Wetlands, Biodiversity and Water Quality Status of Lake Cyohoha South Sub-Basin

Nile Transboundary Environmental Action Project

Nile Basin Initiative

This study was made possible with the financial support from the Canadian International Development Agency and The Netherlands government provided through the Nile Basin Trust Fund managed by the World Bank. NTEAP would like to take this opportunity to thank all development partners for their continued support.

Published by: The Nile Basin Initiative – Nile Transboundary Environmental Action Project

Citation: Chapter Author (2009). Chapter Title. In: The Wetlands, Biodiversity and Water quality Status of Lake Cyohoha Sub Basin. Edited by Henry Busulwa. Wetlands and Biodiversity Conservation Component of the Nile Transboundary Environmental Action Project. Nilebasin Initiative Secretariat. pp

Professional Editing: Charles Odoobo Bichachi
Typesetting and Design: Mabonga Apollo Khayak & John Pius Sentongo

Printed By:

Available from: Nile Basin Initiative Secretariat
P. O. Box 192,
Entebbe Uganda.
Tel +256 414 321329/321424
www.nilebasin.org

ISBN: 978-9970-148-26-4

Contents

Acknowledgements v

Preface vii

Abreviations and Acronyms x

Chapter 1: Introduction to Lake Cyohoha Sub-Basin 1

Henry Busulwa

Chapter 2: Limnological Status of Lake Cyohoha Sub-Basin 13

John Bosco Gashagaza Mukwaya

Chapter 3: Plants of Lake Cyohoha Sub-Basin 39

Benoit Nzingidahera

Chapter 4: Invertebrates of Lake Cyohoha Sub-Basin 75

John B. Kaddu

Chapter 5: Fishes of Lake Cyohoha 101

Gaspard Ntakimazi

Chapter 6: Reptiles and Amphibians of Lake Cyohoha Sub-Basin 125

Domnick Victor Wasonga

Chapter 7: Birds of Lake Cyohoha Sub-Basin 145

Ronald Kale Mulwa

Chapter 8: Mammals of Lake Cyohoha Sub-Basin 181

Robert M. Kityo

Chapter 9: Socio-economic status of Lake Cyohoha Sub-Basin 209

Fredrick Williams Kiwazi

About the Contributors/Researchers 278

Acknowledgements

The Nile Transboundary Environmental Action Project is very grateful to the experts who carried who carried the studies presented in this report, the stakeholders from Rwanda and Burundi who participated in discussing the results and the reviewers who guided the technical inputs into the studies.

Special gratitude goes to the Regional Wetlands and Biodiversity Working group especially the members from Rwanda and Burundi who were directly involved in guiding the logistical collection of the information and discussing it.

Thanks also go to the Development Partners of the Nilebasin Initiative whose support made the studies possible.

The Nile Transboundary Environmental Action Project.

Foreword

The Nile Basin Initiative (NBI) is a partnership between riparian countries of the Nile; namely Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. The NBI's shared vision is to "achieve sustainable socio-economic development through the equitable utilisation of, and benefit from the common Nile Basin water resources". To translate this shared vision into action, there are two complimentary programmes: the Shared Vision Programme (SVP) which creates a basin wide enabling environment for sustainable development; and the Subsidiary Action Programmes (SAPs) engaged in concrete activities for long term sustainable development, economic growth and regional integration of the Nile Basin countries.

The Nile Transboundary Environmental Action Project (NTEAP), one of the projects under the NBI's Shared Vision Programme, is mandated to provide a strategic environmental framework for the management of the trans-boundary waters and environmental challenges in the Nile River Basin. One of the ways in which NTEAP met this objective was to conduct studies to improve the understanding of the relationship between water resources, development and the environment; enhancing basin wide cooperation and capacities for better environmental management of Nile Basin resources.

This study was initiated by the Wetlands and Biodiversity Conservation component of NTEAP to promote the understanding of the functions of wetlands, biodiversity and water resources in sustainable development. The study was a response to requests by the Nile Equatorial Lakes Subsidiary Action Plan Cordination Unit (NELSAP-CU) which envisaged a series of investment and development projects in the Lake Cyohoha Sub-Basin. The selection of the study area took into account preliminary observations that there are already ongoing and proposed interventions which would benefit from the in-depth study on water quality, wetlands and biodiversity. The sub-basin catchment, its wetlands and forests are very important natural resources and are habitats for biodiversity on which the livelihood of the communities living around the sub-basin evidently depends. The results of this study serve as a baseline to guide future investement programmes for this area.

Studies on limnology and water quality were done to complement the wetlands and biodiversity surveys so as to propose solutions to the major threats facing the lake and its associated wetlands. Some of the threats include rapid population growth and agricultural activities, unwise land use practices, intense erosion and silt loading in river and lake basins, severe organic nutrient pollution, wetland drainage and un-

sustainable water usage. The ecological processes, impact of wetland modifications, status of water quality, habitat and biodiversity have been studied. This report is the first attempt to address the threats of a degrading eco-system.

In this study, it has been established that Lake Cyohoha South's limnology has changed over the years with significant changes in its morphometry, turbidity, high rates of retention of nutrients and organic matter and low water retention time (WRT), which may have had an effect on its biodiversity. It has also been established that as wetlands continue to be hotspots for biodiversity, they provide a buffer to the chocking sediments from the catchment and hence should be conserved.

An assessment of the economic value and major threats, together with the underlying socio-economic functions has been made for effective management of the sub-basin resources. The wetland vegetation along with other unique species is harvested for fodder, decorations and making fishing boats and mats. The forest vegetation is harvested for sale or domestic use as fuel wood. People also harvest the wetlands and forest products for various uses including commercial purposes. This implies that guidelines to sustainable utilisation of the resources should be devised, including massive sensitisation to reduce the loss of wetland habitat and reverse their degradation that has occurred in recent years.

The result of this study has also recommended that Lake Cyohoha and its wetlands qualify for the special status of being a trans-boundary Ramsar Site. It has potential for eco-tourism and other investment opportunities based on existing wetlands and their biodiversity. It is therefore imperative to establish a management authority to cordinate efforts of Rwanda and Burundi to harness the full investment potential of the sub-basin. The authority shall strengthen the current institutional efforts to regulate sustainable best practices for wetlands and biodiversity management of these trans-boundary resources.

We hope that this study contributes towards research in the field of wetland management in the sub-basin. Continued appropriate data collection will fill the gaps identified in the study to monitor and strengthen management measures for the wetlands and biodiversity in the sub-basin.

Gedion Asfaw
Regional Project Manager
Nile Transboundary Environment Action Project.

Abreviations and Acronyms

ABO :	Association Burundaise pour la Protection des Oiseaux
ACNR :	Association pour la Conservation de la Nature au Rwanda
ADB :	African Development Bank
AM :	Afrotropical Migrant
Bio. Control :	Biological Control
BU :	Burundi University
CBD :	Convention on Biological Diversity
CBO :	Community Based Organisation
CFM :	Consultant Firm Member
CGIS :	Centre for Geographical Information System
CEPGL :	Communauté Economique des Pays des Grands Lacs
CNECN :	National Institute for Environment and Conservation of the Nature
COMESA :	Common Market of Eastern and Southern Africa
CRS :	Catholic Relief Services
CSO:	Civil Society Organisation
DGFTE :	Direction Générale des Forêts, du Tourisme et de l'Environnement
DPAE :	Direction Provinciale de l'Agriculture et de l'Elevage
E :	Endangered
EANHS :	East Africa Natural History Society
Ec. Import:	Economic importance, ecological role
Ecosystem:	A self-regulating community of living things in their physical and chemical environment.
Eng.:	English
FACAGRO :	Faculté d'Agronomie
FAO :	Food and Agriculture Organisation
UNFA :	United Nations Organisation for Food and Agriculture
FIDA :	Fonds International de Développement Agricole
GEC :	Green Environment Conservation
GDP :	Gross Domestic Product
GPS:	Geographical Position System
GoR :	Government of Rwanda
HIMO :	High Intensity Manpower (Labor Intensive)
HIMO :	Haut Intensité de la Main-d'œuvre
HLIS :	High Learning Institution Student
IBA :	Important Bird Area
IGEBU :	Institut Gégraphique du Burundi
INCN :	Institut National de Conservation de la Nature
INECN :	Institut National pour l'Environment et la Conservation de la Nature
IRAZ :	Institut de Recherche Agronomique et Zootechnique
ISTR :	Institute of Scientific and Technological Research

IRST :	Institut de Recherche Scientifique et Technologique
ISABU :	Institut des Sciences Agronomiques du Burundi
ISAE :	Institut Supérieur d'Agriculture et d'Elévage
ISAR :	Institut des Sciences Agronomiques du Rwanda
ISP :	Institut Supérieur Pédagogique
Kd:	Kirundi
Kn:	Kinyarwanda
IUCN	International Union for Nature Conservation
KIST :	Kigali Institute of Science and Technology
LC :	Least Concern
MAO :	Ministerial Agency Officer
MINAGRI :	Ministère de l'Agriculture et des Ressources Animales
MINATETAP :	Ministry of Environment, Land Developmet and Public Works
MINECOFIN :	Ministère de l'Economie et des Finances
MINITERE :	Ministère des Terres, Environnement, Forêts, Eau et des Mines
NBI:	Nile Basin Initiative
NGOs :	Non Government Organisations
NELSAP :	Nile Equatorial Lakes Subsidiary Action Project
NEPAD :	New Partnership for African Development
No doc :	Not documented
NT :	Near Threatened
NTEAP:	Nile Transboundary Environmental Action Project
NTU :	Nepherometre Turbidity Unit
NUR :	National University of Rwanda
ROTNP :	Rwanda Office of Tourism and National Parks
PASTA :	Plan Stratégique de Transformation Agricole
PDL-HIMO :	Programme de Développement Local-Haute Intensité de Main d'Oeuvre
PM :	Parlaearctic Micrant
PNUD :	Programme des Nations Unies pour le Développement
PSTA :	Plan Stratégique de Transformation Agricole
Q :	Quantity
R :	Resident
RADA :	Rwanda Agricultural Development Authority
REASON :	Rwanda Environmental Awareness Services Organisation Network
REMA :	Rwanda Environment Management Authority
SGP:	Small Grants Programme
SSG :	Site Support Group
Sp. :	Species
TSD :	Technical Service of District
UICN/IUCN :	International Union for Nature Conservation
UNDP :	United Nations Development Program
UNEP :	United Nations Environnent Program
WHO :	World Health Organisation

Chapter One

Chapter Six

Chapter Six

Reptiles & Amphibians of Lake Cyohoha Sub-Basin

Domnick Victor Wasonga

National Museum of Kenya, Email: dvw.jabungu@gmail.com

6.1 Introduction

It is widely known, that reptiles and amphibians not only constitute an important part of biodiversity of an ecosystem but also have great potential in the socio-economic development of local communities. Although, anecdotal regional herpetological accounts comprising of taxonomic descriptions exist (Loveridge, 1936a, b) and other classical literature also available for Burundi, Rwanda, and the surrounding territories (Lindahl, 1956; Laurent, 1956a; Laurent, 1956b; De Witte, 1965; Hinkel and Fischer, 1988), species distribution patterns of amphibians and reptiles remain poorly known in Lake Cyohoha South Sub-Basin. Nevertheless, more recently, the Global Amphibian Assessment (GAA) database has presented the status of described amphibians of Rwanda and Burundi.

Despite these gaps in knowledge, the overall patterns of species richness, in critical habitats like the Lake Cyohoha South Sub-Basin was worth noting, and hence was the need for the study. During this study period, a checklist of herpetofauna in Lake Cyohoha Sub-Basin was established and the ecological importance of herpetofauna and its linkage to the livelihoods of the riparian communities was evaluated. Furthermore, the impact of environmental modification on the distribution, composition and abundance of herpetofauna as well as the socio-economic and major threats affecting herpetofauna was assessed.

Reptiles and amphibians of Lake Cyohoha South were documented from historical records and field sampling within selected eco-sites in Rwanda and Burundi. The places sampled included Ngenda, Bugarama and Kagenge in Rwanda, and in addition, Marembo, Iyalanda and Muyebe in Burundi (Figure 4.1). These areas included aquatic, terrestrial, wetlandland and farmland habitats. A total of 67 species were recorded comprising of 48 reptiles and 19 amphibians.

During the present study 43% of the expected herpetofauna (i.e. 15 reptiles and 14 amphibians) were recorded from field sampling. It is noted that in the last 50 years since the first herpetological excursion was carried out in this part of East Africa, the habitats have considerably changed. Even though a good diversity of herpetofauna is still found here, the notable local extinction of the Nile crocodile in the lake had serious conservation implications for the remaining species assemblage.

In Rwanda, the local community members' perception regarding reptiles and amphibians still remains that of fear as expressed in their traditional beliefs and folklores. However, in Burundi, some documentary evidence supports a newly acquired culture of domestic as well commercial but unregulated consumption of selected species of reptiles and amphibians. The combination of these factors constitutes gradual but continuous influence on the reptile and amphibian fauna inhabiting the sub-basin.

In an effort to diversify local community livelihoods and promote conservation of this important component of biodiversity, four investment options are suggested. These include reptile parks for eco-tourism, live reptile and amphibian trade, commercial breeding of amphibians for harvesting and snake milking. Capacity building among local communities and national experts and further monitoring and research are underscored. The guiding principle for effective implementation of these priority actions would be the development and integration of cross-border institutional and legislative frameworks for Rwanda and Burundi regarding Lake Cyohoha South Sub-Basin management and conservation.

6.2 The study area

Field sampling was done in three representative eco-sites within the Lake Cyohoha Sub-Basin as shown in **FIGURE** 4.1.

1) the area of Lake Cyohoha towards the Akanyaru River and associated wetland. In this section, surveys were conducted in the general Ngenda area on the Rwanda side and the Muyebe general area on the Burundi side of the lake.
2) a mid-section in the lake towards the areas of Rugarama and Kagenge.
3) the southern section of Lake Cyohoha around Iyalanda and Marembo.

The surveys were also extended up hill into the Murehe woodland which represented the more or less natural and more extensive vegetation growth in the trans-boundary areas.

6.3 Methods used

6.3.1 Literature review

A literature review to compile accessible knowledge and other existing databases on past records of herpetofauna in Cyohoha South Sub-Basin was done as well as institutional and legal frameworks through visits to training and research institutions, public and private services in Rwanda.

6.3.2 Field Sampling methods

Standardized visual transect sampling (SVTS): Sampling was performed during daytime. Transects were intensively patrolled at a constant speed (0.30–0.35m/s), thereby recording all amphibians and reptiles within a distance of 100cm from either side of the path. As far as possible all individuals were captured and/or recorded. Details of these methods are described elsewhere (e.g. Heyer *et al.*, 1994; Karns, 1986).

Visual encounter surveys. *(VES)*: Due to the simplicity of the method, VES is frequently used for rapid assessments and the evaluation of larger areas. An area or habitat was searched systematically for individuals using diurnal as well as nocturnal walks. The resulting data was expressed in numbers of species found in an area. Time-constrained technique or search and seize survey (SSS) was used as described by various authors (Campbell & Christman, 1982; Karns 1986; Sutherland 1996; Corn & Bury 1990; Crump& Scott 1994).

Sweep sample*:* This technique was mainly employed in the lake-edge waters and ponds using mesh dip nets through the water columns (Karns, 1986). Information on larval species, life histories such as egg deposition and tadpole's micro habitat requirements were obtained as a measure of breeding activity of amphibians.

Acoustic (Call) surveys: Presence of amphibians were confirmed by advertisement calls heard at the various sampling sites. Thorough searches were then conducted and species found noted. No calls were recorded. Call survey was used to obtain information on breeding sites. Some individuals for each species were collected as representative voucher specimens and were deposited at National Museums of Kenya, Nairobi (none of the institutions in the two countries are currently holding scientific collections where duplicate materials could be deposited). Photographs of some species recorded from the field were taken and tissue samples (for future studies) were preserved in absolute alcohol.

Human impact assessment

Human activities within and around the species habitats were qualitatively assessed. The impact of the activities was assessed to determine their effects on the distribution and abundance of the amphibians and reptiles. Some of these activities that were assessed included forest/vegetation clearance, farming, logging, human settlements, and conducting interviews to support evidence of local community benefit from and/or use of any species of amphibians and reptiles. The impact levels were categorised as: 1 = none; 2 = moderate; 3 = high; 4 = severe. Only key informants (comprising adult men) were interviewed per site. Past records of any exploitation were documented from literature.

6.4 Results and discussion

The diversity of reptiles and amphibians of Lake Cyohoha South Sub-Basin ecosystem is relatively high. A total of 67 species including 48 reptiles and 19 amphibians have been documented in this area. Twelve species (8 amphibians and 4 reptiles) were not previously known in the region. During the present study, 43% of the expected herpetofauna (i.e. 29 species) were recorded from field sampling. **TABLE** 6.1 shows the different species recorded from different localities sampled.

It was noted that much of the natural vegetation had been removed from the riparian areas, so that some of the dendritic ends of the lake that still hold wetland vegetation which are the best refuges left for the amphibian fauna. It is also in these areas where, the remnant populations of large reptiles like snakes are found. The only natural stretch of bushland left is Murehe Forest Reserve whose vegetation spreads over to the Rwanda side but is not under protection status. The lake margins are spotted with reeds and tall grass interspersed with bits of Papyrus.

Out of the 67 species of reptiles that have been documented in the sub-basin, 14.92% are of conservation concern (**TABLE** 6.3). These include nine species that are categorised as endangered (E) and one frog known to be vulnerable (VU). Only two of these threatened species, Montane side-striped chameleon and the African rock python have been confirmed to occur in the sub-basin during the present survey. The Nile crocodile, a large water living reptile, was not seen during the present study and perhaps its abundance has drastically decreased. The occurrence of these threatened species strongly indicates the need for immediate conservation and management plans.

The most important habitats where most species occurred were the wetlands, the marginal vegetation and the scattered bushland and forest. High priority should focus on protection of these habitats by the local communities, e.g. Iyalanda site. A description of the vegetation of each of the eco-sites has been given in Chapter 3 of this report. The eco-sites described and referred to include; the western end of Lake Cyohoha South (including Nyarugenge, Rugarama and Ngenda), Kagenge, Iyalanda, Mugombwe (the slopes above Muyebe papyrus wetland) and Gasenyi (the Burundian border-post within Murehe woodland). The herpetofauna recorded here represents a unique genetic pool which is worth conserving. The colour variation documented in the reed frogs was very striking (Photo 6.1).

Photo *6.1.* **Top:** *Colour variation of Hyperolius angolensis (Angolan reed) frog from Marembo Beach and Muyebe wetlands respectively.* **Above:** *Hyperolius viridiflavus, common reed frog from Rugarama and Marembo respectively.*

TABLE 6.1. Species list for (i) reptiles and (ii) amphibians observed by locality

	Northern Reach			Middle Reach	Southern Reach		
Species/Taxa	Rugurama	Nyarugenge	Muyebe	Ngeruka	Murehe	Marembo	Yalanda
(i) Reptiles (Lizards & Snakes)							
Hemidactylus mabouia	+	+	+	+	+		+
Lygodactylus sp				+			
Trachylepis striata	+	+	+	+	+	+	+
Trachylepis varia	+						+
Chamaeleo ellioti							+
Python sebae	+		+				+
Lamrophis fuliginosus	+	+		+			+
Philothamnus angolensis							+
Philothamnus hughesi						+	
Philothamnus ruandae		+					
Natriceteres olivacea				+			+
Dendroaspis polylepis					+		
Naja melanoleuca					+		+

Naja nigricollis		+	+				
Bitis arietans		+			+		
(ii) Amphibians (Frogs & Toads)							
Arthroleptis cf. adolfifriederici							
Amietophrunus funereus	+						
Amietophrunus gutturalis		+	+			+	
Amietophrunus maculatus		+		+			+
Amietophrunus cf. *regularis*	+	+	+	+	+	+	+
Afrixalus fulvovittatus				+			
Hyperolius cf. angolensis			+			+	+
Hyperolius cf. glandicolour	+		+			+	+
Hyperolius cf. kivuensis							+
Hyperolius cf. lateralis	+						
Hyperolius cf. viridiflavus	+	+	+	+		+	+
Phrynobatrachus cf. natalensis		+					
Ptychadena taenioscelis	+						
Ptychadena cf. *uzunguensis*		+					

Considering that this was a rapid survey in which limited trapping methods were used, a record of 29 species sampled by hand-capture and opportunistic sampling strongly indicates that the region is a biodiversity hotspot. So, the confirmed diversity of reptiles and amphibians in Lake Cyohoha South Sub-Basin might be much less than the actual herpetofuna for the region. Amphibians in particular are widely recognised as environmental indicators. Only the presence of 14 amphibian species was confirmed in the current study. The decreased habitat quality could be impacting on their diversity, but other possible influences e.g. water quality, heavy predation should also be investigated.

In general, herpetofauna are ecologically important in their role as biological control agents within the ecosystem. As the riparian areas consist of subsistence agriculture zones, the presence of a wide range of pests including rats and mice is certain. These small mammals are largely eaten by reptiles (especially snakes) thereby reducing loss to food crops, which constitutes a crucial indirect benefit to the local farmers.

TABLE 6.2. List of reptiles and amphibians of Lake Cyohoha Sub-Basin and their Conservation status (P = recorded in the present study;

IUCN Listing Status LC = Least Concern; DD = Data Deficient; E = Endangered; VU = Vulnerable). The families are indicated in bold lower case.

Species Scientific Name	English Name	Vernecular Name (R = Kinyarwanda; B = Kirundi)	IUCN Listing Status	References
REPTILES				
Testudinidae				
Geochelone pardalis	Leopard tortoise	R: Akanyamasyo	LC	(Laurent, 1956b)
Kinixys belliana	Bells's hinge tortoise	R: Akanyamasyo; B: Igifugwe	LC	(Laurent, 1956a)
Pelomedusidae				
Pelusios subniger	Pan hinged terrapin	Akanyamasyo	LC	Laurent, 1956b?
Pelusios casteneus		R & B: Ikinyamasyo		(Laurent, 1956b); Nzigidahera, 2007)

Pelusios rhodesianus	Zambian hinged terrapin	R & B: Inkinyamasyo		Nzigidahera, 2007)
Gekkonidae				
Hemidactylus mabouia	Tropical house gecko		LC	**P** ; Laurent, 1956b
Lygodactylus gutturalis ?	Chevron throated dwarf gecko		DD	(Laurent, 1956b)
Lygodactylus sp	Dwarf gecko			P
Scincidae				
Trachylepis striata	Striped skink	R: Imiserebanya	LC	**P;** Laurent, 1956b
Trachylepis varia	Variable skink	R: Imiserebanya	LC	**P**
Trachylepis megalura	Long-tailed skink	R: Imiserebanya	LC	Laurent, 1956a&b
Agamidae				
Acanthocerus cyanogaster	Black-necked tree agama	R : Icyugu	LC	(Laurent, 1956b)
Agama mwanzae	Mwanza flat headed agama	B : Icyugu,	LC	Spawls *et al* 2002
Chamaeleonidae				
Chamaeleo ellioti	Montane side striped chamaeleon	R: Nyamondi	E	**P;** De Witte, 1965
Chamaeleo dilepis	Flap necked chameleon	R: Nyamondi	E	Hinkel & Fischer, 1988; (Laurent, 1956b)
Chamaeleo anchiatae	Angola chameleon	R: Nyamondi	E	Laurent, 1956b Spawls *et al* 2002
Chamaeleo laevigatus	Smooth chameleon	R: Nyamondi	E	Spawls *et al* 2002
Chamaeleo bitaeniatus	Side-striped chameleon	R: Nyamondi	E	Laurent, 1956b
Chamaeleo adolfifriedeci	Ituri chameleon	R: Nyamondi	E	Laurent, 1956b
Rhampholeon boulengeri	Boulenger's pygmy chameleon	R : Nyamondi	E	Laurent, 1956b
Cordylidae				
Chamasaura anguina	Highland grass Lizard	R: Imiserebanya	LC	Laurent, 1956b
Gerrhosauridae				
Gerrhosaurus nigrolineatus	Black-lined plated lizard	R: Imiserebanya	LC	Laurent, 1956b
Varanidae				
Varanus niloticus	Nile monitor lizard	B: Imburu		Laurent, 1956b Hinkel & Fischer 1988; Nzigidahera, 2007)
Crodylidae				
Crocodylus niloticus	Nile Crocodile	R & B: Ingona	E	Hinkel & Fischer, 1988 (Laurent, 1956b); Nzigidahera, 2007)
Typhlopidae				
Typhlops angolensis	Anglola blind snake		DD	Laurent, 1956a&b;
Boidae				
Python sebae	African Rock Python	R: Uruziramire; B: Isato	E	**P**; (Laurent, 1956b); Hinkel & Fischer, 1988; Nzigidahera, 2007)

Colubridae				
Lamprophis fuliginosus	Common house snake	R: Imbarara/ Ikiryambeba	LC	**P;** Laurent 1956a
Lamprophis lineatus	Striped house snake	B: Imbarara/ Ikiryambeba	LC	Hinkel & Fischer, 1988; Laurent, 1956b
Philothamnus angolensis	Angolan green snake	R : Inzoka	LC	**P**; Laurent, 1956a
Philothamnus hughesi	Hughes' green snake	R : Inzoka	LC	**P**
Philothamnus ruandae	Rwanda forest green snake	R : Inzoka	LC	**P**
Philothamnus heterolepidotus	Slender green snake	R : Inzoka	LC	Laurent, 1956a&b ; Spawls *et al* 2002 ;
Mehelya capensis	Cape file snake	R : Inzoka	LC	Laurent, 1956b_ Spawls *et al*, 2002
Lycophidion capense,	Cape wolf snake	R : Inzoka	DD	(Laurent, 1956b
Lycophidion ornatum	Forest wolf snake	R : Inzoka	LC	Spawls *et al* 2002; Laurent, 1956b
Natriceteres olivacea	Olive wetland snake	R : Inzoka	LC	**P** ; Laurent, 1956b
Prosymna ambigua	Angolan shovel snout	R : Inzoka	LC	Laurent, 1956b
Duberia lutrix	Slug eater	R : Inzoka	LC	Laurent, 1956b
Dispholidus typus	Boomslang	R : Inzoka	LC	Laurent, 1956b
Thelotornis kirtlandi	Forest vine snake	R : Inzoka	LC	Laurent, 1956b
Elapidae (Cobras & Mambas)				
Dendroaspis polylepis	Black mamba	R: Insana	LC	**P**; Hinkel & Fischer, 1988
Naja melanoleuca	Forest cobra	B: Imvubyi, Incira Kirezi, (Also	LC	**P;** Laurent, 1956b; Hinkel and Fischer, 1988
Naja nigricollis	Black spitting cobra	R: Incira Rukara, (Also	LC	**P;** Laurent, 1956b
Boulengerina annulata	False cobra	B: Ikiroba	LC	Nzigidahera, 2007)
Viperidae (Vipers)				
Bitis arietans	Puff adder	R: Impiri/ Rutenyi B: Imamba		**P;** Hinkel & Fischer, 1988; (Laurent, 1956b); Nzigidahera, 2007)
Atractaspididae				
Polemon christyi	Chrysty's snake eater	R: Ishingu	LC	Hinkel & Fischer, 1988
Atractaspis irregularis	Variable burrowing asp	R: Ishingu	LC	Laurent, 1956b
Atractaspis bibroni	Bibron's burrowing asp	R: Ishingu	LC	Laurent, 1956b
AMPHIBIANS				
Arthroleptidae (Squeakers)				
Arthroleptis cf. adolfifriedirici	Adolf's squeaker	R, B: Umutubu	LC	**P**
Bufonidae (Toads)				
Amietophrynus funereus	Somber toad	R, B: Igiceri	LC	**P**

Amietophrynus gutturalis	Guttural taod	R, B: Igiceri	LC	**P**
Amietophrynus maculatus	Flat backed toad	R, B: Igiceri	LC	**P**
Amietophrynus regularis	Common toad	R, B: Igiceri	LC	**P** ; Laurent, 1956b
Hyperoliidae (Reed frogs)				
Afrixalus fulvovittatus	Four-lined spiny reed frog	R: Umutubu	LC	**P ;** Hinkel & Fischer, 1988; Laurent, 1956b
Hyperolius cf. angolensis	Angolan Reed Frog	R: Umutubu	LC	**P**
Hyperolius cf. glandicolour	Peter's reed frog	R: Umutubu	LC	**P**
Hyperolius cf. kivuensis	Kivu reed frog	R: Umutubu	LC	**P ;** Hinkel & Fischer, 1988
Hyperolius cf. lateralis	Side-striped reed frog	R: Umutubu	LC	**P ;** Laurent, 1956b
Hyperolius cf. viridiflavus	Common reed frog	R: Umutubu	LC	**P ;** Laurent, 1956b
Leptopelis bocagii	Bocage's tree frog	R: Umutubu	LC	(Laurent, 1956b
Callixalus pictus	Variable reed frog	R: Umutubu	VU	(Laurent, 1956b
Hyperolius cinnamomeoventris	Cinnamon-bellied reed frog	R: Umutubu	LC	(Laurent, 1956b
Phrynobatrachidae				
Phrynobatrachus cf. natalensis	Natal puddle frog	R: Igiceri / Umutubu	LC	**P ;** Hinkel & Fischer, 1988; Laurent, 1956b
Ptychadinidae				
Ptychadena taenioscelis	Small ridged frog	R: Igiceri	LC	**P**
Ptychadena uzunguensis	Udzungwa ridged frog	R: Igiceri	LC	**P**
Ranidae				
Hydrophylax galamensis,	Galam white lipped frog	R: Igiceri	LC	Laurent, 1956b
Hydrophylax albolabris	Forest white-lipped frog	R: Igiceri	LC	(Laurent, 1956b

Striped Skink

Variable Skink

Tropical House Gecko

Montane Side-striped Chameleon

Common House Snake

Part of Skin shed by Black Forest Cobra?

Photo 6.2: Some reptiles recorded in Lake Cyohoha Sub-Basin

Small Ridged Frog

Udzungwa Ridged Frog

Somber Toad?

Flat-backed Toad

Guttural Toad

Natal Puddle Frog

Photo 6.3: Some amphibians recorded in Lake Cyohoha Sub-Basin

TABLE 6.3. Summary of IUCN conservation status of reptiles and amphibians of Lake Cyohoha Sub-Basin

Measure	IUCN Listing Category				Totals
	E	VU	DD	LC	
Number of Species	9	1	3	54	67
Percentage (%)	13.24	1.47	4.41	80.88	100

6.5 Indigenous knowledge of Herpetofauna in Lake Cyohoha Sub-Basin

6.5.1 Perception of reptiles and amphibians in Rwanda

Reptiles and amphibians are rarely regarded as having meaningful benefits to mankind among the riparian communities of Lake Cyohoha Sub-Basin in Rwanda. The following is an account of their perceptions as narrated by various informants during the the study in Rwanda. There was no systematic selection of the number of informants from the population but all respondents were above 25 years of age. The species are categorised according to terminologies easily recognisable in the local language (i.e. Kinyarwanda).

Terrapins

These are fresh water members of shelled reptiles that also include land tortoises. At least three species of the genus *Pelusios* (Hinged terrapins) have been documented to occur in the basin in the past. All the people interviewed stated that it was considered a taboo to eat terrapins and any person who does so would die. Incidental catches in gillnets have to be released immediately by the fishermen. While conducting this study, a group of eight fishermen at Kagenge beach were asked if they could bring a terrapin for observation and confirmation of its identity. During the study period, there were no terrapins observed and besides, the fishermen were conspicuously absent from what was understood to be the operation base for their loose fisheries association at the beach. This confirms that the local people still hold onto this belief very strongly.

Snakes

Unlike the terrapins, people tend to kill snakes whenever they see them out of fear that all snakes are potentially dangerous. Any person who is bitten by a snake is taken to a traditional healer for treatment. The concoctions used by these 'doctors' normally consist of a variety of herbs but also includes a rather bizarre paraphernalia: a snake head. Whenever a snake is killed in the village, a traditional healer would come and chop off its head to use for medicine. All victims are reported to recover after visiting the healers and there has never been need to seek further treatment using conventional medicine. First aid is normally administered by tying a tourniquet. The healers are usually offered a cash equivalent to two beers as their payment.

Chameleons

They are known to be very common around human habitations. They prefer to live on hedges of "imiyenzi" (Euphorbia) that is normally planted around each home. People like the presence of chameleons near them and no one ever kills them. They tend to be intrigued by the animal's characteristic colouration that perfectly mimics its micro habitat.

Lizards

There is a belief that Lizards should not be killed especially by ladies for fear of not bearing children. If a lizard crosses ones path or falls on some one from a tree, it is considered a bad omen.. The victim has to consult a fortune teller about the impending bad omen.

Frogs

The "ibikeri" as they are known in the local Kinyarwanda dialect are very useful in traditional weather forecasting. Whenever frog calls are heard near the home, people know it is about to rain. On the other hand smaller frog species termed as "imitubu" are captured and used by fishermen as bait on hooks. Fishing is done both during the day and night. During night fishing, the frogs serve as biological clock as the fishermen would tell the onset of dawn. Frogs encountered in kitchens and gardens are never killed since they are recognized as members of the community.

6.5.2 Perception of reptiles and amphibians in Burundi

Reptiles

Burundians have over the years been influenced by other people from neighbouring countries like Tanzania and Democratic Republic of Congo and have adopted various use values for some reptile species (Nzigidahera, 2007). These reptiles include pythons, crocodiles, terrapins, monitor lizards, vipers and cobras (e.g. **Photo 6.4**). Indeed the local people presently appreciate their meat in the same manner as a chicken meal.

On the other hand, there is negative attitude towards some reptiles like snakes. Some religions consider snakes as mysterious creatures with superpowers used by traditional witches*1*.

Chameleons

In the study conducted by Nzigidahera (2007), most people interviewed confessed that they have no positive value for chameleons. The first instinct, according to Burundians, is to kill these animals on sight. It is believed that a chameleon is a symbol of death and one is expected to make this pronouncement: "because I have seen you first, you will die before me" in reference to the animal before killing it or simply letting it go.

Snakes

Burundians believe that when you encounter a blind snake, a close relative would die. However, majority of people are tolerant towards a house snake (*Lamprophis fuliginosus*) which is regarded as harmless, living with people and eating rats. The rest of the snakes are regarded as dangerous. But according to Baransata (1981), the number of venomous snakes previously known from Burundi is very few.

TABLE 6.4: Methods used to capture reptiles in Burundi

Species	Method of capture	Remarks
Python	Trapped in cages, hunted using dogs	Used for meat

1. Rosselot, B. 1977. Les serpents dangereux du Burundi. Fonds d'Aide de la Cooperation de la Republique Francaise

Vipers	Trapped in cages, hunted using dogs	Used for meat
Cobra (*Boulengerina annulata*)	Baiting with meat e.g. goat head on wire	Used for meat
Nile crocodile	Baiting with meat e.g. goat head on wire	Nzigidahera (2003) estimated that average of 8 crocodiles are captured per month each sold for 15,000 FBU. Young crocodiles are preferred.
Terrapins (*Pelusios casteneus*)	Mostly caught in fishing nets. Immersed in hot water to die before slaughter.	Catches high during rainy season within the shorelines. Used for meat. Sold for about 100 – 300 FBU. Exports to China can fetch up to 3,000 FBU. 5 – 10 terrapins caught each day.
Snakes	Baited using small mammals and fish. Occasionally gillnets, hand capture is also practiced.	The head is removed first and discarded, carcass skinned and meat obtained for consumption
Nile Monitor lizard (*Varanus niloticus*)	Baiting with meat e.g. goat head on wire	Believed to have poison in blood this is drained ("Kuzitura imitsi") before slaughter.

Amphibians

Some frog species are consumed especially on a commercial scale in the hotel industry in the city of Bujumbura, although local people rarely eat them as they consider them toxic. The substance on frog skin is believed to cause leprosy. With time, the locals have learnt to catch frogs for sale.

There is a Kirundi proverb that states that "if you kill a frog, your mother will lose her breasts (*Uwishe igikere nyina acika amabere*)". In another saying "Frogs keep jumping as a sign of happiness for not having a tail (*ubwishime bw'igikere bwakibujije kumera umurizo*). However, some people already appreciate the economic importance of amphibians in Burundi.

TABLE 6.5: Capture methods and consumption of amphibians

Species	Capture Method	Remarks (prices in January 2008)
Hoplobatrachus sp.	Hand capture, or Dip nets by day or preferably night. 9 to 12 individuals can make up to 1kg of meat.	The most abundantly exploited. 4 – 5 kg can be obtained within one hour at night. I kg is sold for 2,000 – 4,000 FBU.
Ptychadena sp.	Hand capture, or Dip nets by day or night. About 40 individuals can make up 1kg of meat.	Smaller weighing 10 – 15g. Sold for 1500 – 3000 FBU per Kg.

FIGURE 6.4. At Iyalanda and Kirundo village in Burundi, this man is displaying a snake skin (*Naja melanoleuca*) which he killed and skinned for a meal in 2007.

6.6 Impact of environmental modifications and other human impacts on reptile and amphibian diversity

The following table shows the varuous threats on herpetiles and their habitats in the Cyohoha Sub-Basin as reavealed by questionnaires administered in the local communities.

TABLE 6. 6. Levels of impacts of human activities on reptile and amphibian diversity as documented in Lake Cyohoha Sub-Basin. Impact Classes: 1 = none; 2 = moderate; 3 = high; 4 = severe.

Locality	**Impact**			
	Direct Harvesting	Vegetation Clearance	Farming	Settlement
Rugarama	2	2	4	3
Nyarugenge	2	3	3	3
Ngeruka	2	3	3	3
Muyebe	3	2	3	2
Murehe Forest	3	2	2	2
Marembo Beach	4	3	3	3
Yalanda	4	3	4	4

Loss of habitats

This is mainly due to human population pressure leading to loss of natural forests, wooded savannahs and wetlandlands (Republic of Rwanda, 2003). In the present survey, farming scored predominantly high in all the sites (**TABLE** 6.6). All around Lake Cyohoha South, the anthropogenic activities have led to alteration of the natural habitat. The implementation of a 50m buffer zone of tree plantation on the Rwanda side has not been fully realised. The Burundians who share a bigger percentage of the lake have not put in place any initiatives to protect the lake and wetlands because the cultivated fields reach shores. Other factors that modify habitat include vegetation clearance, farming and settlements as observed (**TABLE** 6.6).

