trees through pitsawying and later the entire forest is opened up for agricultural activities. In addition, the non timber producing trees were felled for charcoal production. Because of the relaxed enforcement of the Forestry law, use of chain power saws by timber harvesters on private and community forests is on the increase. As such, clear felling was on the increase. In Nyantonzi parish, Masindi district, sugar cane and tobacco growing have contributed heavily to forest loss. In Hoima district, it was mainly the upland rice and tobacco cultivation that were driving forest depletion while in Bulisa district, immigrant cattle keepers with large herds of cattle were degrading the forest due to overgrazing. There is yet another problem of international refugees particular in Kyangwali subcounty, Hoima district. Congolese who were officially settled in the refugee camps have been escaping and moving to the districts of Kibale and Kyenjojo. A combination of the Congelese refugees and the immigrant Bakiga and Bafumbira from southwest Uganda to Kibaale, and Kyenjojo districts has also exacerbated the loss of forests in the region. Forests between Itwara and Muzizi Central Forest Reserves (Mirambi parish) were cleared to deter rebels from using the area for their rebellious operation.

During the meetings with the district leadership, local councils and NFA staff, a number of challenges were noted. These include

1) Inadequate facilitation for District Forest Officers (e.g. financial and personnel). The structuring of the Forest Department and the subsequent formation of both the DFS and NFA led to downsizing of staff and decentralisation of the forestry sector. As a consequence, the DFS, which is now under the local government authority, have limited budgets to supervise forestry related activities in the districts. In most cases, the DFO works single handed due lack of resources to hire support staff. It is therefore impossible for them to control/monitor illegal forest activities;
2) Inadequate land for the households makes it difficult for them to plant trees;
3) Insecure land tenure for tenants and squatters also makes it for people to engage in tree planting;
4) Political involvement/interference from the top government officials such as presidential directives stopping forest managers to from evicting encroachers makes their work dirty, dangerous and difficult;
5) Local people cannot afford to pay for the tree seedlings because the initial price and the transportation cost are too high. Where efforts have been made by NFA to provide free or subsidised tree seedlings, the timing for distribution is always not favourable for tree planting. Farmers reported that the seedlings are distributed at the end of the rain season making it difficult to plant and yet they are unable to keep them till the next planting season. Consequently, the seedlings are left to root behind peoples homes.

Some of the on-going Initiatives

- In Hoima and Kyenjojo, the District Forestry Services are encouraging tree planting through the provision of free seedlings to the communities;
- In Kyabigambira subcounty, NFA working with the Local Council prohibited the use of power saws

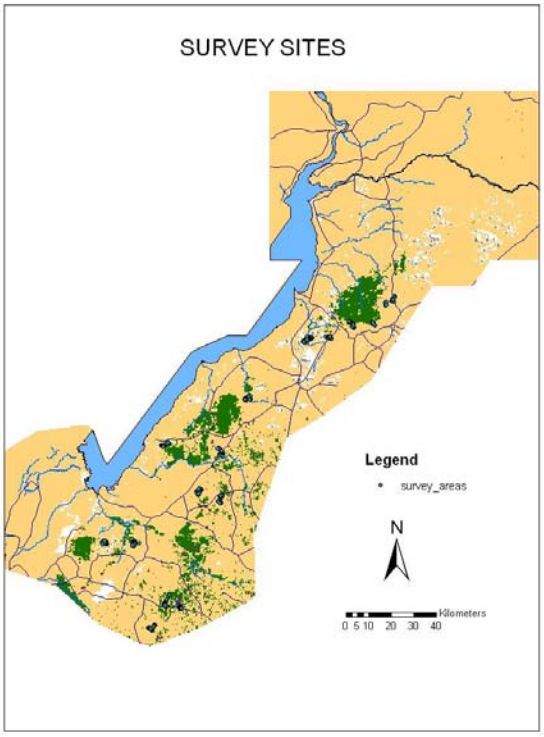
- ECOTRUST with support from PW, supported the restoration of degraded forest patches and facilitated the CFM process in Masindi and Hoima districts. JGI is working with NFA to operationalise CFM in Budongo FR and promote Ecotourism at Busingiro and Kaniyo Pabidi forest sites

District official made some recommendations on how to address the problem of forest loss. These include

- there need to sensitize both community leaders and the local people on the need to use forests and woodlands sustainably;
- Involve local communities in the protection of the forest buffer zones by allowing them to plant trees in the degraded areas under the CFM arrangement;
- promote afforestation and/or agroforestry programmes on farm to provide wood products outside the natural forests in future;
- the government of Uganda should quickly address the problem of international refugees and immigrant groups from Kabale and Kisoro to western Uganda who they claim are responsible for the rapid loss of mainly private forests;
- tobacco companies should invest in technologies such as tobacco varieties that do not require fuel wood to curing, and also help farmers to establish woodlots to compensate for the natural forests that are being cut down to grow tobacco.

3.3.3.2 Results from the household survey and field observations

In each of the four districts where the socio economic survey was carried out, parishes where high vegetation cover loss was indicated on the forest cover change map were chosen. On arrival in each parish, we visited the Local council leaders who helped us identify the exact local councila one villages to visit. The interviewers would spread out in the different directions to ensure a good coverage of the area. Each interviewer then carried out interviews at every third house along his way. Sites visited are indicated in **Figure 3.2**.



Along the way, the interviewers also made observations of the crops grown and the uses of the land that had recently been cleared. Out of the 502 respondents, 39.8% were female, 58.6% were male. For 1.6% of the respondents, their sex information was not included.

Figure 3.4 Sites visited in the socioeconomic survey

3.3.3.3 Drivers of forest cover loss

The majority (71%) of the respondents are involved in subsistence farming on small landholdings averagely 1.2 ha in size. Of the households that we visited and interviewed, 19.6% are involved in commercial farming mainly tobacco, sugar cane and rice at least in Hoima, with an average garden size of 0.8 ha, and 9.5% (1.4 ha) of the household land was under livestock grazing of the land was under cattle grazing. Most of the crops grown are consumed at the household level and any surplus is sold out to earn some money. In Masindi district, maize was the most common cash crop (35.8%) followed by tobacco (15.2%) and cassava (14.6%), sugar cane and the other crops (34.4%). Sugar cane growing was very common around the nucleus of Kinyara Sugar factory but not wide spread to other parts of the districts. In Hoima, the most grown crop was tobacco (21.2%) followed by maize and groundnuts in the proportions of 19.6% and 12% respectively. Kibaale district was a little different in that majority (50%) of the households grew beans and maize followed by rice (11%) and other crops shared the remaining percentage. Maize was grown by most (22%) of the households in Kyenjojo district. For other crops grown, 17.5% of the households are involved in beans and Irish potatoes (11%) among others. We observed that some of the local forest reserves under private ownership and local government management had been converted to homesteads, agricultural farmland, trading centres and administration centres.

Besides agriculture and human settlements, there were quite a number of other important activities that were reported to be driving forest loss in the landscape. Twenty seven (27%) percent of the households in the parishes we surveyed in Masindi districts were involved in forest-related businesses such as carpentry, timber harvesting and charcoal burning. In comparison with all the other districts, Kibaale district was leading in forest conversion, initially to produce charcoal and later plant crops. In all districts surveyed, over 35% of the households were involved in off-farm businesses such as market vending, local transport services, purchase of produce and retail shop keeping. Respondents from the districts of Hoima, Kibaale and Kyenjojo were asked to give their opinion about what they thought could be the cause of forest loss in the area. In all the three districts, over 50% of the respondents reported population increase as the major cause of forest loss. The increase in human population has created a lot of demand for both agricultural and settlement land. Also, the over use of the small land units by the households has resulted in soil fertility decline forcing people to open up new areas for agriculture.

Other causes reported include timber harvesting due to high market demand, especially in North Uganda and South Sudan, charcoal burning combined with timber harvesting, tobacco growing. Increase in poverty among the local communities and lack of alternative incomes sources are driving the rural poor to cut down trees to get some money needed to meet household requirements. Some of the respondents cited the lack of information concerning the dangers that might arise out of forest loss as contributing to the careless conversion of forests. In areas where the forests still support some wild animals, mainly primates, cutting down these forests was seen as a more practical way of eliminating vermin and problem animals. Other indirect causes reported were the increasing use of firewood for waragi (local gin) distillation and curing of tobacco, unrestricted licensing of timber and charcoal producers by the district forest officers to cut down trees was cited by some of the community members as driving forest loss. Change in management of local forest reserves, that is, from NFA to District forest services created a lot of weaknesses in the management of both local and private forest reserves. During the preliminary analysis of the satellite imagery, we observed that some of the central forest reserves had been encroached. As such, we asked the communities whether or not they knew where and what constituted a forest boundary. The majority (56.2%) of the respondents were aware of the existence and location of the forest boundaries for the immediate forest reserves in the community. In all the four districts, planted trees and fire lines were reported as the most common boundary markers for forest reserves. In Kibaale and Kyenjojo districts some forest reserve boundaries were marked with signposts and concrete respectively, although some natural features such as wetlands, rivers or streams were also mentioned.

3.3.3.4 Impact of forest loss to communities

Water sources and quality

In Masindi and Hoima districts, the main source of water was the protected well or spring whereas in Kibaale and Kyenjojo, shallow wells were the most common source of water for the communities. Other water sources included boreholes, river and stream (from both protected forests and people's private land), lake, piped and/or gravity water. Some families used more than one water source depending on the season and quality of water. On average households travelled half a kilometre to collect water. Thirty one percent (31%) of the respondents indicated that the water quality had remained the same over the years. 46% of the respondents indicated a decline in water quality. During the discussions with community members, there was a general consensus that the quality of what had improved or remained the same due to protection of the sources while the decline in quality for some sources was attributed to poor soil and water management by farmers. In Kibaale district, siltation was reported as the major cause of water quality decline. Other causes of water quality decline were a decline in the water volumes at the point source due to over harvesting, use of poor water collection methods, contamination from tree debris (leaves and papyrus) and wild animals (including frogs). Clearing of forests and wetlands around water sources, contaminated rain water, poor maintenance of wells and the prolonged dry spells (decline in precipitation and groundwater recharge) were reported as some of the causes for the decline.

Fuel wood sources and availability

In districts of Masindi and Hoima, 51% of the respondents reported protected forests/park as the main source of fuel wood while in Kyenjojo it was reported to be second to on-farm/own land sources. It was however, reported by majority (74%) respondents that firewood had declined and now women have to walk long distances or spend lots of time looking for firewood. Only 22% of the respondents had planted a woodlot.

3.3.3.5 Discussion of the forest change map results

The main drivers of deforestation in Murchison Falls – Semliki Landscape were noted to be mainly the conversion of forests to agricultural land characterised by slash-and-burn to plant maize, cassava, and bananas for subsistence needs and the expansion of commercial agriculture mainly sugar canes and tobacco for the Budongo forest system and tea, tobacco, rice and sugarcanes for the Bugoma system. Other causes of forest cover loss include charcoal production mainly from freehold and private forests, timber mining (due to increased market demand from northern Uganda, Rwanda and Southern Sudan) and unsustainable harvesting of Non Timber Forest Products. On the other hand, forest degradation is being exacerbated by livestock grazing, mining of bricks and sand, fires and non selective harvesting of trees to provide poles for construction and encroachment by adjacent communities to grow food crops.

In the central forest reserves where concessionaires are allowed to cut timber, the main causes of forest degradation were noted to include use of high impact harvesting techniques (poor tree felling and high skidding leading to destruction of seedlings and poles, lack of compliance with national environmental regulations particularly when logging on steep slopes to reduce soil destruction and loss), use of unskilled and ill trained logging personnel and wastage due to use of power saws in private and public forests. Although there are clear guidelines, regulations and conditions for logging contractors set by NFA with support from European Union (NFA, 2005) these are rare followed probably because of inadequate supervision by NFA or just ignored by the contractor.

From the forest change map it can be observed that there was more forest loss in the districts of Kibaale and Kyenjojo. Most of the forest loss occurred in the Local Forest Reserves. The district with the lowest forest loss was Masindi. Depletion of forests was increasingly progressive southwards over the Prime West area of study. This southwards progression is even evident at forest level e.g. whereas the northern part of Bugoma Forest Reserve was hardly depleted, the southern part was almost cleared away. When population increases, the demand for land and natural resources also increases. This occurs in many forms such as increase in demand for the actual land needed for cultivation, need for more fuelwood and a greater demand on the water resource. Land clearing follows a chain of events. The increasing population leads to greater demand for land for subsistence agriculture. On the other hand, commercial farming demands for large continuous pieces of land. The local people are often enticed to sell or rent out the larger pieces of land that they own to rich sugarcane out growers. They then start cultivating the marginal land such as along the streams and rivers. It was reported that pieces of land that were once used as communal grazing land are slowly being claimed by the local people who had first converted them to cultivation sites. This chain of events was very evident in many the areas that we visited. Klunne and Mugisha (2001) also report that the land that had once been abandoned by the initial owners (mainly of Indian origin) and was being used by the communities for cultivation was being converted to sugarcane plantations. At the time of our visit, much of such land had already been converted to sugarcane plantations.

Some of the commercial crops grown in the area such as tobacco require very fertile soils. They are therefore the first crops grown once a piece of land has been cleared **(Photo 1)**. After two or three years the cash crop is replaced by other crops. Maize and Irish potatoes were also being planted in newly cleared areas (**photo 2 & 3**). This was mainly observed in the districts of Kibaale and Kyenjojo where immigrants had just acquired new pieces of land.

.

Photo 2

Photo 3

This reduction in water quality was directly related to forest depletion. The main reason given for water quality decrease was soil erosion because of cultivation close to the water source. Cultivation of these fragile lands has been due to decrease in available land for cultivation. Equally, the decline in fuel wood availability is a major concern for the communities in the region. Klunne and Mugisha (2001) noted that as the fallow areas in Masindi district that were the main fuel wood source were being converted to sugarcane plantations, communities were turning to protected forests as the fuel wood source. Our study also corroborated Klunne and Migisha's report that the distances travelled to acquire the fuel wood were becoming longer.

In Hoima, Kibaale and Kyenjojo districts where there was more recent forest clearing for agriculture, observed both in the forest change map and during the socio economic survey, the respondents' own land was ranked as the main source of fuel wood. Large forest conversion to agriculture land just increasing (**Photo 4).** This type of fuel wood source is temporary. When the forests to be clear run out, a major fuel wood scarcity problem may occur. There is need for immediate control/stopping of clearing of natural forests for agriculture. Trees take long to grow and so tree planting initiatives will only yield fruit in 20 to 30 years. The highest fuel wood shortage may occur in the period between when the natural forests have been cleared and the planted trees are yet to mature.

Photo: A recently cleared natural forest (private forest) for agriculture in Kinaga village, Kabamba parish, Kibaale district.

4.0. Special biodiversity support activities

4.1 Capacity building and Institutional support (students & MUIENR Biological Data bank)

Under the WCS subcontract, MUIENR was subcontracted to identify and train five Ugandans at both master's level (3) and PhD level (2) in biodiversity assessments and general conservation of wildlife. The five students completed their fieldwork successfully and some have already submitted their theses for examination (summaries of students project reports are provided as annexes **II-IV** to this report). As an additional contribution, the project supported biological data entry into the MUIENR National Biological Data Bank (NBDB) and the production of species distribution maps highlighting areas where more effort should be committed in order to save the vulnerable and endemic species (**Annex VI**). As such, the data collected by students and WCS field staff during the course of the project were entered into the NBDB database accumulating a record of geo-referenced on fish (278); Birds (4,560); and Mammals (471) to the database. A total of 33 fish species where recorded on Lake George and the Kazinga channel, 500 species of birds; 30 species of large mammals and 22 species of amphibians. The project also contributed over 20% of the salaries for two University staff, who worked with the students and also managed the biological data entry in the databank.

4.2 UWA census unit

Under the subcontract to WCS, the project supported Uganda Wildlife Authority Census Unit to undertake both aerial and ground surveys of large mammals. UWA staff where trained by WCS staff in both ground and aerial survey techniques, analyses of the Ranger Based Monitoring data and reporting of results. During the project period, UWA together with WCS staff undertook the census of chimpanzees and other large mammals in the central forest reserves (Kasyoha Kitomi, Kalinzu-Maramagambo FR) of the greater virunga landscape. In addition, UWA independently conducted the aerial survey of large mammals in Queen Elizabeth Protected area including the Kibale corridor in 2006 and 2008. The results for this census are included in this report except those of 2008 are yet to be fully analysed.