Direct exploitation of species

There is widespread collection and consumption of a number of species both for subsistence and commercial purposes (Nzigidahera, 2007). Interviews with a number of people within the study eco-sites during the present survey confirmed continuous small scale purposeful and incidental harvests of animals like terrapins, snakes and frogs. The intensity of such harvests was observed as moderate in Rwanda but more severe in Burundi (**TABLE** 6.6).

Negative perception and lack of awareness

Due to lack of awareness and influence of traditional myths, many people have failed to appreciate the existence value of herpetofauna. Some species that are not of immediate value e.g. lizards and chameleons are more often killed.

Domestic and international trade

Even though herpetofauna are traditionally avoided by indigenous communities, especially in Rwanda, they are routinely harvested for national and possibly international markets. The biggest challenge is the information gap on human exploitation and lack or limited data/statistics on species populations (Leuteritz, *et al.* 2005).

Little has been previously documented on Rwanda or Burundi herpetofauna. Among the documented issues hampering the conservation of the species in general and reptiles and amphibians in particular in Sub-Saharan Africa are the live trade and general unsustainable harvesting of species from the wild. The Animals Committee of CITES[2] noted that legal and illegal trade on reptiles and amphibians was on the increase across Africa. According to statistics collected by the US Fish and Wildlife Service, in 1997 the United States imported 1.8 million live reptiles worth more than $7 million[3]. Such trade implies notable impact on many species and populations across the world. In the present study, no formal reptile or amphibian husbandry establishment were documented in Rwanda or Burundi and therefore specific data on trade was not ascertained. It would be expected that if species utilisation is to be regularised, the practitioners would submit periodical reports to the respective national CITES management authority.

2. Report prepared at the Eighteenth meeting of the Animals Committee (CITES) San José (Costa Rica), 8-12 April 2002

3. Excerpts pertaining to turtles from the November 18, 1999 Federal Register announcement: The United States' Final Submission for April CITES Conference. Turtle and Tortoise Newsletter. The Newsletter of Chelonian Conservationists and Biologists. 2000, 1: 12 – 13.

6.7 Recommendations

In order to diversify livelihood options for the local communities in Lake Cyohoha South Sub-Basin, the diverse reptiles and amphibians as documented in this study present numerous chances for local investment. Prior to any such decision, sustainable utilisation is possible if the following recommendations are considered:

- Identify formally registered individuals and CBOs that would adequately engage in reptile husbandry with eco-tourism objectives in the short term and commercial export in the long term.
- Familiarise the CBOs with the relevant wildlife breeding and utilisation guidelines. Some of the countries in the region like Kenya, Zambia and Tanzania are currently successfully regulating such initiatives. The relevant authorities in the two countries should identify modalities of developing and implementing such guidelines.
- There is need to study the general ecology of modified landscapes in the savannahs and wetlandlands of Lake Cyohoha Sub-Basin that are potentially rich in endangered or rare species with a view to promoting their sustainable utilisation.
- More awareness strategies should be developed especially by environmental authorities and organisations in the region to open up opportunities for wise use of natural resources.
- It is imperative that the capacity of local communities is enhanced with a view to ensuring they understand ecological importance of reptiles and amphibians as well as ways in which they can gainfully and sustainably exploit selected species. While this would help in poverty alleviation, it would also improve conservation awareness for these lower vertebrates.
- In order to guide correct decision making and to build on the current baseline data of the herpetofauna of Lake Cyohoha Sub-Basin, the natural populations of the species need to be monitored very closely. Such data and more intuitive-type assessments (such as local knowledge) need to be used within an elaborate framework that includes regular monitoring, annual reviews, and stakeholders' participation.

There is critical need for Burundian and Rwandese nationals to enhance technical capacity in herpetological research. One important step would be to encourage university students to do research on subjects of natural history of reptiles and amphibians.

- There is need for Rwanda and Burundi to enter into an agreement on environmental management that will improve the management of Lake Cyohoha Sub-Basin ecosystem. Such an agency will harmonise laws and regulations and implement conservation actions across the ecosystem.
- At the moment, the Rwandan authorities are enforcing an agro-forestry programme to create a buffer zone around the lake, this should be improved by diversifying the tree species planted and replicated across the border. This initiative should be implemented also on Burundian side.

6.8 Areas of investment

6.8.1 Reptile parks for eco-tourism

These are recreational centres having various reptile species on display in semi-natural setting. Fifteen reptile species including 10 snakes and five lizards have been recorded

in the present study (**TABLE** 6.1). These could all be suitable for the establishment of a snake/reptile park. The local communities would set up such ventures either in groups or individually in order to tap the eco-tourism potential in this region. Small enclosures with well designed display cages can easily be set up on a low budget. The availability of infrastructure like road network linking the towns of Nyamata, Kirundo and the cities of Kigali and Bujumbura would be conducive for the inflow of visitors from far flung parts of the countries and the rest of the world. The upcoming international airport in Bugesera district would be a major boost to the tourism potential in the region. Observations made in Kenya indicate that snake parks are extremely popular among the local populations (personal observation), and can adequately sustain the industry in low seasons for tourism. The parks normally offer crucial value addition to the conventional tourism circuit.

6.8.2 Live reptile and amphibian trade

Live animal trade refers to breeding of selected species for export. On the international scene, many animal species are of key interest to nature lovers in the form of pets. Chameleons and the beautifully coloured reed frogs are of great desire in the western world where prices are set by global supply and demand. Formal breeding units can be set up at the local level for people to gainfully earn income from natural resources on their land. These would be guided by the national authorities at the regional level, but subject to CITES regulations. Since both Rwanda and Burundi are parties to the world regulator of trade in endangered fauna and flora (CITES), the mechanisms for operation would be easily harmonised by the concerned scientific and management authorities.

6.8.3 Commercial breeding of amphibians for food

Harvesting of some frog species for food is common practice in Asian countries. But the "frog-leg-meal", a delicacy in the conventional restaurants is fast becoming ordinary meal across Africa. There are indications documented in this study of availability of demand for amphibians in the city of Bujumbura, where the locals collect the frogs from the wild for sale. Two species of Ridged frogs (*Ptychadena*) within the sub-basin, were confirmed to be harvested for food. On a commercial scale, artificial ponds would be constructed in which intensive breeding of these species would be enhanced.

6.8.3 Snake milking

Extraction of snake venom and marketing in form of crystallised powder is called snake milking. This is the raw material in the manufacture of anti-venom for the treatment of snake bites. Four poisonous snakes that occur in Lake Cyohoha Sub-Basin are candidate species for extraction of venom. These include the Black mamba (*Dendroaspis polylepis),* Black forest cobra (*Naja melanoleuca),* Spitting cobra (*Naja nigricollis),* and the Puff adder *(Bitis arietans).* The Black mamba and the cobras can be milked at intervals of every two weeks each. The puff adder can be milked more frequently. Special cages as opposed to display cages of the snake park would be required for these snakes. The packaged crystals would then be exported to the pharmaceutical companies in South Africa or elsewhere.

References

Baransata, B. 1981. Contribution a l'etude de la faune pertelogique dans la region de Rumonge-Kigwena et Nyanza-Lac. Les familles : Colubridae, Elapidae et Viperidae. Memoire de fin d'Etude. Universite du Burundi.

Nzigidahera, B. 2008. Study of the Flora of the Lake Cyohoha Sub-Basin. In Studies on Wetlands Biodiversity and Water Quality Assessment in Lake Cyohoha. Nile Transboundary Environmntal Action Project – Nile Basin Initiative.

Campbell, H.W., & S.P. Christman. 1982. Field techniques for herpetofaunal community analysis. Pp. 193–200 *in* Scott, N.J., Jr. (ed.): Herpetological communities. Wildlife Research Report 13. US Department of the Interior, Fish and Wildlife Service 13.

Corn, P.S., & R.B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. General Technical Report, PNW-GTR-256, U.S. Department of Agriculture, Forest Service.

Crump, M.L., & N.J. Scott, Jr. 1994. Visual encounter surveys. Pp. 84–92 *in* Heyer, W.R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.-A.C., & M.S. Foster, (eds.): Measuring and monitoring biological diversity. Standard methods for amphibians. Washington & London, Smithsonian Institution Press, 364 pp.

Curry-Lindahl, K. 1956. Ecological studies on mammals, birds, reptiles and amphibians in the Eastern Belgian Congo. Report No. 1 of the Lund University Congo Expedition 1951 – 1952. Annales Musee Royal de l'Afrique Centrale, Tervuren – Belgique. Sĕrie in 8º – Sciences Zoologiques 42: 1 – 78. 21 plates.

De Witte, G. F. 1965. Les camĕlĕons de l'Afrique Centrale (Rĕpublique Dĕmocratique du Congo, Rĕpublique du Rwanda et Royaume du Burundi. Musee Royal de l'Afrique Centrale, Tervuren – Belgique. Annales, Sĕrie in 8º – Sciences Zoologiques nº 142. pp. 215 + xii planches.

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.-A. Hayek and M.S. Foster (1994); *Measuring and monitoring biological diversity. Standard methods for amphibians.* Washington and London.

Hinkel, H and Fischer, E 1988. Reptiles et amphibiens du Rwanda et leurs environnement. Universite de Mayence, Rhenanie, Palatinat, R.F.A.

Howell, K. 2002. Amphibians and reptiles: the herptiles. Pp. 17–44 *in* Davis, G., (ed.) 2002. African forest biodiversity. A field survey manual for vertebrates. Oxford, U.K., Earthwatch Institute (Europe), 161 pp.

Karns, D.R. 1986. Field Herpetology: Methods for the study of Amphibians and Reptiles in Minnesota. *James Ford Bell Museum of Natural History, University of* Minnesota, occasional Paper: No. 18 September 1986.

Laurent, R. F. 1956a. Contribution ă l'Herpetologie de la Rĕgion des Grands Lacs de l'Afrique Centrale. Annales Musee Royal de l'Afrique Centrale, Tervuren – Belgique. Sĕrie in 8º – Sciences Zoologiques 48: 1 – 390. xxxi planches.

Laurent, R. F. 1956b. Esquisse d'une faune herpĕtologique du Rwanda-Urundi. Extrait du Bulletin Les Naturalistes Belges. Pp 280 – 287.

Leuteritz T. E. J., Lamb, T. and Limberaza, J. C., (2005). Distribution, status, and conservation of radiated tortoises (*Geochelone radiata*) in Madagascar. Biological Conservation. **124:** 451-461.

Loveridge, A. (1936a) Scientific results of an expedition to rain forest regions in eastern Africa. V Reptiles. *Bulletin of Museum of Comparative Zoology, Harvard* **79**: 209-337.

Loveridge, A. (1936b) Scientific results of an expedition to rain forest regions in eastern Africa. VII Amphibians. *Bulletin of Museum of Comparative Zoology, Harvard* **79**: 369-430.

Nzigidahera, B. 2007. Ressources biologiques sauvages du Burundi: Etat des connaissances traditionnelles. Institut National pour l'Environnement et la Conservation de la Nature (INECN), Bujumbura.

Republic of Rwanda, 2003. National Strategy and Action plan for the Conservation of Biodiversity in Rwanda. Ministry of Lands, Resettlement and Environment, Kigali.

Rödel, M-O. and Ernst, R. 2004. Measuring and Monitoring Amphibian Diversity In Tropical Forests. I. An Evaluation of Methods with Recommendations for Standardization. Ecotropica 10: 1 – 14.

Sutherland, W. J. (ED) (1986); *Ecological Census Technique*: A Hand book. Cambridge University Press

Chapter Seven

Chapter Seven

Birds of Lake Cyohoha Sub-Basin

Ronald Kale Mulwa

National Museum of Kenya. Email: ronmulwa@yahoo.com

7.1 Introduction

Birds are arguably the best known vertebrates. They are considered a useful indicator group of biodiversity for monitoring environmental change/health (Furness *et al* 1993, Bennun *et al* 2005, Musila *et al* 2006) or assessing biodiversity richness (Thirgood and Heath 1994, Stattersfield *et al* 1998). Birds as a group have many characteristics that make them good indicators; they are well studied, taxonomically stable, easy to survey, widely distributed across all habitats, have aesthetic appeal and avi-tourism is becoming more popular. Birds have been used in setting priority for biodiversity conservation through the Important Bird Area process (Bibby *et al* 1992, Howard *et al* 1998, Bennun and Njoroge 1999).

Due to varied topography, Rwanda and Burundi have remarkably diverse habitats and large number of bird species for countries of their size. Over 600 bird species have been recorded in Rwanda alone of which 475 are presumed to be resident while 117 are regular seasonal migrants. However, 17 species are of conservation concern (Fishpool and Evans 2001).

There are eight Important Bird Areas in Rwanda, three of which are wetlands. In terms of bird conservation Rwanda has a BirdLife affiliate and has ratified many international conservation conventions. In Burundi there are 683 bird species, seven of which are globally threatened. There are seven IBAs in Burundi (Fishpool and Evans 2001).

Wetlands are among the most threatened habitats after forests, so efforts to foster their conservation can never be enough. There are two internationally recognised categorisation of important sites for birds conservation namely; IBA and Ramsar Sites.

This comprehensive baseline survey of birds (and other biodiversity) within the Lake Cyohoha Sub-Basin complements the current efforts by the BirdLife Partners in Rwanda (Association pour la Conservation de la Nature au Rwanda - ACNR) and Burundi (Association Burundaise la protection des Oiseaux - ABO) in producing national bird atlas, establishing Important Bird Area and Ramsar Sites as well as promoting avi-tourism and monitoring of birds.

7.2 Objectives of the study

This study aimed at appraising the ornithological information of Lake Cyohoha Sub-Basin with specific focus as follows;

Produce a comprehensive checklist of the birds of Lake Cyohoha Sub-Basin, its wetlands and catchment areas.

To assess and document the conservation status of bird species in accordance with IUCN, CITES and BirdLife standards criteria

Document the migratory bird species that use Cyohoha wetlands as critical stop-over sites.

Establish the importance of different habitat types in supporting particular bird species in the sub-basin.

Document the ecological importance of various bird species and their roles as indicators of environmental health.

Guide the conservation of birds as a viable investment option.

7.3 Methods used

Six eco-sites within three pre-earmarked macro-habitats of the sub-basin were selected for sampling since it was not possible to sample the whole lake sub-basin. The sites at which bird surveys were conducted included the following;

Rwanda Side

Rugarama beach (Ruhuha): GPS coordinates– S 02° 20´ 44.3" E 030° 01´ 51.7",
Cyeru – Kagenge beach (at the water works) S 02° 20´ 29.7" E 030° 00´ 08.4".

Burundi side

Iyalanda beach (Kirundo) S 02° 31´ 02.4" E 030° 07´ 05.1",
Marembo beach – S 02° 27´ 15.9" E 030° 10´ 12.3",
Murehe Nature Reserve – (Gasenyi – Burundi/Rwanda transboundary woodland) GPS S 02°22´ 19.8" E 030° 13´ 14.3" (**FIGURE** 4.1 in Chapter 4).

Akanyaru River S 02° 21´ 48.9" E 029° 56´ 43.5" and Lake Rwihinda (S 02° 33´ 39 3" E 030° 03´ 51.4") which are near Kirundo town at an altitude of 1420m and about 5km from Lake Cyohoha was also studied. Lake Rwihinda is also known as "Lac aux Oiseaux" (the lake of birds), because it is a home to huge populations of water birds including some endangered species and many migratory species. It is a protected area and is one of Burundi's Important Bird Areas.

Extensive literature review was conducted both in Rwanda and Burundi institutions. In particular, literature was sought from the National University of Rwanda Library, the offices at the Ministry of Agriculture, FAO, and the NELSAP library. Discussions were done with staff of the BirdLife Partners in both Rwanda and Burundi who were particularly useful in determining threat categories and status of various bird species.

Detailed bird field surveys were conducted in the lake and the surrounding catchment area among human settlements and farmland between November 2007 and January 2008. Observations were carried out in the company of local communities who provided valuable indigenous knowledge on birds that is useful in creating awareness on the importance of conserving birds. University students and staff from local conservation organisations were involved in the study in order to develop capacity for bird identification, survey methodology and interpretation of their ecological roles. Binoculars, telescopes, camera and East African regional bird field guidebooks were used to confirm species identification (Steyn and Arnott 1990, Zimmerman *et al* 1996, Stevenson and Fanshawe 2002).

The following methods were employed to generate bird species list;

Total Counts

This entailed identifying all birds occurring in open habitats especially in open wetland and lake shores (Sutherland, 1986). Where practicable, the open waters and thick vegetation at the water edges were accessed by boat and/or walking in shallow waters. Where the birds occurred in significantly huge flocks total counts were made.

Transects

Birds were observed and identified in transects (Sutherland 1986) along the lake's swampy and bushy vegetation as well as along small paths in the human settlements and farmlands. Opportunistic discussion with local people provided more information regarding the economic importance of certain species.

Assessment of breeding activity

Breeding activities were observed opportunistically during the entire survey. Observations were based on the Reproductive Index approach proposed by Vickery *et al.* (1992). This

method does not rely on discovery of nests, which are often difficult to find (Bull 1981), but is based on the assumption that behaviours indicative of different stages of breeding cycle can be observed. These stages include:- (i) nest building, (ii) egg laying and incubation, (iii) feeding nestling and (iv) fledgling (v) observation of immature birds in the field. Breeding information was gathered by observing any behaviour related to these stages.

Mistnetting

Mist-nests were used but also as a demonstration to field assistants and other local counterparts the means of sampling cryptic terrestrial bird species occuring in thickets of bush and papyrus. Mist-netting was also used in the papyrus swamps at Iyalanda beach and Kanyaru River (**PLATE** 3-4). The rings and ringing schedules from the East Africa Ringing Scheme of the East African Natural History Society (EANHS) were used to tag birds that were captured and records kept for future reference

Categorisation of birds and habitat types

The habitat and birds were catergorised according to global and regional threat categories following Collar *et al.* (1994) as well as migratory species as documented by EANHS (1996). The existing habitats associated with different bird species were classified into open water, riparian vegetation, wetlandland/swamp, grassland, woodland and farmland.

7.4 Results and discussion

7.4.1 Bird species conservation and migration status

A total of 278 bird species representing 60 different families were documented during this study. These included 166 observed in the field during the current survey and additional 112 recorded from previous surveys (Schoutenden, 1966a 1966b - 98 species, Nzigidahera, *et al* 2005 - 14 species Appendix 7.1-7.3). This constitutes about 42% of total number of bird species in Rwanda and 41% of total number of bird species in Burundi.

Six species globally threatened with extinction have been recorded in Lake Cyohoha Sub-Basin (**TABLE** 7.1), while another eleven (11) species are known to be rare in the East African region (**TABLE** 7.2). Seventy-four (74) bird species recorded here are migrants of which, 88% are palaearctic and 12% Intra-African migrants.

TABLE 7.1: Globally threatened bird species recorded in Lake Cyohoha Sub-Basin (E – endangered NT – Near Threatened, PM – Parlaearctic Migrant, R - Resident)

Species (common names)	IUCN Threat status	Habitat type	Migratory status
African Darter	NT	Wetland	R
Maccoa Duck	E	open water	R
Pallid Harrier	NT	Open grasslands and farmland	PM
European Roller	NT	Woodland/ Farmland	PM
Papyrus Gonolek	NT	Papyrus Swamps	Rt
Red-faced Barbet	NT	Woodland	R

TABLE 7.2. Species considered as rare in the East African region (LC – Least Concern) (EANHS 1996)

Species Name	IUCN Threat status	Habitat type	Migratory status
1. Great Crested Grebe	LC	Open water & wetlands	R
African Darter	NT	Open water and Reeds near water	R
Dwarf Bittern	LC	Wetlandy reeds and sedges	R
Little Bittern	LC	Wetlandy reeds and sedges	AM, PM
Maccoa Duck	E	Open waters	R
White-bucked Duck	LC	Open water	R
African Wetland Herrier	LC	Cultivation, lake edges	R
Ovampo Sparrowhawk	LC	Woodlands, suburban gardens	R
Common Quail	LC	Bush, woodlands	PM

7.4.2 Bird ringing

Three individual birds in two species were ringed and released back to the wild as a demonstration to the local field assistants on the role of ringing in bird monitoring of migration, dispersal and longevity. **TABLE** 7.3 below provides the summary. The data will be used as reference. Due to limitation in time, it was not possible to ring more birds but it is recommended that the locals should be trained to do this work as part of capacity building to make them appreaciate that the birds use habitats away from Cyohoha.

TABLE 7.3: Details of birds ringed as a demonstration during the study

Species	Age	Sex	Ring number	Location
Yellow-backed weaver	Adult	M	AA4877	Iyalanda beach S 02º31'06.7" E030º 07'13.7"
Yellow-backed Weaver	Adult	M	AA4878	Iyalanda Beach S 02º31'06.7" E030º 07'13.7"
Swamp Flycatcher	Immature	F	K45126	Kanyaru River S 02º21'48.9" E029º 56'43.5"

7.4.3 Congregatory birds total counts

Observations were noted of congregatory water birds species occurring in significantly large numbers. This is an important criterion for qualifying a site as an IBA and also a Ramsar Site. **TABLE** 7.4 gives a summary of some of the species observed in large numbers.

TABLE 7.4: Some of the bird species observed in large flocks at one place.

Species	Number counted	Location
White-faced Whistling ducks	2000	Lake Rwihinda
Fulvous Whistling Duck	100	Iyalanda
Yellow-billed Duck	80	Iyalanda
African Open Bill Stock	100	Iyalanda
African Jacana	100	Iyalanda

Iyalanda site is among the sites with the highest diversity, having a fairly large wetland of papyrus swamp, and floating vegetation in the open water – which favour the occurrence of Jacanas and other water birds. Due to the soggy nature of the soils in this area, it suffers low human pressure and it is certainly a birdwatchers paradise (**PHOTO** 7.14). The large numbers of White-faced Whistling Ducks roosting and resting on small islands in Lake Rwihinda are a major attraction for birders (Photo 7.1). According to the local people these birds fly to other places during different parts of the day and most certainly they make use of several areas of Lake Cyohoha Sub-Basin habitats.

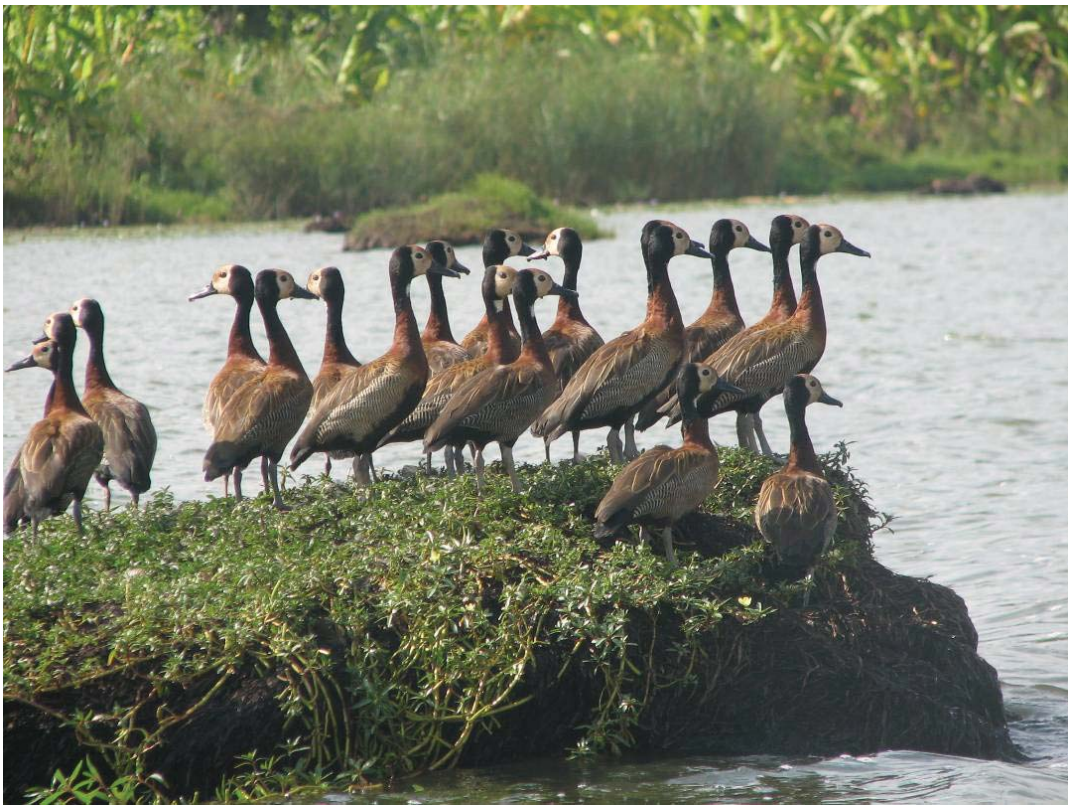

Photo 7.1: White-faced Whistling Ducks (*Dendrocygna viduata*)

7.4.4 Breeding bird records

Eight bird species were confirmed to be breeding during the survey (**TABLE** 7.5). These included a huge colony of over 100 pairs of Black-headed Herons which were nesting in

a four-hectare Eucalyptus woodlot at Ruhuha parish. Other species noted breeding are included in the **TABLE** 7.5 below.

TABLE 7.5: Breeding bird record in Lake Cyohoha Sub-Basin.

Species	Breeding Status	Location	**Date observed**
Black-headed Heron	Mating, nesting, starting incubation (over 100 pairs counted)	In Eucalyptus plantation at Ruhuha parish: S 02º 18' 29.6" E 030 º 03' 10.0"	Nov 20 2007
Hadada Ibis	Incubation	Ruhuha parish: S 02º 18' 29.6" E 030 º 03' 10.0"	Nov 20 2007
Holub's Golden Weaver	Nesting	Rugarama	Nov 22 2007
Arrow-marked Babbler	Immature bird	Murehe nature reserve	Nov 24 2007
Black-headed weaver	Nesting	All sites	Nov 2007
Hamerkop	Nest	Nyarugenge site	Nov 25 2007
Grossbeak Weaver	Nesting	Marembo beach	Nov 26 2007
Yelow-backed weaver	Nesting	Iyalanda papyrus wetlands	Nov 27 2007

7.4.5 Species categorisation by habitat types

Categorisation of bird species according to their habitat types revealed that some the species recorded depend on wetlands for their survival which further emphasises the importance of Lake Cyohoha Sub-Basin for birdlife conservation. Other birds occupied farmland habitats (**FIGURE** 7.1). Most of the birds occuring in farmlands are actually useful to farmers e.g. they help in pest control and pollination although a few are pests. The habitats for birds in the sub-basin may therefore be summaried as woodlands, riparian vegetation, wetlands, grasslands and open waters.

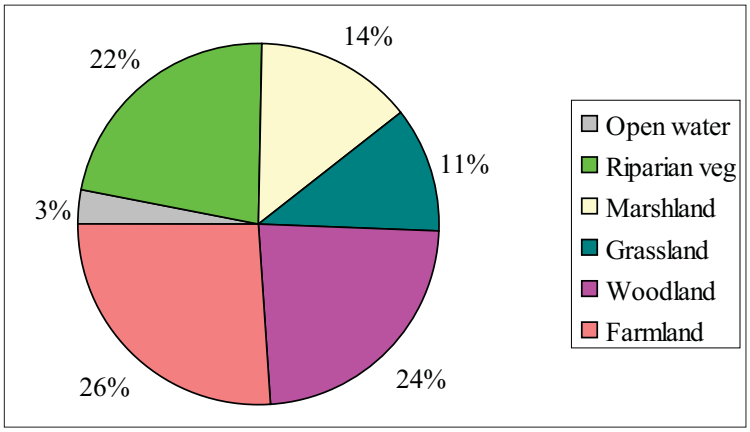

FIGURE 7.1: Proportion of birds that depend on different habitat types at Lake Cyohoha based on the observed sample. The wetlands birds use the open water, riparian vegetation and wetlandlands hence represent the biggest

7.4.6 *Feeding guilds as an indication of ecological and economic roles of birds*

Birds play a pivotal role in the ecosystem. They are indicators of environmental health and biodiversity richness. When birds are found feeding on other smaller taxa, its an indication of the presence of rich biodiversity of lower organisms which can not easily be seen. Using information from literature (Zimmerman *et al* 1996, Steyn and Arnott 1990) and experience/observation during the study, a synthesis of the food items utilised by the birds observed during the study was done and clusted them into feeding guilds. This analysis showed that invertebrates formed the largest bulk of the food items utilised by birds in this sub-basin (34%), followed by plant material mainly flowers, seeds and fruits (17%). Small mammals, birds, fish, amphibians and reptiles also provide food for a considerable number of birds occurring here (about 8% for each taxa). These interactions between birds and other biodiversity demonstrate the ecological and economic roles played by birds in this area, e.g. biological pest control that may lead to increased crop yield. Other species are scavengers (2%) and thus help remove carrion and other discarded waste that would otherwise pollute the environment (**FIGURE** 7.2)

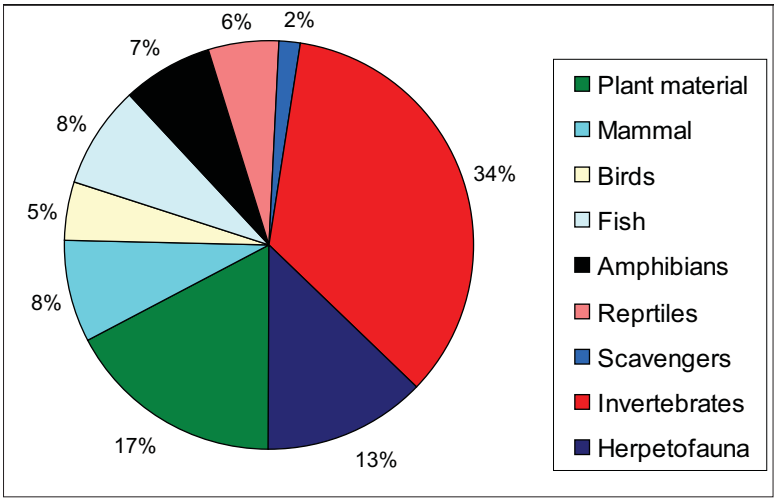

FIGURE 7.2: Proportions of birds within different feeding guilds as recorded in Lake Cyohoha

By eating, birds provide many crucial services to man especially in agriculture where they can control pests. The efficiency of birds of prey and insectivorous species in locating and eliminating pests (invertebrates, rodents, birds, etc) can be immensely enhanced through ensuring the availability of natural or artificial perching platforms (from where to spot their prey). In open crop fields, the predatory birds can stand on these perches rather than hover, as they search for prey. They can control pest densities while scaring away the pest birds, hence can better be used than scare crows whose efficiency is only short lived since the bird pests get used and learn to ignore them. Farmers should be encouraged to plant agro-forestry trees, leave standing dead wood in their farms or erect artificial perches for birds of prey. This enhanced biological pest control can help increase crop yield and food security considerably, if applicable in Cyohoha given the large number of raptor species found here (over 20 species).

Other species are useful in different ways, e.g. at Iyalanda where humans frequent rice fields, African Open-billed Stock is present in large numbers. These birds largely feeds on the main vectors for Bilharzia (snails) and thus may be playing an important role in controlling the diseases.

7.4.7 Capacity building and awareness creation

University students, the communities and staff members in conservation organisations especially in Rwanda gained variously through participating in this study; particularly on bird identification, interpretation of ecological roles and research methodology. The students engaged in this study further broadened their network with biodiversity experts in different taxonomic groups from the regions.

Awareness on birds and their importance and potential was raised among the local communities during this study who also shared their traditional knowledge on birds and biodiversity in general together with their rich cultural and indigenous knowledge on birds specifically. Some traditional beliefs held by these communities have helped the conservation and protection of birds. For example, according to Burundi and Rwandese tradition, some birds are not supposed to be killed such as the African Pied Wagtails (Inyamanza). They believe that if one killed the wagtail, their mother's breast would get cut off. Additionally the nest of the Hamerkop is not destroyed, the people believe that if you destroy it, your own house will be destroyed too (Nzigidahera 2007). Also there is gender disparity when it comes to eating birds, whereby women are not supposed to eat the following birds; Pink-backed Pelican, Common Bulbul, Black and White Mannikin and Brown Parrot. This in a way means that less birds end up being killed than they would have if everyone was to eat them. Women only eat birds such as doves, francolins and ducks (Nzigidahera *et al* 2005). Varied methods are used by local communities to trap birds in Burundi (and same in Rwanda).

More awareness is still needed to ensure that birds particularly endangered and migratory species are recognised by local communities who can then help in their monitoring, report sightings and refrain from persecution even of common birds. Overall the local people at all the sites visited were keen to participate in any conservation initiatives that could bring Cyohoha back to a healthy wetland.

7.4.8 Legal and institutional frameworks for management and conservation of birds

The main policies and strategic initiatives for protecting biodiversity exist for various ecosystems such as forests and protected areas. However, various state parastatal and private institutions in the conservation and use of biological resources are guided by existing policy and legal documents which are often un-harmonised and skewed to favour development and production rather than biodiversity conservation.

For example, the 1987-1997 development plan for aquatic areas for Rwanda prepared by the Ministry of Agriculture considers wetlands as high potential areas for agricultural production, yet these are critical habitats for rare and unique biodiversity (such as birds) that could equally bring much revenue through eco-tourism (Republic of Rwanda 2003).

It was noted that some policies should be in a language that can be understood or should be translated to the target audience. In the case of Burundi, Nzigidahera *et al* (2005) records how wetlands and their resources suffered degradation at the hands of local communities due to language barrier (Legislation documents written in French) and lack of consideration for the socio-cultural values the rural communities attach to their wetlands. Therefore, many policies and management plans will fail if they do not fully engage the key players particularly the local communities or secure the ownership by all stakeholders.

In terms of institutional frameworks for birds conservation, BirdLife International (www.birdlife.net) works through the Important Bird Areas (IBAs) programme which is

a worldwide initiative implemented through country partners. This programme carefully identifies sites and on the basis of the internationally agreed criteria are selected such that taken together, they form a network throughout the species biogeographic distributions (BirdLife International 2002, Bennun and Njoroge 1999). This network may be considered as the minimum essential to ensure the survival of these species across their ranges should remaining habitat elsewhere be lost through modification.

A good knowledge of birds provides a short-cut to identify protected areas, because data on many plant and animal groups e.g. insects is highly deficient. Birdwatchers have made it easy for data on birds to accumulate in form of birding records and this information has allowed IBAs to be defined thereby protecting sites that are important for birds and other biodiversity.

Ramsar Convention is among the conventions that support the conservation of wetlands. A number of the criteria for IBA section are related directly to criteria for selection of Ramsar Site (BirdLife International 2002) as a wetland considered internationally important if it;

- Supports vulnerable, endangered or critically endangered species or threatened ecological communities
- Supports plant/or animal species at a critical stage in their life cycles (e.g. breeding), or provides refuge during adverse conditions (e.g. migration).
- Regularly supports 20,000 or more waterbirds
- Regularly supports 1% or more of the individuals in a population of one species or subspecies of waterbird.

Both Rwanda and Burundi have BirdLife partners and are signatories to the Ramsar Convention on Biological Diversity (CBD). This study advances the implementation of articles 6 and 7 of CBD relating to the general measures for conservation and sustainable use, and identification and monitoring of biodiversity. A simple protocol for waterbird monitoring that can be implemented cheaply by institutional staff working the at site with local people who are always knowledgeable about their birds has been proposed (Appendix 7.5). This is normally conducted annually or biannually depending on resources and personnel, and requires basic initial training.

BirdLife partners in the two countries advance the aims of BirdLife International which works with a global network to:-

- Prevent the extinction of any bird species
- Maintain and where possible improve the conservation status of all bird species
- Conserve and where appropriate improve and enlarge sites and habitats important for birds
- Help, through birds, to conserve biodiversity and to improve the quality of people's lives
- Integrate bird conservation into sustaining people's livelihoods.

BirdLife partners' key activity is to spearhead the IBA process among other things. The BirdLife partner for Burundi is Association Burundaise pour la Protection des Oiseaux (ABO) whose mission is "Promoting natural and biodiversity conservation in Burundi by focusing on birds". Its main activities include;

- promoting bird conservation through increasing public awareness,
- supporting ornithological research,
- protection of threatened bird species and biodiversity rich natural habitats.

The association conducts waterbird census in various areas and wetlands IBAs. In Rwanda on the other hand, the BirdLife partner is Association pour la Conservation de la Nature au Rwanda (ACNR) who are active in awareness creation and environmental education among schools.

7.4.9 Proposed bird-based investment options for Lake Cyohoha Sub-Basin

1. Avi-tourism

Tourism is a fundamental factor of growth and development in any country. The growing demand of the sector has allowed the creation of many jobs and contributes immensely to revenue generation. Tourism expenditure has an effect on the revenue of a region's businesses, to the immediate advantage of those who work in direct contact with tourists (hospitality and food service firms, travel agencies, etc.) and, indirectly, of all those who supply the former with intermediate goods and services. Moreover, since part on the revenue earned by businesses is paid in the form of family income (wages for employees), the consumption of residents is added to the initial consumption of tourists thus creating amplified effects.

While the "Big Five" tourism continues to grow today, it's near-asymptote expansion has bred new innovations which will surely rejuvenate the industry to new heights. Bird watching in general and avi-tourism, in particular, is expected to define future tourism demand in East Africa. Avi-tourism has enormous potential, and by far, it is easy to run as a business. Revenue from avi-tourism flows closer to local people as the birds that bird-watchers want to see are found in community areas; giving local community guides a unique opportunity to tap from the industry.