4.3 Support to the Problem Animal interventions

PRIME West through WCS and in collaboration with UWA and the Community Protected Area Institution (CPI) of Katerera sub county Bushenyi district, and the communities of Kagarama and Rusoro villages, constructed a three kilometre trench along the Kyambura WR starting from the corridor area between the wildlife reserve and Kasyoha Kitomi forest reserve. This was a direct contribution to UWA's effort to reduce Human – Wildlife conflict by establishing animal barriers to reduce crop loss and livestock predation. In addition, other initiatives such as planting of unpalatable crops such as chilli pepper and the Mauritius thorn hedge were piloted around Muhokya (corridor to the west of Lake George) and Kyambura – Kasyoha Kitomi corridor. The project worked with over 100 farmers to establish a 5 meter buffer strip of chilli pepper along the wildlife reserves to reduce crop raiding and also generate income for the adjacent households.

4.4 Formal EIA for Oil and Gas development training

Awareness of the importance of environmental issues has become more and more central to the thinking of nations that are blessed with oil and in particular the oil companies and the regulatory authorities. The role of government in setting and enforcing regulations is essential in minimizing the potential environmental impacts and offers an opportunity to stimulate more innovative and effective environmental management systems. However, this demands specialized skills and knowledge for both the government workers and the oil companies. In Uganda, the oil industry is a very young industry but more likely to create dramatic environmental changes and promote

economic and social development. As such, USAID/PRIME West felt it very important to start developing the capacity of Ugandans to be able to handle the environmental challenges.

Louise Johnson who did a consultancy for WCS on the economic impacts of oil and gas exploration together Karl Fuller who is an EIA environmental consultant specialized in oil and gas development projects were contracted to deliver a training course in Environment Impact Assessment for Oil and Gas Development in Uganda. The trained targeted mainly the government agencies such as PEPD, NEMA, UWA, NFA, Wetlands Management Department (WMD), MUIENR, and the department of Fisheries involved in conducting the monitoring environmental impacts as a result of development projects, the EIA practitioners and Civil society organization specifically working on oil or interfacing with the Albertine Oil graven such as WWF and WCS. A total of 20 participants attended the training which was structured in such away that two days were purely classroom lectures held at Hotel Africana in Kampala from 8th-9th January and another three days (10th-13th) for the fieldwork in Kabwoya and Kaiso Tonya where Tullow Oil Company is actively drilling testing wells and conducting seismic surveys onshore and offshore. The training had been planned for December 2007 but the consultants were already committed and Louise had to source a partner with vast experience in EIAs concerning Oil development for the last 20 years.

The objective of the training course was to increase awareness and capacity of trainees involved in Environmental Impact Assessment with specific regard to impacts & mitigation required as part of oil development in Uganda. In addition, the training course was designed such that trainers share their experiences elsewhere and offer international exposure to what is regarded as best practices for achieving oil development while maintaining the integrity and/or minimizing negative impacts to the environment.

EIA and Oil development trainees at Hotel Africana

Louise Johnson and Karl Fuller, Trainers

During the training it was noted that more capacity building needs to be done not only for government officers but also district environment officer who interact with the oil development processes at the site and are more likely to detect localized environmental impacts and EIA practitioners who always consulted to conduct EIAs for the developer. Secondly, it was noted by the participants for the need to set up a more structured EIA and impact monitoring committee with representation from the mandated institutions and civil society organizations. This is because the oil industry demands a multidisciplinary team if the impacts are to be monitored well and mitigation measures are conducted. Also noted that there was need for government to produce sensitivity maps/atlases for the entire country with the initial priority area being the oil belt located in the Western and Northern rift valley.

A visit to the exploration drilling sites offered the trainees an opportunity to have hands on practical experience of the activities involved in the oil industry. The trainees were able to see the oil exploration surveying on-going (seismic surveys) both offshore and onshore, exploration drilling at Ngassa drilling site, drilling testing wells before (Mputa 4) and after (Waraga) restoration of sites. While at the oil exploration sites, the trainees were able to have a practical experience of the oil and gas exploration process and quickly identified a number of environmental management issues that needed to be addressed by the oil companies.

These included

1. An increasing network of roads through the Kabwoya Wildlife Reserves;
2. increasing vehicle traffic mainly the seismic survey team and growing public;
3. transport vehicles including buses to the fishing villages;
4. the number of active camps including those that are meant to be demolished and sites restored;
5. poor waste storage and disposal management;
6. inadequate environment management systems in place such as the risk management plans, waste management plans and environmental monitoring protocols;
7. poor road construction work leading to soil erosion effects and the impacts they are already presenting to the wetland at Ngassa well. The road was constructed in the middle of a wetland and interfered with the water drainage and flow with one side of the road flooded and the other drained. This is likely to affect the migration of fish (mud fish) and feeding of waterfowl birds in the area.

5.0 Synthesis, conclusions and recommendations

5.1 Mammals, birds and threats monitoring

Although the biodiversity monitoring results indicated an increase in mammals and birds, at least for some species, such changes can not be entirely attributed to the project interventions. Increases or decreases in mammal or bird populations depend on a number of factors (e.g. ecological, biological, environmental, human influences) that act both in time and space. Given the project life of five years, it would be spurious to conclude that the changes witnessed were a result of project interventions. It is however, important to acknowledge the pivotal role played by the project towards improving the ecosystem conditions appropriate for biodiversity conservation. A combination of both the project interventions and law enforcement by the protected area agencies contributed a lot towards the decline in illegal human activities. It is worth mentioning, however, that among all the illegal activities recorded, poaching is still a major challenge. Well as poaching for subsistence bush meat seems to be declining in some protected areas such as RMNP, commercial hunting targeting mainly chimpanzees and elephants in QEPA is on the increase. These animals are potentially targeted because of the medicinal value attached to their body parts such as the teeth, claws, genitals and limbs, and the financial returns if captured and sold live to international buyers.

Natural resources based enterprises such as craft making, apiary and mushroom growing for wetland adjacent communities, and Arabica coffee around RMNP were very successful strategies towards reducing threats and improving ecosystem health for biodiversity. Development of community wetland management and action plans helped to implement the restoration of 2000 ha of Nyamurilo wetland, create a stream buffer zone of nearly two kilometres and also provided an opportunity for the communities to start income generating activities such as crafts making and fish farming. In terms of coffee –bird interactions, a great number of bird species especially frugivores were recorded in the shaded coffee compared to coffee without shade trees. This was reasonable evidence that probably if the shaded coffee gardens were sizeable enough to constitute an adjoining buffer with the park, in turn, this would support more bird species. On the ground, the coffee gardens were very small and scattered. In terms of threats to biodiversity, some illegal activities were observed to occur irrespective of the good coffee prices the farmers enjoyed. It is therefore possible that some community members still invest a portion of the proceeds from other income sources into illegal activities especially dogs and snares to engage in hunting.

5.2 Household dependence on protected area resources

Understanding the role natural resources play in the lives of the rural poor, one needs to know the nature of livelihoods and the social differences in the community where they live. It was noted that rural households typically have a wide livelihood portfolio, encompassing a range of activities. Households are involved in mainly subsistence agriculture (growing a diversity of crops), livestock -raising, collecting forest/park/wetland/lake products for subsistence needs and sales. They were also involved in a variety of reciprocal transactions with fellow community members; where one family member in an off-farm employment remits money back to the household and having another involved in some small-scale industry such as brick making, carpentry, craft production, beer-brewing and small retail shops. The proportion of mean annual forest/park incomes in relation to the total annual income for the communities around Queen Elizabeth Protected Area (QEPA) ranges between 2-18% and the costs suffered due to protected areas are still high. Over 60% of the household income was derived from agriculture (livestock and crop husbandry) off-farm (6%) and remittances (2.5%). It was noted that in absolute terms poor households derive more benefits from forests and parks than the medium and relatively wealthy households. These results are consistent with other studies conducted in the region in the recent past (Bush *et al.*, 2005; Tumusiime, 2005; Bush and Mwesigwa, 2008). Among the constraints to improving household incomes reported, inadequate land, inability to access financial capital, limited access

to forest or park resources, low agricultural market prices and the high crop loss to animal damage and livestock predation were common across all project sites. The above constraints are more evident at the household level and to a reasonable degree influence the household decision behaviour and response to biodiversity conservation. In these community settings, individual households generally face different constraints such as low availability of capital (land and money), vulnerability to risks (e.g. extreme weather conditions which can decimate crop and livestock production, illnesses, poor housing; gender discrimination), little formal education and opportunities (e.g. position in society, access to information, credits and markets). Having explained the rural community dilemmas, it is important that you view the project results in a broader contextual framework.

The reduction in the proportion of income from forests, wetlands and fisheries resources emphasises the significance of regulation in resource use. However, strengthening of law enforcement or increased regulation of resource use produced two important results for the project; First, the relatively wealthy households and the influential persons in the community benefited more because they could influence decisions and actions in their favour but also had the capacity to negotiate. This is the expected scenario when dealing with public or common-pool resources, where the wealthy people shift from subsistence to commercial harvesting because they can afford capital assets for the business (e.g. power saws, vehicles, boats, nets) and are able to pay the poor to harvest resources. The poor households, women and the youth became more vulnerable and poorer because they were heavily constrained by the institutional rules and lack of disposable income. For example, they were not willing to invest time in community meetings, unable to raise money required for group membership leading to complete isolation. In addition, poor households had limited opportunities and capacity to engage in off-farm economic activities.

Around Budongo FR, it was mainly the rich businessmen who got licensed to harvest timber from the communal forests by the district forest officer. As such, majority local forest users were confined to extraction of minor products purely for domestic use, yet expected to collaborate in the management of the forest. The second outcome was the creation of power resource user groups in the communities. In the case of BMU and bamboo user groups, the membership was formed around local council leadership and key persons in the community. As a result, BMU members with opportunistic behaviours used it as an opportunity to negotiate for an increase in the number of boats on the lake and where BMU committees were very strict; boat owners relocated the boats or sold the undersize nets to neighbouring BMUs without effective law enforcement. In the case of bamboo basket making groups, some groups negotiated for more access to particular areas of Echuya Forest reserve. The less active poor community members resorted to clandestine means of accessing the resources such as anchoring boats on islands and hand over the fish caught to an authorised boat owner to market the fish at a negotiated commission fee. In the bamboo case, this particular group continued to access the bamboo through illegal means and did not attempt to harvest for commercial basket making.

The implication was that enforcement of regulations to a large extent reduces over-harvesting of resources because it cuts out some people but it increases the exclusion costs to both the community (crafting rules, conduct patrols, levy user fees) and protected area managers (monitoring and law enforcement). The finding also raises an important question about what would be the safe minimum standard (policy) for conservation that allows natural resource use by the communities to avoid extreme deprivation of mainly the poor households, at the same time, viable enough to conserve the natural resource. The household income results across all project sites consistently indicated that over 60% of the household income comes from agricultural related activities, including households that own private forests. Thus, agriculture offers higher marginal returns to land than forests, which is a disincentive for conservation. This finding is very important for conservation proponents because the rural poor will continue to view forested areas or wetlands as potential areas for agricultural expansion unless such land use became competitive enough to provide direct financial returns as opposed to public benefits.

Improve Arabica coffee processing and link to markets/buyers was noted to benefit the communities around the RMNP. As such, the demand for the pulping/wet processing machines exceeded the supply and farmers slowly started purchase their own machines without the support of Good African Coffee. Farmers close to the forest did not have access to coffee wet processors and had little access to better market opportunities for their coffee produce, which could have helped to create a direct linkage between the park and the project support. As hypothesised in the conceptual model, coffee processing was noted to be labour intensive and consumed a lot of the household heads time both to produce and market. Farmers recorded reasonable income benefits from the coffee sales contributing slightly above 10% of the total profits from agricultural products sold at the household level. Long-term studies are required to determine the contribution of PRIME/West intervention in improving the livelihoods of the communities and biodiversity conservation

5.3 Knowledge Attitudes and Practices

Knowledge, attitudes and practices were heavily influenced by property rights attached to the resource, social differentiation within the household or community (wealth classes, age and between gender), time and risk perceptions (e.g. whether to poach or not). Again, these attributes are not new and specific to this project but have long been cited as being influential in determining how communities respond to policy change (CBNRM, CFM) and technological change (e.g. coffee wet processing, pond sitting). In the case of problem animal management interventions, we noted that relatively wealth households were tolerant to crop raiding animals than the poor households. Also for the BMU, those who owned fishing canoes/boats supported the idea of protecting breeding zones because to them, protection of these areas meant increasing the fish stocks in the lake, which would sustain their business. On the other hand, the barias (actual fishing crews) were not happy because it is in these areas that fish catch is high and since they are paid according to fish caught and on a per day system, regulating the fishing zones would inevitably reduce their earnings and reduce their livelihood in the short run. Related to the BMU, was the age aspect, elderly men and women understood very well the importance of protecting breeding zones and restricting undersize nets during fishing, unfortunately for the youths, any fishing method that would earn them a big catch was very important.

Quite different attributes played for the illegal park and forest resource users were noted during the focus group discussion with ex poachers. For example, the decision to go poaching in the forest was dictated by the economic return, perceived taste of the animal being targeted (e.g. hippos are culturally known to be tasty and of medicinal value to the Banyaruguru ethnic group) and the risk involved. Interestingly time was not considered important for the poachers to engage in bush meat hunting. Indeed, the conflict monitoring data indicated that majority of poachers arrested in the park travelled distances exceeding 10 km and sometimes, these suspects were from another district. The adjacent communities, however, were mainly involved in illegal collection of firewood, poles, grass for thatching, charcoal burning, grazing in the park and hired to lift timber or charcoal from the forest. In the case of forests and wetlands, households that benefited directly either under the CFM arrangement to restore degraded areas or a household member/relative worked for a forest related project, their attitudes towards forests was very positive. In addition, those households that depended heavily on water from the forest or wetland, they appreciated the importance of those resources. The point we are making here is that if people associated strongly with a resource, their attitude towards that resource was good because of developed sense of property ownership.

Property rights played a very important role in deciding whether to implement a problem animal intervention or not. For the land owners, a trench meant reducing their land size but also one that restricted encroachment on park land, where as planting of Artemisia or chilli pepper was easily accepted because it was seen as a means of earning income but also increased the value of the land. To the tenants, a trench meant reducing crop damage and hence increasing the harvest so they were able to pay the land rent. Unfortunately for them, the decision to excavate the trench on that adjacent piece of land lay with the property owner. Worse still, if the problem animal deterrent

or barrier accepted and became effective in reducing crop loss, the landlord increased the rent for the next growing season. As such, maintenance of problem animal barriers became a challenge to both the community and the park authorities. Tenants were not willing to commit themselves on landlords who treated them unfairly. As a response, each growing season most of tenants would find land elsewhere. In addition, if the crop harvests were not good, some tenants would abandon the plots and look for causual labour to cope with the hunger gap. This was common around Muhokya, where cotton growers who were mainly people from the Rwenzori mountains reverted to collection of forest products or moved to Kasese town to find odd jobs.

5.4 Natural resource related conflicts

Conflicts or expressed disagreements among people who see incompatible goals and potential interference in achieving these goals, regarding the conservation and or utilisation of natural resources is one of the greatest challenges of the 21st century. Conservation involves deciding which ecosystems, landscapes, habitats, and species deserve protection or other forms of management. It also involves determining the level of resource allocation appropriate for each management objective. Increasing human populations and demands for improved standards of living, combined with limited natural resources, changing society values and meanings, lead to conflict over economic, ecological, political, and social costs associated with use, wise or otherwise, and protection of natural habitats and wildlife therein. One common characteristic of serious environmental conflict is that it is firmly rooted in the moral authority, or basis people use to determine whether something is considered good or bad, right or wrong, acceptable or unacceptable.