Good avi-tourism service however requires adequate training for bird-guides who can efficiently guide birders who have come to see the unique birds in the region. Various instituitions in Rwanda and Burundi are actively trying to improve tourism services by training professional guides; notably Institut National Pour I'Environment et la Conaervation de la Nature (INECN) in Burundi (for Bugesera region, Cyohoha, Rwihinda, Rweru and Murehe Nature Reserve) and Kitabi Conservation Training Centre that trains driver guides in Rwanda. The guides should be prepared to take up the challenge and take on bird-guiding as a form of full time employment. Avi-tourism goes very well with the IBA programme since these are the places one would expect to see rare and unique bird species as well as other biodiversity opportunistically. Therefore a site being an IBA is a hidden marketing strategy for avi-tourism.

Bird watchers are a special clientele that require strategic marketing to tap. It will also require good marketing to incoparate Lake Cyohoha into the world famous tourist destinations like the Virunga Naionl Park (with Mountain Gorillas). Additionally, clear birding circuits in East Africa need to be clearly defined and marketed concertedly combining birding safaris in Rwanda, Burundi, Uganda, Tanzania and Kenya offering a complete birding cuisine from Albertine rift to Great Lakes, coastal species and typical dryland birds.

Avitourism is a very sustainable venture since most birders are already environmentally

sensitive and birding in itself is a low impact activity since most of the time it involves walking on foot. Avitourism can also generate useful monitoring data on species and site conditions by the guides. Some infra-structural investment for avi-tourism may include; accommodation facilities/camp sites, board walks over papyrus, boating and bird hides. A general caution however is that most tourism developments often come with some environmental modification at sites or most devastatingly disturbance to birds especially the insensitive use of motor boats in wetlands too close to nesting, roosting or resting birds or venturing thereabouts frequently which may cause the birds to abandon the site. Bird observatories with powerful telescopes or other optices are recommended for watching birds in sensitive parts of their life cycle. Bird hides are the other options.

2. Rearing of birds for food and for sale

Literature on the biological resources and traditional knowledge in Burundi list bird species that are hunted for food and for sale (Nzigidahera, 2007). In many areas genus *Francolinus* is the bird most hunted for food and can be found in some restaurants in Bujumbura. The birds are sold at US 1$. The Guineafowls (Numida) are also eaten in many families and sold at upto US $3 for an adult bird.

Given the evident quest of the local communities to eat and trade wild birds, rearing of game birds (e.g. Guineafowls, Francolins etc) as a source of protein and income has great potential in the Lake Cyohoha Sub-Basin. This investment must engage the necessary government policies and permit systems in respective countries. It has also to be informed by research and specialists in veterinary and poultry production.

3. Keeping live birds in zoos

Some beautiful birds of Lake Cyohoha Sub-Basin like the Grey-crested Crane and Guinea fowls can be kept in zoos along with other biodiversity of the area (e.g. reptiles, small mammals, butterflies, etc) for both local and international tourism and for education purposes.

4. Sport hunting tourism

Among birds that are good candidates of sport shooting tourism occurring in Cyohoha are the ducks. However activity has to be conducted in line with the country's conservation and wildlife policy permit systems. The species involved must not be threatened or listed in CITES. Overall the venture must be done very carefully being informed by long term research and monitoring to identify the target species, their population dynamics, specific sites and seasons.

7.5. Conclusions

The assemblage of birds documented here and results of other biodiversity aspects, water quality and socio-economic under this study makes Lake Cyohoha a unique biodiversity hotspot that requires recognition as an IBA and/or Ramsar site

Some species of birds recorded by 1960s might have gone locally extinct due to the change in habitats that were more naturally vegetated (forested/wooded) than todate. Detailed bird surveys and monitoring are still needed to ascertain the current status of these species with the results of current study forming a baseline.

Lake Cyohoha and its Sub-Basin has a great potential for bird conservation and Avi-tourism. Some key locations in the sub-basin stand out as hotspots for birding namely;

Iyalanda for wetland birds and Murehe Nature reserve for woodland species. Lake Rwhinda is a must visit for any birder and most likely it is a complementary site for Lake Cyohoha offering ideal roosting grounds for the large numbers of White-faced Whistling duck.

The investment options proposed will require strategic preparation and implementation efforts before they can be actualised. All the investments should recognise the local people as real custodians of the lake and its biodiversity and engage them accordingly.

Proper management and conservation of the Lake Cyohoha require coordinated efforts from both Rwanda and Burundi.

7.6 Recommendations

a) Lake Cyohoha Sub-Basin qualifies to be declared an Important Bird Area (IBA) and a Ramsar Site. Based on the bird species assemblage recorded here, the site meets the shared criteria for IBA and a Ramsar Site, thus: (i). Holds a numbers of globally threatened bird species, (ii). Holds large congregations of water birds (e.g. ducks, storks) and (iii). Is inhabited by species at a critical stage in their life cycles (breeding), or provides refuge during adverse conditions (migrants). It is now upon the responsible institutions to engage the necessary processes to have the site ratified as IBA and Ramsar Site.

b). Lake Cyohoha has a great potential for biodiversity conservation and needs a concerted and harmonised effort by Rwanda/Burundi. This will entail key government agencies responsible for managing the sites as well NGOs and local CBOs coming together to conserve this important resource through a trans-boundary coordination framework. Some strategic actions will include; a joint management plan for Lake Cyohoha, protection and expansion of buffer zone around the lake, Fund raise to support conservation action and jointly report to multilateral environmental agreements e.g CBD on the status of Lake Cyohoha ecosystem and its biodiversity.

c). Community structure like the ones that exist in Rwanda and Burundi, in particular the institutionalization of communities into Umuganda, that can be used very well to rehabilitate and restore Lake Cyohoha ecosystems particularly the wetland buffer zones. The communities could be motivated through income generating initiatives proposed in this study by various experts e.g. bee-keeping within the buffer zones areas and eco-tourism ventures. This will help maintain and expand the riparian vegetation and wetlands at the lake. It is recommended that planting of indigenous trees (such as *Ficus sp.*) should supplement the native biodiversity as lake buffer zones.

d). More detailed bird surveys and monitoring are still needed to ascertain the current status of these species. Since a baseline against which the status and trends of birds of Lake Cyohoha has been established, it is imperative that birds be monitored annually or bi-annually. The African Waterfowl Census has developed a simple standard protocol for waterbird monitoring that can be implemented cheaply by institutional staff working the site along side local community members (Appendix 7.5). This monitoring scheme is already being implemented in some sites in the Nile Basin partner countries and now Lake Cyohoha can be included. This scheme can be implemented sustainably by field officers in government and conservation NGOs in partnership with local communities (e.g. CBOs).

e). Local communities are very knowledgeable and enthusiastic to conserve biodiversity. Involving them in the conservation of Lake Cyohoha Sub-Basin will safeguard their ownership of the process as the real custodians of biodiversity. For IBA conservation, BirdLife uses an innovative approach of forming Community Conservation Groups – referred to as Site Support Groups (SSG – BirdLife International 2007) who use birds as an entry point for biodiversity conservation. Their capacity needs to be built in entrepreneurship, implementation of some of the recommended investment options, monitoring of birds and other biodiversity, bird guiding for avi-tourism and involvement as research assistants.

f). Enhanced biological pest control – this where where birds of prey are provided with perching sites in farmlands in order to be more efficient in locating and catching prey which are often crop pests. These perches can be agro-forestry trees for birds, upright dead wood left in farms, or artificial posts for birds of prey to perch (**PHOTO** 7.12). Such farms can also be used for bird watching.

g). Most certainly the use of agro-chemicals has a great negative impact on birds and biodiversity that survive on this wetland since these are often washed down to the lake. Minimising the use of these chemicals such as pesticides and fertiliser in the surrounding agro-ecosystem and the use of more friendly nature based alternatives is strongly recommended.

References

Bennun and NJoroge 1999. *Important Bird areas of Kenya.* Nature Kenya

Bennun, L., Matiku, P., Mulwa, R., Mwangi, S. and Buckley, P. (2005) Monitoring Important Bird Areas in Africa: towards a sustainable and scaleable system. Biodiversity and Conservation 14(11): 2575–2590.

Bibby, C. J., Collar, N. J., Crosby, M. J., Heath, M. F., ch. Imboden, T. H.,

Johnson, T. H., Long, A. J., Stattersfield A. J. and Thirgood S. J. 1992. *Putting biodiversity on the map: Priority areas for global conservation.* ICBP, UK.

Birdlife Interantional (2002). *Important areas and potential Ramsar Sites in Africa.* Cambridge UK

Birdlife International (2007) *Conserving biodiversity in Africa: Guidelines for applying the Site Support Group approach*

Bull, E. L. (1981). Indirect estimates of abundance in birds. Pp. 76-80: In: *Estimating numbers of terrestrial birds* (C. J. Ralph and J. M. Scott, eds.). Stud. Avian Biol. 6.

Collar, N. J., Crosby, M. J. and Stattersfield, A. J. (1994). *Birds to watch 2. The world list of threatened birds.* Cambridge, BirdLife International.

East Africa Natural History Society (1996). *Checklist of the birds of Kenya.*

Fishpool L. D. C. and Evans M. I. Eds. (2001) *Important bird Areas in Africa and associated Islands: Priority Sites for Conservation.* Newbury and Cambridge, UK: Picses Publications and BirdLife International (BirdLife Conservation Series No. 11).

Howard, P.C., Viskanic, P., Davenport, T. R.B., Kigenyi, F.W., Baltzer, M., Dickinson, C.J., Lwanga, J.S., Mathews, R.A., and Balmford, A. (1998). *Complementarity and the use of indicator groups for reserve selection in Uganda.* Nature 394: 472-475

Musila S. N., Ngw'eno F., Matiku P., Mwema M., Kanyanya, E., Mulwa R., Musina, J., Buckley P. and Njehia S. (2006) Kenya's Important Bird Areas Status and Trends 2005. Nature Kenya, Nairobi.

Nzigidahera, B. Fofo, A. et Misigaro A. 2005. Paysage aquatique protégé du Nord du Burundi. Etude d'identifcation.

Nzigidahera, B 2007. Resources Biologique sauvages du Burundi. Etatdes connaissances traditionalles.

Republic of Rwanda 2003. National Strategy and Action Plan for the conservation of Biodiversity in Rwanda. Ministry of Lands, Resettlement and Environment. Kigali

Schouteden H. 1966. La Faune Ornithologique du Rwanda. Musee Royal de lAfrique Centrale, Tervuren.

Schouteden H. 1966. La Faune Ornithologique du Burundi. Musee Royal de lAfrique Centrale, Tervuren.

Stattersfield, A. J., Crossby, M. J., Long, A. J. and Wege, D. C. 1998. Endemic Birds of the world: Priorities for bird conservation. Cambridge, UK: BirdLife International, BirdLife Conservation Series 7.

Stevenson T. and Fanshawe J. 2002. Birds of East Africa. T & A D Poyser London.

Steyn P. and Arnott G 1990– Hunters of african sky. Cape Town

Sutherland, W. J. (ED) (1986); Ecological Census Technique: A Hand book. Cambridge University Press

Sutherland (2000). The conservation handbook. Research, Management and Policy. Blackwell Science 278 pp.

Thirgood, S. J. and Heath, M. F. 1994. Global patterns of endemism and the conservation of biodiversity: In: P. L. Forey, C. J. Humphries and R. L. Vane-Wright (Eds.) Systematics and Conservation Evaluation. Pp. 207-227, Oxford. Oxford University Press.

Vickery, P. D., Hunter, M. L. and Wells, J. V. 1992. Use of a new reproductive index to evaluate relationship between habitat quality and breeding success. The Auk, 112(1): 146-155.

Zimmerman D. A., Turner, D. A., Pearson D. J. 1996. Birds of Kenya and Northern Tanzania

Appendices

Appendix 7.1: Bird species recorded in Lake Cyohoha and the sub-basin.
Key to abbreviations: LC -least Concern, NT – Near threatened. Migration status PM – Palaearctic Migrant, AM – Afro-tropical migrant, R – Rare species, * rarities in East Africa.
Records and taxonomic order are based on Stevenson and Fanshawe (2002)

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
1. Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC	R	Open water and wetlands
2. Pink-backed Pelican	*Pelecanus rufescens*	Pelecanidae	LC	R	Open water and tall lake shore trees
3. Long-tailed Cormorant	*Phalacrocorax africanus*	Phalacrocoracidae	LC	R	Open water, reeds, trees near water,
4. African Darter*	*Anhinga rufar*	Anhingidae	NT	R	Open water, trees and reeds near water,
5. Grey Heron	*Ardea cinerea*	Ardeidae	LC	AM, PM	Open wetlands, shallow water and riparian vegetation
6. Black-headed Heron	*Ardea melanocephala*	Ardeidae	LC	R	Dry open grounds and farmlands, not restricted to aquatic or littoral habitats
7. Purple Heron	*Ardea purpurea*	Ardeidae	LC	R	Tall wetlandy vegetation
8. Great Egret	*Casmerodius albus*	Ardeidae	LC	R	Open swallow water and trees near water
9. Intermediate Egret (Yellow-billed Egret)	*Mesophoyx intermedia*	Ardeidae	LC	R	Secluded swamp edges
10. Little Egret	*Egretta garzetta*	Ardeidae	LC	R	Shallow water wetlands and riparian vegetation
11. Squacco Heron	*Ardeola ralloides*	Ardeidae	LC	AM, PM	Grass and reeds near water, floating vegetation, shrubs and reeds above water
12. Rufous-bellied Heron*	*Ardeola rufiventris*	Ardeidae	LC	R	Reeds and grass at water edges, reeds and submerged shrubby cover
13. Cattle Egret	*Bubulcus ibis*	Ardeidae	LC	R	Wet area, pasture, cultivated and dry grasslands often in company of wild and domestic mammals
14. Striated Heron (Green-backed Heron)	*Butorides striatus*	Ardeidae	LC	R	Creeps low waterside roots and branches
15. Black-crowned Night-Heron	*Nycticorax nycticorax*	Ardeidae	LC	AM, PM	Riverine trees, reeds and thickest near water. NB: only seen in the island at lake rwihinda
16. Little Bittern*	*Ixobrychus minutus*	Ardeidae	LC	AM, PM	Thick wetland, reeds and sedge vegetation,

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
17. Hamerkop	*Scopus umbretta*	Scopidae	LC	R	Swallow waters, swamp edges, slow flowing rivers and streams, require big trees to build their massive nests
18. Yellow-billed Stork	*Mycteria ibis*	Ciconiidae	LC	R	Swallow waters, swamp edges, slow flowing rivers and streams and grassy banks and trees
19. African Open-bill Stork	*Anastomus lamelligerus*	Ciconiidae	LC	R	Swallow waters, swamp edges, rice fields,
20. Sacred Ibis	*Threskiornis aethiopicus*	Threskiornithidae	LC	R	Shallow water and soft mud, also forage in grassland, lawns and cultivated land
21. Hadada Ibis	*Bostrychia hagedash*	Threskiornithidae	LC	R	Shallow water and soft mud, grasslands, lawns and cultivated land
22. African Spoonbill	*Platalea alba*	Threskiornithidae	LC	R	Shallow water, wetlands, rice paddies,
23. Fulvous Whistling-Duck	*Dendrocygna bicolour*	Anatidae	LC	R	Open freshwaters, flooded grassland, irrigated fields and rice paddies
24. White-faced Whistling-Duck	*Dendrocygna viduata*	Anatidae	LC	R	Open freshwaters, tall grass and reeds near water, irrigated field and rice paddies
25. Spur-winged Goose	*Plectropterus gambensis*	Anatidae	LC	R	Flooded grassland, swamps and fresh water edges
26. Yellow-billed Duck	*Anas undulata*	Anatidae	LC	AM	Shallow water, wetlandy grasslands and papyrus swamps
27. Hottentot Teal	*Anas hottentota*	Anatidae	LC	R	Open water and water edge,
28. Osprey	*Pandion haliaetus*	Accipitridae	LC	PM	Rivers and wetlandy lake sides with trees
29. Black-shouldered Kite	*Elanus caeruleus*	Accipitridae	LC	R	Open grassy areas and cultivation
30. Black Kite	*Milvus migrans*	Accipitridae	LC	R	Associated with humans in villages, towns, rubbish dumps, fishing sites and along highways
31. African Fish-Eagle	*Haliaeetus vocifer*	Accipitridae	LC	R	Inland lakes and rivers with big trees around for perching and nesting
32. Palm-nut Vulture (Vulturine Fish Eagle)	*Gypohierax angolensis*	Accipitridae	LC	R	Shores and flood plains, cultivation areas

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
33. Black-chested Snake-Eagle (Black-breasted Snake-Eagle)	*Circaetus pectoralis*	Accipitridae	LC	R	Open country with big trees to perch
34. Eurasian Wetland Harrier	*Circus aeruginosus*	Accipitridae	LC	PM	Lake edges, swamps, moist grasslands and cultivation.
35. African Wetland-Harrier*	*Circus ranivorus*	Accipitridae	LC	R	Grassy plains, valley bottoms, cultivation, lake edges and swamps
36. Pallid Harrier	*Circus macrourus*	Accipitridae	NT	PM	Open grasslands and farmland
37. Montagu's Harrier	*Circus pygargus*	Accipitridae	LC	PM	Open grasslands and farmland, rests on poles (good user of bird perches – to control birds and rodent pests)
38. African Harrier-Hawk (Gymnogene)	*Polyboroides typus*	Accipitridae	LC	R	Woodland, forests, suburban farmlands and wooded water courses. NB: raids weavers nests – pest control
39. Lizard Buzzard	*Kaupifalco monogrammicus*	Accipitridae	LC	R	Wooded grasslands, cultivation and suburban gardens, scans prey from utility poles and wires. NB: good user of artificial perches
40. Gabar Goshawk	*Micronisus gabar*	Accipitridae	LC	R	Woodlands and agro-human settlements
41. African Goshawk	*Accipiter tachiro*	Accipitridae	LC	R	Forest, woodland, dense secondary growth and wooded gardens
42. Little Sparrowhawk	*Accipiter minullus*	Accipitridae	LC	R	Forest, thick woodland, dense, riverine acacias, suburban gardens and tree plantations
43. Ovampo Sparrowhawk*	*Accipiter ovampensis*	Accipitridae	LC	R	Forest, thick woodland, suburban gardens and plantations
44. Great Sparrowhawk	*Accipiter melanoleucus*	Accipitridae	LC	R	Forest, thick woodland, wooded suburban gardens and also nests in plantation e.G. Eucalyptus
45. Eurasian Buzzard (Common Buzzard; Steppe Buzzard)	*Buteo buteo*	Accipitridae	LC	PM	Forest edge, woodland, bush and cultivation with scattered trees

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
46. Augur Buzzard	*Buteo augur*	Accipitridae	LC	R	Open or cultivated areas, With scattered trees. NB: perches on posts and dead trees - biological control for rodent pests
47. Steppe Eagle	*Aquila nipalensis*	Accipitridae	LC	PM	Wooded cultivated areas and plains
48. Wahlberg's Eagle	*Aquila wahlbergi*	Accipitridae	LC	AM	Open or cultivated areas, Woodlands, bush country
49. Booted Eagle	*Aquila pennatus*	Accipitridae	LC	PM	Open or cultivated areas, With scattered trees
50. Long-crested Eagle	*Lophaetus occipitalis*	Accipitridae	LC	R	Cultivation areas, woodlands, near wetlands. Good user of pest control perches
51. African Hobby	*Falco cuvierii*	Falconidae	LC	R	Cultivation areas
52. Coqui Francolin	*Francolinus coqui*	Phasianidae	LC	R	Bushed woodland,
53. Red-necked Francolin (Red-necked Spurfowl)	*Francolinus afer*	Phasianidae	LC	R	Bushed woodland and cultivation
54. Common Quail*	*Coturnix coturnix*	Phasianidae	LC	PM	Bushland, grassland and cultivation
55. Helmeted Guineafowl	*Numida meleagris*	Numididae	LC	R	Grassed woodlands, farmland
56. Black Crake	*Amaurornis flavirostris*	Rallidae	LC	R	Swamp with friging vegetation
57. Lesser Moorhen	*Gallinula angulata*	Rallidae	LC	AM	Swamp with friging vegetation
58. Common Moorhen	*Gallinula chloropus*	Rallidae	LC	R	Swamp with friging vegetation
59. Grey Crowned-Crane	*Balearica regulorum*	Gruidae	LC	R	Swamps, wet grasslands, moist pasture and cultivation,
60. Lesser Jacana	*Microparra capensis*	Jacanidae	LC	R	Wetlands with floating lilies and muddy shores.
61. African Jacana	*Actophilornis africanus*	Jacanidae			Wetlands with floating lilies and muddy shores.
62. Water Thick-knee	*Burhinus vermiculatus*	Burhinidae	LC	R	Wetlands and flood plains
63. Crowned Lapwing	*Vanellus coronatus*	Charadriidae	LC	R	Dry grasslands and open fields,

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
64. Long-toed Lapwing	*Vanellus crassirostris*	Charadriidae	LC	R	Wetland edges and floating vegetation
65. Senegal Lapwing	*Vanellus lugubris*	Charadriidae	LC	R	Bushed grassland
66. Wetland Sandpiper	*Tringa stagnatilis*	Scolopacidae	LC	PM	Wetland edges and muddy shores
67. Green Sandpiper	*Tringa ochropus*	Scolopacidae	LC	PM	Wetland edges and muddy shores
68. Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	LC	PM	Wetland edges and muddy shores
69. Curlew Sandpiper	*Calidris ferruginea*	Scolopacidae	LC	PM	Wetland edges and muddy shores
70. Speckled Pigeon	*Columba guinea*	Columbidae	LC	R	Suburban areas and human settlements
71. African Mourning Dove	*Streptopelia decipiens*	Columbidae	LC	R	Woodlands, cultivation often visit water
72. Red-eyed Dove	*Streptopelia semitorquata*	Columbidae	LC	R	Woodlands, cultivation often visit water
73. Ring-necked Dove	*Streptopelia capicola*	Columbidae	LC	R	Woodlands, cultivation often visit water
74. Laughing Dove	*Streptopelia senegalensis*	Columbidae	LC	R	Woodlands, cultivation often visit water
75. Emerald-spotted Wood-Dove	*Turtur chalcospilos*	Columbidae	LC	R	Woodlands, cultivation often visit water
76. African Green-Pigeon	*Treron calva*	Columbidae	LC	R	Woodlands, cultivation often visit water
77. Meyer's Parrot (Brown Parrot)	*Poicephalus meyeri*	Psittacidae	LC	R	Woodland and riverine forests.
78. Ross's Turaco	*Musophaga rossae*	Musophagidae	LC	R	Woodland, forest, open bush and cultivation with trees
79. Bare-faced Go-away-bird	*Corythaixoides personatus*	Musophagidae	LC	R	Woodland, forest, open bush and cultivation with trees
80. Red-chested Cuckoo	*Cuculus solitarius*	Cuculidae	LC	R	Woodlands and suburban gardens
81. Black Cuckoo	*Cuculus clamosus*	Cuculidae	LC	R	Woodlands and suburban gardens
82. Common Cuckoo (Eurasian Cuckoo)	*Cuculus canorus*	Cuculidae	LC	PM	Woodlands and suburban gardens
83. Blue-headed Coucal	*Centropus monachus*	Cuculidae	LC	R	Prefers papyrus swamps
84. White-browed Coucal	*Centropus superciliosus*	Cuculidae	LC	R	Woodland thickets and farmlands egderows

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
85. Barn Owl	*Tyto alba*	Tytonidae	LC	R	Associated with man in urban and suburban areas
86. Spotted Eagle-Owl	*Bubo africanus*	Strigidae	LC	R	Forest, riverine woods, wooden suburban areas. NB: a resident pair in ruhuha parish.
87. Pennant-winged Nightjar	*Macrodipteryx vexillarius*	Caprimulgidae	LC	AM	Bushland and open habitats
88. Mottled Swift	*Apus aequatorialis*	Apodidae	LC	R	Open country flying over different habitat types – wetlands, low woodlands/forest, farmlands
89. Little Swift	*Apus affinis*	Apodidae	LC	R	
90. White-rumped Swift	*Apus caffer*	Apodidae	LC	R	
91. Speckled Mousebird	*Colius striatus*	Coliidae	LC	R	Gardens, cultivation, bush and forest edges.
92. Blue-naped Mousebird	*Urocolius macrourus*	Coliidae	LC	R	Dry woodland
93. Malachite Kingfisher	*Alcedo cristata*	Alcedinidae	LC	R	Fringing vegetation along open water.
94. African Pygmy-Kingfisher	*Ispidina picta*	Alcedinidae	LC	R	
95. Woodland Kingfisher	*Halcyon senegalensis*	Alcedinidae	LC	R	Wooded and cultivated areas
96. Giant Kingfisher	*Megaceryle maxima*	Alcedinidae	LC	R	Wooded lake and river banks
97. Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC	R	Lake and riverside vegetation
98. Cinnamon-chested Bee-eater	*Merops oreobates*	Meropidae	LC	R	Grasslands, cultivation, , open woodlands
99. European Bee-eater	*Merops apiaster*	Meropidae	LC	PM	
100. European Roller	*Coracias garrulous*	Coraciidae	NT	PM	Woodlands and cultivation
101. Lilac-breasted Roller	*Coracias caudate*	Coraciidae	LC	R	Woodlands and cultivation
102. African Grey Hornbill	*Tockus nasutus*	Bucerotidae	LC	R	Open woodland, cultivation
103. Spot-flanked Barbet	*Tricholaema lachrymosa*	Capitonidae			Woodland and riverine vegetation
104. Red-faced Barbet	*Lybius rubrifacies*	Capitonidae	NT	R	
105. Wahlberg's Honeyguide	*Prodotiscus regulus*	Indicatoridae	LC	R	Forest edge,riparian woodland; and wooded farmland
106. Cardinal Woodpecker	*Dendropicos fuscescens*	Picidae	LC	R	Forest edge and riparian woodland

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
107. Sand Martin	*Riparia riparia*	Hirundinidae	LC	PM	Grassland, wetlandlands, woodlands, suburban areas, cultivation, often nest in houses and bridges.
108. Plain Martin	*Riparia paludicola*	Hirundinidae	LC	R	
109. Banded Martin	*Riparia cincta*	Hirundinidae			
110. Barn Swallow	*Hirundo rustica*	Hirundinidae	LC	PM	
111. Angola Swallow	*Hirundo angolensis*	Hirundinidae	LC	R	
112. Lesser Striped-Swallow	*Hirundo abyssinica*	Hirundinidae	LC	R	
113. Mosque Swallow	*Hirundo senegalensis*	Hirundinidae	LC	R	
114. Wire-tailed Swallow	*Hirundo smithii*	Hirundinidae	LC	R	
115. African Pied Wagtail	*Motacilla aguimp*	Motacillidae	LC	R	Grasslands, muddy shores, lawns, cultivation
116. Yellow Wagtail	*Motacilla flava*	Motacillidae	LC	PM	
117. Grey Wagtail	*Motacilla cinerea*	Motacillidae	LC	PM	
118. Common Bulbul	*Pycnonotus barbatus*	Pycnonotidae	LC	R	Wooded and shrubby habitats, readily adapts to habitat modification.
119. Arrow-marked Babbler	*Turdoides jardineii*	Timaliidae	LC	R	Bush, riverine bushes, lakeside,
120. Olive Thrush	*Turdus olivaceus*	Turdidae	LC	R	Gardens, dense shrubbery, often feeding from ground
121. White-browed Robin-Chat	*Cossypha heuglini*	Turdidae	LC	R	
122. Red-backed Scrub-Robin (White-browed Scrub Robin)	*Cercotrichas leucophrys*	Turdidae	LC	R	
123. White-headed Black-Chat	*Myrmecocichla arnotti*	Turdidae	LC	R	
124. Swamp Flycatcher	*Muscicapa aquatica*	Muscicapidae	LC	R	Papyrus swamps
125. Winding Cisticola	*Cisticola galactotes*	Sylviidae	LC	R	Bushland, pastureland and cultivation with trees
126. Zitting Cisticola	*Cisticola juncidis*	Sylviidae	LC	R	Bushland, pastureland and cultivation with trees
127. Tawny-flanked Prinia	*Prinia subflava*	Sylviidae	LC	R	Bushland, pastureland and cultivation with trees
128. Grey-capped Warbler	*Eminia lepida*	Sylviidae	LC	R	Bushland and cultivation with trees
129. Miombo Camaroptera (Miombo Wren-Warbler)	*Calamonastes undosus*	Sylviidae	LC	R	Wooded bushland

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
130. African Reed-Warbler	*Acrocephalus baeticatus*	Sylviidae	LC	AM	Reedbeds in swamps
131. Olivaceous Warbler	*Hippolais pallida*	Sylviidae	LC	PM	Busland, pastureland and cultivation with trees
132. Willow Warbler	*Phylloscopus trochilus*	Sylviidae	LC	PM	Busland, pastureland and cultivation with trees
133. Garden Warbler	*Sylvia borin*	Sylviidae	LC	PM	Busland, pastureland and cultivation with trees
134. Grey-backed Camaroptera	*Camaroptera brachyura*	Sylviidae	LC	R	Busland, pastureland and cultivation with trees
135. African Bush-Warbler (Little Rush Warbler)	*Bradypterus baboecala*	Sylviidae	LC	R	Busland and cultivation with trees
136. Red-faced Crombec	*Sylvietta whytii*	Sylviidae	LC	R	Woodlands, busland and cultivation with trees
137. African Paradise-Flycatcher	*Terpsiphone viridis*	Monarchidae	LC	R	Tree canopy, woodlands and gardens
138. Grey-backed Fiscal	*Lanius excubitoroides*	Laniidae	LC	R	Wooded grasslands, moist acacia bush and cultivation
139. Tropical Boubou	*Laniarius aethiopicus*	Malaconotidae	LC	R	Dense bush, thickets, shrubby cultivation, gardens
140. Black-headed Gonolek	*Laniarius erythrogaster*	Malaconotidae	LC	R	Dense bush, thickets, shrubby cultivation, gardens
141. Fork-tailed Drongo (Common Drongo)	*Dicrurus adsimilis*	Dicruridae	LC	R	Woodland, forest edges, cultivation
142. Pied Crow	*Corvus albus*	CORVIDAE	LC	R	Grasslands, cultivation, riparian vegetation, urban areas
143. Greater Blue-eared Glossy-Starling	*Lamprotornis chalybaeus*	Sturnidae	LC	R	Open bush, woodland and cultivation
144. Rüppell's Long-tailed Starling	*Lamprotornis purpuropterus*	Sturnidae	LC	R	
145. Scarlet-chested Sunbird	*Chalcomitra senegalensis*	Nectariniidae	LC	R	Shrubs, wooded cultivation
146. Red-chested Sunbird	*Cinnyris erythrocerca*	Nectariniidae	LC	R	
147. Purple-banded Sunbird	*Cinnyris bifasciatus*	Nectariniidae	LC	R	
148. Variable Sunbird	*Cinnyris venustus*	Nectariniidae	LC	R	

Common name	Scientific name	Family	IUCN Threat status	Migratory status	Habitat category
149. Black-headed Weaver (Village aver)	*Ploceus cucullatus*	Ploceidae	LC	R	Bushes and trees in varying climatic conditions
150. Holub's Golden-Weaver	*Ploceus xanthops*	Ploceidae	LC	R	
151. Spectacled Weaver	*Ploceus ocularis*	Ploceidae	LC	R	
152. Yellow-backed Weaver	*Ploceus melanocephalus*	Ploceidae	LC	R	
153. Cardinal Quelea (Pest on cerial crops)	*Quelea cardinalis*	Ploceidae	LC	R	
154. Yellow Bishop	*Euplectes capensis*	Ploceidae	LC	R	
155. Fan-tailed Widowbird	*Euplectes axillaris*	Ploceidae	LC	R	
156. White-winged Widowbird	*Euplectes albonotatus*	Ploceidae	LC	R	
157. Grosbeak Weaver	*Amblyospiza albifrons*	Ploceidae	LC	R	
158. Green-winged Pytilia	*Pytilia melba*	Estrildidae	LC	R	Grassy bushlans, hedge rows, cultivation
159. Red-billed Firefinch	*Lagonosticta senegala*	Estrildidae	LC	R	
160. Red-cheeked Cordonbleu	*Uraeginthus bengalus*	Estrildidae	LC	R	
161. Common Waxbill	*Estrilda astrild*	Estrildidae	LC	R	
162. Bronze Mannikin	*Spermestes cucullatus*	Estrildidae	LC	R	
163. Pin-tailed Whydah	*Vidua macroura*	Viduidae	LC	R	Open bushland, grassland, cultivation
164. Papyrus Canary	*Serinus koliensis*	Fringillidae	LC	R	Papyrus
165. Yellow-fronted Canary	*Serinus mozambicus*	Fringillidae	LC	R	Bushland, farmland
166. Grey-headed Sparrow	*Passer griseus*	Passeridae	LC	R	Human habitation, grassland, cultivation

Appendix 7.2: Bird species recorded in earlier studies in Rwanda and Burundi (Schouteden 1966a, 1966b) NB: This list only includes birds that were not recorded during the current study.