The formal conflicts reported were based on actions that violated the state laws or regulations related to the resource use by the communities. It was therefore evident that most of the cases committed were a true reflection of community's responsible to the loss of access to the resources that plays a fundamental role in their livelihood. Unfortunately, conflicts that were created by the resource (mainly crop damage and livestock predation) or the presence of a resource (e.g. lion or elephant) to the community were not recorded by the protected area authorities. The poorest households are heavily dependent on the natural resource that limiting access only encourages illegal harvesting. In addition, people who suffered heavy crop damage or livestock predation by wild animals had no choice but to resort to forests, parks and lake resources in order to manage the shocks and environmental stress (e.g. crop failure due drought, pests and diseases). The same behavioural response was true for the livestock keepers who had to feed and water their cattle in the park of forest during dry periods. Also, the negative political pronouncements made during the political campaigns accelerated the conflicts while putting the protected areas managers in very difficult position to deal with encroachers and illegal resource harvester. In addition, the resettlement by government of cattle keepers in the park promoted different interest groups to access to different parts of the park illegally making too difficult for the park authorities to monitor and effectively manage the situation. Such incidental actions accounted for the observed increase in resource related conflicts. The decline in conflicts observed in 2005-2006, was due to an increase in law enforcement supported by the project initiatives that targeted mainly park user groups such as the ex-poachers, wetland user groups by promoting wetland related enterprises (e.g. crafts, honey and farmed fish production) and fisheries user groups targeting the Beach Management Units. Other initiatives such as problem animal management strategies such as trenches, buffalo wall, unpalatable crops (e.g. chilli, Artemisia) and Mauritius thorn hedge play a vital role in reducing costs and help improve relations between the community and protected area managers. The project results revealed important functional and management issues that both protected area managers and project funding organisations needed to address.

Clearly understanding the practices of communities and performance should enable natural resource managers to minimise the negative aspects of environmental conflicts while developing more effective strategies for involving communities in natural resource management policy formulation and implementation. Increasingly, natural resource managers will have to engage or train dispute resolution specialists as an important step in integrating the strategies and tactics

that offer systematic representations and explicitly recognise the significance of cultural identity and community values attached to the resources they manage. We noted that most of the environmental conflicts had cultural dimensions, property rights, and livelihood values. Environmental policy makers and managers alike should familiarise themselves with the literature or historical facts of the communities and nature of conflicts (e.g. Basongola who claimed historical land ownership, fishermen who claim cultural values and Bakonzo tribe who are historically known to hunt for game meat). It is very important that the park and forest rangers, wetland and fisheries officers who have limited information about the community history be provided with some art facts about the communities before deployment to serve in foreign areas.

There is need for the resource managers to improve their relations with adjacent communities and also to recognise their cultural attachments to the resources that they had long depended on without regulated access. Following repeated negative experiences with the communities, local UWA, NFA, WMD and Fisheries personnel should stop at playing passive neutrality as a management option. There is need to reciprocate and naturally show sympathy for lost property by responding once communities report incursions from wild animals. It has been argued that much of the failure to resolve natural resource related conflicts is traced to the human preference for addressing superficial problems while ignoring the "psychological or sociological dynamics". Resource managers need to improve their communication, dispute resolution skills and should be in position to explain changes in management strategies, objectives and regulation so that the community is not left in darkness. For example, up to date local people do not understand why the practice cropping /culling some animals by the Games Department/Uganda National Parks, where adjacent communities would be served with free game meat does not occur under UWA management.

On the other hand, during the analysis of the resource-related conflicts, we recognised that the natural resource interspaced by the community can be an incentive for the protected area authorities and the communities to bridge tensions and create harmony because the resource becomes a uniting factor. As such, UWA, NFA, WMD and Fisheries department should use these resources as an opportunity to reach out to the local people and develop a deeper understanding of their immediate needs and stresses. In so doing, the resource managers will be able to evaluate their efforts and also design approaches that are in tandem with the local people's needs, capacities and expectations.

Project planners and design needs to contend with the fact that rural poor have limited opportunities to create incomes and acquire assets without relying on the natural resources. Besides, such communities continue to suffer huge costs and any project intervention must work towards reducing dependence on the resource but also take into account the community social construction (cultural values, power relations and capacities), land and tree security and economic changes at the local and international level. The project framework should provide for the sustainability of good approaches, environmental mainstreaming should be inherent in the project design and time frame should be realistic to deliver the good lessons for replication elsewhere.

5.5 Community based natural resource management approach

5.5.1 Decentralisation of forestry resources management

According to the results of the socioeconomic survey, conversion of forests to agricultural lands is the number one driver of forest loss in the Uganda's portion of the Albertine rift. The other causes noted were unsustainable harvesting of forest related products (timber, poles, firewood) and bye-products mainly charcoal; livestock grazing, and settlement by immigrant ethnic groups, mainly in Kibale and Kyenjojo. At management and operational level, inadequate technical capacity to manage forest estates and poor remuneration of forest managers (NFA and DFS) together with the increased market demand for timber from northern Uganda and the neighbouring countries mainly Southern Sudan and the increased pressure for the local governments to generate fiscal

revenue have exacerbated forest loss. Furthermore, the poor integration of the forest sector services in the National Agricultural Advisory Services (NAADS) program and the high value of alternative land use mainly agriculture and livestock grazing have accelerated forestry loss mainly on the private lands.

Reducing deforestation is already a hard battle to win because more than 75 percent of the landscape's three million people who live adjacent to the forests depend on land and natural resources for their welfare. The carbon credit initiatives, managed by Environmental Conservation Trust of Uganda (ECOTRUST) represent an innovative way to tackle the problem. Offset schemes and avoided deforestation could help to slow down forest loss in this particular landscape and seems to be one of the best ways for the communities to benefit while providing a source of foreign currency to the country. By promoting such non-regulatory programmes, particularly those concerned with water quality, climate related disasters and indirectly biodiversity will offer property owners the incentives to maintain forests and wetlands though the purchase of development rights and easements. The NFA and the government of Uganda had made some success in forest protection till 2003 but the recent restructuring of the forestry sector leading to the creation of the District Forest Services under the decentralisation policy has lead to an increase in forest loss on both private and freehold land, and to a limited extent the protected central forest reserves. More so, both the forest protection and restoration programmes do not necessarily enjoy a net increase in area and improvement in condition (c.f. loss of nearly 32,000ha to <1000ha restored in the landscape). Consequently, both reductions in the rates of forest loss and increases in the rates of restoration, afforestation and protection are needed in tandem to achieve overall improvements in forest cover and condition. It is a fact of life that forests will continue to be affected by economic pressures of urban expansion and construction, demand for agricultural land to feed the ever increasing population and the demand for both domestic forest products and income.

5.5.2 Land and tree tenure insecurity

For a long time, there has been a sustained argument that property rights and resource control constrain investment and development in natural resources by the private sector. The government of Uganda responded to this concern by implementing the decentralisation policy, promoting political and administrative decentralization across major sectors and only retaining the facilitatory and regulatory roles. The forestry sector like other sectors was decentralised and the enactment of the National Forestry and Tree Planting Act No 8/2003 provided for the restructuring of the forest department to create the National Forestry Authority (NFA) in charge of Central Forestry Reserves, Forestry Inspection Division (responsible for policy formulation) and District Forestry Services (DFS) in charge of local forest reserves and private forest estates. In a way, it was assumed that by devolving the resource control powers, it will encourage the local governments and the communities to plan and manage natural resources. In the process, the country would experience the burst of entrepreneurship or productivity growth with an increase in revenue and investments by the private sector in forestry related business both at the local and national level. Unfortunately, at the local level, communities have not benefited much and instead feel more disenfranchised than before the forest sector reforms. Timber concessions in both the central and local forest reserves continue to be awarded to business people from outside the communities and in turn the local people are mainly left to provide labour at very low returns. This has created negative community attitudes towards forests and conservation.

The private forests have continued to decline due to known constraints (Makumbi, 2003; Forestry Policy, 2001) such as the high value of alternative land uses mainly agriculture (e.g. rice, tobacco, tea, sugarcane and cattle grazing); inadequate information about the markets and wood prices, and conservation benefits; inadequate technical skills in forest management and low priorities by both central and local governments in the forestry sector as always reflected by the meagre national budgetary allocations (yet forestry revenues collected are transferred to the national treasury). In addition, the removal of graduate tax in 2006 added an extra burden to the local governments to raise money to supplement the resource envelope from the central government. As a result, the district leadership has put more pressure on natural resource managers to collect

more revenue hence increasing the licensing and issuance of timber and charcoal harvesting permits to the business people. Also, there is considerable land and tree tenure insecurities by the local communities in the Murchison Fall – Semliki landscape resulting from land ownership complexities (absentee landlords) and unclear law on the ownership of unplanted high value trees (reserved species) on private land.