Common name (migration & conservation status in parenthesis)	Family	Scientific name	Record from Rwanda	Record from Burundi

1. Great Crested Grebe (X)	Podicipedidae	*Podiceps cristatus*		Lake Rwhihinda, Lake Cyohoha
2. Glossy Ibis (AM, PM)	Threskiornithidae	*Plegadis falcinellus*		Rwihinda
3. Intermediate Egret (Yellow-billed Egret)	Ardeidae	*Egretta intermedia*		Rwihinda
4. Dwarf Bittern (X)	Ardeidae	*Ixobrychus sturmii*	Akanyaru River	
5. Southern Pochard (AM)	Anatidae	*Netta erythrophthalma*	Akanyaru River	Rwihinda, Cyohoha
6. White-backed Duck (X)	Anatidae	*Thalassornis leuconotus*		Rwihinda
7. African Pygmy-goose	Anatidae	*Nettapus auritus*		Lake Rwhihinda, Lake Cyohoha
8. Maccoa Duck (NT, X)	Anatidae	*Oxyura maccoa*		Rwihinda
9. African Water Rail	Phasianidae	*Rallus caerulescens*		Rwihinda
10. African Wattled Lapwing	Charadriidae	*Vanellus senegallus*		Lake Cyohoha
11. Kittlitz's Plover	Charadriidae	*Charadrius pecuarius*		Bugesera
12. White-winged Tern (PM)	Sternidae	*Chlidonias leucopterus*	Akanyaru River	Rwihinda
13. Blue-spotted Wood-Dove	Columbidae	*Turtur afer*	Akanyaru River	
14. Eastern Plantain-eater	Musophagidae	*Crinifer zonurus*	Bugesera	
15. Great Blue Turaco	Musophagidae	*Corythaeola cristata*	Akanyaru River, Bugesera	Bugesera
16. Levaillant's Cuckoo	Cuculidae	*Clamator levaillantii*	Bugesera	
17. Common Cuckoo (Eurasian Cuckoo) (PM)	Cuculidae	*Cuculus canorus*	Akanyaru River	
18. Yellowbill	Cuculidae	*Ceuthmochares aereus*	Akanyaru River	
19. Pearl-spotted Owlet	Strigidae	*Glaucidium perlatum*	Akanyaru River	
20. Freckled Nightjar	Caprimulgidae	*Caprimulgus tristigma*	Akanyaru	
21. Striped Kingfisher	Alcedinidae	*Halcyon chelicuti*		Rwihinda
22. Grey-headed Kingfisher	Alcedinidae	*Halcyon leucocephala*	Bugesera	Bugesera

23. Blue-cheeked Bee-eater	Meropidae	*Merops persicus*	Lake Cyohoha	Rwihinda Cyohoha
24. White-fronted Bee-eater	Meropidae	*Merops bullockoides*		Cyohoha
25. Common Scimitar-bill	Phoeniculidae	*Rhinopomastus cyanomelas*		Bugesera
26. White-headed Woodhoopoe	Phoeniculidae	*Phoeniculus bollei*	Akanyaru River	
27. Hoopoe (African / Eurasian Hoopoe AM PM)	Upupidae	*Upupa epops*	Bugesera	Bugesera
28. Southern Ground-Hornbill	Bucerotidae	*Bucorvus leadbeateri*	Akanyaru River	
29. Yellow-rumped Tinkerbird	Capitonidae	*Pogoniulus bilineatus*	Akanyaru	
30. Greater Honeyguide	Indicatoridae	*Indicator indicator*	Bugesera	Bugesera
31. Scaly-throated Honeyguide	Indicatoridae	*Indicator variegatus*	Akanyaru	
32. Red-throated Wryneck	Picidae	*Jynx ruficollis*	Akanyaru	
33. Green-backed Woodpecker	Picidae	*Campethera cailliautii*	Bugesera, Akanyaru	Bugesera
34. Grey Woodpecker	Picidae	*Dendropicos goertae*	Akanyaru	
35. Rufous-naped Lark	Alaudidae	*Mirafra africana*	Akanyaru	
36. Red-capped Lark	Alaudidae	*Calandrella cinerea*	Akanyaru	
37. White-headed Sawwing	Hirundinidae	*Psalidoprocne albiceps*	Akanyaru	
38.Mountain Wagtail	Motacillidae	*Motacilla clara*	Akanyaru	
39. Tree Pipit (PM)	Motacillidae	*Anthus trivialis*	Akanyaru	
40. Yellow-throated Longclaw	Motacillidae	*Macronyx croceus*	Akanyaru	
41. Yellow-whiskered Greenbul	Pycnonotidae	*Andropadus latirostris*	Akanyaru	
42. Yellow-throated Greenbul	Pycnonotidae	*Chlorocichla flavicollis*	Akanyaru	
43. Red-shouldered Cuckoo-shrike	Campephagidae	*Campephaga phoenicea*	Akanyaru	
44. Black-lored Babbler	Timaliidae	*Turdoides sharpei*	Akanyaru	
45. Red-capped Robin-Chat	Turdidae	*Cossypha natalensis*	Akanyaru	
46. Familiar Chat	Turdidae	*Cercomela familiaris*	Akanyaru	
47. Miombo Rock-Thrush	Turdidae	*Monticola angolensis*	Akanyaru	
48. Greencap Eremomela	Sylviidae	*Eremomela scotops*	Akanyaru	
49. Grey Apalis	Sylviidae	*Apalis cinerea*	Akanyaru	

50. Yellow-breasted	Sylviidae	*Apalis Apalis flavida*	Akanyaru	
51. Chestnut-throated Apalis	Sylviidae	*Apalis porphyrolaema*	Akanyaru	
52. Grey Wren-Warbler	Sylviidae	*Calamonastes simplex*	Akanyaru	
53. Stout Cisticola	Sylviidae	*Cisticola robustus*	Akanyaru	
54. Siffling Cisticola	Sylviidae	*Cisticola brachypterus*	Akanyaru	
55. Croaking Cisticola	Sylviidae	*Cisticola natalensis*	Akanyaru	
56. White-chinned Prinia	Sylviidae	*Prinia leucopogon*	Akanyaru	
57. African Moustached Warbler	Sylviidae	*Melocichla mentalis*	Akanyaru	
58. Broad-tailed Warbler (Fan-tailed Grassbird)	Sylviidae	*Schoenicola brevirostris*	Akanyaru	
59. White-winged Scrub-Warbler (White-winged Warbler)	Sylviidae	*Bradypterus carpalis*	Akanyaru	
60. African Yellow Warbler (Dark-capped Yellow Warbler)	Sylviidae	*Chloropeta natalensis*	Akanyaru	
61. Icterine Warbler PM	Sylviidae	*Hippolais icterina*	Akanyaru	
62. Pale Flycatcher	Muscicapidae	*Bradornis pallidus*	Bugesera/ Akanyaru	
63. White-eyed Slaty-Flycatcher	Muscicapidae	*Melaenornis fischeri*	Akanyaru	
64. Yellow-eyed Black-Flycatcher	Muscicapidae	*Melaenornis ardesiacus*	Akanyaru	
65. Collared Flycatcher	Muscicapidae	*Ficedula albicollis*	Akanyaru	
66. Wattled Starling	Sturnidae	*Creatophora cinerea*	Bugesera	
67. Chinspot Batis	Platysteiridae	*Batis molitor*	Akanyaru	
68. Black-headed Batis	Platysteiridae	*Batis minor*	Akanyaru	
69. White-tailed Blue-Flycatcher	Monarchidae	*Elminia albicauda*	Akanyaru	
70. White-headed Sawwing	Hirundinidae	*Psalidoprocne albiceps*	Akanyaru	
71. Brown-crowned Tchagra	Malaconotidae	*Tchagra australis*	Akanyaru	
72. Black-crowned Tchagra	Malaconotidae	*Tchagra senegala*	Akanyaru	
73. Sulphur-breasted Bushshrike	Malaconotidae	*Telophorus sulfureopectus*	Akanyaru	
74. Doherty's Bushshrike	Malaconotidae	*Telophorus dohertyi*	Akanyaru	
75. Doherty's Bushshrike	Malaconotidae	*Telophorus dohertyi*	Akanyaru	
76. Papyrus Gonolek (NT)	Malaconotidae	*Laniarius mufumbiri*	Akanyaru	
77. Common Fiscal	Laniidae	*Lanius collaris*	Akanyaru	
78. African Penduline-Tit	Remizidae	*Anthoscopus caroli*	Akanyaru	

79. African Yellow White-eye	Zosteropidae	*Zosterops senegalensis*	Akanyaru	
80. Green-headed Sunbird	Nectariniidae	*Cyanomitra verticalis*	Akanyaru	
81. Slender-billed Weaver	Ploceidae	*Ploceus pelzelni*	Akanyaru	
82. Lesser Masked-Weaver	Ploceidae	*Ploceus intermedius*	Akanyaru	
83. Northern Brown-throated Weaver	Ploceidae	*Ploceus castanops*	Akanyaru	
84. Strange Weaver	Ploceidae	*Ploceus alienus*	Akanyaru	
85. Black-necked Weaver	Ploceidae	*Ploceus nigricollis*	Akanyaru	
86. Red-headed Weaver	Ploceidae	*Anaplectes rubriceps*	Akanyaru	
87. Compact Weaver	Ploceidae	*Pachyphantes superciliosus*	Akanyaru	
88. White-collared Oliveback	Estrildidae	*Nesocharis ansorgei*	Akanyaru	
89. African Firefinch	Estrildidae	*Lagonosticta rubricata*	Akanyaru	
90. Peters's Twinspot	Estrildidae	*Hypargos niveoguttatus*	Akanyaru	
91. Red-headed Bluebill	Estrildidae	*Spermophaga ruficapilla*	Akanyaru	
92. Black-faced Waxbill	Estrildidae	*Estrilda erythronotos*	Akanyaru	
93. Black-crowned Waxbill	Estrildidae	*Estrilda nonnula*	Akanyaru	
94. Fawn-breasted Waxbill	Estrildidae	*Estrilda paludicola*	Akanyaru	
95. Red-billed Quailfinch (Black-chinned Quailfinch)	Estrildidae	*Ortygospiza gabonensis*	Akanyaru	
96. Gray-headed Negrofinch	Estrildidae	*Nigrita canicapilla*	Akanyaru	
97. Dusky Twinspot	Estrildidae	*Euschistospiza cinereovinacea*	Akanyaru	
98. Golden-breasted Bunting	Emberizidae	*Emberiza flaviventris*	Akanyaru	

Appendix 7.3: Bird species recorded from Lake Rwihinda in 2005 by Nzigidahera *et al* (2005)

Common name *(migration & conservation status in parenthesis)*	**Family**	**Scientific name**
1. Great White Pelican	Pelecanidae	Pelecanus onocrotalus;
2. Goliath Heron	Ardeidae	Ardea goliath
3. White Stork (PM)	Ciconiidae	Ciconia ciconia
4. Northern Pintail (PM)	Anatidae	Anas acuta
5. Garganey (PM)	Anatidae	Anas querquedula
6. Crowned Hawk-Eagle (African Crow-ned eagle)	Accipitridae:	Stephanoaetus coronatus
7. Martial Eagle	Accipitridae:	Polemaetus bellicosus
8. Dusky Turtle-Dove	Columbidae	Streptopelia lugens

9. Rameron (Olive) Pigeon	Columbidae	Columba arquatrix
10. Olive Woodpecker	Picidae	Dendropicos griseocephalus
11. White-headed Sawwing	Hirundinidae	Psalidoprocne albiceps
12. Spotted Flycatcher (PM)	Muscicapidae	Muscicapa striata
13. Ruwenzori Batis	Platysteiridae	Batis diops
14. Southern Red Bishop	Ploceidae	Euplectes orix

Appendix 7.4: Some Birds of Cyohoha that are eaten/sold in Burundi (Nzigidahera 2007)

English name	**Family**	**Scientific Name**	**Kirundi name**
Pink-backed Pelican	Pelecanidae	Pelecanus rufescens	Igishuhe
Long-tailed Cormorant	Phalacrocoracidae	Phalacrocorax africanus	Ikirofyi
Spur-winged Goose	Anatidae	Plectropterus gambensis	Imbata/Igisafu
Southern Pochard (AM)	Anatidae	Netta erythrophthalma	Imbata
Hottentot Teal	Anatidae	Anas hottentota	Imbata
Fulvous Whistling-Duck	Anatidae	Dendrocygna bicolour	Ikinera/Imbata
White-backed Duck (R)	Anatidae	Thalassornis leuconotus	Imbata
White-faced Whistling-Duck	Anatidae	Dendrocygna viduata	IKINERA
African Pygmy-goose	Anatidae	Nettapus auritus	Imbata
Yellow-billed Duck (AM)	Anatidae	Anas undulate	Imbata
Helmeted Guineafowl	Numididae	Numida meleagris	Inkanga
Sacred Ibis		Threskiornis aethiopicus	Nkongora
Grey Crowned-Crane	Gruidae	Balearica regulorum	Umusambi
Speckled Mousebird	Coliidae	Colius striatus	Umusule
Laughing Dove	Columbidae	Streptopelia senegalensis	Igihuguhugu
Red-eyed Dove	Columbidae	Streptopelia semitorquata	Seruhuguhugu
Blue-spotted Wood-Dove	Columbidae	Turtur afer	Nyabworo
African Green-Pigeon	Columbidae	Treron calva	Intuku
African Mourning Dove	Columbidae	Streptopelia decipiens	
Ring-necked Dove	Columbidae	Streptopelia capicola	Igihuguhugu
Speckled Pigeon	Columbidae	Columba guinea	Inuma
Common Quail PM, R	Phasianidae	Coturnix coturnix	Mivunduruko
Coqui Francolin	Francolinus coqui	Francolin coqui	Inkware
Red-necked Spurfowl	Francolinus afer	Francolin à gorge rouge	Inkware
Red-chested Cuckoo	Cuculidae	Cuculus solitarius	Syatwaturo
Common Moorhen	Rallidae	Gallinula chloropus	Inguma
Red-billed Firefinch	Estrildidae	Lagonosticta senegala	Ifundi
Cinnamon-chested Bee-eater	Meropidae	Merops oreobates	Umusamanzuki
Ross's Turaco	Musophagidae	Musophaga rossae	Kidumuradumura
Sunbirds (many sp)	Nectariniidae		Umununi
Arrow-marked Babbler	Turdoidae	Turdoides jardineii	Ikijwangajwanga

Kwekwe			
Black-headed Weaver	Ploceidae	Ploceus cucullatus	Iseka
Holub's Golden-Weaver	Ploceidae	Ploceus xanthops	Intwenzi
Spectacled Weaver	Ploceidae	Ploceus ocularis	Iseke
Brown Parrot	Psittacidae	Poicephalus meyeri	Gasuku
Common Bulbul	Pycnonotidae	Pycnonotus barbatus	Ikinongorye

Appendix 7.5: Simple protocol for monitoring waterbirds in Lake Cyohoha Sub-Basin
May include activity title, site name, logos for participating institutions etc on top

Wetland: _____ Date:
Section:
Recorder: _____ Start: Stop:
Weather Condition: Record: % cloud cover; windy, calm, rainy, drizzling, cool, warm, hot, chilly etc.
All Counters : Please write your full names and addresses below (N/B) Emails: Write Legibly

	Name	Address	Cell phone	Emails
1				
2				
3				
4				
5				

Comments/Notes: (Include habitat conditions, difficulties in counting due to weather, disturbance etc.)
Record Uncommon Species in the TABLE Below

	Species	Numbers	Totals

N/B: Provide detailed description and sketches for any unusual observation on the back of this form
The following species are uncommon/rare
Great Crested Grebe (*Podiceps cristatus)*, Eurasian Wigeon (*Anas penelope)*, Maccoa Duck (*Oxyura maccoa),* Red-knobbed Coot (*Fulica cristata),* Pied Avocet (*Recurvirostra avosetta),* Blacksmith Plover (*Vanellus armatus),* Little Ringed Plover (*Charadrius dubius),* Greater Sand Plover (*Charadrius leschenaultia),* Black-tailed Godwit (*Limosa limosa),* Dunlin (*Calidris alpine),* Red-necked Phalarope (*Phalaropus lobatus),* Black-headed Gull (*Larus ridibundus),* Caspian Tern (*Hydroprogne caspia),* Egyptian Plover (*Pluvianus aegyptius),* Pectoral Sandpiper (*Calidris melanotos)*
*list is based on rare birds of Lake Cyohoha Sub area

WATER BIRD SPECIES	SEPARATE TALLIES OR NUMBERS WITH A '(PLUS (+)'	Totals
GREBES		
Black-necked Grebe		
Little Grebe		
PELICANS		
Great White Pelican		
Pink-backed Pelican		
CORMORANTS		
Great Cormorant		
Long-tailed Cormorant		
HERONS & EGRETS		
Cattle Egret		
Little Egret		
Common Squacco Heron		
Yellow-billed Egret		
Great Egret		
Grey Heron		
Purple Heron		
Goliath Heron		
Black-headed Heron		
Unidentified herons		
HAMERKOPS & STORKS		
Hamerkop		
White Stork		
Saddle-billed Stork		
Marabou Stork		
African Open-billed Stork		
Yellow-billed Stork		
IBISES & SPOONBILLS		
Sacred Ibis		
Hadada Ibis		
Glossy Ibis		
African Spoonbill		
DUCKS & GEESE		
Fulvous Whistling Duck		
White-faced Whistling Duck		
Spur-winged Goose		
Egyptian Goose		
Knob-billed Duck		
Cape Teal		
Garganey		
Yellow-billed Duck		
Northern Pintail		

Red-billed Teal		
Hottentot Teal		
Northern Shoveler		
Southern Pochard		
Maccoa Duck		
Unidentified ducks		
FLAMINGOS		
Greater Flamingo		
Lesser Flamingo		
Dead Flamingo (dead bird only)		
BIRDS OF PREY		
Osprey		
Eurasian Wetland Harrier		
African Fish Eagle		
CRANES		
Grey Crowned Crane		
GALLINULES, COOTS & Jacanas		
Black Crake		
Common Moorhen		
Red-knobbed Coot		
African Jacana		
	PHOTO	
STILTS & AVOCETS		
Pied Avocet		
Black-winged Stilt		
PLOVERS & SANDPIPERS		
Ringed Plover		
Kittlitz's Plover		
Long-toed Plover		
Three-banded Plover		
Spur-winged Plover		
Blacksmith Plover		
Crowned Plover		
Little Stint		
Curlew Sandpiper		
Ruff		
Common Snipe		
Black-tailed Godwit		
Wetland Sandpiper		
Common Greenshank		
Green Sandpiper		
Wood Sandpiper		
Common Sandpiper		
Unidentified sandpipers		
GULLS		
Grey-headed Gull		
Black-headed Gull		
Unidentified gulls		

TERNS		
Gull-billed Tern		
Whiskered Tern		
White-winged Black Tern		
Unidentified terns		
KINGFISHERS		
Malachite Kingfisher		
Pied Kingfisher		
Woodland Kingfisher		

Appendix 7.6. Assorted PHOTOS taken during this study

PHOTO *7.1: A simple tourist resort at Lake Muhazi, ideal destination for avitoruism. Similar investments can be made in Lake Cyohoha.*

PHOTO *7.2: African Fish Eagle; A species whose population is declining in many wetlands and lakes due to diminishing fish resources.*

PHOTO *7.3: Mistneting during the study*

PHOTO *7.4: Swamp Flycatcher*

PHOTO *7.5: Fulvous Whistling Duck occured in large flocks in Iyalanda*

PHOTO *7.6: Grey-backed Fiacal*

PHOTO *7.7: Black-headed Heron*

PHOTO *7.8: Little egret*

PLATE *7.9: Black Crowned Heron*

PHOTO *7.10: Grey Crowned Cranes*

PHOTO *7.11: An ornithologist observing birds in Lake Cyohoha.*

PHOTO *7.12: Common Drongo. Perching sites for bird can henhance biological pest control in farm.*

PHOTO *7.13: The study team opportunistically created awareness among local communities on the importance of Lake Cyohoha as a biodiversity hotspot.*

PHOTO *7.14: Iyalanda site in Kirundo – Burundi. The site is very rich in wetland birds due to its fairly pristine state.*

Chapter Eight

Chapter Eight

Mammals of Lake Cyohoha Sub-Basin

Robert M. Kityo

Makerere University, Kampala, Email: rkityo@zoology.mak.ac.ug

8.1 Introduction

This chapter contains some aspects of the mammalian biodiversity of Lake Cyohoha Sub-Basin resulting from studies carried out to assess the situation of mammalian species. Existing literature hardly mentions anything on the mammals of the area. Luigi *et al.* (1999) although not directly referring to Cyohoha, shows maps of mammalian distribution in Africa from which over 60 species of medium to large mammals are mapped as having their range currently or historically in the general area of the Kagera Basin and can be assumed to have extended their range into the Lake Cyohoha Sub-Basin (the list of these is included as Appendix 8.1). It is also understood that the wetlands of the sub-basin are major sources of livelihoods to the neighboring communities of the lake and the Kagera region.

The Kagera River is fed by three main tributaries: the Nyabarongo River, the Akanyaru River, and the Ruvubu River. The three rivers have relevance to Lake Cyohoha which as noted already lies in this sub-basin. In the Kagera Basin Monograph, (BRL Ingénierie Kagera River Basin Monograph/Database Team 2007), the authors reported that there is a wide variety of flora and fauna which they attributed to the diversity of topography and climate in the Kagera Basin.

It has been reported that the mean estimated human population density in the sub-basin was 248 peoples/km² (as of 2007), eight times the average (28 peoples/km²) in Sub-Saharan Africa, and that the population was getting bigger. Of all the Kagera Basin countries, the population density is reported to be highest in Burundi and Rwanda (two countries that share the highest population density in Africa). Such high population densities have without doubt serious and direct bearing on resource use and sustenance.

Major impacts on the Cyohoha wetlands arise from agricultural practices and perhaps increasing demand for land for settlement and water. These human activities may encourage the survival of certain species of mammals while causing many others to disappear due to the human pressures and loss of habitat. A sample of climate data Chapter 1, Figures 1.2, 1.3 and 1.4) suggest that there has over the years been a general trend towards reduction in annual precipitation and that temperatures have risen. Note that for the 10-year period (**FIGURE** 1.3) and the 25-year period (**FIGURE** 1.4) there was marked reduction in amount of rainfall received and a notable rise in annual temperatures for the same 10-year period (**FIGURE** 1.2).

8.1.1 Situation description

Rwanda is reported to contain a wide variety of species (USAID/Rwanda Integrated Strategic Plan 2004-2009) due in part to its varied topography that is responsible for diverse regional climatic conditions. Despite the rich biodiversity however, endemism is not thought to be high. Its vegetation is described as a regional mosaic that includes sections of the Guineo-Congolian and Sudanian vegetation.

Cyohoha is listed among the lakes of Bugesera (Ministry of Lands, Resettlement and Environment (MINITERE, 2003) which together with other wetlands and aquatic systems represented at the time 10% of Rwanda's national territory. Already by 2005, agricultural pressures were recognised as an important anthropogenic impact on at least some of these wetland ecosystems. The National Strategy and Action Plan for the Conservation of Biodiversity in Rwanda (Ministry of Lands, Resettlement and Environment 2003) identified the major threats to biodiversity to belong to two categories: -

Natural threats that included erosion, floods, drought, proliferation of competitive species, disease and pests and

Man induced threats of which the main ones were population pressure, population resettlement, over-exploitation of biological resources, and uncontrolled introduction of exotic species, poaching and pirating, bushfires, conflicts and wars.

The modification and/or destruction of natural ecosystems no doubt results in the loss of flora and fauna in the affected areas, ultimately resulting in local extinction of certain species of plants and animals.

Huggins & Musahara (2004) reported that of the estimated 165,000 ha of the wetlands that Rwanda had, an estimated 94,000 ha were cultivated. The same authors further observed that given the land scarcity and very high population density, family farm holding had by 2001, reduced from 2 hectares to as little as 0.5 ha for more than 60% of the population. With Rwanda's population projected to grow to 16 million by 2020 this presents considerable concerns for the already small land holdings and any surviving natural ecosystems.

Population growth and the structural constraints in Rwanda resulted into increasingly smaller farm holdings due to constraints on land availability and holdings getting more fragmented. Cultivation has already pushed into valley-bottom lands and fragile, marginal lands on steep slopes previously used for pasture and/or wood lots. Fallow periods have become shorter and cultivation periods have grown longer, leading to a decline in soil fertility.

The ecosystems of Burundi are divided into the terrestrial ecosystems, aquatic and semi-aquatic ecosystems. The terrestrial ecosystems include the ombrophilous mountain forests on the highlands of Burundi located between 1,600m and 2,600m altitude, the forests of average altitude appear in the form of clear forests and of gallery forests located between 1,000m and 1,600m and the forests of low altitude made up of Kigwena peri-guinean dense forest and Rukoko Hyphaene forest located between 775m and 800m.

There are also savannahs primarily occupying a big part of the east of Burundi and groves found in the north of Burundi in Bugesera and in the Rusizi plain. The lawns and steppes are types of vegetation forming mainly the Bututsi pastures and a part of Mugamba and Kirimiro.

The aquatic and semi-aquatic ecosystems include wetlands, lakes (Lake Tanganyika and northern lakes), ponds as well as rivers. The vascular flora of Burundi is estimated at 2,950 species belonging to 195 families. The endemicity of the wild flora with more than 70 species of higher plants is very pronounced in high altitude. The fauna of Burundi includes about 163 species of mammals of which 17 species of high altitude montane forest are reportedly endemic (Republic of Burundi Ministry of Urban Planning, Tourism and Environment 2006).

As a country, Burundi is occupied by pastoral peoples who have settled the hills (Vanden Bossche and Bernacsek 1990), but in addition there is also intensive agriculture; growing coffee as the main cash crop. Like is the case in Rwanda, Lake Cyohoha in Burundi is in the Bugesera region, a region of undulating hills and valleys with wetlandland or lakes. The Bugesera region in Burundi has altogether eight lakes (Rweru, Cyohoha, Rwihinda, Kanzigiri, Gacamirindi, Nagitamo, Narungazi and Mwungere) which together occupy a surface area of 16,010 ha (about 8% of Burundi).

Together these lakes constitute the Aquatic Landscapes Protected Area of Bugesera (Paysage aquatique protégé de Bugesera) which gives them quasi elevated status. This kind of protection is however not accorded to the lakes and/or wetlands of the Bugesera region in Rwanda. Several general laws however exist in Rwanda aimed at regulating the use or abuse of aquatic and wetland ecosystems. The main objective of the protection status in Burundi is to ensure rational use of the aquatic ecosystems.

Until a few decades ago, the Bugesera region of Burundi was famous for its wildlife that included among others big populations of Elephant, Buffalo, Lion, Waterbuck and Impala and in addition Bushbuck, Bush Duiker and Grass hares in the Murehe woodland (Nzigidahera et. al. 2005). In the wetlands and areas nearby were species that included the Sitatunga, Warthog, Serval cat and Wetland Mongoose, among others.

8.1.2 Laws and obligations

After the Earth Summit in Rio 1992, Rwanda signed and ratified several international conventions for the protection and the conservation of the environment. These ranged from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) through the UN Convention to Combat Desertification (USAID/Rwanda Integrated Strategic Plan 2004-2009).

Rwanda developed an Action plan for the conservation of Biodiversity that has five major aims (albeit with as many as 12 attendant objectives): -

- Improved conservation of protected areas and wetlands
- Sustainable use of the biodiversity of natural ecosystems as well as agro ecosystems
- Rational use of biotechnology
- Development and strengthening of policy, institutional, legal and human resource frameworks
- Equitable sharing of benefits accruing from the use of biological resources

The objectives upon which the above aims were premised are: -

- Improved protection and management of protected areas and wetlands
- Improved knowledge of the diversity of protected areas and wetlands
- Conservation of genetic diversity of native plant and animal species
- Sustainable use of natural resources and ecosystems
- Sustainable use of agro-biodiversity
- Development of an environmentally sustainable and economically viable tourism
- Improved access to biotechnology
- Risk free use of biotechnology
- Improved policy and legal frameworks for sustainable conservation of biodiversity
- Institutional and human resource capacity building for sustainable conservation of biodiversity

- Strengthening regional and international co-operation for the conservation and sustainable use of biodiversity
- Strengthening the rights of grassroots communities for the control and sustainable use of biodiversity

These put considerable responsibility upon the government and people of Rwanda to ensure the long term survival and use of their biodiversity.

The Rwanda National Environmental Strategy, the Environmental Action Plan and its National Strategy for Biodiversity together address environmental priorities such as poverty, food security, and the energy crisis. They also address land management planning based on the characteristics of affected ecosystems; forestation and biodiversity; the future of wetlands; climate change at the national level; and urban environmental management and pollution control.

The National Decentralisation Policy adopted in May 2000 holds local populations responsible for managing resources, including natural resources. Districts are responsible for production and protection of water, tourism, and the environment. Similarly, cities, towns, and municipalities are responsible for land and environmental management, urban planning, road maintenance, maintenance of protected and recreational areas, and providing drinking water, sanitation, and waste treatment and disposal.

In its Part 3 on State-owned land Section A (Article 12) the Rwanda Draft Land Law delimits as "Public government land" lands that among others include the following four categories:

- Land containing lakes and rivers as listed by the decree of the Minister of Water;
- Shores of lakes and rivers the width of which shall be determined by decree of the Minister of Lands using the furthest line reached by successive floods;
- Land occupied by springs and wells;
- Government land for the protection of the environment, such as natural forests, national parks, protected wetlands, public parks and tourist sites;

All such land is meant for use by the public or is reserved for public services or national land for environmental protection. In Section B on State-owned land, Article 14 lists wetlands that can be put to agricultural use as included among state-owned lands.

Nzigidahera *et al.* (2005) mentioned the existence of policies and laws that are meant to regulate the use and conservation of natural resources. They however recognised the fact that the laws have not been specific enough, for example in protecting wetlands. A weakness they point out is that the laws failed to recognize local community values and resources they derived from wetlands. They in addition blame most of the destruction of wetlands on the lack of political and inter-ministerial laws protecting them.

The same authors also observe that Law No. 1/010 of 30 June 2000 which covers the environmental protection in general for Burundi is cross cutting and implementation is shared by various stakeholders. The law specifically addresses the problems of degradation and natural resource use, control of pollution, improving people's livelihood while maintaining a balance between ecosystem and human populations.

Both Rwanda and Burundi are signatories to the Ramsar Convention and CBD for which they are variously implementing the provisions of the conventions particularly article 6 and 7 relating to the general measures for conservation and sustainable use, identification and monitoring of biodiversity.

Overall, in both countries there are a number of provisions in the law, aimed at protecting and enhancing biological diversity, while at the same time ensuring sustainable development. The extent to which the different provisions are effected is however what does not seem to be as strict as it ought to be.

8.1.3 Objectives

The main aim of the surveys was to carry out inventories of the mammalian diversity surviving in the Lake Cyohoha Sub-Basin. The study in addition assessed the socio-economic roles/relations of any mammals in the sub-basin to the local communities, assessed the conservation status of these mammals and evaluated the role of the Lake Cyohoha Sub-Basin in the long term survival of the species.

This study specifically reports on the following: -

- An inventory of mammals in the Lake Cyohoha Sub-Basin
- A detailed literature review in as far as was possible and compilation of baseline information on the mammalian diversity of the sub-basin
- Recommendations addressing the above and additional details from stakeholders consultations on utilisation of mammalian resources of the sub-basin
- Assessment of direct and indirect benefits and costs of utilising mammalian resources in the sub-basin
- Identification of gaps and recommendations for trans-boundary management actions cognisant of existing laws, regulations and conventions
- Recommendations for a monitoring protocol for future assessment of the mammalian diversity of the Lake Cyohoha Sub-Basin

8.2 Description of the study sites and field methods

8.2.1 Selection of areas to survey

A key consideration is that the study areas should reflect objectives and animal habitat associations. A map of the Lake Cyohoha Sub-Basin was studied and used to establish the general sample areas in which the surveys were conducted. Although these sample areas were not selected based on representative vegetation types along the lake, the selected sites were considered to be the best for a representative sample for mammalian survey around the lake. on locations shown in **FIGURE** 8.1 were chosen to represent: -

- the area of Lake Cyohoha towards the Akanyaru River and associated extensive wetlands. In this section surveys were conducted in the general Ngenda area on the Rwanda side and the Muyebe general area on the Burundi side of the lake.
- a mid-section in the lake in the areas of Rugarama and Kagenge.
- the general areas by the southern section of Lake Cyohoha were surveyed around Iyalanda and Marembo.
- the surveys were also extended up hill into the Murehe woodland (off the map) which represented the more or less natural and more extensive vegetation growth in the area in the two countries although not directly bordering the lake.

All the locations above were largely areas in which a large section of the wetland or other lakeside vegetation was cultivated to grow a variety of crops including rice, bananas, maize, potatoes, beans and tomatoes, among others. Cultivation in the Rugarama and Kagenge areas left a narrow strip of vegetation in most cases of Phragmites separating the gardens from the lake. In Muyebe, Ngenda and Iyalanda on the other hand, a denser stand of papyrus continues to buffer the lake from the intense cultivation in these areas.

Lake Cyohoha is situated in a low depression which is shielded or separated from the upland by a ridge that in the majority of cases has a strip containing the remnants of the former vegetation with some large or coppicing trees, thickets of shrubs and clumps of bushes. Together these provide a thin vegetation cover on the ridge or dense swamp vegetation where it is not yet cleared that is exploited by any surviving mammals.

8.2.2 Description of field methods

The study was conducted in two main phases: -

A literature review phase to compile accessible knowledge and information on the mammals of the Lake Cyohoha Sub-Basin and region, as well as institutional and legal frameworks for Burundi and Rwanda.

Field inventories conducted with the objectives of estimating population distribution (presence/not detected) and relative abundance. The primary approach in this was the use of standard mammal traps and mist nets to capture for identification species of terrestrial small mammals and bats respectively, and surveys for mammal signs such as scats, skeletal material and spoors. In order that a trap-line set for small mammal surveys yields satisfactory data, it needs to be maintained for at least five trapping nights. For logistical and time constraint reasons, three trap-lines were used in the different locations and maintained for only three trapping nights in each of the locations.

The field work for this study was conducted between November and December 2007.

FIGURE 8.1: Outline map of Lake Cyohoha showing location of the general areas where the field surveys were conducted.

A number of field and statistical methods are available for studying populations of small mammals. For purposes of the work for this report, field methods divided into trapping systems and indirect signs were used for the surveys. In addition interviews with the local communities were done.

8.2.2.1 Trapping systems

The secretive behavior and physical size of small mammals generally makes them difficult to census by direct counts or quantification of indirect sign (e.g. prints, fecal material). For the most part, determining the presence or abundance (relative or absolute) of small mammals requires the physical capture of individuals to provide data that can be interpreted correctly. For this reason, trapping is considered the most efficient means of inventorying small mammal populations. Small mammal trapping was accomplished by live-trapping using Sherman traps and removal trapping using snap-traps.

The Grid-based trap design developed from efforts to achieve maximum coverage over a study area was used for sampling the small mammals. The Grid-based design is a more efficient trapping method, and is most useful when trying to capture every individual in a population, for individual identification.

8.2.2.2 Indirect signs

For species not possible to trap with the available equipment, either because they are particularly cryptic, or it was simply not possible within the framework of the project, indirect signs were used as an index of presence. The benefit of using indirect methods is that they have a minimal, if any, effect on animal behavior. However there is an associated cost that the relationship between the index and true density may not be properly known, and furthermore it may vary with time, environment and individual behavior. However since these surveys were only aimed at establishing presence of mammalian species, the foregoing were not critical limitations. Indirect signs looked for included animal spoor prints, fecal pellets, feeding signs and skeletal material (**PHOTO** 8.1). Using a combination of all these indirect sign methods, it is possible to establish presence or absence of mammals over a relatively fine scale of resolution.

In addition to the above two, Owl roosting locations were found from which pellets were collected as well as scats of several small carnivores that were also recovered. The Owl pellets and carnivore scats were analysed to recover skeletal material for identification of species that had been fed on.

PHOTO 8.1: Some signs of mammalian presence that were encountered in the Cyohoha area

Top L to R: fecal pellets in cave, a mole rat mound, Hare pellets Bottom L to R: Bush Duiker pellets, small carnivore scat, Rusty nosed rat's nest

8.2.2.3 Interviews with local people

A lot of valuable information about mammals' occurrence, use, and opinions, among other things, was collected by talking to the local people. The local people very quickly gained interest in the work that was being done first out of curiosity to know what and why it was being done and then for the reward they got for bringing in a useful specimen or information about the occurrence of any such species. In all the locations visited, interviews were held

with local people in groups ranging from five people to as many as 20 individuals in some places.

In these interviews the local people would name in their vernacular mammals species they know to occur in their area today or those that used to occur in past years. For those no longer present, an attempt was made to get an indication of when they were last seen/heard about in the areas. Following such interviews, the *Field Guide to the Larger Mammals of Africa* (Stuart & Stuart 2006) was used to show pictures of mammals of Africa to the interviewees to establish recognition of any of the species they had mentioned and that way confirm whether they occurred in the areas visited at the present time or in previous times.

The vernacular names given by the interviewees were eventually compared with the lists in Nzingidahera (2007) and other locally available sources, to come up with the English and scientific names of the mammals.

8.3 The Mammals of Lake Cyohoha, its environments and related issues

8.3.1 Mammalian diversity

The ground cover in most of the area surrounding Lake Cyohoha is very low except for narrow strips of semi-natural vegetation surviving along the ridges commonly separating the upper grounds from a more or less flattened or gently sloping ground towards the lake. This latter in majority of the cases would have been or is the wetland abutting the lake or a lakeshore that was not necessarily water logged. In addition however, natural vegetation and therefore considerable ground cover survives where wetlands still make it hard for agriculture, and here papyrus, *Phragmites* or *Typha* stands dominate. In such situations only mammals that have adaptations for swamp or wetland environments could survive while the typically dry land species will not survive in Lake Cyohoha Sub-Basin.

Appendix 1 estimates the Kagera Basin area to have as many as 72 species of mammals while Appendix 2 estimates the total species richness for Rwanda and Burundi to be 189 species. Detailed surveys for small mammals have not been done for many parts of these two countries and surveys done for these studies represent the first for the Lake Cyohoha area. A more comprehensive checklist of the mammals of the sub-basin would benefit from further and extended field surveys.

PHOTO 8.2: Some natural habitats surviving around Lake Cyohoha

(The first & second columns have examples of the thickets and bushes along the ridges, while the last column shows in the top two pictures vegetation on wetlands while last picture is of the thickets typical of the Murehe woodlands.)

In total, 50 species of mammals (**TABLE** 8.1 and Appendix 3) have been recorded in the environments around Lake Cyohoha representing in the case of the larger mammals a subset of those mapped for the area by Luigi *et al.* (1999). Eight of these are almost certainly locally extinct from the Lake Cyohoha Sub-Basin while the rest still exist but in the majority of cases in much reduced densities in the case of medium to larger sized mammals. The more frequent evidence of the presence of mammals was scats (fecal pellets) and spoors in the Murehe reserve, but even then no live mammals were actually seen. This may be a reflection of an absolute low abundance or alternatively weariness by the mammals of human presence, due to heavy hunting pressures in the area.

The mammal richness recorded for Lake Cyohoha Sub-Basin represents a little over 26% of the mammalian richness for Rwanda and Burundi. The largest of the surviving mammals in the area are the Hippopotamus of which only a lone individual survives in the lake. Of the species recorded present, carnivores represent the larger number of species. There is no doubt, however, that if thorough and extended surveys for smaller mammals (insectivores, bats and rodents) were to be conducted, these would represent even greater diversity. Some of the small mammals recorded are shown in **PLATE** 8.3.

The presence of such a diverse array of carnivores is reflective of a similarly high if not richer diversity of their potential prey which in many cases would comprise for a large part of rodents and insectivores.

PHOTO 8.3: Some of the small mammals recorded in the Cyohoha area

First column: *Chaerephon pumila, Myotis bocagei, and Graphiurus murinus.* **Second column:** *Epomophorus labiatus and Oenomys hypoxanthus,* **Third column:** *Eptesicus tennuipinis, Nycteris hispida and Scotoecus hirundo*

TABLE 8.1: Summary of the diversity and status of the mammals recorded in the Lake Cyohoha Sub-Basin

Orders Recorded	Presence/absence Status of mammals	Numbers per category	Total number of species
Artiodactyla	a	3	
	b	1	
	c	5	9
Carnivora	a	2	
	b	13	
	c	1	15
Chiroptera	a	6	6
Hyracoidea	b	1	1
Insectivora	a	1	1
Lagomorpha	a	1	1
Macroscelidea	a	1	1
Perissodactyla	c	1	1
Pholidota	c	1	1
Primates	b	2	2
Rodentia	a	9	
	b	3	12
Grand Total		50	50

Notes:

a – Species certainly present. For these evidence of presence was either that they were actually seen/trapped/netted or for which very recent evidence such as fecal piles or scats or skeletal remains were encountered.

b – Species for which the likelihood of their occurrence is high. Their presence is based on interviews.

c – Species that do not occur in the area any more. These are based on interviews and there is a high likelihood that they no longer exist

A monkey that may be the Blue Monkey *Cercopithecus mitis* was described in the Muyebe Cell region near the extensive Akanyaru wetlandland in Burundi. If this normally arboreal monkey still exists in this area, it must now have taken on a more terrestrial habit in the swamp because there is a general absence of trees in this swamp. It would also suggest that its foraging and feeding habits would have to have changed tremendously to exploit resources in the swamp. The only other alternative might be that these local people were describing the Vervet monkey which is a more hardy species and can survive even in very human impacted habitats.

8.3.2 Conservation status of the mammals

The conservation status is only described for those species of mammals in Category (**a)** and (**b)** of **TABLE** 8.1. Species in category (**c)** are left out because it is considered they are no longer relevant to the Lake Cyohoha Sub-Basin. **TABLE** 8.2 lists 12 out of the 50 species recorded for the sub-basin that are also on the CITES Appendices. None of the listed species is however specifically on the CITES appendices for either Burundi or Rwanda as is the case for some species. For example Huffman (2004) summarised the critical conservation information for the Sitatunga that is listed as a low risk, near-threatened species by the IUCN (2002) but with only its population in Ghana listed by CITES on Appendix III. Any surviving populations of Sitatunga in Rwanda and Burundi may require a special action for their conservation given that much of the wetlandland in which they should survive has been heavily impacted for agriculture.

TABLE 8.2.CITES listed mammals also recorded for Lake Cyohoha Sub-Basin

Scientific name	English Name	Cites listing	IUCN listing
Chlorocebus aethiops	Vervet/Grivet Monkey	II	LR/lc
Hystrix cristata	Crested Porcupine,	III	LC
Aonyx capensis	African Clawless Otter	II	LC
Aonyx congicus	Congo Clawless Otter	I/II	DD
Lutra maculicolli	Spotted Necked Otter	II	LC
Mellivora capensis	Honey Badger	III	LR/lc
Civettictis civetta	African Civet	III	LR/lc
Felis silvestris	Wild Cat	II	LC
Leptailurus (Felis) serval	Serval	II	LC
Profelis (Felis) aurata	African Golden Cat	II	VU
Hippopotamus amphibious	Hippopotamus	II	VU A4cd
Tragelaphus spekii	Sitatunga	III	LR/nt

Notation for the table: **VU** Vulnerable, **LR** Lower Risk, **LR/nt** Lower Risk/Near threatened

LR/lc Lower Risk/Least concern, **DD** Data Deficient

This list of mammals in **TABLE** 8.2, is based on the UNEP-WCMC (2005) *Checklist of mammals listed in the CITES appendices and in EC Regulation 338/97* (7th edition). JNCC Report No. 380. The full list of mammal species for the two countries is presented in Appendix 2 with the IUCN conservation category for each. All 12 species in **TABLE** 8.2 are medium to large sized mammals. Their survival would very much depend on the availability of foraging grounds, forage and cover. All these three factors are to a large extent becoming more and more scarce or limiting resources in the Cyohoha environment.