Although article 237 of the 1995 Uganda constitution and article 3 of the Land Act, 1998 provide a lead on the question of land ownership and tenure, in the context of forestry, it is ambiguous in the special conditions applying to trees of Reserved Species. Sections 21 and 22 of the National Forestry and Tree Planting Act 2003 grant forest/tree tenure by the land owner but demand that such forest (natural or plantation) be registered by the District land board and licensed, both land and forest/tree tenure are privately owned, giving the owner rights of access and security of tenure. Unfortunately, such owners of private forests are reluctant to register their forests either due to ignorance of the law or fear the bureaucracies involved. Despite the presence of guidelines for the private forestry management and development in Uganda provided for in the National Forest Plan of 2002, most private forests lack management plans, which make monitoring of activities and sustainable use very difficult. The District Forest Services expected to encourage private owners to register their forests and acquire licenses after providing detailed management plans. However, the DFS lacks both man power and financial resources to implement the regulations.

Although there are clear guidelines, regulations and conditions for logging contractors set by NFA with support from European Union (NFA, 2005) these are rarely followed probably because of inadequate supervision by NFA or they are just ignored by the contractor. Lastly natural forests are perceived by the communities in many cases to be open-access resources including those protected and managed by government institutions. The consequences of this are that few incentives are available for communities/individuals to protect such high trees and forests. In our opinion, both NFA and the local governments need to respond to the alarming rate of forest loss by tagging the protection of forests to highly perceived needs of the community such as watershed management and fuelwood energy sources rather than emphasise conservation and protection of wildlife. In addition, there is need to sensitize people about the environment and forestry laws, particularly the private forest owners highlighting the benefits that come along with compliance to laws. For example, private forest owners could benefit from the forestry advisory services by offering skills in forest business management, and offer incentives such as payment for ecosystem systems, if one looked after his forest in a sustainable manner. Also, there is need to strengthen the link between NFA and the DFS in order to achieve effective management of the forest estates that they are responsible for.

There is need to plan for the oil and gas related revenues and benefit schemes to include a small fund dedicated to the protection of such fragile ecosystems that support the oil industry either directly or indirectly. The central government needs to increase its budget allocation to natural resources sector to reduce the burden of local governments to finance budget deficit which accelerates extractive forest use in order to raise local fiscal revenue. Finally, from ecological knowledge, we know that deforestation coupled with poor soil management results in higher deposition of chemicals and sediments into water bodies. The effects on water quality and fish in lakes, rivers and wetland are detrimental resulting increased poverty and loss of livelihood for communities dependent on these resources. As such, the need for ecological and hydrological monitoring of the water bodies for both point and non- point source contamination was highly recognised; unfortunately, this task was beyond our mandate but if taken into account, the ecosystem health gains in the upstream could have been reduced by the downstream pollution. In the same vain, NFA needs to monitor the performance of the private partners under the CFM agreements to ensure compliancy but also to remind them that the resource is intended to provide public goods and not exclusively individual benefits.

5.5.3 Lessons learnt from the natural resource e related enterprises and collaborative management – Wetland, parks and fisheries resources

Although the primary objective of the project was to improve the management of natural resources and peoples' welfare, the support only benefited but one small segment of the resource user groups, the relatively wealthier and politically connected commercial harvesters and farmers (e.g. wetlands and bamboo related enterprises). With regard to fish farming, the majority households did not get enough fish production capacity, acreage, or the income level necessary to qualify for participation in the project programs. It was observed that the needs, financial constraints, aspirations, and the social and political differences at the local level mattered a lot and yet these dimensions were totally ignored in the project design. For example, during the process of forming producer organisations and resource user groups, an effort was made to ensure that gender was considered, not much was done about the socio-political power relations to enable effective participation in resource management. Women and the youth within a producer or user group were dominated by the influential and powerful men in the community. The same community structural differences were observed among Collaborative Forest Management (CFM) groups, leaving the weak communities isolated and less concerned about the entire process. These are some of the groups that continued to free ride on resources because they felt less bound by the crafted rules of the user groups. By strengthening the competitive position of wealthier and influential households and commercial user groups, the project was responsible for worsening the competitive position of the small and poor subsistence farmers and natural resource users.

Unlike the fish production strategy which supported one hatchery and fish seed production farmer in each district, the Arabica coffee enterprise, which target individual farmers and organised them into producer groups, produced dramatic results. The lesson learnt here was that utilising the village as the major planning unit and program design, united under a common and economically viable enterprise rather than one individual or progressive farmer, the intervention proved more successful, at least in increasing household incomes. The project intervention only helped to strengthen the Arabica coffee growers already united under a common agenda and linked them to buyers (Good African Coffee), triggered off in increase in the coffee production and demand for wet processing machines. The results for Nyamurilo wetland community management were related to the Arabica coffee around the RMNP because of the strong attachment of the communities to the resource. The basic assumption inherent in much of these interventions was that adjacent communities were the primary cause of forest/wetland loss or degradation. Thus, those communities are willing to regulate themselves voluntary or influence behaviour change and reduce the threats to the resource that supports their lives. This assertion worked very well for Nyamurilo wetland where farmed agreed to set aside a strip of land buffer the stream and the Beach Management Units towards the protection of breeding zones, but did not apply very well to bamboo harvesters and forest/park resource users. Communities that entirely depend on forest/park/lake resources exhibit different *de facto* user rights and power play. As such, they responded differently to the interventions, reflecting their social construction (e.g. cultural values and beliefs, needs and power) and economic dependence on the resource.

Experiences drawn from the restructuring of the forest sector especially the inability by the District Forestry Services (DFS) as a structured and legal institution to manage local forest reserves under the decentralisation concept, provides clear evidence that the consequences of passing on the button to local communities to manage protected areas will be disastrous an and unrealistic at this point. This typically so because of two major concerns; First, CFM agreements or instruments only provide a framework for access to negotiated resources and to a limited extent, monitoring of the designated areas for resource extraction by NFA. Unfortunately, these agreements do not protect or provide legal standing for the user groups to manage, limit entry and use of the natural resources. Both NFA and DFS lack the monetary resources and personnel to exclude unauthorised users and monitor the harvesting activities of resource users themselves. Second, there were no rules developed by the user groups beyond membership requirements to regulate entry and extraction/withdrawal rights making it difficult to appropriate the use of the resource units (e.g. poles, firewood, medicinal plants, and craft materials) by the resource user groups. The

absence of constraints upon timing, technology/harvesting techniques used, purpose of use and quantity of resource units harvested, usually determined by the operational rules devised by the user groups themselves under collective authority (rights) of management and exclusion over the resource system (e.g. bamboo, wetlands) made it difficult to achieve meaningful community based natural resource management. Thus, the notion that communities should and could, satisfactorily manage their own resources according to their local customs, indigenous technical knowledge and technologies developed over time is not sustainable. These institutional arrangements were long distorted by the colonial governments, later shaped and reshaped by history, different outsiders through time such as rural development consultants, political regimes/policies, academics and environmental opportunities and stresses. Time is needed for community transformation to understand these new concepts and innovations as seen by the development partners, management authorities and conservation organisations.

5.6 Challenges encountered during monitoring of the project

1. During the project life, there were unanticipated externalities such as the demand for timber from Southern Sudan, Northern Uganda and local markets that were not fully addressed in the conceptual framework. These heavily contributed to the negative impacts on the outcome of forest related interventions. Also the return of the Basongola cattle keepers in early 2006 from DR Congo who were temporarily resettled in the northern sector of QENP exacerbated the threats to the park resources (e.g. the presence of these groups in the park, facilitated open access);
2. Ecological and biodiversity cumulative impacts will only be felt after sometime, way beyond the project life (≥10 years). The period was too short to fully understand the environmental and biological changes that will happen as a result of the project;

3. Project adjustments had an impact on the implementation process and consequently the results making it difficult to attain significant differences between areas that interfaced with the project and those that did not;

4. In addition, controlling for cumulative impacts from previous and on-going non PRIME West intervention was difficult in most of the project areas.

5.7 General conclusions and recommendations

The assumptions made in the conceptual models were correct but the net effects were over stretched given the project life and level of intervention. The implementation was not less continuous and sporadic for some areas making it difficult to show distinguishable results between areas and communities which interfaced with the project and those that did not.

For natural resource-related enterprises to deliver successful results, interventions should target individual households as opposed to emphasising community shared projects or benefits. The Arabica coffee strategy produced outstanding results in terms of income and farmer organisation to jointly market their crop. The linkage between the increase in household incomes and threats to biodiversity could not be concluded because the time was too short to realise explicit behavioural and attitude change. It should be emphasised however, that support to ex poachers to process and market Arabica coffee was a good incentive for reducing poaching of animals but this achievement can only be sustained if the coffee prices are still competitive to maintain the farmers in business and continue to receive support from both UWA and funding organisations. Shaded coffee around the Rwenzori Park was noted to support high bird species diversity including forest visitors, however, this needed to constitute a reasonable buffer zone around the park offer a long-term habitat for birds and other wildlife.