Of the species listed in **TABLE** 8.2, eight (8) are considered to be of lower risk and least concern; the lowest in terms of rank of the IUCN threat categories. However like is said above for the Sitatunga, their local populations around Lake Cyohoha in the two countries would benefit from much more stricter preservation of groves of natural vegetation cover. The two species listed as vulnerable (the Golden Cat and the Hippos) probably don't have very much future in the Lake Cyohoha environment given the current regime of land utilisation. In the case of Hippos only one individual survives in Lake Cyohoha. However, populations of this species are supposedly present in two other lakes, Lake Rweru at the border of Burundi and Rwanda and Lake Kazingiri in Burundi. The corridors that would also otherwise connect these three water bodies have a heavy human presence making the connections difficult for any dispersing or migrating populations.

Of the three Otters in **TABLE** 8.2, one *Aonyx congicus* is listed as DD while the rest are considered Lr/Lc. The survival of these aquatic carnivores is very much dependent on a healthy and clean fresh water body. Siltation of fresh water bodies has been shown else where to be a major issue in the conservation and survival of Otters primarily because it pollutes the water causing death of/or disappearance of the food base. Fish and aquatic invertebrates form the major foods of the Otters and with the fish stocks getting more and more depleted the long term survival of these species will remain suspect. Rowe-Rowe (1986) makes a good highlight of the issues most important to Otter conservation, key of which is soil erosion destroying freshwater bodies.

All other species of mammals recorded for the area (Appendix 3) that are not listed in **TABLE** 8.2, are also either in the Lr/Lc or DD categories. Data deficient (DD) species require additional detailed studies to understand their ecology so that they can be objectively assessed. Species designated as Lr/Lc are in this category on the global scale but it may be that on individual country scales such species may be highly endangered or vulnerable. As a different exercise therefore, it might be worthwhile to assess the conservation status of the different species for Burundi and Rwanda.

8.3.3 Local communities and mammals

This section highlights areas of importance regarding mammals to humans, some of which are direct or indirect and beneficial or may negatively affect the welfare of the local communities around Cyohoha. In these are therefore embedded the costs and benefits associated with wild mammals.

The mammal species recorded around Lake Cyohoha each had a local name in both the Kinyarwanda and the Kirundi languages. In some cases it is a generic name that is referred to groups of animals such as Imbeba to describe the bulk of rats and mice or Umushushwe to describe insectivores. In a few cases even when the names are more specific, they have

been applied to more than one species making, in these few instances, species delineation a little difficult. And yet another observation is that a few species have been described by more than one vernacular name. The fact that mammals have a local vernacular name would imply they have significance in the people's lives. The peoples of the two countries belong to various clans, each having a totem.

For example the Abatare in Rwanda and the Abazigaba in Burundi have their totem animal as the Lion. Like is the case with other communities in Africa with clan and totem symbols, certain animals or plants are revered and therefore respected by clan members. This could be taken advantage of to further the protection of those species that are important to different communities. It may be the case, however, that although clans and totems exist, many people don't bother very much any more to follow and identify with them.

Not much evidence therefore, was found to suggest a considerable cultural attachment to mammals in the areas that were visited for these surveys. That said however, one can't rule out the possibility that such uses or value attachments may exist. Several persons who had been hunters were interviewed from among the local communities.

It is apparent that hunting for mammals was previously important in the lives of some of the local people interviewed. Hunting provided them with meat: -

- for home consumption,
- for sharing with friends and family that were not hunters,
- to sell excess for cash that would then be used to procure other necessities for the home.

Today the population of mammals is too low in all of the areas visited and in most cases the species that were previously hunted for are locally extinct.

Only three local persons (one elderly man in Ngenda and two middle-aged men in Kagenge) had animal parts (skins or bits of skin and horn) as evidence of mammals they had killed (or at least which had been killed in these areas). All such animal parts seen were fairly old; from animals killed not less than three or four years ago.

The elderly man in Ngenda showed pieces of skin from a Bushpig, Hyrax, Vervet/ Grivet monkey and from an Otter. Without any elaboration he indicated that whenever he killed a mammal, he saved a piece of its skin for medicinal purposes.

Nzigidahera *et. al.* (2005) reported that in the Murehe area the most hunted species were the Bush/Common Duiker (*Sylivicapra grimmia*), the Porcupines, and Grass Hare (*Lepus wythei*). The same species were consistently mentioned as existent in each of the areas that were visited for these surveys. All are fairly small sized and can manage to survive in marginal habitats in human impacted areas. Nzigidahera (2007) presents a list of as many as 32 species of mammals ranging from antelopes, carnivores, primates, pigs, aardvarks and a variety of rodents that are eaten by people in Burundi. It may be the case that the same species would be consumed also by people in the Rwandan communities. The impact on the mammal fauna would therefore be wider spread over various taxa and species.

The only other indication that some mammals are used for more than just meat was from the forest guard at Murehe who informed that Mole rats (*Tachoryctes*) are used to treat malnourishment in children. The way it reportedly works is that the animal is killed, boiled and the child is given the soup to drink. The medicinal utility of Mole rats is also reported in Nzigidahera (2007).

Besides the foregoing, different species of rodents that survive in most of the fields now turned into gardens continue to be pests on the crops grown: -

- Mole rats on root tuber crops such as sweet potatoes
- *Aethomys*, *Mastomys*, *Leminiscomys*, *Dasymys* and *Oenomys* on the rice
- *Lemniscomys* and perhaps *Cricetomys* on Tomatoes

Whether their depredation is high enough to cause considerable crop yields loss is an issue that needs to be concretely established.

It has been noted in the foregoing sections that the mammalian fauna of the Lake Cyohoha Sub-Basin is now very depaupurate, and that any of the medium to larger sized species that survive can be safely assumed to occur at very low densities.

Nzigidahera (2007) has reported that hunting and trapping have caused the disappearance of several species of mammals in Burundi and that evidence of their ever existing in Burundi can only be got from saved animal parts such as skins, hooves and horns. He adds that since 1950 Burundi had lost through hunting at least 10 species of mammals (Cheetah, Lion, Elephant, Rhino, Common Eland, Impala, Lichtenstein's Hertebeest, Hunter's Hertebeest and the Gorilla). It is also very likely that some of the species named from interviews for the Lake Cyohoha Sub-Basin study are now locally extinct. For example there were no signs of occurrence of the Waterbuck, Bushbuck or the Impala.

8.4. Discussions

The high human population and increased demand for land to farm around Lake Cyohoha has already resulted into the conversion of a lot of the natural vegetation into gardens with obvious negative impacts on the large mammals species that might have been in this area. The conflicting policies on nature/wetlandland preservation and increased agricultural productivity can't help the situation either. Understandably in some areas, the desire for better and more productive lands is appreciably high. **PLATE** 8.4 for example shows gardens uphill in Ngeruka where the ground on which crops are being grown is literally large pebbled sands. Water retention capacity and therefore that of essential soil nutrients can't be high in such soils, which might translate into very poor yields.

PHOTO 8.4: Two garden scenarios with sandy soils in Ngeruka

The situation in **PLATE** 8.4 will without a doubt continue to drive the local population to look for better farmland in the valley bottoms with continuing negative effects on the mammals unless the buffer zone is strictly enforced and managed.

Chemonics International Inc. (2003) reported of Nyungwe Forest Reserve, that poaching of large mammals was high. As a result, Duiker densities were very low, Buffalo were extirpated early in the 1980s, and the last Elephant was shot in 1999. They noted too that hunters now targeted smaller mammals like giant rats and squirrels as larger mammal populations had declined. Given the state of the environment around Lake Cyohoha where most of the wild-lands have been reduced in extent or converted for agriculture the normal range of larger wild mammals has been greatly reduced or removed. It would not be surprising that any members in the communities bordering the lake, who have a hunting culture, would resort to hunting the smaller mammals too.

None of the terrestrial mammals recorded have migratory tendencies. But well as those for example in the general Kagera Basin ecosystem could have extended their ranges into the Lake Cyohoha Sub-Basin, there is a lot of anthropogenic impacts today to make this less of a possibility.

Nzigidahera *et. al.*, (2005) had already observed a precarious situation for the Hippo population in the lakes of the Bugesera region. At the time they reported that: -

only four Hippos survived in Lake Rweru,

the last of Lake Rwihinda had been killed in 1989 and that

Only one hippo survived in Lake Cyohoha and moved between Burundi and Rwanda.

The same authors also noted that the population of Vervet monkeys was high at least in the riverine habitats of Lake Rwihinda.

For Burundi, Nzigidahera (2007) observed that wild animals are captured/hunted for consumption or sale. He also noted that some mammal parts such as hides and horns are used for medicine or as part of the attire or instrumentation during traditional dance.

8.5 Recommendations

The recommendations section is divided into two general sections; one that make general observations and general recommendations and another that makes specific suggestions for enhancement of tourism based on mammals.

8.5.1 General recommendations

Mammal inventories, especially of the small species, happen very slowly when compared to other taxa that are either day flying and/or not cryptic. In a heavily human impacted ecosystem like Cyohoha, any medium to larger sized mammals that survive will also be harder to sight and therefore document. To fully understand the surviving diversity of mammals in the Lake Cyohoha Sub-Basin, it will require an investment of longer periods of field surveys and covering different seasons of the year.

There was in general the absence of fruiting trees such as fig trees which provide food for fruit bats. Elsewhere these have been shown to be vital allies for seed dispersal and regeneration and at no cost in terms of human resource (see for example Fujita & Tuttle, 1991), www.lubee.org/about-whyconserve.aspx, Taylor *et. al.* 2007). Fig trees such as *Ficus natalensis* have been associated with agro-ecosystems where they have functions in soil conditioning, provisioning of fuel-wood and backcloth. Two other species of fig trees (*F. thorningi,* & *F. valischoude*) are already growing in the Iyalanda area. The tree planting program that is currently widely embraced in the Lake Cyohoha Sub-Basin should be extended to

include additional tree species such as the above and shrubs such as *Solanum mauritianum* which will on maturity attract increased diversity of fruit bats and other fruit-eating fauna. Ultimately, these will result into the introduction of seed of other trees and shrubs by the fruit eating vertebrates and increasing the absolute biodiversity across several taxa.

Any rehabilitation of the Lake Cyohoha Sub-Basin environment to suit recovery or even re-introduction of mammalian populations would require very drastic measures to be instituted. These would involve moves such as massive evictions and relocations of a big population of people. This would most probably not be a very desirable move. For the development of ecotourism based on mammals the, Murehe woodland presents the best option since it is already protected as a military preserve in Rwanda and a Nature reserve in Burundi. Stricter monitoring and patrols to control illegal removal/hunting of mammals would help their populations to recover and therefore could be a basis for tourism.

As an additional strategy, the strict management of the buffer zone, its reforestation, and enrichment with trees that attract increased biodiversity should be embraced. Although Bamboo and *Sena spectabilis* have their own advantages and utilities the wide use of these in the buffer zones should be carefully examined as they can become quite invasive and support very low biodiversity in the case of bamboo.

For purposes of bringing wild mammals' appreciation into the local peoples' perceptions, a wildlife preserve managed as a zoo or education centre allowing more open air exhibits could be developed in the Bugesera region near the lake. This would create a reason for visitors to go into the Bugesera region.

Mammalian presence and relative abundance could be assessed on a biannual basis. The assessment could make use of: -

- Survey of indirect signs of presence such as scats/fecal pellets, spoors, feeding evidence and others that tell of mammal presence.
- Inventory and actual censuses of any mammals that can be seen.
- Trapping and mist-netting for small mammals and bats
- Monitoring Owl roost sites to recover their pellets. These pellets will give information about the small mammal diversity in the area and a rough idea about their relative abundance.

This could particularly be useful following implementation of ideas suggested in 2, 3, & 4 above. This would help to establish whether the buffer zone programme is achieving more than just guarding against erosion and other direct impacts to the lake.

8.5.2 Proposals for enhancement of the tourism industry

Specialist tourism could be developed aimed at particular species that might attract the curious visitor in a similar way that a birder would go out to try and record the sight of a tiny rare bird species. Such possibilities that could be tried out include: -

The three species of Otters

This would initially require a thorough survey to establish their occurrence, range and commonly used locations in the Lake Cyohoha Sub-Basin. Hides built in such areas that are frequented by the Otters could then be used by paying tourists to watch either one of the species. The locations could also be enhanced by provision of the preferred foods of the different Otters in the different locations to encourage them to come out.

Sitatunga

It will be essential to enhance and improve management of the surviving wetlands where this species still occurs and removal of as much of the hunting pressure. This could allow the population of the Sitatunga to recover making it possible to frequently view them. Viewing platforms overlooking the swamp could then be erected to allow un-interrupted viewing

Caves and Bats

There are a number of caves along the cliff in the Kagenge area. At the time of these surveys there was evidence to suggest these caves were frequented by humans; most probably fishing folk who lighted fires in the caves perhaps for roasting fish to eat. Caves are otherwise favored roost sites for a good number of bat species. Large congregations and massive flocks of such bats emerging at nightfall earn from $3 - 10 million annually for the city of Austin, Texas (see for example www.batcon.org and http://cornyn.enews.senate.gov). Pennisi *et al.* (2004) also gave a practical example of using bats for tourism. Conservation of the caves such as in Kagenge and removal of human interference could see the caves getting occupied by bats that could then also be marketed as a component of a specialist tourist package.

The Murehe woodlands

Not very far removed from Cyohoha and separating it from Lake Rweru, Murehe presents an opportunity for an ecosystem that could be developed in a tourism chain that would include the two lakes in a package of foot safaris and boat rides. Enhanced management and patrol of the Murehe ecosystem could allow mammal populations to recover for purposes of developing tourism based on large mammals.

Tourism based on viewing of remaining few large mammals can still be an opportunity if such animals are confined to zoos or wildlife education centres in the area to show collection of the heritage of large mammals previously known to the area and improve the chances of sighting them since the chances of seeing them in the wilderness are very slim.

8.6 References

Kagera River Basin Monograph/Database Team (2007), *Kagera River Basin Trans-boundary Integrated Water Resources Management and Development Project*: *Kagera River Basin Monograph Basin Development Report* Draft prepared for stakeholder review and discussion, including French executive summary.

Chemonics International Inc. (2003), Rwanda Environmental Threats and Opportunities Assessment Task Order No. 818 under the Biodiversity & Sustainable Forestry (BIOFOR) IQC USAID Contract No. LAG-I-00-99-00014-00

Cornyn J A texas Visitor Heads south for winter. http://cornyn.enews.senate.gov/common/maillings

Fujita, M. S. & Tuttle, M. D. (1991), Flying foxes (Chiroptera: Pteropodidae): threatened animals of key ecological and economic importance. Conserv. Biol. 5, 455 - 463.

Huffman B., 2004 *Tragelaphus spekii* Sitatunga www.ultimateungulate.com

Huggins C. and Musahara H (2004)**Land Reform, Governance and the Environment: The Case of Rwanda (DRAFT)** Paper Prepared for 4th Regional Session of the Global Biodiversity Forum (GBF) for Africa, White Sands Hotel and Resort, Dar es Salaam, Tanzania 9-11 June 2004, Workshop on Biodiversity, African Governance and land Reform

http://www.batcon.org/home/index.asp?print

http://www.lubee.org/about-whyconserve.aspx

Luigi B., Corsi F., De Blaise A., Caranza M.D, Ravagli M., Reggiani G., Sinibaldi I., Trapanese P., 1999. A Databank for the conservation and Management of the African Mammals.

Ministry of Lands, Resettlement and Environment 2003. National strategy and action plan for the conservation of biodiversity in Rwanda.

Nile Basin Initiative Nile Equatorial Lakes Subsidiary Action Program 2005. Strategic/Sectoral, Social and Environmental Assessment of Power Development Options in The Nile Equatorial Lakes Region Stage II *Final Stakeholder Consultation Report*

Ntakimazi, G., Nzigidahera, B., Nicayenzi, F. et West, K. 2000 L'Etat De La Diversite Biologique Dans Les Milieux Aquatiques Et errestres Du Delta De La Rusizi. Étude Spéciale De Biodiversité (ESBIO) Rapport

Nzigidahera B., Fofo A. et Misigaro A. 2005 Paysage Aquatique Protégé Du Nord Du Burundi *Etude D'identification*

Nzigidahera B 2007. Mammiferes du Burundi *Lexique de noms Kirundi.*

Nzigidahera B. 2007. Resource biologues savages du Burundi: Etat des connaissances traditionalles.

Pennisi L. A., Holland S. M and Stein T. V. 2004 Achieving Bat Conservation Through Tourism Journal of Ecotourism Vol. 3, No. 3

Republic of Burundi Ministry of Urban Planning, Tourism and Environment 2006 National Biosafety Framework in Burundi

Rowe-Rowe, D. (1986) African Otters - is their Existence Threatened? IUCN Otter Spec. Group Bull. **1**: 9 – 11

Stuart C.T. and Stuart M.D 2006. Field Guide to the larger Mammals of Africa. Struik Publishers

Taylor D.A.R, Kankam B.O., and Wagner M.R., 2007 The role of the fruit bat, *Eidolon helvum,* in seed dispersal, survival, and germination in *Milicia excelsa,* a threatened West African hardwood.

UNEP-WCMC (2005). *Checklist of mammals listed in the CITES appendices and in EC Regulation 338/97*. 7th edition. JNCC Report No. 380.

USAID/Rwanda Integrated Strategic Plan 2004-2009 Volume 2: Annexes

Vanden Bossche, J.-P.; Bernacsek, G.M. 1990. Source book for the inland fishery resources of Africa: 1. CIFA Technical Paper. No. 18.1. Rome, FAO.. 240p.

Appendices

Appendix 8.1: Potential list of medium to large sized mammals in and around the Lake Cyohoha ecosystem (based on Luigi *et. al.* 1999)

Species	English Name	IUCN Status
Atelerix albiventris	Four-toed hedgehog	LR/cd
Micropotamogale ruwenzorii	Ruwenzori Otter Shrew	NT
Petrodomus tetradactylus	Four-toed Elephant-Shrew	LC
Potamogale velox	Giant Otter Shrew	LC
Perodicticus potto	Bosman's Potto	LR/lc
Galago senegalensis	Lesser Galago	LR/lc
Galagoides demidoff	Dwarf Galago	LR/lc
Otolemur crassicaudatus	Greater Galago	LR/lc
Cercopithecus aethiops	Vervet monkey	LR/lc
Cercopithecus ascanius	Redtail monkey	LR/lc
Cercopithecus lhoesti	L'Hoest's Monkey	LR/nt
Cercopithecus mitis	Blue monkey	LR/lc
Colobus angolensis	Angolan colobus	LR/lc
Colobus guereza	Guereza colobus	LR/lc
Papio anubis	Olive Baboon	LR/lc
Pan troglodytes	Chimpanzee	EN A3cd
Canis adustus	Side-striped Jackal	LC
Canis aureus	Jackal Asiatia	LC
Aonyx capensis	Cape clawless otter	LC
Aonyx congicus	Congo Clawless Otter	DD
Ictonyx striatus	Striped Polecat Zorilla	LR/lc
Lutra maculicollis	African Spot-necked Otter	LC
Mellivora capensis	Ratal/Honey Badger	LR/lc
Poecilogale albinucha	East African Striped Weasel	LR/lc
Genetta servalina	Servaline genet	LR/lc
Genetta genetta	Small spotted Genet	LR/lc
Nandinia binotata	African Palm Civet	LR/lc
Civettictis civetta	African civet	LR/lc
Atilax paludinosus	Wetland Mongoose	LR/lc
Helogale parvula	Dwarf mongoose	LR/lc
Herpestes ichneumon	Ichneumon Mongoose	LR/lc
Herpestes sanguineus	Slender mongoose	LR/lc
Ichneumia albicauda	White-tailed Mongoose	LR/lc
Mungos mungo	Banded Mongoose	LR/lc
Crocuta crocuta	Spotted Hyaena	LR/cd
Felis serval	Serval	LC
Felis silvestris	Wild Cat	LC
Panthera leo	Lion	VU A2abcd
Panthera pardus	Leopard	LC
Equus burchelli	Grant's Zebra	LC
Dendrohyrax arboreus	Southern Tree Hyrax	LC
Heterohyrax brucei	Bruce's dassie	LC

Procavia capensis	Johnaston's dassie	LC
Orycteropus afer	Aardvark	LC
Aepyceros melampus	Impala	LR/cd
Alcelaphus lichtensteinii	Lichtenstin's Hartebeest	LR/cd
Cephalophus monticola	Blue duiker	LR/nt
Cephalophus nigrifrons	Black-fronted duiker	LR/nt
Cephalophus weynsi	Weyn's duiker	LR/nt
Damaliscus lunatus	Topi	LR/cd
Hippotragus equinus	Roan antelope	LR/cd
Kobus ellipsiprymnus	Defassa waterbuck	LR/cd
Oreotragus oreotragus	Klipspringer	LR/cd
Ourebia ourebi	Oribi	LR/cd
Redunca redunca	Bohor reedbuck	LR/cd
Sylivicapra grimmia	Bush/ Common duiker	LR/lc
Syncerus caffer	African Buffalo	LRcd
Taurotragus oryx	Eland	LRcd
Tragelaphus scriptus	Bushbuck	LR/lc
Tragelaphus spekeii	Sitatunga	LR/nt
Hippopotamus amphibius	Hippopotamus	VU A4cd
Hylochoerus meinertzhageni	Giant Forest Hog	LR/lc
Phacochoerus africanus	Warthog	LR/lc
Potamochoerus larvatus	Bushpig	LR/lc
Manis gigantea	Giant Pangolin	LR/lc
Manis tricuspis	Tree Pangolin	LR/lc
Atherurus africanus	Brush-tailed porcupine	LC
Hystrix africaeaustralis	South African Porcupine	LC
Hystrix cristata	Crested porcupine	LC
Lepus capensis	Cape Hare	LR/lc
Lepus victoriae		LR/lc
Poelagus marjorita	Central African Hare	LR/lc

Appendix 8.2: Checklist of the mammals of Burundi and of Rwanda

Order and English name	Scientific name	IUCN Status
Tubulidentata		
Aardvarks	*Orycteropus afer*	LC
Hyracoidea		
Western Tree Hyrax	*Dendrohyrax dorsalis*	LC
Yellow-spotted Rock Hyrax	*Heterohyrax brucei*	LC
Proboscidea		
African Bush Elephant	*Loxodonta africana*	VU
Primates		
Potto	*Perodicticus potto*	LR/lc
Demidoff's Dwarf Galago	*Galago demidoff*	LR/lc
Eastern Needle-clawed Bushbaby	*Galago matschiei*	LR/nt
Mohol Galago	Galago moholi	LR/lc
Senegal Bushbaby	*Galago senegalensis*	LR/lc
Thomas's Bushbaby	*Galago thomasi*	LR/lc

Order and English name	Scientific name	IUCN Status
Brown Greater Galago	*Otolemur crassicaudatus*	LR/lc
Vervet/Grivet Monkey	*Chlorocebus aethiops*	LR/lc
Black-cheeked White-nosed Monkey	*Cercopithecus ascanius*	LR/lc
Hamlyn's Monkey	*Cercopithecus hamlyni*	LR/nt
L'Hoest's Monkey	*Cercopithecus lhoesti*	LR/nt
Blue Monkey	*Cercopithecus mitis*	LR/lc
Grey-cheeked Mangabey	*Lophocebus albigena*	LR/lc
Olive Baboon	*Papio anubis*	LR/lc
Angola Colobus	*Colobus angolensis*	LR/lc
Mantled Guereza	*Colobus guereza*	LR/lc
Eastern Gorilla	*Gorilla beringei*	EN
Common Chimpanzee	*Pan troglodytes*	EN
Rodentia		
Cape Porcupine	*Hystrix africaeaustralis*	LC
Greater Cane Rat	*Thryonomys swinderianus*	LC
Striped ground squirrel	*Xerus erythropus*	LC
Carruther's Mountain Squirrel	*Funisciurus carruthersi*	LC
Red-legged Sun Squirrel	*Heliosciurus rufobrachium*	LC
Ruwenzori Sun Squirrel	*Heliosciurus ruwenzorii*	LC
Boehm's Bush Squirrel	*Paraxerus boehmi*	LC
Forest Giant Squirrel	*Protoxerus stangeri*	LC
Ruanda Mole Rat	*Tachyoryctes ruandae*	LC
Delany's Swamp Mouse	*Delanymys brooksi*	EN
Remarkable Climbing Mouse	*Dendromus insignis*	LC
Kivu Climbing Mouse	Dendromus kivu	LC
Gray Climbing Mouse	*Dendromus melanotis*	LC
Chestnut Climbing Mouse	*Dendromus mystacalis*	LC
Forest Poouch Rat	*Cricetomys emini*	LC
Gambian Pouch Rat	*Cricetomys gambianus*	LC
Congo Forest Mouse	*Deomys ferrugineus*	LC
Medium-tailed Brush-furred Rat	*Lophuromys medicaudatus*	NT
Rahm's Brush-furred Rat	*Lophuromys rahmi*	NT
Woosnam's Brush-furred Rat	*Lophuromys woosnami*	LC
Tropical Vlei Rat	*Otomys tropicalis*	LC
Boehm's Gerbil	*Tatera boehmi*	LC
Kemp's Gerbil	*Tatera kempi*	LC
Savanna Gerbil	*Tatera valida*	LC
Hinde's Rock Rat	*Aethomys hindei*	LC
Kaiser's Rock Rat	*Aethomys kaiseri*	LC
African Water Rat	*Colomys goslingi*	LC
Woodland Thicket Rat	*Grammomys dolichurus*	LC
Shining Thicket Rat	*Grammomys rutilans*	LC
Ruwenzori Hybomys	*Hybomys lunaris*	VU
Peters' Striped Mouse	*Hybomys univittatus*	LC
Montane Wood Mouse	Hylomyscus denniae	LC
Stella Wood Mouse	*Hylomyscus stella*	LC
Buffoon Lemniscomys	*Lemniscomys macculus*	LC
Typical Striped Grass Mouse	*Lemniscomys striatus*	LC
Guinea Multimammate Mouse	*Mastomys erythroleucus*	LC
Natal Multimammate Mouse	*Mastomys natalensis*	LC
Dwarf Multimammate Mouse	*Mastomys pernanus*	DD
Toad Mouse	*Mus bufo*	LC
African Pygmy Mouse	*Mus minutoides*	LC

Order and English name	Scientific name	IUCN Status
Thomas's Pygmy Mouse	*Mus sorella*	LC
Gray-bellied Pygmy Mouse	*Mus triton*	LC
Mill Rat	*Mylomys dybowskii*	LC
Rufous-nosed Rats	*Oenomys hypoxanthus*	LC
Creek Groove-toothed Swamp Rat	*Pelomys fallax*	LC
Hopkins's Groove-toothed Swamp Rat	*Pelomys hopkinsi*	VU
Degraaffi Soft-furred Mouse	*Praomys degraaffi*	VU
Jackson's Soft-furred Mouse	*Praomys jacksoni*	LC
Kemp's Thicket Rat	*Thamnomys kempi*	VU
Charming Thicket Rat	*Thamnomys venustus*	NT
Hildegarde's Zelotomys	*Zelotomys hildegardeae*	LC
Lagomorpha		
Bunyoro Rabbit	*Poelagus marjorita*	LR/lc
Cape Hare	*Lepus capensis*	LR/lc
African Savanna Hare	*Lepus microtis*	LR/lc
Erinaceomorpha		
Four-toed Hedgehog	*Atelerix albiventris*	LR/lc
Soricomorpha		
Tiny Musk Shrew	*Crocidura fuscomurina*	LC
Hildegarde's Shrew	*Crocidura hildegardeae*	LC
Jackson's Shrew	*Crocidura jacksoni*	LC
Lemara Shrew	*Crocidura lanosa*	VU
Greater Gray-brown Musk Shrew	*Crocidura luna*	LC
Tenebrous Shrew	*Crocidura nigrofusca*	LC
Small-footed Shrew	*Crocidura parvipes*	LC
Roosvelt's Shrew	*Crocidura roosevelti*	LC
Tumultuous Shrew	*Crocidura turba*	LC
Greater Shrew	*Paracrocidura maxima*	NT
Ruwenzori Shrew	*Ruwenzorisorex suncoides*	VU
Armored Shrew	*Scutisorex somereni*	LC
Grant's Shrew	*Sylvisorex granti*	LC
Johnston's Shrew	*Sylvisorex johnstoni*	LC
Crescent Shrew	Sylvisorex lunaris	LC
Climbing Shrew	*Sylvisorex megalura*	LC
Volcano Shrew	*Sylvisorex vulcanorum*	LC
Chiroptera		
Straw-coloured Fruit Bat	*Eidolon helvum*	LC
Ethiopian Epauletted Fruit Bat	*Epomophorus labiatus*	LC
Wahlberg's Epauletted Fruit Bat	*Epomophorus wahlbergi*	LC
Dobson's Fruit Bat	Epomops dobsoni	LC
Franquet's Epauletted Fruit Bat	*Epomops franqueti*	LC
Angolan Rousette	*Lissonycteris angolensis*	LC
Peter's Dwarf Epauletted Fruit Bat	*Micropteropus pusillus*	LC
Little Collared Fruit Bat	*Myonycteris torquata*	LC
Egyptian fruit bat	*Rousettus aegyptiacus*	LC
Long-haired Rousette	*Rousettus lanosus*	LC
Rufous Mouse-eared Bat	*Myotis bocagii*	LC
Cape Hairy Bat	*Myotis tricolour*	LC
Welwitch's Bat	*Myotis welwitschii*	LC
Silvered Bat	*Glauconycteris argentata*	LC
Butterfly Bat	*Glauconycteris variegata*	LC
Banana Pipistrelle	*Neoromicia nanus*	LC
Rendall's Serotine	*Neoromicia rendalli*	LC

Order and English name	Scientific name	I U C N Status
Somali Serotine	*Neoromicia somalicus*	LC
White-winged Serotine	*Neoromicia tenuipinnis*	LC
RÜppel's Pipistrelle	*Pipistrellus rueppelli*	LC
African Yellow Bat	*Scotophilus dinganii*	LC
Nut-coloured Yellow Bat	*Scotophilus nux*	LC
Lesser Long-fingered Bat	*Miniopterus fraterculus*	LC
Greater Long-fingered Bat	Miniopterus inflatus	LC
Gland-tailed Free-tailed Bat	*Chaerephon bemmeleni*	LC
Spotted Free-tailed Bat	*Chaerephon bivittata*	LC
Little Free-tailed Bat	*Chaerephon pumila*	LC
Angolan Free-tailed Bat	*Mops condylurus*	LC
Midas Free-tailed Bat	*Mops midas*	LC
Railer Bat	*Mops thersites*	LC
Large-eared Free-tailed Bat	*Otomops martiensseni*	NT
Madagascan Large Free-tailed Bat	*Tadarida fulminans*	LC
Bate's Slit-Faced Bat	*Nycteris arge*	LC
Hairy Slit-Faced Bat	*Nycteris hispida*	LC
Large-Eared Slit-Faced Bat	*Nycteris macrotis*	LC
Dwarf Slit-Faced Bat	*Nycteris nana*	LC
Egyptian Slit-Faced Bat	*Nycteris thebaica*	LC
Yellow-winged bat	*Lavia frons*	LC
Geoffroy's Horseshoe Bat	*Rhinolophus clivosus*	LC
Eloquent Horseshoe Bat	*Rhinolophus eloquens*	DD
RÜppell's Horseshoe Bat	*Rhinolophus fumigatus*	LC
Hildebrandt's Horseshoe Bat	*Rhinolophus hildebrandti*	LC
Hill's Horseshoe Bat	*Rhinolophus hilli*	CR
Lander's Horseshoe Bat	Rhinolophus landeri	LC
Ruwenzori Horseshoe Bat	*Rhinolophus ruwenzorii*	VU
Sundevall's Roundleaf Bat	*Hipposideros caffer*	LC
Cyclops Roundleaf Bat	*Hipposideros cyclops*	LC
Noack's Roundleaf Bat	*Hipposideros ruber*	LC
Pholidota		
Giant Pangolin	*Manis gigantea*	LR/lc
Ground Pangolin	Manis temminckii	LR/nt
Long-tailed Pangolin	*Manis tetradactyla*	LR/lc
Carnivora		
Wildcat	*Felis silvestris*	LC
Serval	*Leptailurus serval*	LC
African Golden Cat	*Profelis aurata*	VU
Lion	*Panthera leo*	VU
Leopard	Panthera pardus	LC
African Civet	*Civettictis civetta*	LR/lc
African Palm Civet	*Nandinia binotata*	LR/lc
Wetland Mongoose	*Atilax paludinosus*	LR/lc
Slender Mongoose	*Galerella sanguinea*	LR/lc
Egyptian Mongoose	*Herpestes ichneumon*	LR/lc
Banded Mongoose	*Mungos mungo*	LR/lc
Spotted Hyena	*Crocuta crocuta*	LR/cd
Side-striped Jackal	*Canis adustus*	LC
African Wild Dog	*Lycaon pictus*	EN
Striped Polecat	*Ictonyx striatus*	LR/lc
African Striped Weasel	*Poecilogale albinucha*	LR/lc
Ratel	*Mellivora capensis*	LR/lc

Order and English name	Scientific name	IUCN Status
Speckle-throated Otter	*Lutra maculicollis*	LC
African Clawless Otter	*Aonyx capensis*	LC
Oriental Small-clawed Otter	*Aonyx congicus*	DD
Perissodactyla		
Burchell's Zebra	*Equus burchellii*	LC
Black Rhinoceros	*Diceros bicornis*	CR
Artiodactyla		
Warthog	*Phacochoerus africanus*	LR/lc
Giant forest hog	*Hylochoerus meinertzhageni*	LR/lc
Bushpig	*Potamochoerus larvatus*	LR/lc
Hippopotamus	*Hippopotamus amphibius*	VU
Warer Chevrotain	*Hyemoschus aquaticus*	DD
Topi	*Damaliscus lunatus*	LR/cd
Klipspringer	*Oreotragus oreotragus*	LR/cd
Oribi	*Ourebia ourebi*	LR/cd
African Buffalo	*Syncerus caffer*	LR/cd
Common Eland	*Tragelaphus oryx*	LR/cd
Bushbuck	*Tragelaphus scriptus*	LR/lc
Sitatunga	*Tragelaphus spekii*	LR/nt
Peters's Duiker	*Cephalophus callipygus*	LR/nt
Blue Duiker	*Cephalophus monticola*	LR/lc
Black-fronted Duiker	Cephalophus nigrifrons	LR/nt
Yellow-backed Duiker	*Cephalophus silvicultor*	LR/nt
Weyns's Duiker	*Cephalophus weynsi*	LR/nt
Common Duiker	*Sylvicapra grimmia*	LR/lc
Roan Antelope	*Hippotragus equinus*	LR/cd
Impala	*Aepyceros melampus*	LR/cd
Waterbuck	*Kobus ellipsiprymnus*	LR/cd
Bohor Reedbuck	*Redunca redunca*	LR/cd

Appendix 8.3: Mammal species recorded for the Lake Cyohoha Sub-Basin November/December 2007

Species	English name	Kirundi/Rwanda Name	Method	Notes
Crocidura gracilipes[I]	Peter's Musk Shrew	Umushushwe	FRC	a
Crocidura olivieri[I]	Giant Musk Shrew	Umushushwe	FRC	a
Epomophorus labiatus[C]	Little Epauletted Fruit Bat	Agahungarema	FRC	a
Nycteris hispida[C]	Hairy Slit faced Bat	Agahungarema	FRC	a
Eptesicus tennuipinis[C]	White winged Serotine	Agahungarema	FRC	a
Myotis bocagei[C]	Rufous moused eared Bat	Agahungarema	FRC	a
Scotoecus hirundo[C]	Dark winged lesser House Bat	Agahungarema	FRC	a
Chaerophon pumila[C]	Little Free-tailed Bat	Agahungarema	FRC	a
Cercopithecus aethiops[P]	Grivet/ Vervet Monkey	Inkende	In	b
Cercopithecus mitis[P]	Blue Monkey	Inkima	In	b
Canis adustus[Cv]	Side striped Jackal	Imbwebwe	In	a
Felis aurata[Cv]	African Golden Cat	Ibikara/Igikara/ Ikigomba	In	c
Felis serval[Cv]	Serval Cats	Imondo	In	a
Felis silvestris[Cv]	African Wild Cat	Injangwa	In	b

Species	English name	Kirundi/Rwanda Name	Method	Notes
Atilax paludinosus[Cv]	Wetland Mongoose	Umukenke	In	b
Helogale parvula[Cv]	Dwarf Mongoose	Umukara	In	b
Mungos mungos[Cv]	Banded Mongoose	Umukenke	In	b
Herpestes ichneumon[Cv]	Egyptian Mongoose	Umuterere/ Igikara/ Umukenke	In	b
Herpestes sanguineus[Cv]	Slender Mongoose		In	b
Poecilogale albinuca[Cv]	Striped Weasel	Akasamunyiga	In	b
Aonyx capensis/congica[Cv]	African/ Congo Clawless	Igihura	In	b
Lutra maculicoli[Cv]	African Spot-necked Otter	Inzivyi	FRC & In	a
Mellivora capensis[Cv]	Honey Badger	Umusakanyika	In	b
Civettictus civetta[Cv]	African Civet	Igihimbi	In	b
Genetta genetta[Cv]	Small spotted Genet	Orutoni	In	b
Equs quaga[P]	Zebra	Imparage	In	c
Heterohyrax brucei[H]	Yellow spotted Rock Hyrax		In	b
Syncerus cafer[Ar]	Buffalo	Imbogo	In	c
Aepyceros melampus[Ar]	Impala	Impara	In	c
Tragelaphus scriptus[Ar]	Bushbuck	Impongo	In	a
Kobus ellipsiprymnus[Ar]	Waterbuck	Indonyi	In	c
Sylivicapra grimmia[Ar]	Common Bush Duiker	Ingeragere	In	a
Tragelaphus spekii[Ar]	Sitatunga	Injobe	In	b
Hippotamus amphibius[Ar]	Hippopotamus	Invubu	In	a
Hylochoerus meinertzhageni[Ar]	Giant forest Hog	Isatura	In	c
Potamochoerus porcus[Ar]	Bush pig	Ngurube	In	c
Manis gigantea[Ph]	Giant pangolin	Igisamunjojo	In	c
Cricetomys gambianus[R]	Gambian Giant Rat	Isiha	In	b
Atherurus africanus[R]	African Brush tailed	Ikinyugutu	In	b
Hystrix africae-australis[R]	South African Porcupine	Ikinyugutu	In	b
Lemniscomys striatus[R]	Common Striped grass Mouse	Imende	FRC	a
Aethomys kaiseri pedester[R]		Imbeba	FRC	a
Dasmys incomtus[R]	Shaggy Wetland rat	Imbeba	FRC	a
Grammomys dolichurus[R]	Common thicket Rat	Imbeba	FRC	a
Mastomys natalensis[R]	Multimate Rat	Imbeba	FRC	a
Mus triton[R]	Grey bellied Pygmy Mouse	Imbeba	FRC	a
Oenomys hypoxanthus[R]	Rusty nosed Rat	Imbeba	FRC	a
Graphiurus murinus[R]	Common Dormouse	Imbeba	FRC	a
Tachyoryctes splendens[R]	Mole Rat	Ifuku	FRC	a
	Tree squirrels	Umuhare	In	b
Lepus whytei[L]	Hare	Inkwavu	In	a
Elephantulus rufescens[M]	Rufous Elephant Shrew		FRC	a

Notation for the table

These letters as superscripts represent the following orders : - Ar – Artiodactyla, C – Chiroptera, Cv – Carnivora, H – Hyracoidea, I – Insectivora, L – Largomopha, M – Macroscelidea, R- Rodentia, P – Perisodactyla, Ph – Pholidota, FRC – Actual field record from trapping, netting, sighting, fecal pellets, skeletal material or spoors/footprints
In – Record from interviews

a, b and c are the same as in table 1

Chapter Nine

Chapter Nine

Socio-economic status of Lake Cyohoha Sub-Basin

Fredrick Williams Kiwazi

Ministry of Lands, Water & Environment, Kampala. Email: kiwazi@gmail.com

9.1 Introduction

9.1.1 Importance of the sub-basin resources in supporting livelihoods

This chapter deals with the linkage of the unique sub-basin ecosystem (both terrestrial and aquatic) to livelihood. The Lake Cyohoha Sub-Basin has rich biodiversity, some of which has not been adequately described before. This biodiversity has suffered over the last 20 years due to loss of natural habitat occasioned by the need to support livelihood in the area.

The catchment is an exclusively agricultural area with serious threat of soil erosion and siltation which threatens the existence of Cyohoha lakes and their potential as the main freshwater body for surrounding communities and biodiversity conservation. Its hydrology is important to the existence of the wetlands and biodiversity in the Akanyaru, Nyabarongo and Akagera tributaries which feed in the main Kagera River.

9.1.2 Demographic and socio-cultural aspects

9.1.2.1 Population

According to the most recent census, Burundi (2005) and Rwanda (2002) have a natural growth rate of 3.1% (UNDP, Dec. 1997). The population density in the sub-basin is put at 205 inhabitants/km^2 for Bugesera. 289 for Busoni, 315 for Bugabira and 449 for Kirundo (Table 9.1). Compared to the national average of 273 in Burundi and 321 in Rwanda, this density is unsustainably high. As expected, areas like Ngeruka, Ruhuha and Nyarugenge with brisk trans-boundary businesses have population densities between 345 and 400 habitants/km^2 (UNDP, GoR and UNEP 2007).

The active population (15 – 64 years) is about 45.2% in Busoni, 47.5% in Kirundo, 45.0% in Bugabira and only 15.6% in Bugesera. Majority of the population consists of children below 15 years of age. In the district of Bugesera and communes of Busoni, Kirundo and Bugabira, which are in the Lake Cyohoha Sub-Basin, it has been reported that less than 55% of the population can read and write (Figures 9.1 - 9.5 and Table 9.1 - 9.5).

9.1.2.3 Social cohesion

Social cohesion is low compared to other parts of Rwanda and Burundi. Many people in these areas are immigrants probably resulting from civil strife of the 1990s in the two countries. Since 1960, the sub-basin has experienced inflow of people which progressively changed the demographic structure.

Most people came in to search for better ecosystem services, especially for food production and access to water. As expected, this resulted into loss of the natural vegetation of the savannah, woodlands, forests and now the wetlands.

Demographic figures further show that the growth rate in Bugesera district slowed down between 1991 and 2002 which may be explained by **(i)** 1994 genocide, **(ii)** 1999-2004 drought–induced famine, and **(iii)** other related factors. All these led to massive deaths and migrations.

The annual income per capita is put at about US $210 which is low and hence many have to live on less US $1per day (Table 9.5).

TABLE 9.1: Basic data – population

Commune adjacent to lake in Burundi	Sub-basin zones	Population						
		M	**F**	**T**	**Density:**	**Active pop. (15-64yrs.)**		
					prs/ Km2	**M**	**F**	**T**
Busoni (420.9km2)	5	58,924	62,711	121,626	289	25,570	29,389	54,959
Kirundo (207.34km2)	4	44,619	48,665	93,284	449	20,551	23,790	44,341
Bugabira (235.32km2)	3	35,448	38,800	74,248	315	15,169	18,209	33,378
Districts adjacent to lake in Rwanda	**Sub-basin sectors**							
Bugesera (1,334km2)	4	131, 979	142,134	274,113	205	21,973	20,856	42,829

Population Structures

FIGURE 9.1: Population pyramid for Bugesera

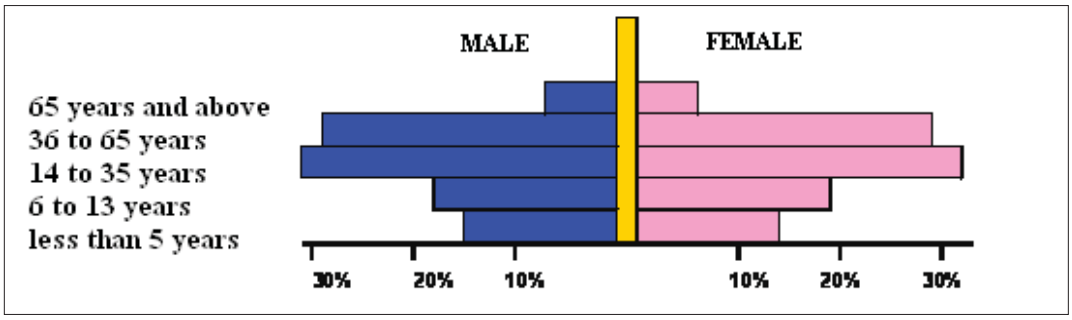

TABLE 9.2: Population per age Busoni Commune

Groups of years old	Sex		
	Men	**Women**	**Total**
0-4	15.850	14.856	30.707
5-9	9.230	9.525	18.755
10-14	6.653	7.088	13.741
15-19	5.165	5.192	10.357
20-24	4.528	5.710	10.238
			83.798
25-29	4.279	4.667	8.946
30-34	3.449	4.019	7.468
35-39	2.529	2.769	5.298
40-44	1.611	2.142	3.753
45-49	1.345	1.621	2.966
50-54	1.225	1.586	2.811
55-59	821	791	1.612
60-64	618	892	1.511
65-69	442	444	886
70-75	398	559	957
70-79	249	261	510
80+	532	586	1.119
Total	**58.924**	**62.711**	121.635

Sources: Population Department in MINITERE

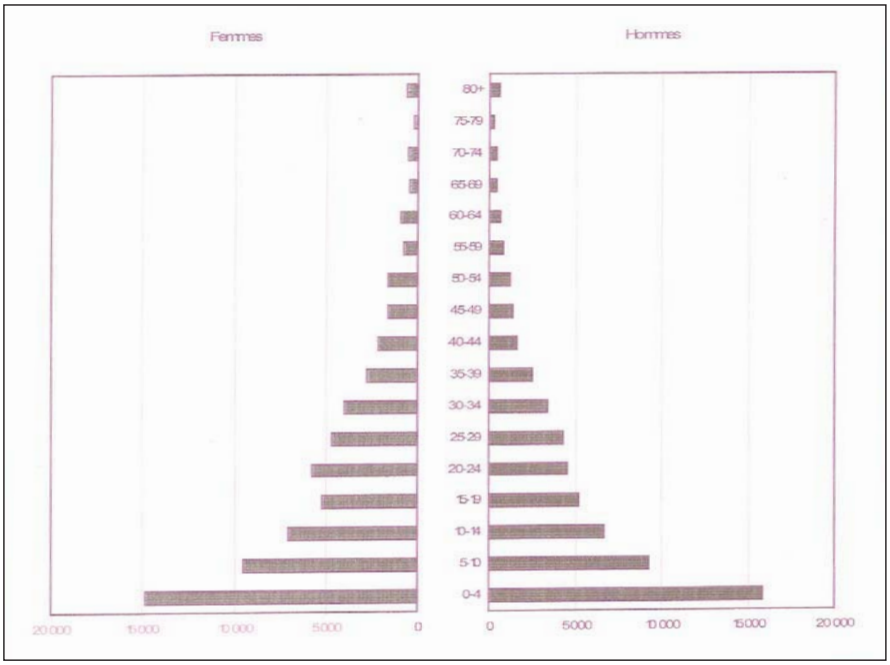

FIGURE 9.2: Population pyramid for Busoni commune

TABLE 9.3: Population per age Bugabira Commune

Groups of years old	Sex		
	Men	Women	Total
0-4	9.045	8.712	17.757
5-9	6.086	6.217	12.303
10-14	4.256	4.459	8.715
15-19	3.216	3.134	6.352
20-24	2.489	3.261	5.749
			50.876
25-29	2.351	2.959	5.312
30-34	2.319	2.757	5.076
35-39	1.444	1.711	3.154
40-44	996	1.235	2.231
45-49	628	893	1.523
50-54	770	1.075	1.845
55-59	441	592	1.034
60-64	515	592	1.107
65-69	244	293	537
70-75	249	387	635
70-79	132	161	293
80+	217	360	631
Total	35.448	38.800	74.248

Source: Population Department, MININTERE

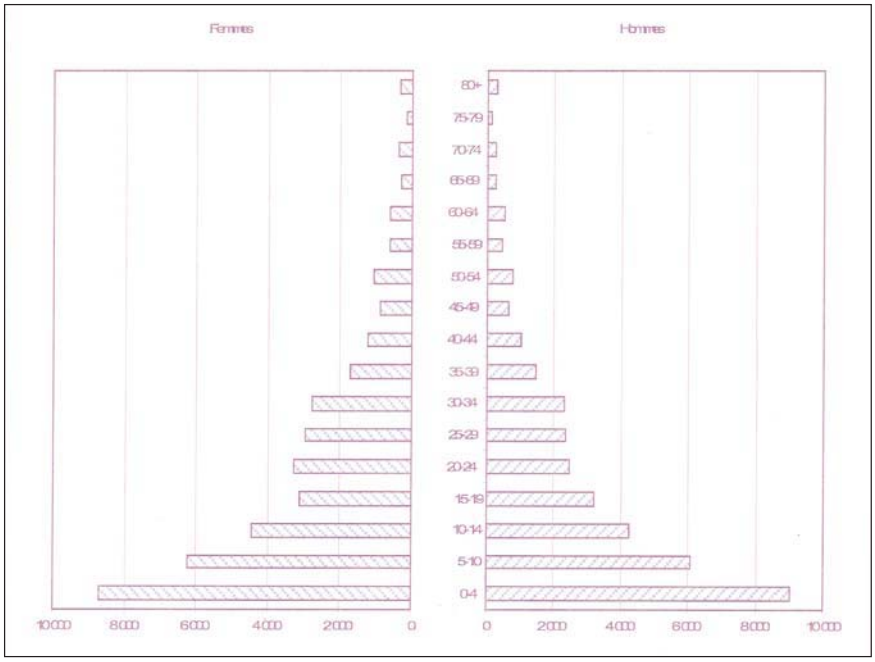

FIGURE 9.3: Population pyramide for Bugabira Commune

TABLE 9.4: Population per age Kirundo Commune

Groups of years old	Sex		
	Men	Women	Total
0-4	10.507	10.633	21.140
5-9	6.812	6.953	13.765
10-14	5.068	5.159	10.227
15-19	3.997	3.999	7.996
20-24	3.464	4.068	7.532
			60.660
25-29	3.449	3.688	7.136
30-34	3.219	3.216	6.435
35-39	2.019	2.153	4.171
40-44	1.320	1.590	2.910
45-49	916	1.289	2.204
50-54	886	1.539	2.427
55-59	623	1.157	1.833
60-64	658	1.157	1.813
65-69	556	656	1.121
70-75	397	666	1.063
70-79	239	311	552
80+	372	494	566
Total	**44.619**	**48.665**	93.284

Source: Population Department, MININTERE

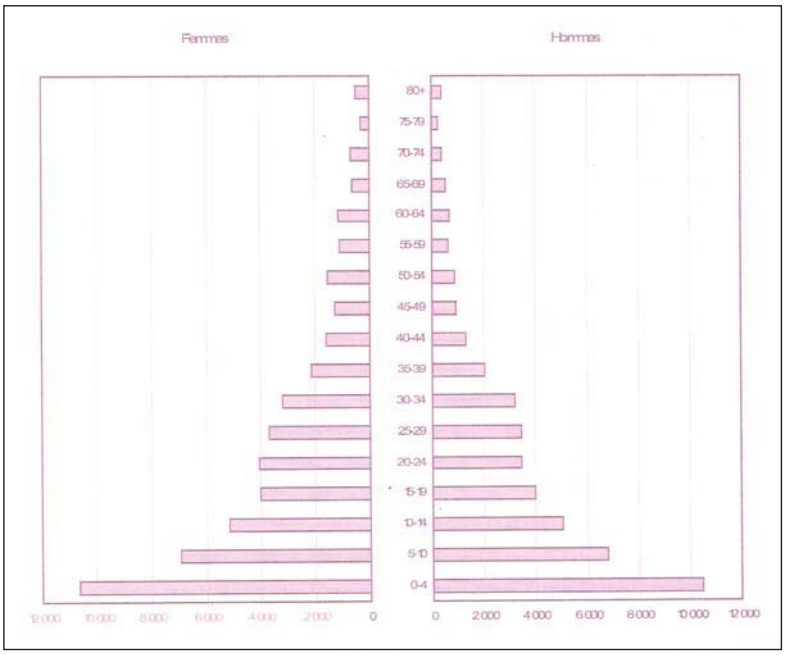

FIGURE 9.5: Population pyramid for Kirundo Commune

The sub-basin is mainly rural with an agricultural subsistence economy. However, given the high population density, unequal land distribution and some areas being held as nature reserves or unfit for agriculture, over 60% of the inhabitants work on less than the FAO recommended 0.9Ha; therefore, they depend on;

- Unskilled labour for food,
- Unskilled labour for cash that is used to buy food from markets,
- Food hand-outs to those without labour (female, child-headed household and the elderly).

This raises concern for the carrying capacity of this fragile ecosystem and the very high dependence ratio.

TABLE 9.5: Livelihood-Poverty indications

	Capable		Poor (about 60%)	
	Better-off	Middle	Fairly poor	Very poor
%of HH	10-20%	20-30%	35-45%	15-25%
HH size	8-10	6-8	6-8	4-6
No. of active people	2-5	2-4	2-3	1(child or elderly)
Characteristics	Salary earners, Traders, Own farms, Employ thers.	Small traders, May employ others.	Work for others Do petty trade.	Rely on food handouts from church, WFP, community.
Livestock	Have >5cows Have >goats Have chicken.	Have <3 cows, Have<8goats, May have pig, chickens, rabbits.	Have<2goats, Some chicken, Some rabbits.	No animals

9.1.3 Organisation/ political structure and institutional arrangement

Despite the difference in naming, the administrative structures in both Burundi and Rwanda are almost similar as indicated in **TABLE** 9.6 and **FIGURE** 9.6 below.

TABLE 9.6: Administrative units in Lake Cyohoha Sub-Basin

Country	Province	Cmne/Dist.	No. Zn/Sctor	Areas in the 1500-1600m catchments
Burundi	Kirundo	Busoni	5	Gatete Rwabikara Marembo Murambi Higiro Nyabisindu
		Kirundo	4	Runyonza Iyalanda
		Bugabira	3	Kiri Kiyonza Gataranda Kigina Nyamabuye Gitwe
Rwanda	Eastern	Bugesera	23	Nyarugenge Ruhuha Ngeruka Kamabuye

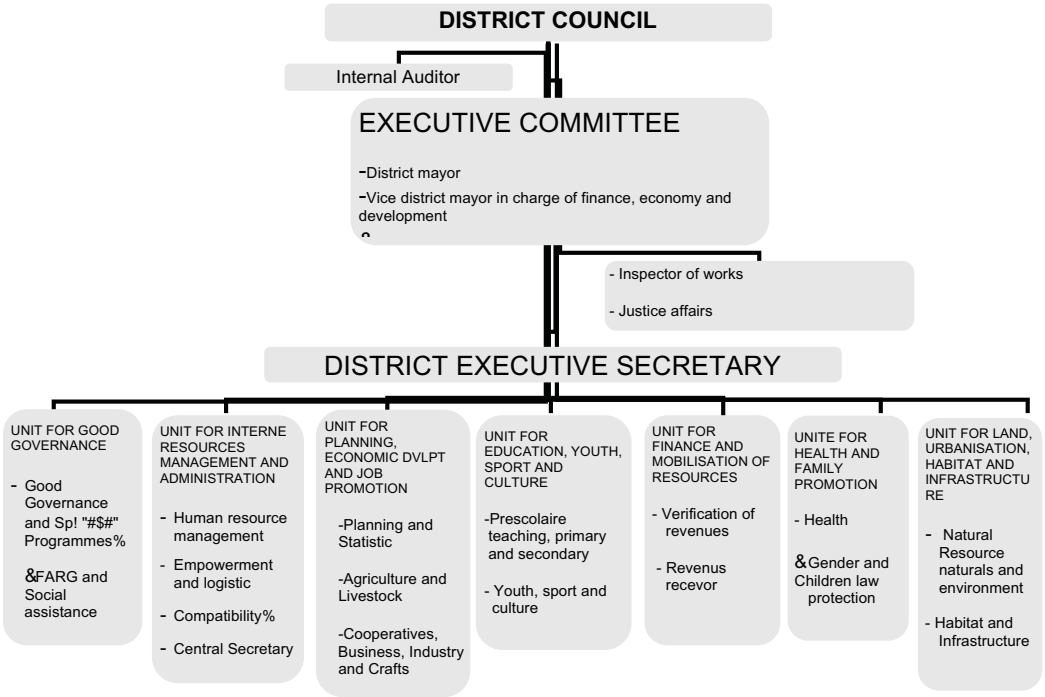

FIGURE 9.6: Administrative structure for Bugesera District

The sub-basin enjoys services from NGOs, cooperatives, civil societes development agencies that support various programmes in the sub-basin. They include Caritas, USAID, UNDP, FAO, USA Peace Corps in collaboration with DAPA and DPAE.

PHOTO 9.1: Types of houses owned by the various groups

1. Rugarama village banana-thatched house

2. Modern rural house in Ruhuha

3. Iron roof

4. Tiled roof

9.1.4 Objectives of the study

The main objective of this study was to assess the socio-economic importance of the resources of Lake Cyohoha Sub-Basin and understand their contribution to the livelihood of those that live in the sub-basin. Specifically the following issues have been addressed;

- The socio-economics of the Lake Cyohoha Sub-Basin including the cultural, gender and indigenous values of the people to the wetlands and biodiversity,
- Major threats that affect wetlands, biodiversity and water resources,
- Economic potential of water, wetlands and biodiversity resources of Lake Cyohoha Sub-Basin,
- Trans-boundary management options of these resources,
- Investment opportunities,
- Flood control measures and prevention of siltation of feeder rivers and lakes in the Lake Cyohoha Sub-Basin.

9.2 Methods used

9.2.1 Selected study sites

9.2.1.1 Criteria

The selected study sites were deemed to be able to yield information considering the available time and resources set for the activity.

9.2.1.2 Sites selected

For practical purposes, sites similar to those studied for wetlands and biodiversity describes in section 4.1.2 and section 8.2 in this report were used.

9.2.2 Approach

9.2.2.1 Situational analysis/document and literature review on the site

Before estimating the human use and non-use benefits, situational analysis through document and literature review (Roggeri, 1995) was undertaken as follows:

a) Expected output: An inventory of probable benefits (IPB)

Resource survey

This was conducted to confirm the existence of the resources/benefits as identified above. Using topographic maps, (1:50,000) and global information systems (GIS), the Lake Cyohoha Sub-Basin area was studied to estimate and resource line transects, each in the direction of a parishes/villages.

Direct observation

Using a checklist, direct observations around the sub-basin were made to cross-check the information already collected from key informants, discussions and resource line transects.

These direct observations were made at various times of the study to bring out the seasonal variation in use of resources and reduce the potential biases associated with timing of the observation. However, this was quite limited and it may lead to more studies in future.

b) Expected output: Definite Inventory of Benefits (DIB)

Structured questionnaire

A questionnaire was used to determine people's willingness to pay (WTP) for the community preferred/most mentioned service(s) or a specified unit area of Lake Cyohoha Sub-Basin.

c) Expected output: A hypothetical value of parts or the whole of the sub-basin.

Economic valuation tools

The diverse nature of goods and service provided by Lake Cyohoha Sub-Basin necessitated the use of a combination of valuation techniques to assign monetary values to the various products.

These included, among others:

- Compilation of market prices for goods for which market prices exist;
- Computing surrogate market prices for goods with no market price but have substitutes in the markets.
- Contingent valuation methods (CVM) or hypothetical markets where no market prices may be forthcoming.

9.3 Data analysis

9.3.1 Total economic value

For a reasonable result package, this study attempted to come up with total economic value (TEV) of the sub-basin, thus bringing out the direct (production and consumption of goods and services), indirect values (ecosystem services and functions), option values (premium placed on future uses and applications) and non-use values. Only selected set benefits of use and non-use were considered during this study.

9.4 Results of the study

9.4.1 Socio economic environments of Lake Cyohoha Sub-Basin

The wetlands and biodiversity have benefits to the various communities in the sub-basin as follows:

9.4.1.1 Flora and livelihood

This involved assessing the ecological influence of the eco-system on socio-economic life of people:

a) Ecological importance of wetlands

Hydrology and climate:- the long lake shoreline avails water, aquatic resources and moist soils to many;

- Barrier against erosion and siltation of waters and hence providing a purifying zone for water;
- Protection of aquatic life/biodiversity;
- Water storage during the rains and controlled discharge during the dry seasons;
- Habitat for biodiversity where dense covers of papyrus, *Typha, Vossia* and *Phramites* under moist cover provide zones of food, reproduction, rest and passage for fish, birds and mammals.

b) Ecological importance of the thickets (savannah, woodlands)

- The physiological nature of the flora reduces the mobilisation of soil moisture for evaporation and evapotranspiration remains limited;
- Control termites in some areas;
- Fights erosion and protects gardens;
- Provides relatively good micro-climate to some habitats for flora and fauna.

The assessment of the above gives an indication to guide the wise-use of the sub-basin given that many socio-economic activities are possible.

9.4.1.1.1 Socio-economic importance of flora resources

Many of the floral species are used in the riparian day-to-day lives in various ways as indicated below:

TABLE 9.7: Use of the floral species in the sub-basin

No.	Use	No. of species used	Remarks
1	Construction of houses	24	This caters for poles, support sticks, fibres, thatch.
2	Firewood	43	Search for firewood is now taking on agricultural residues like maize, sorghum or rice stalks;
3	Food	14	Not popular but with drought-driven famine, *Nymphaea lotus* is harvested for food;
4	Herbal medicine	23	Many community members are knowledgeable about it and information is passed from generation to generation.
5	Handcrafts	21	These handcrafts span the whole socio-cultural spectrum including the grass mats for sleeping on, drying produce or burying the dead.
6	Apiary	4+	Hanging places for the bee-hives.
7	Animal fodder/ pasture	5+	Livestock keeping is an important economic activity of the **Sub-Basin**.
8	Agro-forestry and forestry	26	

Therefore, discussions, interviews and consultations with various stakeholders and field observations around the study sites brought out the provisioning, regulatory, cultural and supporting services (ecosystems services) offered by the Lake Cyohoha Sub-Basin.

9.4.1.2 Limnology and livelihood

Ecological influence of water resources on socio-economic life of people:

- Protection of aquatic life/biodiversity
- Water storage during the rains and controlled discharge during the dry seasons
- Habitat for aquatic biodiversity

Socio-economic importance of water resources

- Main sources of water
- A trans-boundary water transport facility
- A fishing ground to many
- A recreational ground (swimming) to many

9.4.1.3 Invertebrates and livelihood

Invertebrates known by people in Lake Cyohoha Sub-Basin are indicated below:

9.4.1.3.1. Ecological influence of invertebrates on socio-economic life of the people

Many invertebrates are set in many natural processes including food webs, pollinators, cleaners, parasites/pests, vectors, producers (honey/silk), ornamentals, biological controllers, etc.

9.4.1.3.2 Socio-economic importance of invertebrate resources

Their ecological setting clearly brings out economic importance to man in very vital ways, especially as pollinators or producers, part of the food on one hand and agents of death (disease-carriers) on another.

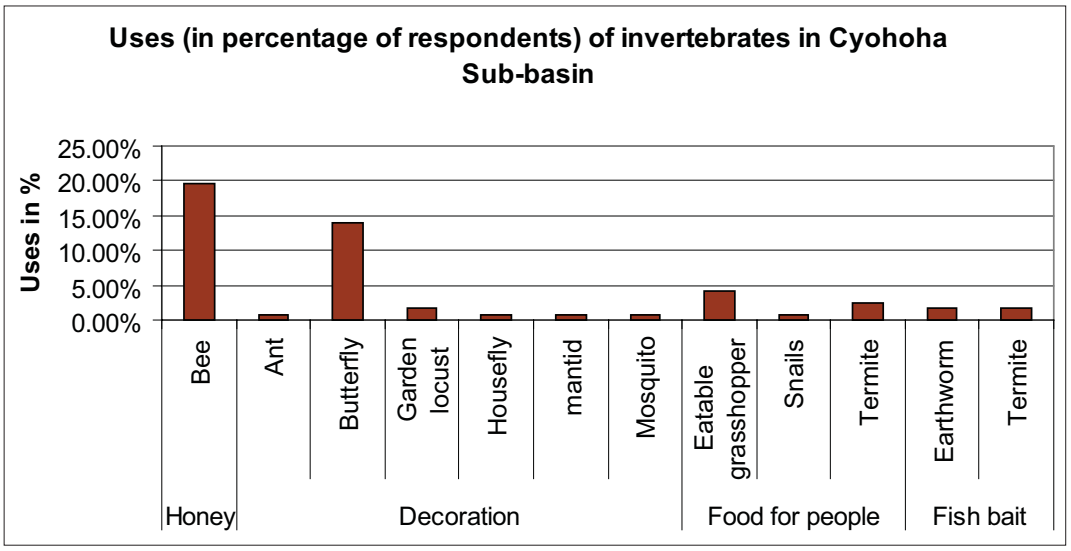

FIGURE 9.6: Uses of invertebrates in the Cyohoha Sub-Basin.

Indicator invertebrates of environmental health: Lice, fleas, ticks, leeches, mosquitoes, Nairobi fly, Brister beetles (Cantharides).

9.4.1.4 Fish and livelihood

Ecological influence of fish on socio-economic life of people

The various fish species are set within the food web of the ecosystem of which people are a part. Smaller fish species (Haplochromis) are in large populations, which is quite normal as they are feeds for larger fish species and people feed on the relatively large ones. The biomass of large planktivorous species (Tilapias) is abnormally low.

Socio-economic importance of fish resources

The fish stocks available for fisheries have dramatically decreased as a consequence of fishing pressure.

In Burundian waters of the lake, the production was about 280 tons per year in the period between 1966 and 1968 (47kg/ha/year) (Roest, 1977). In 1981 - 1982, the annual

production was evaluated at 75 tons (12kg/ha/year) (Ntakimazi, 1985). In Rwandan waters, the production was evaluated, for the same period, at 17kg with a fishing effort three (3) times higher (Chevalier, 1981).

Since the introduction of piscivorous fishes in the lake (Clarias and Protopterus), the potential yield changed in composition and quantities.

To the riparian community and beyond, fish/fishing is an important source of food, income and recreation.

9.4.1.5 Birds and livelihood

A total of 278 bird species representing 60 different families have been documented. This constitutes about 40% of total number of bird species in both Rwanda and Burundi (41% and 40% respectively). A total of six species threatened with extinction have been recorded in Lake Cyohoha Sub-Basin, while another 14 species are known to be rare in the East African region. A total of 74 bird species found here are migrants of whom 88% are Palaearctic and 12% Intra-African migrants.

Overall 32% of the species recorded depend on wetlands for their survival while the rest are terrestrial.

As a sign of biodiversity inter-dependence, food for these bird species have shown that invertebrates form the largest bulk (40%) of the food items utilised by birds in this sub-basin. The next most preferred food item are plant materials, mainly flowers, seeds and fruits (20%); small mammals, birds, fish, amphibians and reptiles are food for a considerable number of birds occurring here.

Ecological influence of birds on socio-economic life of people

These interactions between birds and other biodiversity demonstrate the ecological roles played by birds in this area in facilitating development of food for other biodiversity, and as biological pest control, etc that lead to increased productivity of the ecosystem. Some of the species are scavengers/cleaners (2%) and thus help remove carrion and other discarded waste that would otherwise pollute the environment.

Socio-economic importance of bird resources

The interactions above again reflect the economic role of birds in the sub-basin. The communities, directly or indirectly, utilise certain bird species such as Cranes, Guinea-fowls, Francolins and Doves for food on subsistence and sometimes commercial levels.

Certain species have benefited from traditional believers that protect them from being killed or eaten.

9.4.1.6 Mammals and livelihood

A total of over 50 species of mammals are recorded in the environments around Lake Cyohoha, representing about 26% of the mammalian richness of Rwanda and Burundi.

Eight of these are almost certainly locally extinct from the Lake Cyohoha Sub-Basin while the rest still exist but in the majority of cases in much reduced densities in the case of medium to larger sized mammals. In fact no medium to large size live mammal was seen - a reflection of an absolute low.

Ecological influence of mammals on socio-economic life of people

Generally, mammals are set in the natural plant reproductive/pollination, seed disposal and food web processes that keep the ecosystem of Lake Cyohoha Sub-Basin.

Socio-economic importance of mammal resources

Not much evidence was found to suggest a considerable cultural attachment to mammals in the areas that were visited for these surveys. However, the fact that those mammals have local vernacular names implies that they had significance in the people's lives and as such, uses or value attachments exist.

Several persons who had been hunters were interviewed from among the local communities. It is apparent that hunting for mammals was previously important in the lives of some of the local people. Hunting provided them with meat for home consumption, income generation for necessities of the households, and recreation/sports especially amongst the youth.

Presently, the population of mammals is too low in all areas visited and in most cases the species that were previously hunted are locally rare.

9.4.1.7 Amphibians, reptiles and livelihood

The diversity of reptiles and amphibians of Lake Cyohoha South Sub-Basin ecosystem is relatively high. A total of 69 species including 52 reptiles and 17 amphibians have been documented in this area.

It was noted that much of the natural vegetation that supported the herpetofauna has been removed from the riparian areas; some of the dendritic ends of the lake, that still hold wetland vegetation (of *papyrus, Phragmites and Typha)* are the best refuges left for the amphibian fauna. It is also in these areas where, the remnant populations of the large reptiles like snakes are found. The only natural stretch of bushland left in the sub-basin is the Murehe Forest Reserve.

Ecological influence of herpetofauna resources on socio-economic life of the people

Frogs are very useful in traditional weather forecast; frog calls are associated with on-set of the rain season. During night fishing, the frogs serve as biological clock for fishermen tell day break when the frog choruses subside. Frogs encountered in the gardens are never killed since they are recognised as members of the community.

Socio-economic importance of amphibians and reptiles

Generally, reptiles and amphibians are regarded as having low meaningful benefit to people among the riparian communities of Lake Cyohoha Sub-Basin in Rwanda. However, smaller frog species, the *imitubu*, are captured, sold and used by fishermen as bait on hooks.

Burundians have over the years adopted various use values for some reptile species (Nzigidahera, 2007): reptiles like pythons, crocodiles, terrapins, monitor lizards and vipers are trapped for meat.

Some frog species are consumed especially on a commercial scale in city hotels. So with time, the locals have learnt to catch frogs for sale.

There is a Kirundi proverb that states that "if you kill a frog, your mother will lose her breasts (*Uwishe igikere nyina acika amabere*)". In another saying "Frogs keep jumping as a sign of happiness for not having a tail (*ubwishime bw'igikere bwakibujije kumera umurizo*). This means amphibians are part and parcel of the social setting.

TABLE 9.8: Capture and consumption of amphibians

Species	Capture	Remarks
Hoplobatrachus sp.	Hand capture, or Dip nets by day or preferably night. 9 to 12 individuals can make up to 1 kg of meat.	The most abundantly exploited. 4 – 5 kg can be obtained within one hour at night. 1kg is sold for 2000 - 4000 FBU.
Ptychadena sp.	Hand capture, or Dip nets by day or night. About 40 individuals can make up 1 kg of meat.	Smaller weighing 10 – 15g. Sold for 1500 – 3000 FBU per Kg.

9.4.2. Identified land use systems in the Lake Cyohoha Sub-Basin

9.4.2.1 Crops production

The following were observed as the main land-use systems: Cultivated area, pastureland, thickets (possibly these were forests/woodlots areas), water, and wetlands.

The main food crops grown in the sub-basin are beans, maize, sorghum, cassava and bananas, as well as sweet potatoes, Irish potatoes, rice, ground nuts, soya beans, various vegetables and fruits. Coffee is grown for cash while rice is getting popular for both food and cash.

Agricultural production is getting constrained because of droughts (soil water stress).

The main economic activities identified from each part of the sub-basin component are tabulated below:

TABLE 9.9: Resources from the dry land catchments component, in order of ranking

Activity	Resource	Use	Level
1.Cultivation	Cassava	Food	Mainly subsistence
	Beans		
	Maize		
	Sorghum		
	Bananas		
	Sweet potatoes		
	Fruits*		
	Vegetables**		
	Trees***	Fuel wood, poles, herbal, environment protection, ornamental,	Household use and income generation
	Coffee	Income generation	Small scale
2.Livestock keeping	Local and hybrid cattle	Food, insurance/bank	Small hards ranging from 2-10 for locals while 1-3 zero-grazing hybrids.
	Local and hybrid goats/sheep		
	Local Chicken	Food and income generation	Limited Free-range birds.
3.Natural resource harvesting	Trees	Fuel wood, poles, herbal, handles;	Substance and sale.
	Grass	Grazing/fodder; crafts making	Grazing for domestic animals, crafts for household use and income generation.
	Shrubs/undergrowth	Fodder, Herbal medicine****	Small quantities for household medication.
	Water harvesting from house roofs		Little
	Papyrus/raw materials	Crafts making eg. Mats.	

*Fruits** = pineapples, avocados, mangoes, Vegetables** = cabbages, carrots, dodo/spinach, tomatoes, etc.*
*Trees*** =eucalyptus, gravellia, Ficus spp., markemia, etc.*
Herbal medicine**** = *umuravumba, umubirizi, igikarubamba, ikicamahirwe, umubogora, umukuzanyana,*

PHOTO 9.4: Receiving seeds for planting. The seeds were stored from the previous harvest at Ruhuha Sector headquarters.

TABLE 9.10: Farming activities in a normal seasonal calendar

Period of the year	**Status of rainfall**	**Major farming activities**
February - April	Heavy rains	Planting
May - August	Dry season	Harvesting;
		Planting in wetlands
September – Dec.	Short rains	Harvesting;
		Planting sorghum.

Wetlands cultivation bridges the severe dry seasons and ensures food security and supplements income, but this could be in the short run if not done with the total economic value of wetlands in plan.

Over 30% of the wetlands in the sub-basin have been heavily channelled and cultivated for food crops like pumpkin, sweet potatoes, Irish potatoes and vegetables.

Since 2000, individual households and cooperative societies with the help of research institutions like ISAR and local governments took on wetlands for paddy rice and maize cultivation, and water extraction for irrigation. This form of wetland use, however, requires guidelines to ensure their sustained roles in hydrology and ecological functions.

PHOTO 9.5: Rice growing in Rwabikona wetlands (linking to Lake Cyohoha North

PHOTO 9.6 Mixed cropping in Mayebe flood plain wetland of Akanyaru River

Wetlands cultivation require guidelines to ensure their continued regulatory services (purification, storage, recharge and distribution of surface water from the catchments) that they provide. Therefore, there is an immediate need to:

- Take stock of what wetlands are available.
- Research on the various ecological and hydrological aspects of those wetlands, advise policy-makers accordingly and agree to what use they can be put to.
- Review, revise or develop more relevant rules and regulations, ordinances, national acts or a trans-boundary memoranda of understanding (MoU) on water and wetlands in the two countries.
- Mobilise all the relevant stakeholders to come up with workable wetlands management plans.

This approach will help to ensure that wetlands in the sub-basin are widely used.

The wetlands wise-use is their sustainable utilisation of the benefits to mankind in a way compatible with maintenance of the natural properties of the ecosystem. It is a wise-use of a wetland if it is correctly identified, socially and legally acceptable, economically viable and environmentally sustainable.