Law enforcement was noted as a vital ingredient for all community based natural resource management. Thus, technical and financial support to UWA, NFA, WMD and Fisheries department should be sustained. Support to UWA, NFA and BMU under this project provided good learning experiences as reflected by the decline in illegal activities in the park and on Lake George. The socioeconomic results have demonstrated that where there is regulation of access and increased protection, household benefits from the protected resources drop but the wealth households enjoy more benefit under community based resource management. Unfortunately for the poor households, this institutional arrangement makes them even much poorer. As such, special programs that address individual household needs and interests and do not rely on protected area resources need to be considered. Provision of alternative income generating activities based on the household's capacity, opportunities and the inherent resources is likely to be a more credible strategy than the community based approach if the objective is to raise household incomes. Thus, conventional tourism, including community tourism need to be developed in order to increase park management revenues, and both direct incomes and revenue sharing money to the communities.

In addition, information communication and education for the communities should be scaled up in order to increase awareness, empower communities to make informed decisions and actions that support conservation. Protected area managers need to package the information in a simplistic manner and make it available to the communities. In addition, UWA needs to be involved in the monitoring of Revenue sharing projects to ensure that what was proposed by the communities is actually implemented. The revenue sharing money is seen to benefit the politicians rather reducing the costs of the most affected communities mainly due to problem animals raiding crops.

Project planners and designers need to appreciate the fact that the rural poor have limited opportunities to create incomes and acquire assets without relying on the natural resources. Besides, such communities continue to suffer huge costs; any project intervention must work towards reducing dependence on the resource but also take into account the community social construction (cultural values, power relations and capacities), land and tree security and economic changes at the local and international level. The project framework should provide for the sustainability of good approaches learned, environmental mainstreaming should be inherent in the project design, project objectives and the time frame should be realistic to deliver the good lessons for replication elsewhere.

Reduction of forest and wetland degradation on private land demands another strategy such as creating incentives for land owners which deliver competitive economic benefits to the land and motivate them to protect the resource. Economic incentives could include carbon credit schemes, payment for ecosystem services, (e.g. watershed management), offer subsidised technical services to private forest owners to manage them as a profitable business and develop sustainable financing mechanisms for the protected areas to reduce the temptation of managers to increase harvesting quotas rather capitalise on promoting afforestation and support innovations that provide alternatives to the forest products. Traditional approaches to natural resource degradation on private lands such as direct regulation, taxation, and economic subsidies are difficult to enforce and only work best with state managed protected areas but fall short when it comes to private owned resources. For example private forest owners have their own objectives for keeping forests on their land, the fundamental question which future studies should attempt to answer is; what incentives do these private forest owners have in order to maintain these forest on their land to meet broader societal benefits. The most important and ultimate goal of private forest and wetland owners is money and easy access to products when in need. Since such resources offer tangible benefits and ecological services way beyond the owner, the public should be willing to pay for them.

Landscape approach was demonstrated as a viable strategy towards conserving key landscape species such as lions, elephants and flagship species such as gorillas and chimpanzees, and maintaining connectivity between protected areas. Elephant and lion tracking have proved that such species with large home ranges often cross political boundaries in search of food, water and mates. As such, corridors play an important role in maintaining viability species and genetic

diversity within animal populations and plant communities. Although lions and leopards occur under low densities, they continue to face threats from hunters/poachers who are interested in body parts for both medicinal and cultural values. Any conservation initiatives that work towards increasing the protected area contribute immensely towards the survival of such key landscape species. The elephant and lion monitoring data can be utilised in planning for those core habitat areas and also to target interventions in areas deemed to be conflicting with communities. More support is needed implement the already developed corridor plan with immediate intervention to strengthen Kyambura-Kasyoha Kitomi mainly used by elephants and chimpanzees and Muhokya corridors (allow elephants to move to Kibale NP).

Monitoring of biodiversity and human threats is an integral part of the conservation program, one which is highly prioritised by protected areas managers but less funded because it is very expensive and considered unproductive given the financial constraints. The wetland management Department and Fisheries department need to address themselves to periodic monitoring of the status and trends of wetlands and fisheries resources. Reliance on inventories or “wall to wall” mapping, although useful for some purposes, does not provide an effective tool for monitoring wetland and fisheries change through time unless such inventories can be repeated. Given the prohibitive technological and budgetary constraints, it may not be attainable to conduct more frequent inventories. UWA needs to make use of the Ranger based monitoring in order to assess the change in threats and evaluate their efforts and resources towards addressing the negative impacts. NFA and District Forestry Services need to improve their collaboration in order to address forest loss in local forest reserves and private forests. In the same vein, local governments and communities need more financial and capacity building support towards the natural resource and environmental management sectors if they are to be relevant and good allies in addressing environment and conservation impacts.

Lastly, WCS and MUIENR were able to demonstrate the importance of using conceptual models to monitor the impacts of the projects using affordable monitoring techniques and allocation of resources in areas of priority. Training of Ugandans and staff in government agencies is still needed.

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Appendix 1 Mammal dung densities per hectare for monitored sites

	Density of mammal dung per hectare					
Site	**Species**	**Baseline**	**2**	**3**	**4**	**5**
ECHUYA	CARNIVORE	1.31	0.00	0.00	0.00	0.00
	MONKEY DUNG	9.15	0.00	0.00	0.00	0.00
ISHASHA NOPW	BABOON	6.25	0.00	0.00	0.00	0.00
	BUFFALO	162.50	134.69	190.00	135.42	304.17
	ELEPHANT	18.75	36.73	42.00	104.17	181.25
	RABBIT	0.00	0.00	4.00	0.00	0.00
	TOPI	0.00	6.12	74.00	0.00	2.08
	UGANDA KOB	35.42	30.61	138.00	352.08	191.67
	WATER BUCK	0.00	0.00	12.00	18.75	0.00
ISHASHA PW	BABOON	0.00	0.00	2.00	0.00	2.17
	BUFFALO	13.04	0.00	8.00	6.52	52.17
	BUSH PIG	0.00	0.00	0.00	0.00	13.04
	CATTLE	0.00	0.00	6.00	0.00	0.00
	EDIBLE RAT	0.00	0.00	0.00	0.00	2.17
	ELEPHANT	2.17	91.67	84.00	78.26	84.78
	SAVANA MANGOOSE	0.00	0.00	0.00	0.00	2.17
	UGANDA KOB	52.17	18.75	96.00	15.22	145.65
KK-K NOPW	BLUE DUIKER	1.67	0.00	0.00	0.00	0.00
	BUSH PIG	3.33	1.92	1.79	0.00	2.08
	BUSHBUCK	1.67	15.38	0.00	0.00	8.33
KK-K PW	BLUE DUIKER	0.00	0.00	0.00	0.00	5.77
	BUSH PIG	0.00	1.74	0.00	0.00	5.77
	BUSHBUCK	0.00	1.74	0.00	0.00	0.00
	CARNIVORE	0.00	0.00	0.00	2.08	0.00
	CHIMP	0.00	0.00	0.00	0.00	1.92
	CHIMP	0.00	0.00	2.00	0.00	0.00
	GOAT	0.00	0.00	0.00	0.00	5.77
KWR-KKFR NOPW	BLUE DUIKER	6.33	0.00	0.00	0.00	0.00
	BUFFALO	0.00	18.75	0.00	0.00	0.00
	BUSH PIG	3.80	0.00	0.00	0.00	2.52
	BUSHBUCK	10.13	0.00	0.00	0.00	0.00
	ELEPHANT	2.53	2.50	8.97	3.75	6.29
	MONKEY DUNG	16.46	0.00	0.00	0.00	0.00
	RED DUIKER	7.59	1.25	0.00	0.00	0.00
KWR-KKFR PW	BLUE DUIKER	3.28	6.67	0.00	0.00	0.00
	BUSH PIG	0.00	3.33	0.00	10.08	0.00
	BUSHBUCK	3.28	15.00	0.00	0.00	0.00
	ELEPHANT	4.92	20.00	15.00	0.00	3.45
	RED DUIKER	0.00	1.67	0.00	0.00	0.00
QE WOOD NOPW	BLUE DUIKER	1.92	0.00	0.00	0.00	0.00
	BUFFALO	13.46	6.52	0.00	0.00	2.27
	BUSHBUCK	28.85	0.00	0.00	0.00	0.00
	ELEPHANT	0.00	10.87	0.00	32.00	9.09
	UGANDA KOB	42.31	0.00	0.00	0.00	15.91
	WATER BUCK	11.54	0.00	1.98	2.00	13.64
QE WOOD PW	BLUE DUIKER	2.94	0.00	0.00	0.00	0.00
	BUFFALO	8.82	35.62	0.00	3.13	0.00
	BUSH PIG	8.82	0.00	0.00	0.00	0.00
	CATTLE	0.00	123.29	0.00	0.00	0.00
	ELEPHANT	32.35	79.45	25.00	12.50	0.00
	HIPPO	2.94	0.00	0.00	0.00	10.00
	RABBIT	2.94	0.00	0.00	0.00	0.00
	UGANDA KOB	761.76	90.41	241.67	540.63	56.67