Productivity at farms: Discussions with many community members indicated that productivity declined from that of previous years which was attributed to declining soil fertility, low and unpredictable rainfalls, small plots (less than 1ha) to each household, inadequate modern farming and extension services (Tables 9.11 - 9.12).

TABLE 9.11: Reasons for fall in productivity

Causes of fall in productivity	Percentage of surveyed farms
Soil erosion	15.2
Over-cultivation	48.7
Diseases	4.1
Others, including lack of water	32

TABLE 9.12: Comparison of productivity of typical farms and standard (ISAR) plots in Bugesera

Crop	Current productivity on farm (MT/Ha)	Standard productivity at ISAR plots (MT/Ha)
Cassava	15	60
Maize	2.0	4.0
Beans	0.6	3.0
Bananas	12	35

As already indicated, the sub-basin lies between 1,300-1,600m altitude and is characterised by hilly topography and hence one of the prevailing causes of decline in soil productivity is soil erosion.

On average, 27% of the cultivation in Rwanda is done on slopes of more than 20 degrees, 23% is on slopes of 10-20 degrees, 16% is on slopes of 5-10 degrees and 34% is on slopes of 0-5 degrees. Soil erosion increases with increasing slope and going by the C value index that shows the degree of crop cover, the lower the C value the higher the rate of soil erosion (Clay and Lewis 1996).

Generally, the sub-basin, with such characteristic slopes, is losing 22,100 RwF/ha/year (Clay *et al*, 1996), and setting erosion in only its 50% of about 200km2, the sub-basin may be losing well above 221,000,000RwF ($442,000) per year.

This decline was attributed to a number of factors as indicated in TABLE 9.13.

Silting of wetlands, rivers and lakes is mainly a result of the erosion of the catchments in the sub-basin. The eroded soils carry with them highly valued humus and the agro-chemical residues (fertilisers, herbicides, pesticides, etc) leading to various problems in the water bodies. Eventually, the silt is a big loss to the catchments and contributes to the drop in crop productivity.


PHOTO 9.7: Silted River Akanyaru in Mayebe flood plain wetland (Cyiri zone, Bugabira commune)

TABLE 9.13: Resources from the wetlands component, in order of ranking

Activity	Resource	Use	Level
1.Cultivation	Rice	Food	Sale (main) and subsistence.
	Maize	Food	Sale (main) and subsistence.
	Vegetables	Food	Sale (main) and subsistence.
	Trees	Conservation / restoration of biodiversity in the wetland	Planting all around the Lake.
2.Collection of water	Water	Drinking & other domestic use; watering livestock; construction & brick-making; watering tree nurseries.	Common.
3.Harvesting	Trees	Fuel wood, poles, herbal.	Substance and sale.
	Grass	Fodder for livestock, mat - making	Grazing for domestic animals
	Shrubs/ undergrowth	Fuel wood, Herbal medicine	Home care medication
	Fish	Food and baits for food and income generation.	Small scale
	Papyrus	Mat - making	
4.Clay extraction	Clay	Brick-making	

9.4.2.2 Livestock production

Field observations indicated that there are cattle in sectors of Nyarugenge, Ruhuha and Ngeruka which before the 1994 Rwanda genocide and 1999-2004 the civil strife in Burundi was dominated by large pastoral herds. Those herds are slowly being replaced by zero-grazing improved hybrids.

In discussions with Ruhuha sector leaders, it was revealed that, on average, each household has two improved hybrid cows.

Large herds of cattle were seen in Cyiri zone of Bugabira commune which graze in Mayebe flood plain of Akanyaru River.

PHOTO 9.8: Cattle grazing in the Mayebe flood plain of Akanyaru River

In the sub-basin, a numbers of goats could be seen in many households and were plenty in Ruhuha general market.

PHOTO 9.9: Goats for sale in the Ruhuha market

Generally, the sub-basin livestock schemes have cattle, goats, sheep, pigs, poultry and apiary.

TABLE 9.14: Livestock populations in the Lake Cyohoha Sub-Basin

Livestock type	Distribution by Commune/District				Total
	Bugesera (2004)	Bugabira	Busoni	Kirundo	
Cattle	26,646	4,053	4,172	3,499	38,37
Goats	98,102	16,600	28,300	10,912	153,914
Sheep	2,624	580	1,213	398	981,837
Pigs	5,457	1,002	1,360	2,100	9,919
Poultry	76,808	8,560	23,700	11,296	120,364
Rabbits	6,000 (2002)	-	-	-	6,000
Apiary (beehives)	2,000 (2002)	-	-	-	2,000

Livestock development in the sub-basin is constrained (ADF 2006) by:

- Inadequate quantity and quality of pasture; only those with money may access pasture in a range of 40 RwF/cow/day on top of long distances to find the pasture and water,
- Increasing scarcity of agricultural residues which have nutritional value (eg. maize and sorghum stalks or cone husks); these are becoming the only thatching materials for houses (**PHOTO** 9.10).
- Use of low yielding herds (especially the Ankole cow),
- Limited extension services and hence high frequency of epidemics,
- Prolonged drought (1999 – 2004) which explains the famine and food insecurity in the sub-basin (Save the Children 2000, USAID 2001, WFP 2001, WFP 2006),
- Shortage of water especially where there are no designated water points for animals.

PHOTO 9.10: A house thatched with maize/sorghum/banana leaves in Ruhuha sector

9.4.2.3 Fish production

Lake Cyohoha South was a lucrative fishing ground in the 1950s and livelihood depended on fishing with occasional cultivation (UNDP *et al* 2007). Today, fishing activities are done on a part-time basis because fish stocks have gone down considerably; standing at an average catch of 50kg/boat.

Generally, fishing as an ecosystem service has declined in the sub-basin and the key factors given by the people and documented (IIED/UNEP 2005, ADF 2006) are destruction of wetland around the lake, loss of fish habitat, invasion by weeds, siltation of the lake and rivers, introduction of species into the lake, inadequate regulatory controls and lack of awareness amongst the fishing communities about the Cyohoha fisheries.

Since 1999, local governments of the sub-basin in collaboration with UNDP, FAO, and USAID have been trying to establish fish farming using associations and individuals. For example in Kirundo province, there were 26 associations, two of which were in Busoni. However, the programme was constrained by lack of quality fish seeds, training centres, presence of fish predators, lack of fish pond maintenance equipment, and limited funding.

Generally fish farming generates little income and therefore it is not taken seriously.

TABLE 9.15: Resources from the lake water component, (in order of ranking)

Activity	**Resource**	**Use**	**Level**
1.Fishing	Fish	Food, income generation	Widespread though with poor catches of tilapia, *clarias spp* and lung fish.
2.Boat transport	Water	Transport for people and goods	Only means of crossing between the Burundi and Rwanda.
3.Watering	Water	Domestic water needs	Wide spread including the untreated water for the majority and treated water for Bugesera District & at times Busoni Commune.
		Animal watering;	-do-
		Tree nurseries & vegetable gardens.	A bridging intervention.
		Ecosystem maintenance especially wetlands.	
4.Recreation	Water	1. Swimming/boat racing. 2. Fishing?	Common to many especially the youth.

TABLE 9.16: Fish catches from around the water bodies in the Lake Cyohoha Sub-Basin

COMMUNE	LAKES	N^{O} PLACE	SPECIES	**PRODUCTION (TONNES)**
*BUSONI	Cyohoha and Rweru	16 -Marembo -Kigara -Murambi	-Tilapia - Nilotica -Clarias -Claridae -Imbojo -Impawe -Ibiragi -Ibiranga -Haprochromis	193

KIRUNDO	Cyohoha	6 -Iyalanda	-Tilapia -Clarias spp. -Haprochromis -Carpes	124
*BUGABIRA	Cyohoha and Gacamirindi	8 -Kigira -Kigoma -Kiri	-Tilapia -Clarias spp. -Claridae -Haprochromis	71
BUGESERA	Cyohoha	- Kagenge - Rugarama - Muramira	-Tilapia -Clarias spp. -Haprochromis -Carpes	45

*Data is available for total district catches at the time.

PHOTO 9.11: Young fish at Ngenda

9.4.2.4 Provision of water

The main sources of water in the sub-basin were ranked as:

1) Lake Cyohoha and streams that drain in it as well as some areas of Cyiri zone in Bugabira commune along the flood plain of Akanyaru River;

2) Public wells;

3) Improved water sources;

4) Rain water.

Safe water for domestic consumption: Despite the seemingly huge amounts of water (over 70km2), water per capita uptake is less than five litres/person/day which is only a half of Rwanda's or Burundi's and a fifth of the recommended FAO/WHO per capita (MINITERE 2004)

Hence, provision of water from these natural water bodies makes them such vital ecosystems to both human and livestock's well-being.

Therefore, given the water-stress character of the two countries, the sub-basin or a portion of it should be enlisted for a higher conservation status.

As brought out by the Bugesera House Survey (2006), this low access to clean and safe water accounts for the high incidences of water borne diseases where people infested with malaria stood at 49%, worms at 1.1%, throat infection at 6.7% and a combination of the three at 15.7%.

PHOTO 9.12: Fetching water from Marembo in Busoni commune

PHOTO 9.13: Water extraction for highway construction from Marembo

PHOTO 9.14: Water extraction and treatment at Mirambi in Ngenda

PHOTO 9.15: Rain water harvest from Ruhuha market structures

Watering livestock from streams, rivers and lakes is a well known pastoral activity but due to cultivation pressure and lack of designated watering points and animal paths, the practice is running out except in Bugesera commune where herds of cattle still enjoy this right.

Irrigation is one of those production interventions which has been received with mixed whether there is enough water to sustain this activity. It is presently limited to nurturing a few tree nurseries,tending vegetable gardens, and in paddy rice which is reclaiming large parts of the wetlands.
Such wetlands have lost much of their capacity for water retention (through drainage and massive eva-transpiration), purification and their vast biological diversity.

Water transport is a significant service provided by Lake Cyohoha South between villages and countries. However, this activity was highly threatened by the 1999-2004 droughts that led to water levels dropping by about two metres.

Water for fisheries. This was once the leading activity for the people in the sub-basin. However, with declining water quantities and quality, fish stocks have declined significantly.

Therefore in view of the water resources in the area, it has been established that limited access to safe water has a big bearing on the human well being around Lake Cyohoha Sub-Basin. A good indicator of the low quality of water is the high prevalence of water and environmental related diseases that include diarrhoea, intestinal worms and malaria which are the principal causes of morbidity and mortality amongst infants and children while malaria, HIV/AIDS and respiratory tract infections stand out for the adults (IEA Household Survey 2006, MoH Epidemiological record 2006).

The cost of water in the sub-basin has greatly increased over time which has various implications for human well being, including among others, lost time for productive work by men and women leading to reduced income, lost schooling time for children who must fetch water over long distances, and expenditure on water purification.

To address this, many communities or individuals around the sub-basin have shifted to cultivating the already stressed soils and moving closer to lakes and wetlands for better access to water and crop cultivation.

But other have adopted environment-friendly practices like rainwater harvesting from residential, markets, schools, churches structures. The sectors of Nyarugenge, Ruhuha, Ngeruka and Kamabuye have taken on restoring the Lake Cyohoha shores by planting riparian buffer forest of about 50 metres.

On top of the above initiatives, there is need the two countries to review, revise or develop well harmonised legislations on water, water bodies and wetlands use/management in the sub-basin.

9.4.2.5 Provision of fuel wood in the sub-basin

Fuel wood is used in forms of firewood and charcoal; its use in the sub-basin is prioritised for domestic cooking which caters for over 95%, brick-making which is legally banned in Rwanda though it is leading to loss of income especially for the youths, and lighting, especially for the very low income households, though kerosene is the main source of lighting.

The main types of biomass species used as firewood include, among others *Euphorbia spp* esp. *turcali* and *Olea Africana* especially which are shrub of low caloric value but common due to its drought resistance; *Grevelia; Cassia spp; Gueria similes; Makhemia spp* which would otherwise provide good construction poles; eucalyptus, a native of Australia of high calorific value nurtured as a plantation tree and critised as a high evo-transpiration tree in some areas; *Vernonia spp*, especially *amygdalina*, which is otherwise herb; fruit trees including avocadoes and mangoes;

Crop residues, especially those from maize, sorghum, beans and ground-nuts which would otherwise be ploughed back into the fields for sustained soil productivity and grasses like hippo, elephant and spear grasses that would go garden mulching and also used for energy.

Though it may require about 10kg to produce one kilograme of charcoal, a significant amount of firewood is turned into charcoal before sale to especially urban centres of Kigali, Kirundo and beyond for high energy productivity, easy transportation and storage.

It is also worth-noting that many of the tree species cited above are both accessed from natural forests or woodlands and raised as agro-forest trees both of which have serious implications on the quality of the ecosystem and hence people's livelihood. These implications include, among others, loss of biodiversity and loss of capacity to contribute towards the ecosystem regulatory services (rainfall stabilisation, temperature amelioration, surface water flow, recharging water bodies, etc).

Throughout the rural markets visited, firewood and charcoal stalls were a prominent feature involving youths, women, and men; an indicator to this problem as far as increased household expenditures is concerned. Therefore, hidden elsewhere is the lost time for production (women and men) and school (children).

The study revealed that individuals, NGOs/CBOs, cooperative societies, private sector and governments in the sub-basin were trying to come up with various interventions to avert the problem caused by the shortage of fuel wood. They include, among others adoption of energy saving technologies (stoves) and alternative sources of energy (biogas) especially amongst the big users.

They have also taken on reforestation programmes involving raising awareness about forest and tree planting issues, and identification and planting of suitable (drought & pest resistant) tree species of *Cassia, Luecaeama, Calliandra, Makhamia, Sesbania and Caesalpinia* around lake shores, river banks, and eucalyptus species for the denuded hills;

Others measures include legislative reforms for tree and forest management, development of solar, thermal and wind energy. Development of the planned integrated hydro-electrical power grid and possible rural electrification will go a long way to save the natural biomass and restore the ecosystem services of the sub-basin the Lake Victoria catchments in general.

PHOTO 9.16: Selling/buying firewood in Ruhuha general market

Biodiversity

The study components brought out the biophysical status of the sub-basin which pointed at the various sub/sub-ecosystems aquatic zones (permanent or seasonal *palustrine, lucastrine* and riverine wetlands and the lake) and the terrestrial zones (grasslands, thickets and farmlands).

The sub-basin may host over 500 species of organisms, a number of them threatened with extinction due to natural, population pressure or misuse factors.

TABLE 9.17: Biodiversity in the sub-basin as it stood in Dec. 2007 (for invertebrates see Tables 4.2 - 4.8)

			No. of species so far found.	No. of threatened.
Flora	Microphytes:			
	Macrophytes:		60	

Fauna	Microbes:			
	Invertebrates:	Acarina		
		Crusteceans		
		Insecta		
		Molluscs		
		Worms		
	Vertebrates:	Amphibians	17	
		Birds	272	
		Fish	21(6 introduced)	
		Mammals*	50	Hippos and Golden cat are vulnerable while Sitatungas, Spot necked otters, Congo and Cape clawless otters need special attention.
		Reptiles	52	

There is need to do more research to identify the various species for each component of the ecosystem (**TABLE** 15) so as to guide proper management measures as suggested in Table 9.18.

TABLE 9.18: Number of species identified from each component of in Lake Cyohoha Sub-Basin ecosystem

			I.Dryland:			**II.Wetlands:**			**III.Lake / Lentic:**		**IV. River / Lotic:**	**Tot. no. of Sp.**
				I.A	I.B	II.A	II.B	II.C	III.A	III.B		
Flora	Macrophites		*No sp.*									
	Microphytes	Phytoplanktons	*No sp.*									
Fauna	Vertebrates	Amphibians	*No sp.*									
		Birds	*No sp.*									
		Fish	*No sp.*	-	-							
		Mammals	*No sp.*									
		Reptiles	*No sp.*									
	Invertebrates	Acarina	*No sp.*									
		Crustacean	*No sp.*									
		Insects	*No sp.*									
		Molluscs	*No sp.*									
		Worms	*No sp.*									
	Microzytes?	Zooplanktons	*No sp.*									
	Tot. no. of Sp.											

Components of the ecosystem:

I.A = Savanna
I.B = Woodland
II. A = Lucastrine permanent (p) & seasonal (s)
II.B = Riverine (p & s)
II.C = Palustrine/wetlands (p & s)
III.A = Euphotic (littoral & limnetic) zone
III. B = Pelagic (prefundal & benthic) zone

Ecosystem services

The community appreciation of the sub-basin biodiversity (see Appendix ....) goes a long way to prove that to a significant level of the population in the sub-basin depends on the services availed by the ecosystem.
The ecosystems services are the benefits that people in the Lake Cyohoha Sub-Basin access from the ecosystems defined above; they are grouped into the following four categories:

- Provisioning services which are the products got from the ecosystem; in this sub-basin, these products include water, food, fuel wood, medicines, raw materials for crafts-making and house construction, etc;
- Regulating services which are the benefits accruing from the ecosystem processes that include water purification, storage and distribution, discharge and recharge, storm and flood control, waste treatment, biological (pest/disease) control, etc;
- Cultural services which are the non-material benefits the people get from the ecosystem through activities like landscape beauty experiences, spiritual reflections; cultural diversity, recreation like swimming in the lake waters and eco-tourism based on the various aspects of the sub-basin, cultural heritage and sense of place, etc;
- Supporting services that are the basis of all the other ecosystem services; they include the primary production (Photosynthesis) and soil formation to mention a few.

These services provide a set of conditions for physical, social, psychological and spiritual fulfilment: it is the human well-being that needs basic materials for a good life, health, personal security and good social relations, absence of which spells poverty or ill-being for the sub-basin.

The five constituents of well-being identified by the Millennium Ecosystem Assessment (MEA) are also the concern of the sub-basin populations. They are concerned with:

- Materials for good life that include enough food and water all the time, shelter and clothing, income, access to goods;
- Health;
- Good social relations including cohesion, good gender relations, provision for children;
- Security including access to resources, safety of persons and possessions, and living in a predictable and controllable environment;

- Freedom and choice including control over what happens and being able to achieve one's values doing or being.

A survey of the Ruhuha, Ngeruka and Nyarugenge sectors as well as the Ruhuha general market for the areas in Bugabira commune, Bugesera district and Kigali city generally indicated the prominence of agricultural production in the sub-basin. Kirundo trading centre's main market shows almost the same products though in less quantities.

Implication on the well-being of the community in the sub-basin

The analyses of observations indicate that the:

- Economy is generally agrarian;
- Food availability depends on household's ability to **produce** own food or **purchase** it from the market;
- Household food production is declining due to the declining available land and labour as well as the unfavourable climatic conditions.
- Purchasing power for household may depend on income generating activities including trade, provision of unskilled labour, salaried employment and monetary supports from outside, all of which are limited in this rural agrarian sub-basin.
- Market has become as important as own farmland since drought rendered land very unproductive.

Therefore, the population is faced with serious food insecurity (52,955 / 297,168 people in Bugesera district are severely food insecure) and the community well-being in the sub-basin is declining (FEWS Net 2006a) leading to high, severe and acute malnutrition, stunting and prevalence of underweight (ADF 2006). All these will certainly open the population, especially children, to various diseases.

For emphasis, the commonly identified causes of food insecurity in the Lake Cyohoha Sub-Basin include, among others, prolonged droughts, changing seasonal patterns, pests/diseases, lack of quality seeds and the declining garden/farm size.

Given the diversity of stakeholders in the sub-basin and drought as the common problem, there were bound to be various strategies undertaken.

Strategies by primary stakeholders

These include individual cultivators, herdsmen, cooperatives, etc who directly depend on the natural resources:

- Sell off some household items including livestock to buy less demanding food stuffs.
- Consume less food in terms of meals prepared per day and quantities per person.
- Shift food production to wetlands where some moist soil could still be found;
- Change to cultivation by fishermen;
- Migrate away in search of grass and water by the herdsmen while those that depend on unskilled labour move to other areas, towns or even countries in search for work;
- Open up more land when signs for rain appeared again.

Strategies by the secondary stakeholders

A number of interventions were put in place by NGOs like Caritas, World Vision, Red Cross, UN agencies especially WFP and local governments/GoR; such intervention included:

- Provision of food relief to widows and orphans;
- Development of community work programmes to earn the undertaker some food package (maize flour and beans); community work included construction of community roads, schools, etc);
- Coming up with some food policies - banning food sales to business enterprises; buying off food stuff and storage for future crisis; regulation of food prices;
- Encouraging households to reserve some food with the local food banks which assumed that they had food surpluses;
- Development of projects that would enhance water-shed restoration and food production (PAPSTA in Ruhuha and Ngeruka sectors);
- Creating off-farm employment opportunities.

All the interventions above paint a worrying picture of the sub-basin.
The study agrees with UNDP *et al* 2007 that in summary, the ecosystems' capacity to provide food has changed through the shrinking cultivatable plot sizes, unpredictable seasonal patterns and paid labour becoming a major factor leading to changes in consumption patterns and livelihood strategies.

The study revealed that individuals, NGOs/CBOs, cooperative societies, private sector and governments in Rwanda were trying to come up various interventions to avert the problem caused by the shortage of fuel wood. They include, among others:

- Adoption of energy saving technologies (stoves);
- Adoption of energy saving practices or cooking procedures;
- Adoption of alternative sources of energy (biogas) especially amongst the huge users; (Photo 9.17)

PHOTO 9.19: Energy saving technologies (stoves) in Rugarama village

They have also taken on reforestation programmes involving:

- Raising awareness about forest and tree planting issues;
- Identification of suitable (drought and pest resistant) tree species of Cassia, Luecaeama, Calliandra, Makhamia, Sesbania and Caesalpinia around lake shores, river banks, (**PHOTO** 9.20) and eucalyptus species for the denuded hills;

PHOTO 9.18: Agro-forestry on the Rwanda side of Lake Cyohoha.

Other measures include legislative reforms for:

- Tree and forest management,
- Development of solar energy,

- Thermal energy,
- Wind energy

These need clear strategies and institutional capacity development or ownership must be put in place. Development of the planned integrated hydro-electrical power grid and possible rural electrification will go a long way to save the natural biomass and restoration of the ecosystem services of the sub-basin the Lake Victoria catchments in general.

9.5 Legislations guiding the utilisation and management of natural resources in Lake Cyohoha Sub-Basin

The main goods obtained from Cyohoha ecosystem are water, food (rice, maize and vegetables) and energy (fuel wood/charcoal), grass (grazing, mulching & thatching), fish, herbs and clay (bricks and pottery). The sources of these goods are the components of the sub-basin; mainly the land, lake, rivers and associated wetlands.

However, the sub-basin is threatened by both natural and human-man made factors as identified below:

9.5.1 Threats

Among all threats, the most worring is the high population density of both humans and livestock that are largely dependent on farming. It makes land the most important factor of production and survival for these nations, creating an overwhelming demand for necessities (land for crops, livestock and settlement) to survive and therefore degradation of the ecosystem.

Globally, the increasing human population is the key driver of environmental degradation. However, man cannot depend on nature (resources/environment) forever without proper management.

The sub-basin is hilly, with steep slopes ravaged by massive soil erosion which is exacerbated by land fragmentation and deforestation. Take an example of Rwanda with an economy based on agriculture which accounts for 91.1% of the active population, produces 43.5% of GDP and 80% of the country's exports of coffee and tea (MINAGRI, 1998). Its total surface area of arable land is 1,589,000 ha, or 60% of the national territory (National Land Policy, 2004) and much of the remaining land is occupied by protected and urban areas. Therefore, massive soil erosion, associated with widespread unsustainable agriculture, is the second most important threat to the environment in the sub-basin. Erosion of soils results into loss of fertile top soil as well as siltation of Lake Cyohoha, rivers and associated wetlands which reduces habitat for aquatic organisms and reduces the quality of water.

Pollution of surface waters mainly caused by the eroded soils and nutrients is evident by the highly turbid rivers draining the country, mainly the Akagera. At a regional level, Lake Victoria is at risk of the inputs (silt and nutrients) arising from the upstream catchment through the Akagera.

Unpredictable and low rainfall estimated at 900 mm/year. The area is prone to drought and therefore insecure in terms of food production to support the high population. Wetlands stand out to be the easy option for food production in long dry spells. Many of the crops grown there require drainage, implying that the little water stored in the wetlands is also lost in the process. Therefore, water for ecosystem functioning (wetlands) is critical and should not be drained in order to provide the other multiple benefits (water for human use and livestock watering among others).

De-vegetation (de-forestation) as a direct result of population pressure and a driver for fuel wood to meet domestic, commercial and institutional demands both locally and outside the basin to the urban areas of Kigali, Kirundo, Butare and Bujumbura. The massive deforestation has caused fuel wood shortages and many households in the area have resorted to using agricultural residues (Bugesera IEA, 2007).

Limited access to clean/safe water and sanitation as well low awareness on best hygiene practices are responsible for water related diseases (diarrhoea, intestinal worms and skin diseases) in the area.

Inappropriate fishing management procedures in the Lake Cyohoha Sub-Basin is one of the threats that has not received sufficient attention in the national policy framework (Bugesera IEA, 2007). It is characterised by inappropriate fishing methods, destruction of wetland habitat and introduction of new species.

9.5.2 Ecosystem's goods and services

There is a clear linkage between economic growth and availability of ecosystems goods and services. A balance between the two ensures sustainable development. Stagnating or slow economic growth and escalating poverty has been associated with decline or loss of ecosystem services.

Therefore, any efforts towards poverty reduction that do not address maintaining the availability of ecosystem services are doomed! A clear conceptual understanding of the complex linkage between human wellbeing and environment (ecosystems) is paramount. In developing countries, poverty is twin to environmental (ecosystem) degradation. This study mainly focussed on Lake Cyohoha Sub-Basin. The key element was water and the sustainability of its availability from the ecosystem (the lake, rivers and wetlands).

9.5.3 The environmental policies

The environment policies in the sub-basin that exist are not comprehensive enough to handle pressing issues on environment. There is lack of a coordinated policy framework which makes it difficult to manage the multiple interests related to land and water resource sectors. The policies give generalised interventions that are not really effective.

There is no clear policy to protect water bodies and wetlands. Management of these resources is embedded in general policies on environment which do not explicitly address the interventions on key issues of degradation of these resources

In general, major trade-offs at policy level need to be made in order to develop effective interventions to the identified key threats

9.5.4 Institutional structures

The institutional structures for management of the environment appears to be centralised; it is so lean or thin that they only exist at policy level (e.g. ministries, REMA) but they are not clear at the grassroots (district, sub-county and community). Environmental management should be emphasised at the lower levels (community – the users) since this is where degradation occurs. Under the decentralisation system adopted by Rwanda, a decentralised management structure stating the roles and responsibilities of all institutions and individuals at various levels should be made.

9.5.5 Capacity of the institutions

It was generally observed that the institutional capacity for environmental management is weak which makes implementation of the policies difficult. Key areas that need to

be addressed include personnel and their level of training to do the assigned jobs, and inadequate equipment (office, field equipment for monitoring, vehicles), among others.

Since this is a trans-boundary resource, 'synchronised' implementation of policies is necessary to have any impact towards the desired change. The two countries should harmonise policies and plan joint activities.

The threats to Lake Cyohoha Sub-Basin highlighted under this study all point to degradation of the ecosystem at local and regional levels but the direct impacts are poverty, food insecurity, diseases and water scarcity among others. The overall picture for Lake Cyohoha Sub-Basin requires restoration and or maintaining the flow of ecosystem services as a way of improving livelihoods. Maintenance or restoring of ecosystems has multiple benefits, most of which have no immediate and visible utility.

The biggest challenge in the sub-basin is to balance the competing needs for land (land-use) with the high population and environment. There has been political instability which is a hindrance to development, but hopefully, we are witnessing a move to a better new path.

9.6 Valuation of resources uses

To some extent, the resources and socio-economic activities as identified in Section 9.4 are the ones used to estimate the Total Economic Value (TEV) of the sub-basin. Some of the main uses are highlighted in Table 9.19.

TABLE 9.19: Basis for attaching a monetary Value to Lake Cyohoha Sub-Basin

Total Economic Value			
Human Use Value		**Human Non- Use Value**	
Direct Use Value	Indirect Use Value	Option/Future Use Value	Existence Use Value
1.Water: Supply, Irrigation Environment	1.Purification of water inflows;	1.Water use	1. Biodiversity.
2.Soils: Cultivatable soils, Clay Sand.	2. Storage of water.	2. Pharmaceutical resources.	2. Gene bank.
3.Floral Foods: Cultivated, Wild.	3. Recharge of the surrounding with water.	3. Leisure.	3. Landscape beauty.
4.Fauna Foods: Fish, Meats (birds, antelopes, snakes).	4. Water distribution.	4.Agriculture	4. Cultural/ spiritual heritage.
5.Trees: Firewood, Construction, Fodder, Crafts.	5.Micro-climate modulation;		

6.Grasses: Thatch, Mulch, Grazing, Hand crafts.	6.Air purification: Carbon sink Oxygen adds.		
7.Medicines: Human, Livestock.	7. Nutient retention.		
8.Sedges: Thatch, Fuel wood, Hand crafts.	8. Flood control.		
	9. Habitat provision.		

9.6.1 Processing monetary value to some of the heavily used resources

Due to the multi-benefits/services of the ecosystem, there is a need to attach a monetary value to its components to guide its wise-use. Below are some examples for which available data was used:

Box 9.1: Household water monetary with a pristine ecosystem

Given that: Water capita = 5litres/day,
: A 20 litres of water costing 14 Fr W,
: On average a household hosts 7 persons.
Therefore, expenditure that would be incurred = 5/20 X 7 X 14 X 366 Fr W
= 8,967 Fr W = $16.5 /hh/year.
: With a possible population of 563,271 in the Sub-basin
= 5/20 X 563,271 X 14 X 366 Fr W
= 103,078,593 Fr W = $ 188,913/hh/yr.

Box 9.2: Cost of watering livestock in the sub-basin

Assumptions (with reference to **TABLE** 15):
Livestock consideration for only cattle, goats and sheep & are within Lake Cyohoha Sub-Basin;
1 Large stock unit (LSU), a cattle = 150Kg.
1 Small stock unit (SSU), a goat or sheep= 15Kg.
1LSU water consumption = 20 litres.
20 litres of water cost = 14 Fr W
Therefore:
Total number of LDUs = 38,370 + 153,914 x15/150 +981,837x 15/150
= 151,945.
Cost of water consumed=151,945 x 20/20 x 14 x 366 Fr W/yr.
= 778,566,180 Fr W/yr.
= $ 1,428,562/yr.
Such a facility exists in 3 of the 6 study sites (Kagenge, Ruhuha and Ngenda)

Box 9.3: Income from water transport at Kagenge

At Kangenge landing site in Ngeruka Sector is an association of 10 – 20 youths with who a focus group discussion was held and brought out the following information:

1. Organised to transport passengers and their produce/goods to / fro Burundi and within Rwanda on Lake Cyohoha.
2. Have 15 canoes/boats with an average carrying capacity of 8 persons each.

3. On average, each boat costs 30,000 Frw ($) and the wooden ones may last 3-4 years;
4. At low business (non-market days), each boat earns 1500 Frw/day while at high business (market days) each boat earns 3500Frw/day giving an average of 2500Frw/day.

At a modest 4 working days per week, this income generating activity for the youths stands at = 15 boats X 4d X 4wks X 12 mnths X 2500Frw

= 7,200,000 Frw. ($ 13,413)/yr at Kagenge site.

Box 9.4: Income from fishing activity

There are:

- A number of fishing cooperative societies that derive an income from fishing though due to low catches and the possibly bad fishing methods, they were not free with information and put their returns as:

350 FR/ kg for Tilapias, 250 FRKg for *Clarias* and *Protopterus*.
Their monthly catch of Tilapias is on average 25kg, *Clarias* 250 kg and *Protopterus* 50kg
Giving a gross monthly income of 25x350 + 250x250 + 50x250 = 83,750FrW
With 35fishermen = 35x83,750 = 2,931,250FrW.

- Many individuals especially children and men hook significant quantities from all around the Lake for household use.

However:

- In the 1960s, fish production of the Lake was about 150-200Kg/ha and with an area of 50-70Km2,
- The potential production will be put at = 150 x 50x 100x 200 =150,000,000FrW and 200x70x100x200=280,000,000FrW/Yr.

Box 9.5: Expenditure on firewood in the Ruhuha area

Types of firewood = as given in the text above including pieces picked from construction sited;

1 bundle = 15 to 20 pieces (head-load or about 25Kg);
1 bundle = 1 medium household's fuel for a week;
1 bundle = 500 FrW
Ruhama market serves a radius of up to about 13 Km or a return journey of over 25 Km.
Cost of firewood = 52 weeks x 1 bundle x 500 FrW/household/year, excluding transport or other opportunity costs.

= 26,000 FrW/hh/yr
=$49.5 /hh/year.

Assuming 50% of Bugesera's 59,665 households are in the **Sub-Basin**, firewood worth = 50/100x26000 = 775,645,000FrW/Yr

= $142,320,184/Yr.

Apart from households, the number of institutions using firewood is also increasing; they include schools (primary and secondary), prisons and barracks, add onto the pressure to deplete the resource.

For purposes of completing the pressure picture on the resource, firewood needs for brick-making found in Kirundo need to be computed:

Box 9.6: Firewood for firing bricks in Kirundo

1. BRICKS FROM KIRUNDO WETLAND			
Name of product	**Clay brick**	**Unit**	**Common to village**
RESOURCE CHARACTERISTICS			
	Volume mined per kiln	Kg	50,000.00
	No. of bricks made.	Brick	15,000
	No. of bricks consumed	Brick	2,000
	No. of bricks sold	Brick	13,000

	No. of bricks per m2*	Brick	667
	Seasonal variation: high in dry	kiln	4
	:low in wet	kiln	1
	:total in a year	kiln	5
	Regeneration: non-renewable		
	Change over time: increase since 80s		
RESOURCE USERS	Number :high	people	20
	:low	people	15
	:Average	people	*17.5*
	Gender : female	people	5
	: male	people	15
	Age :15-24 years bracket	people	5
	:25-34 years bracket	people	12
	:35-44 years bracket	people	3
	Income levels :below 10,000FrW	people	
	:between 10,000 - 50,000FrW	people	
	:above 50,000FrW	people	
RESOURCE PRICES			
	Variation in price of a brick : high	FrW	45
	:low	FrW	35
	:average	FrW	40
	Price of dry un-fired brick	FrW	15
LABOR COSTS	No. of hrs. per day for 500 bricks : high	Hour	7
	:low	Hour	5
	:average	Hour	6
	Duration for a 15,000 brick kiln : high	months	2
	:low	months	1
	:average	months	1.5
	Hired labour: mining 500 brick of clay	FrW	2,000
	: making 500 bricks	Frw	2,000
	:drying / tuning bricks	FrW	
	:ferrying 15,000 bricks	FrW	10,000
	:building 15,000 brick kiln	FrW	6,000
	:firing the kiln	FrW	30,000
	:clearing plot	FrW	15,000
FACILITATION COSTS	Equipment :4 hoes per year	Frw.for each	4,000
	:2 spades per yr.	FrW.for each	5,000
	:2 jerry cans per yr.	Frw.for each	2,000
	:6 w/moulds per yr.	FrW.for each	3,000
	:2 stands per yr.	FrW.for each	2,000
	:1 panga per yr.	FrW.for each	3,000
	:1 sickle per yr.	FrW for each	3,000
	Additives :13 tonnes of firewood	FrW.for each	24,000
	:Grass for the 15,000 bricks	FrW.	5,000

This activity has been found to be quite involving but might be paying to the people. At the same time it can be very damaging to the hydrology of the area.

9.6.2: The Worth of Lake Cyohoha Sub-Basin

Elsewhere in Rwanda, it has been computed that there are 580,000ha of wetlands (of which 165,000ha have been cultivated) and the net present value put at US $2,000,000 a year for the direct use value alone giving $12/ha/yr.

However, community members in Ruhuha had the view outlined below.

1. Valuing community WTP for conservation, average cash contribution = 13,750FrW/Yr while average contribution through provision of labor = 3days at 1000FrW/day.
2. Therefore, average WTP = (13,750 +3000)/2 = 8376.5FrW. Community members contribute 3hours/month

   3/8X12 = 4.5days/Yr.

9.7 Areas of Investment: To improve income, livelihood and human well-being

The investment proposals below are based on the agreed expressions and commitments to the IWRM in the Kagera Basin to which Lake Cyohoha is only a sub-basin. There is a proposed budget for proposed investment areas; such expressions and commitments are in line with the:

- UN Millennium Development Goals;
- Principles of International Water laws;
- Vision and Missions of the EAC,
- Vision of the Nile Basin Initiative (NBI),
- Development objectives of the Kagera TIWRMD project.

The investments are framed around integrated or community-based water-shed management. They focus on institutional development and capacity building for good governance, planning and implementation that ensures sustainable development and proper management of the water-shed.

The proposed activities are under;

- Soil and water conservation which involve terracing and water harvesting, reforestation and agro-forestry;
- Intensification of agricultural production focusing on use of improved seeds, agro-chemicals, irrigation/water management, livestock management and rural income diversification;
- Policy support for agricultural research and extension, produce marketing, rural finance systems and agricultural credit schemes.
- It is also imperative that the available strengths and opportunities in the Lake Cyohoha Sub-Basin are exploited; they include, among others:

9.7.1 Strength, Weakness, Opportunity, and Threats (SWOT) analysis

TABLE 9.22: SWOT Analysis

FORCES	WEAKNESS
Young majority population High population density Over 8,000ha of Wetlands Aquatic ecosystem can support pisciculture and touristic exploitation Fair quantities of Akanyaru River Tarmac road Kicukiro-Nemba-Kirundo Bujumbura Electrics lines Kigali –Ruhuha and Kigali-Gako which will soon be extended to Kirundo town ; Many hospitals and health centres Famers cooperatives in all sector. Presence of NGO, co-operative societies, development/donors agencies and other development partners Decentralisation in term of proximity service Use of Umuganda in community work.	Water quality is low to 60%. Low agriculture productivity. High illiterate numbers.(over 50%) Large number of vulnerable people Dominance of traditional agriculture High rate of HIV/AIDS. Insufficient use of electric energy. Hand work of low qualifies. Insufficient of secondary school and lack of universities. High rate of abandoning of primary education. Food insecurity in some places (sides) Weak income of household.
OPPORTUNITY	**THREATS**
Beautiful nature for tourism exploitation National programmes against poverty Presence of water bodies for water exploitation projects International Airport in Bugesera district and regional Airport in Kirundo province construction and tarmacing of roads under construction.	Unpredictable rainfall. Rising Rivers Environment degradation

1. Tourism based on the need to conserve the Murehe and Gako woodlands, lacustrine and riverine wetlands of Lake Cyohoha and Akanyaru River which are habitats, spawning grounds and migratory points for:

- Animals like the cave bats, Otters and Sitatungas;
- Birds like the Papyrus Gonolek which is only one of the seven species of global conservation concern as well as hold large number of migratory species (69) and support large numbers of congregatory species;
- Fish species like the *Synodontin ruandoe*, *Barbus persteui* and *Oreochromis maerdur*;
- Invertebrates for savannah areas;
- Other flora and fauna for which precautionary conservation measure still need to be taken.