	WARTHOG	0.00	0.00	2.78	0.00	0.00
	WATER BUCK	5.88	13.70	5.56	3.13	0.00
RW KASANGALI	BUSH PIG	3.54	0.00			
RW NSENYI	BLUE DUIKER	9.64	0.00	0.00	0.00	0.00
	BUSH PIG	0.00	0.00	0.00	0.00	16.07
	MONKEY DUNG	28.92	0.00	1.79	0.00	0.00
	RED DUIKER	4.82	0.00	0.00	0.00	0.00

Appendix 2 Average bird species sightings per plot in the monitoring sites

	Survey number				
Echuya	**1**	**2**	**3**	**4**	**5**
Mean	11.79		11.21	5.72	8.56
Sdev	3.80		3.59	2.44	2.22
1.96*Sdev	7.44		7.04	4.78	4.36
Lower	4.35		4.17	0.94	4.20
Upper	19.23		18.24	10.50	12.91
KKFR-KFR Corridor Non PW					
Mean	18.07		14.09		12.19
Sdev	4.31		4.38		2.82
1.96*Sdev	8.45	0.00	8.59	0.00	5.53
Lower	9.61	0.00	5.50	0.00	6.67
Upper	26.52	0.00	22.68	0.00	17.72
KKFR-KFR Corridor PW				12.61	
Mean	10.76	9.33	12.51		10.50
Sdev	20.69	18.10	24.63		20.66
1.96*Sdev	19.96	18.14	24.82		20.81
Lower	-9.20	-8.81	-12.31	0.00	-10.31
Upper	30.72	27.48	37.34	0.00	31.31
Nyamuriro					
Mean	9.46	17.40	18.77	9.73	8.86
Sdev	9.43	17.17	18.88	9.79	8.80
1.96*Sdev	18.49	33.65	37.01	19.19	17.24
Lower	-9.03	-16.25	-18.24	-9.46	-8.38
Upper	27.95	51.05	55.77	28.92	26.10
QE Woodlands NonPW					
Mean	15.74	12.00	19.12	13.38	17.87
Sdev	77.98	59.40	93.20		76.83
1.96*Sdev	152.84	116.42	182.67		150.58
Lower	-137.10	-104.42	-163.55		-132.71
Upper	168.58	128.42	201.79		168.45
QE Woodlands PW					
Mean	14.28	14.53	12.63	8.50	16.20
Sdev	69.80	56.40	110.03		94.30
1.96*Sdev	136.80	110.55	215.65		184.83
Lower	-122.53	-96.02	-203.03		-168.63
Upper	151.08	125.08	228.28		201.03
Mean	12.48	10.31	59.44		50.63
Sdev	24.00	29.74	16.08	12.00	12.81
1.96*Sdev	23.54	30.83	15.96	12.00	12.78
Lower	23.10	31.00	15.82	12.00	12.68
Upper	12.48	11.83	15.72	12.00	12.41
Southern Kalinzu NOPW					
Mean	14.08				
Sdev	1.85				
1.96*Sdev	1.85				

Lower	1.85				
Upper	1.91				
Southern Kalinzu PW					
Mean	12.97				
Sdev	1.51				
1.96*Sdev	2.96				
Lower	10.01				
Upper	15.94				
Mulehe					
Mean	7.37	8.95			
Sdev	14.58	17.62			
1.96*Sdev	28.58	34.53			
Lower	-21.21	-25.58			
Upper	35.95	43.49			
Ngoto					
Mean	10.79				
Sdev	20.84				
1.96*Sdev	40.85				
Lower	-30.06				
Upper	51.64				
Rwenzori Kasangali					
Mean	12.72	21.14			
Sdev	60.27	44.02			
1.96*Sdev	118.14	86.28			
Lower	-105.42	-65.14			
Upper	130.86	107.42			

Appendix 3 Project personnel

Person	Designation	Organisation
Wildlife Conservation Society, Uganda Program		
Dr. Andrew Plumptre	Director, Albertine Rift Program	WCS
Dr. Alastair McNeilage	Director, Country Program	WCS/ITFC
Dr. Grace Nangendo	GIS & Remote Sensing Specialist	WCS
Simon Nampindo	Project Manager	WCS
Dr. Mike Kock	WCS Vet	WCS
Geoffrey Mwedde	Project Coordinator	WCS
Scovia Kobusingye	Project Finance Manager	WCS
Joseph Kabaga	Director Finance and Human Resources	WCS
	Biological Field Assistants	WCS
Moses Gonya	Mammals	WCS
Nabert Mutungire	Mammals	WCS
Sam Isoke	Mammals	WCS
Paul Mulondo	Mammals	WCS
Obed Kareebi	Mammals	WCS
Ronald Tukundane	Mammals	WCS
Masereka Kanoti	Mammals	WCS
Baguma Kibonge	Mammals	WCS
Byamukama Lawrence	Mammals	WCS
Timothy Akugizibwe	Mammals	WCS
Jotham Basiima	Mammals	WCS
Ben Kirunda	Botanist/mammal	WCS
Julius Kyamanywa	Botanist/mammal	WCS
Hamlet Mugabe	Birder	WCS
Deo Muhumuza	Birder	WCS
Charles Kabusasi	Birder	WCS
Dennis Tumuhamye	Birder	WCS
Saul Ampeire	Birder	WCS
Richard Kushemererwa Amooti	Cook	WCS
John Rwagara	Cook	WCS
Warren Turinawe	Driver	WCS
	Socioeconomic team	
Dorothy Ninsiima	Field Supervisor	STTA
Allan Katabazi	Field Enumerators	STTA
Shivan K Kamugisha	Field Enumerators	STTA
Naome Naturinda	Field Enumerators	STTA
Angella Arinaitwe	Field Enumerators	STTA
Narice Byaruhanga	Field Enumerators	STTA
Charles Tondo	Field Enumerators	STTA
Godwin Ndemeere	Field Enumerators	STTA
Sarah A Akello	Conflict Monitoring	STTA
Innocent Mpiriirwe	Field Supervisor	STTA
Dariton Ahimbisibwe	Field Enumerators	STTA
Susan Kyamazima	Data Entry	STTA
Emmanuel Ourum	Data entry and wildlife camera trapping photo scanning	STTA
	MUIENR	
Prof. Derek Pomeroy	Honorary Lecturer	
Herbert Tushabe	Databank Manager	
Betty Lutaaya	Data entry	

Marjorie Nakibuka	Accountant	
Polycarp Mwima Musimami	PhD Student	
Robert Bagyenda	PhD Student	
David Bainomugisha	MSc student	
Richard Ssemmanda	MSc student	
Edward Okot Omoya	MSc student	
Sarah Perpetra	Ornithologist	Consultant
Dr. Christine Kabuye	Grasses inventory in QENP-Northern Sector	Consultant -
Aventino Kasangaki	Water quality Monitoring	ITFC
Short Term Technical Assistance		
Louise Johnson and Karl Fuller	Oil and Gas Environmental Impact Monitoring Training	Independent Consultants
Dr. Mathias Behangana	Amphibian Monitoring	Independent consultant
Dr. Nadine Larpote	Landcover and Forest change maps for MF-Semliki Landscape using satellite Imagery	Woods Hole Research Center (USA)
Dr. Wayne Walker		
Dr. Alessandro Baccini		
Malpas Craig and Rob Craig	QECA Corridor Strategic Plan	Conservation Development Center, Nairobi