The eco-cultural tourism or community tourism arrangement will enhance community wise-use of the resource and liberate the natural resources from degradation while at the same time improve the household income.

The species assemblage recorded from the sub-basin, and the wetland qualifies for consideration as an Important Bird Area (IBA) which is a major pre-requisite for declaring it as Ramsar Site and fostering conservation of this fragile ecosystem.

If appropriate conservation actions are taken, Lake Cyohoha has a great potential for biodiversity conservation and tourism.

Ramsar Convention is among the conventions that support the conservation of water birds most directly. A number of the criteria for IBA selection are related directly to criteria for selection of Ramsar Site.

Box 9.7: Criteria for the identification of Ramsar Sites

1. A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities
2. A wetland should be considered internationally important if it supports plant/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.
3. A wetland should be considered internationally important if it regularly supports 20,000 or more water birds
4. A wetland should be considered internationally important if it regularly support 1% or more of the individuals in a population of one species or subspecies of water birds.

Though there should be deeper studies to characterise the site properly, the ornithological study has shown that there:

- Are seven species of global conservation concern in the sub-basin
- Is a large number of migratory species (69)
- Supports large numbers of congregatory species

This site therefore potentially qualifies as both an IBA and a Ramsar Site. This bid is made stronger by it being a trans-boundary resource – quite exciting challenges for managers in both countries to do their part in maintaining this fragile ecosystem in perpetuity.

However, detailed studies to ascertain the status of these species needs to be undertaken and boundaries outlined. It is now upon the responsible institutions to engage the necessary processes to have these ratified as IBA and/or Ramsar Site.

Since any Ramsar Site comes in with a management plan, it may be necessary to incorporate an investment strategy as the Millennium Village Project which is a community-based project to address improvement of livelihood of the rural community.

Rwanda and Burundi are signatories to the Ramsar Convention and CBD for which they are implementing the provisions of the conventions particularly article 6 and 7 relating to the general measures for conservation and sustainable use, identification and monitoring of biodiversity.

This project may go hand-in-hand with development of specialised ranches/parks say for crocodiles or development of natural museums in both Kirundo province and Bugesera district.

2. **Irrigation programmes** for the high value food/cash crops including the horticulture farms that will increase the employment opportunities and promote modernisation of agriculture in the catchments.

However, given the terrain of the sub-basin, the overall significance of irrigation as a way of improving use of water to support better livelihoods is limited. Therefore, there is need to research on how and where to undertake irrigation of small gardens as a way of pushing poverty away.

As a source of water, these programmes should focus on:

- Construction of dams for storm-water/run-offs that can adequately be used to water animals;

- Harvesting rain water from all roofs for domestic use;
- Extraction of water from the lake for horticultural calculated use.

3. Re-stocking the lake on a contractual basis with the private sector or local government/ cooperatives/community memorandum of understanding.

In order to allow the fish stocks in the lake to rise, it is necessary to:

- Review the problems facing the lake and come up with suitable solutions before re-stocking;
- Zone off the spawning areas especially around wetlands for strict protection;
- Encourage fisher folk to engage in fish farming;
- Interest investors into cage fish farming.

4. **Agro/natural** resource based processing diversification based on apiary, sericulture and papyrus (briquettes and paper-making).

5. **Community-based restoration** of the riparian vegetation (forests and wetlands) all around the lake and bringing both Rwanda and Burundi to common approach to its conservation.

Borrowing from and polishing the buffer zone programme in Rwanda, the restoration should target species that promote flora and fauna biodiversity.

Common trees seen around the possible buffer zone include Acacia polyacantha, Ficus vallis cardae and Focus thonninghii; these may be interplanted with value trees and ensure restoration of biodiversity.

6. Water supply to communities like those in Murambi, Marembo, Higiro, Rwabikara, Nyabisindi and Gatete zones whose water-pump house lay without a pump and possibly the pipe network needs to be rehabilitated and expanded. Busoni commune at large may also benefit from the same project.

There are a number of other areas that may need such set-ups while the majority will do with other water access routes including:

- Rain-water harvesting from structures like houses in homesteads, schools, places of worship, commercial buildings, etc;
- Community-managed boreholes.

However, awareness campaigns should be an integral part of such ventures so as to prepare the communities to own the establishments that may ensure their sustainable use.

A joint development of some water supply systems may overcome problems of constructing under-utilised pumps across the opposite side of the lake at just a kilometre apart.

Sanitation, especially, at the fish-landing sites/crossing points needs attention with *Ecosan* toilet systems. This will certainly reduce the fertilisation and faecal problems of the lake.

Water supply and sanitary facilities have coverage of below 57% and 10% in this area and hence the need to take it on.

9.8 General conclusions

In view of the natural endowment and potential of the sub-basin, many investment discussions pointed at how the wise use of the lake and its wetlands can improve livelihood

in the area. However, more focused studies need to be conducted to determine the available quantity of water, how can it be equitably used and the ecosystem dependants could benefit from the proposed investments.

Reviews and consultations around Kagera Basin raised several issues, among them that interventions should benefit communities with a focus on improving productivity through better ecosystem management, and that governments at various levels should undertake community-based natural resources planning, implementations and management in general to ensure sustainability.

9.9 General recommendations

The environmental threats observed in Lake Cyohoha Sub-Basin are not unique to the sub-basin but generally exist elsewhere in the Nile Basin. As a trans-boundary resource, Lake Cyohoha and associated ecosystems therefore requires combined management effort from the two countries (Rwanda and Burundi) as recommended below in order to realise any significant change from the current situation.

1. A compressive environment management plan for Lake Cyohoha Sub-Basin should be formulated with regard to wetlands, biodiversity, forestry and fisheries, like is the case in the rest of the Kagera Basin, and the implementation of legislation regarding the management of the sub-basin should be harmonised between the two countries.
2. Institutional arrangements and linkages for the management of the environment and natural resources should be spelled out clearly both vertically and horizontally.
3. Lake Cyahoha Sub-Basin is proposed for designation as a Ramsar Site.
4. In order to ensure sustainable development, environmental management issues in the sub-basin should be integrated into the district development plans (district of Bugesera and the communes of Busoni,Kirundo and Bugabira) and in national development plans.
5. Rain water harvesting should be promoted and mainstreamed into policy planning as this water could be harnessed for for irrigation, beside being a safe source of domestic water.
6. A comprehensive study for the valuation of wetlands in Cyohoha and their contribution to national economies should be conducted. This valuation will also assess the effectiveness of using economic tools like polluter pay principle, willingness to pay for environmental services as well as the costs and benefit analysis CBA) involved in implementing the environmental policy.
7. Rice growing along the streams and bays draining into the lake should be strictly controlled or completely stopped.
8. Policies and projects that focus on access to safe water, improved sanitation coverage, improved livestock management and agro-forestry should be designed and implemented.
9. Governments should also consider investing in the development of non-agricultural employment so as

References

Ayoo C. (1998). A Cost-Benefit Analysis of Alternative Wetland Uses in Kenya: The Case of Yala Swamp.

Barbier, E.B. (1989). The Economic Value of Ecosystems: Tropical Wetlands. LEEC Gatekeeper Series 89-02, London Environmental Economic Centre, London.

Barbier, E.B., Acreman, M. and Knowler, D. (1997). Economic Valuation of Wetlands: A Guide for Policy Makers and Planners.

Dugan, P. J. C. **(1990).** Wetland Conservation: A Review of Current and Required Action.

Emerton, L. (1998). Economic Tools for Valuing Wetlands in East Africa.

Emerton, L., Iyango, L., Luwum, P. and Malinga, A. (1999). The Present Economic Value of Nakivubo Urban Wetland, Uganda.

D. D. Hook *et al* **(1988).** The Ecology of Wetlands.

Ministere De La Planification Du Developpement et de La Reconstruction Nationale (2006)**.** Monographie De La Communee Bugabira.

Ministere De La Planification Du Developpement et de La Reconstruction Nationale (2006)**.** Monographie De La Communee Busoni.

Ministere De La Planification Du Developpement et de La Reconstruction Nationale (2006)**.** Monographie De La Communee Kirundo.

Ministry of Finance and Economic Planning (1991). The 1991 Population and Housing Census.

Mungatana, E.D. (1999). The Welfare Economics of Protected Areas: The case of Kakamega Forest National Reserve. Kenya, Ph.D Thesis.

Navrud, S. And Mungatana, E.(1994). Environmental Valuation in Developing Countries: The Recreation Value of Wildlife Viewing, Ecological Economics 11.

Nsingwire, S.(1995). A Monetary Estimate of the Human Use of Papyrus, NWP, Kampala.

Ramsar Convention Bureau (1997). The Ramsar Convention Manual: A Guide to the Convention on Wetlands, 2nd Edition.

Sikoyo, G.M. (1995). Economic Valuation of the Multiple use of Forests: The Case of Bwindi Impenetrable National Park (BINP), Uganda. MSc. Thesis.

Skinner, J. and Zalewski (1995). Functions and Values of Mediterranean Wetlands.

Turpie, J., Smith, B. Emerton, L. and Barnes, J. (1998). Economic Valuation of Zambezi Basin Wetlands.

Turpei, J. K. (2000). The Use of Natural Resources of the Rufiji Floodplain and Delta, Tanzania.

Williams (1996). Suitability of Papyrus for Wood-based Panels: An Economic Study.

UNDP, Republika yu Rwanda and UNEP (2007). Pilot Integrated Ecosystem Assessment of Bugesera.

Kanyamibwa S. (1986). Contribution a l'etude de l'avifaune de la Region Rizicole de Cyili (Butare) et de son impact sur les Cultures du Riz.

UNDP, Republika yu Rwanda and UNEP (2007). Economic Analysis of Natural Resource Management in Rwanda.

Ntakimazi G. (1985). Hyrobiologie Du Bugesera (dissertation presentee).

Millennium Ecosystem Assessment Board (2003). Ecosystems and Human Well-being.

Appendices

PHOTO 9.17: Products from the various components of the sub-basin

Chicken in market

Firewood in market at Ruhuha

Harvesting grass from Mayebe.

Drawing water

A boy fishing at Kagenge

Clay brick making in Kirundo

Fish in Ruhuha market

Wetland edge gardening- Ngenda

Transport from Kagenge

Recreation – swimming

Apiculture needed (a beehive in a fruit tree)

Appendix I: Weather/Incident Profile

Weather/ Incident	Year	Impacts on:			
		Dry land/ Agric.	**Wetlands**	**Lakes**	**People**
Heavy rains	1958-62	Limited crops harvests due rotting	High water levels with a lot of wetlands fish.	High water level, a lot of fish.	Sick from malaria.
Civil strife	1963, 1973, 1990-1994	Low production			Heavy deaths; migrations
Rampant HIV/ AIDS	1990s				
Serious Drought	1980s				

	1999 – 2004 (7years)	.no harvest in 2000 at all. .high prices for food brought in. .loss of animals to diseases, lack of fodder & poor sales.	cultivation of sweet potatoes, maize, etc intensified.	Water level dropped severely with very low fish production	.become very poor. .malnourished esp. children. .social fibre broke. .migration to other areas for employment.
New regulation on wetlands use					
New regulation of fishing.					

Remarks:

1. Drought of 1999 – 2004 led to:

- No crop production over a long time.
- Increased thefts to get food.
- Sales of whatever one had, including animals and roofing materials for their houses, at very low prices so as to buy food from markets.
- Children below 5 years were affected greatly with malnutrition.
- Without animals, people grow more beans for protein.
- Increased poverty and declining livelihood.
- Food security interventions, including humanitarian food aid relief, food-for-work programmes, restrictions on sales of food stuff, communal food banks, creation of off-farm employment opportunities, etc. came up.

2. Possible causes of food insecurity, as put forward by various leaders both in Burundi and Rwanda:

- Frequent and prolonged droughts.
- Changing/unpredictable seasonal patterns.
- New emerging diseases (HIV/AIDS) and pests (cassava mosaic virus).
- Lack of quality seeds.
- Use of ineffective technologies (hoes) in production for the increasing populations;
- Declining farm size from the FAO recommended of 0.9Ha due to the increasing population pressure.

3. Constraints facing livestock in the sub – basin:

- Inadequate pasture lands and the little available may restricted or is trans-boundary;

- Shortages of water and animals have to be herded for long distances to water points which may also be trans-boundary;
- Limited use of agricultural by-products which are turned into bio-fuel and thatching materials all of which are essential for life.
- Use of the locally available breeds that produce comparatively less;
- Limited extension veterinary services and the frequent epidemics.

4. Suggested interventions at the various levels:

- Development of sustainable legislations on water management (to include among others : improved soil and water conservation everywhere; irrigation from harvested rain water (roof water collected/stored and run-offs dammed for it; harnessing lake water for production – irrigation for high value crops);
- Increased use of agro-inputs;
- Population control of both animals and people;
- Memoranda of understanding on the management of the trans-boundary natural resources like L.Cyohoha with its catchments and wetlands.

Appendix II: Historical Resource Profile

Decade	Sub-basin component	Item used	Use+	Users++	Status	Remarks+++
1960s	Dry land	Agriculture	Cultivation	Women and daughters	High yields of crops	Fertile soils ,low pop& regular rains
			Animal grazing	Men and boys	Good/extensive pasture	Few heads of animals
	Wetlands	Crafts raw materials	Harvesting & drying papyrus and typha grass	Men & boys	Plenty of raw material.	Few users with limited markets.
		Sitatunga	Food (provision of meat)	Men	A good population of animals	Few hunters with many & healthy animals.
	Lake	Fish	Food & sale	Men & boys	Plenty & healthy tilapia.	Only the poor ate fish.
		Water	House use	Women and girls.	Good/clear water	Household water points were well protected.
			Animal watering	Boys	Easy work	Few animals.
1970s						
	Dry land					
	Wetlands					
	Lake					

1980s						
	Dry land					
	Wetland					
	Lake					
1990s						
	Dry land					
	Wetland					
	Lakes					
2000-to date.						
	Dry land					
	Wetlands					
	Lake					

Use+ should be the prioritised or special one from other discussions.

Users++ should bring out the gender related issues.

Remarks+ should bring out quantity/quality of biodiversity, water on top of management aspect and other salient aspects.

Appendix IIIa: Economic Activities in Ruhuha Sector (Rugarama).

TABLE I: Resources from the dry land catchments component, in order of ranking.

Activity	Resource	Use	Level
Cultivation	Cassava	Food	Mainly subsistence
	Beans		
	Maize		
	Sorghum		
	Bananas		
	Sweet potatoes		
	Fruits*		
	Vegetables**		
	Trees	Fuel wood, poles, herbal.	Household use
Livestock keeping	Local cattle	Food	
	Improved hybrid cattle		
	Local goats		
	Improved hybrid goats		
	Chicken		
Harvesting from the bushes	Trees	Fuel wood, poles, herbal.	Substance and sale.

	Grass	Fodder	Grazing for domestic animals
	Shrubs/undergrowth	Herbal medicine***	Home care medication

Fruits = pineapples, avocados,*
*Vegetables** = cabbages, carrots, dodo/spinach, tomatoes, etc.*
*Herbal medicine*** = umuwivumba, umubirizi, igikakumbamba, ikicamahirwe, umubogora, umukazanyana,*

TABLE II: Resources from the wetlands component, in order of ranking.

Activity	Resource	Use	Level
Cultivation	Rice	Food	Sale (main) and subsistence.
	Vegetables	Food	Sale (main) and subsistence.
	Trees	Conservation / restoration of biodiversity in the wetland	Planting all around the Lake.
Collection of water	Water	Animal watering and domestic use.	Common.
Harvesting	Trees	Fuel wood, poles, herbal.	Substance and sale.
	Grass	Fodder	Grazing for domestic animals
	Shrubs/ undergrowth	Herbal medicine	Home care medication
	Fish	Food	Small scale

TABLE III: Resources from the Lake water component, in order of ranking.

Activity	Resource	Use	Level
Fishing	Fish	Food+	Wide spread though with poor catches.
Boat transport	Water	Transport	Only means of crossing to/fro Burundi.
Watering	Water	Domestic water needs	Wide spread.
		and animal watering;	Wide spread
		Crop watering	Small.
Leisure	Water	Swimming / boat racing.	Common to many especially the youth.

Appendix IIIb: Economic Activities in Ngeruka Sector (Kagenge).

TABLE i: Resources from dry land catchments component, in order of ranking.

Activity	Resource	Use	Level
Cultivation	Cassava	Food	Mainly subsistence
	Beans		
	Maize		
	Sorghum		
	Bananas		
	Sweet potatoes		
	Fruits*		
	Vegetables**		

	Trees	Fuel wood, poles, herbal.	Household use
Livestock keeping	Local cattle	Food	
	Improved hybrid cattle		
	Local goats		
	Improved hybrid goats		
	Chicken		
Harvesting from the bushes	Trees	Fuel wood, poles, herbal.	Substance and sale.
	Grass	Fodder	Grazing for domestic animals
	Shrubs/undergrowth	Herbal medicine***	Home care medication

TABLE II: Resources from the wetlands component, in order of ranking.

Activity	**Resource**	**Use**	**Level**
Cultivation	Rice	Food	Sale (main) and subsistence.
	Vegetables	Food	Sale (main) and subsistence.
	Trees	Conservation / restoration of biodiversity in the wetland	Planting all around the Lake.
Collection of water	Water	Animal watering and domestic use.	Common.
Harvesting	Trees	Fuel wood, poles, herbal.	Substance and sale.
	Grass	Fodder	Grazing for domestic animals
	Shrubs/ undergrowth	Herbal medicine	Home care medication
	Fish	Food	Small scale

TABLE III: Resources from the Lake water component, in order of ranking.

Activity	Resource	Use	Level
Fishing	Fish	Food+	Wide spread though with poor catches.
Boat transport	Water	Transport	Only means of crossing to/fro Burundi.
Watering	Water	Domestic water needs	Wide spread.
		and animal watering;	Wide spread
		Crop watering	Small.
Leisure	Water	Swimming / boat racing.	Common to many especially the youth.

Appendix IIIc: Economic Activities in Busoni Commune (Marembo).

TABLE I: Resources from the dry land catchments component, in order of ranking.

Activity	Resource	Use	Level
Cultivation	Cassava (5)	Food	Mainly subsistence

	Beans(3)		
	Maize (6)		
	Sorghum (2)		
	Bananas (1)		
	Sweet potatoes(4)		
	Fruits*		
	Vegetables**		
	Ground nuts		
	Trees	Fuel wood, poles, herbal.	Household use
Livestock keeping	Cattle	Food	
	Sheep		
	Goats		
	Pigs		
	Chicken		
Harvesting from the bushes	Trees	Fuel wood, poles, herbal.	Substance and sale.
	Grass	fodder	Grazing for domestic animals
	Shrubs/ undergrowth	Herbal medicine***	Home care medication

TABLE II: Resources from the wetlands component, in the order of ranking.

Activity	Resource	Use	Level
Cultivation	Rice	Food	Sale (main) and subsistence.
	Vegetables	Food	Sale (main) and subsistence.
Collection of water	Water	Animal watering and domestic use.	Common.
Harvesting	Trees		Completely cleared.
	Papyrus	Crafts making	Home use and sale
	Grass	fodder	Grazing for domestic animals
	Shrubs/ undergrowth	Herbal medicine	Home care medication
	Fish	Food	Small scale

TABLE III: Resources from the wetlands component, in the order of ranking.

Activity	Resource	Use	Level
Fishing	Fish	Food+	Wide spread though with very poor catches.
Boat transport	Water	Transport	Only means of crossing to/fro Rwanda.
Watering	Water	Domestic water needs	Wide spread.
		Animal watering;	Wide spread

Leisure	Water	Swimming.	Common to many especially the youth.

Distance from the lake line (metre)	Observations on the zone of the eco-site.	Category by habitat.	Description of activity.	Use of item
0 - 10	Grass zone* (mainly vossia & phragmites) with transport & fishing boats anchored.	Lacustrine wetland	scanty	Thatch.
10 -100	Planted with mixed trees species** harvested tomatoes & beans. Zone ends onto a terrace with a 1m grass banding.	Formerly a natural forest.	Regulated planting at about 1tree/3m2.	Restored lake buffer zone;
100 - 130	Mixed garden of young beans, egg-plants. Zone ends onto a terrace planted with 1m grass.	Arable (savannah)	Traditional planting of beans.	Food crops.
130 - 160	Mixed garden of beans, cassava, banana (musa yellowing with a plight), dryland yams, s.potatoes. Zone ending into a terrace edged with grass/vernonia spp band.	Arable (savannah)	Traditional planting system.	Food crops.
160 - 190	Mixed garden of beans, banana, maize, vegetables, herbs, etc.	Arable (savannah)	Traditional planting system.	Food crops.
190 - 250	Homestead with 2 -3 houses, fruit & shade trees. The distance between this homestead and the neighboring ones is about 250m….scanty homesteads on both sides of Rwanda and Burundi. Has a good access to the road down to the Lake and by boat across to Burundi.	Arable (savannah)	Low-cost houses of soil and poles roofed with iron-sheets or sorghum/ maize stalks or typha, vossia, phragmites reeds or banana fibers.	Housing needs.
250 - 290	Gardens of cassava, beans, maize Area is dotted with ficus and markemia trees on some of which bee-hives are secured.	Arable, sloppy & stone (savannah)	About 100 plants of coffee.	Food & cash crops. Bee-honey for food, and medicine and income generation.

TABLE 9.16: Products found in the markets of Ruhuha and Kirundo

RUHUHA GENERAL MARKET				**KIRUNDO TOWN MARKET**			
(Tues & Friday; attracts Burundi)							
Item	Habitat Component			Item	Habitat Component		
Foods:				Foods:			
	Dry land	Wetlands	Lake		Dry land	Wetlands	Lake
Banana	*	*		Banana	*	*	
Beans	*	*		Beans	*	*	
Soya beans	*	*		Soya beans	*	*	
Cow peas	*	*		Cow peas	*	*	
Ground-nuts	*			Ground-nuts	*		
Maize	*	*		Maize	*	*	
Sorghum	*			Sorghum	*		
Cassava	*			Cassava	*		
Sweet potatoes	*	*		Sweet potatoes	*	*	
Irish Potatoes	*	*		Irish Potatoes	*	*	
Rice		*		Rice		*	
Sugar cane	*	*		Sugar cane	*	*	
Coco-yams	*	*		Coco-yams	*	*	
Twine yams	*						
Vegetables				Vegetables			
Cabbages	*	*		Cabbages	*	*	
Anions	*	*		Anions	*	*	
Egg plants	*	*		Egg plants	*	*	
Red pepper	*	*		Red pepper	*	*	
sweet pepper	*	*		sweet pepper	*	*	
Carrots	*	*		Carrots	*	*	
Dodo	*	*		Dodo	*	*	
Spinach	*	*		Spinach	*	*	
Tomatoes	*	*		Tomatoes	*	*	
Fruits				Fruits			
Avocado	*			Avocado	*		
Mangoes	*			Mangoes	*		
Lemons	*			Lemons	*		
Oranges	*			Oranges	*		
Pineapple	*			Pineapple	*		
Palm oil	*			Palm oil	*		
Passion fruit	*			Passion fruit	*		
Pawpaws							
Gauvas							
Herba Medicine:	*			Herba Medicine:			
Livestock				Livestock			
Chicken	*						
Goats	*	*					
Sheep	*	*					
Cows							
Fish				Fish			

Tilapia (dry)		*	*	Tilapia (dry)		*	*
Kamongo (dry)		*	*	Kamongo (dry)		*	*
Lungfish (dry)		*		Lungfish (dry)		*	
Mukene (dry)			*	Mukene (dry)			*
Crafts				Crafts			
Papyrus baskets		*					
Papyrus mats		*					
Palm baskets	*	*					
Palm mats		*					
Clay pots			*				
Clay smoke pipes			*				
Woods	*	*		Woods			
Wooden mortar/pestle		*		Firewood	*	*	
Wooden ladles		*					
Firewood	*	*					

Appendix IVa : Transect walk from lake to hill slope (Bihari Cell)

Country: RWANDA. Province: EASTERN. District: BUGESERA. Sector: RUHUHA. Cell: BIHARI – Rugarama Beach.

Transect No. I.

Date of walk: 20/11 & 4/12 2007.

GPS: 02 deg.20 min. 23 sec. S and 30 deg. 01.863 min E.

Grass zone* = *this zone was about 2.5m under water 10 years ago and with sandy soils, it was phragmites grasses and Acacia polycantha dominated forest belt as per the respondent group.*

*Tree species in the planted buffer zone** = *gravellia, cassia, cedrella, cassuarina, markemia, calliandra, etc with no undergrowth developed.*

Opportunistic observation

- Fishing with hooks bringing 3 clarias spp and about 5 tilapia spp of fish.
- Boat transport to the Burundi side of the Lake. (5people with 3bicycles and sacks of merchandise from Ruhuha market).
- Use of water for washing clothes, bicycles, etc at the lake-shores.
- Children swimming and adults bathing at a distance.
- Cultivation to the edge of the Burundi side of the lake.
- Silting of the Lake.
- Growth of hippo grass and greening of water may be pointing at increasing nutrient levels of the Lake.

Appendix IVb : Transect walk from lake to hill slope (Marembo Colline)

Country: BURUNDI. Province: KIRUNDO. Commune: BUSONI. Zone: GISENYI. Colline: MAREMBO.

Transect No. II.

Date of walk: 29/11/2007.

GPS: 02 deg. 27 min. 13 sec. S and 30 deg. 10min. 14 sec

Distance from the lake line (metre)	Observations on the zone of the eco-site.	Category by habitat.	Description of activity.	Use of item
0 - 50	Grass zone* (mainly vossia & Cyperus spp / sedges)	Lacustrine wetland is completely flooded.	Thick grass cover.	Patches of grass harvested for thatch.
50 -100	S.potatoes	Lacustrine wetland is completely flooded.	S.potatoes planted on raised moulds with water lilies in the flooded ditches.	Potatoes for food.
100 - 140	Mixed garden of beans, coco-yams, s. potatoes, patches of tobacco.	The permanent lacustrine wetland fading into the seasonal zone.	Traditional planting system.	Food crops and tobacco for sale.
140 - 180	Mixed garden of beans, maize, irish and s. potatoes, red & sweet pepper.	Seasonal wetland	Traditional planting system.	Food crops but surplus may be sold.
180 - 250	Beans and maize	Seasonal wetland becoming dryer and hosting trees like markemia and Flemings.	The slope is gentle and traditional planting system is evident.	Food crops and much enough to realise surplus for sale.
250 - 400	Beans and maize	Formerly a wooded savannah.	The area is partitioned with elephant grass into 40mzones and planted with maize and beans.	Food crops and much enough to realise surplus for sale.

Opportunistic Observation:

- Given the high water table, the water line may extend to 70m from where it is now; the gentle continues for about 500m and a relatively sharp rise; all around that zone are banana and maize gardens dotted with trees like Acacia polyacantha, Ficus vallis chaude & Ficus thonnighii hosting a lot of insects, birds and bats; while Erythrina abyssinic, Ephorbia turicali and Markamia lutea all seem to be fully accepted by the gardeners..
- Fishing raft made of banana stems sight at about 70n into the Lake with hooks/ nets being set.
- The site is important for water abstraction and above 50 women and children collected jerry of water in only 30minutes, 2 portable water pumps were filling water trucks for the road construction company while a disused water-pump house remained unattended to without a pump.
- Settlements are at the top of the hill.
- Use of water for washing clothes, bicycles, etc at the lake-shores.

- Growth of hippo grass and greening of water may be pointing at increasing nutrient levels of the Lake.
- A tree nursery was set by women's group about 30m from the water line; it had seedlings foe fruits, timber, etc.

Appendix IV c: Transect Walk through the Ngenda Cell to resources that are being used from the sub-basin.

Country: RWANDA. Province: EASTERN. District: BUGESERA. Sector: NYARUGENGE. Cell: NGENDA.
Transect No. III.
Vegetation zone: Savannah.
Date of walk: 23/11/2007.
GPS: 2 deg.19 min. 45 sec. S and 29 deg.59 min. 19 sec. E

Name resource in use.	Category by habitat from which item is got.	Count of each item observed	Use of item
Boat/timber	Forest	5	Boats for water transport & fishing;
Wood	Dry land	6	Firewood, construction of houses
Papyrus	Wetland	2	Making mats and baskets
Water	Lake and wetland	6	Domestic use (cooking, bathing, construction, animal watering);
Typha	Wetland	3	House thatch
Maize and sorghum stocks	Wetlands and dry land	6	Thatching and fuel;
Rice	wetland	6	Food for domestic and income generation.
Maize, cassava, sweat potatoes, vegetables, beans,	Wetlands and dry land	6	Food for domestic and income generation;;
Small fish	Lake and wetland	1	Food
Clay	Wetland	3	Making bricks and roofing tiles;
Sand	Lake and wetland	3	

Appendix 5: Assessment for the willingness to pay (wtp) for the conservation of Cyohoha

SECTION A: ATTITUDES TOWARDS THE ENVIRONMENT IN THE Lake Cyohoha Sub-Basin.

Q.1. On the whole, how important do you consider environmental conservation issues to be? Press a tick on your answer.

1. Very high (4) 2. High (2) 3. Medium 4. Low 5. Very Low.

Q2. Show the importance you attach to each of the following issues of public concern to you. Use a similar ranking as adopted in Q. 1.

	1	2	3	4	5	6
Agriculture	3	4		1		
Wetlands/wetlands	3	1	2		1	
Lake Cyohoha	2	2	2	1		1
Environment	1	2	1		2	
Health	1	3	2	1	1	
Income generation	1	3	3	2		

Q3. Did you receive any kind of environmental information: from school, workshop/seminar, or mass media?

Yes 8 or No 0

Q4. a) If yes, which information?

Lake 2

Water 1

Food crops 1

Laws on environment 1

Climate change 1

Desertification 1

Ozone depletion 1

Population 1

Wetland 1

Agro forestry 1

Forest 1

Q4 b) If yes, which information? (Methods)

School 3

Radio / media 2

Seminars 1

Extension service/ agriculture 1

Experience for long 1

SECTION B: WETLAND/BIODIVERSITY VALUES AND CONSERVATION

Q5. What important services/values do catchments, wetlands and the lakes in Lake Cyohoha Sub-Basin offer to you?

	Dryland/Catchments	Wetlands	Lake
1	Food/ cultivation 5	Water 6	Water 3
2	Transport 2	Fish 2	Fish 5
3	Eco-tourism 1	Cultivation(food/ vegetation) 4	Transport 4
4	Rain water 5	Eco-tourism 1	Eco-tourism 1

5	Income 1	Rain 1	Rain 1
6	Settlement 2	Grazing 1	Fresh air 1
7	Fuel wood 1	Clay 1	
8	Livestock 1		
9	Labour/ employment 1		

Q6. Considering those services/values of Lake Cyohoha Sub-Basin system, please indicate which activities you can support to conserve it by ticking Yes (Y), No (N) or don't know (D) in the corresponding box.

	Conservation Activity	**Y**	**N**	**D**
1.	Supporting a society/ngo to regulate use of Cyohoha goods	8		
2	Educating others on the importance of the system	6		
3.	Getting the stakeholders organised for its conservation	6		
4.	Supporting efforts to establish a buffer zone for the wetland and lake.	7		
5.	Supporting enacting and implementing laws on its use.	7		1

(WTP I)Q7. If any of the service you give above disappeared, how far away would need to travel to get it? On average = 39 Km,

How long will that take you? On average = 5.9 Hours.

How much does a casual labourer earn per day in your village?

Shs on average 27 000 Frw

Q8. Assuming that on average you use 1Ha of that Sub-basin to get your service, how much would you contribute towards fundraising for its management every year?

1. 0/= 2. About 5000Fwr (3) 3. About 10,000 (1) 4. About 15,000 (1)

5. Above 20,000Fwr (3). 6. 30,000Frw/3 month as a rent price.
7. (better to give 10,000 Frw/month)

Q9. Briefly explain why you feel the amount you pledged is a reasonable value to you to improve the conservation of sub-basin system.

1. Low income (40/month) 1 2. Profit based 23. Based on salary level1
4. Average use 1

5. Many contribute 1

Q10. If you were to contribute in terms of labour , how many days would put aside/ year ?

1. 1.0 days; 2. 2days (3); 3. 3days; 4. 4days; 5. 5 days (1);

6. Above 6 days. (10 days/3months) (4) 7. On average = 4

Q11 . If your contribution was Shs 0 Fwr or 0 days, which of the statements below would be your reasons?

Statement	Tick
1. Conserving that Sub-Basin is not worth it.	0
2. Fundraising moneys will not be used faithfully	1

3. Conservation of natural resources is the duty of government	0
4. There are sufficient people to contribute enough money	0

Q12. The following suggestions on how we could possibly manage a situation when the Lake Cyohoha Sub-Basin system has been destroyed.

READ through and indicate whether you agree with each of the suggestions by answering True (T), False (F) or don't know (D).

Statement	T	F	D
1. Replace the **Sub-Basin** services.		6	1
2. Cannot replace them, thus simply conserve them	5	2	1
3. Compensate people to leave and allow the restoration where necessary.	4		2

How can the funds or days committed be used?

Statement	D	F	T
4. Compensating abusers to leave.	1	6	
5. Restoration of the degraded components of Lake Cyo**hoha Sub-Basin.**	1		6
6. Sensitising stakeholders at all levels using various means.	1	1	5
7. Developing buffer zones where necessary.	1		6

Q13. Who should manage the activity(s) you have chosen?

1. The community (4) 2. Govt./Province (4) 3. Selected NGOs or CBOs Cause they know each other well

SECTION C: PERSONAL INFORMATION

Q14. What is your age category?

1. Under 20 years (1) 2. 20 – 29 (2) 3. 30 – 39 4. 40 – 49 (3)
5. 50 – 59 (2) 6. 60 – 69 7. Above 70

Q15. What is your sex? Male (6) or Female (2)

Q16. Please indicate the highest level of education you attained

Formal education: **Non-formal education**:

1. Primary school and less (2) Workshops
2. Secondary school and less (1) Seminars (1)
3. College
4. University (1) Informal education: mass media

Q17. Are you:

1. Self-employed
2. Employed by government/company/individual (1)
3. Trader

Thank you for completing this question; it will go a long way to help us plan for Lake Cyohoha Sub-Basin system

SECTION D: FOR INTERVIEWER

Q18. Did respondent understand the questionnaire?

1.Completely; 2.To a large extent; 3. Partly; 4.Not very much; 5.Not at all.

Q19. Questionnaire No.……

I certify that I conducted the above interview, and to the best of my ability I have correctly recorded the answer given by the respondent.

Signed: …… Date: …….....……

Supervisor: …….....… Date: 4.12.2007…….

Thank you very much.

APPENDIX 6 : FINANCIAL RETURNS TO UTILISATION OF PRIORITISED WETLAND PRODUCTS PER RESOURCE USER											
Name of wetland product	Gross return / user / year (Frw)	Grossreturn to labour / user / day(Frw)	Gross return to land / Ha (Frw)	Net return / user / year (Frw)	Net return to labour / user / day (Frw)	Net return to land / Ha (Frw)	Cash income / user / year	Cash income / user / day	Home consumption / household / year	Number of users in study area	Possible potential area in the study area
1. Clay:											
a) Clay	240,000	2,286	40,000,000	31,500	1,800	5,250,000	240,000	2,286	0	40	20
b) Fired Bricks	2,080,000	10,833	5,949	536,208	**1,985,778**	**8,936,000**	2,080,000	10,833	0	40	
c) Roofing Ridges	5,760,000	40,000	37,902	3,456,888	222,393,822	133,470,579	5,760,000	49,000	0	2	
2. Sand	2,835,000	29,531	28,682	1,923,472	40,500,000	27,478,243	2,835,000	29,531	0	14	
3. Papyrus:											
a) papyrus	135,000	2,500	2,236	120,717	29	26	125,820	2,330	9,180	30	561
b) papyrus mats	384,000	3,556	1,976	51,408	914	12	388,000	3,407	32,000	100	N/A
c) papyrus chair	240,000	3,333	3,260	126,720	5,714,285	3,020,000	240,000	3,333	0	15	N/A
4. Water:											
a) water fetching	109,575	400	373	-360,303	N/A	N/A	109,575	400	0	5,637	N/A
b) water selling	767,025	2,400	2,345	749,525	N/A	N/A	693,975	2,171	73,050	805	N/A
c) water livestock	1,095,750	24,000	21,562	915,953	N/A	N/A	1,095,750	24,000	0	28	N/A
5. Grass:											
a) grass mulch	247,500	4,950	4,900	140,000	618,780	350,000	247,500	4,950	0	20	
b) grass o-graze	990,060	7,333	7,228	773,280	3,666,667	2,864,000	810,000	4,500	180,000	22	
6. Firewood- domestic	180,000	6,000	5,950	135,500	909,091	674,242	144,000	4,800	36,000	12	
7. Cultivated crops:											
a) mixed gardens	1,089,600	62,079	59,532	714,065	1,024,060	670,483	685,200	10,151	404,400	30	
i) tomatoes	57,600	3,413	2,999	25,295	230,400	101,180	43,200	2,560	14,400	30	
ii)cabbage	360,000	21,333	19,200	268,688	2,400,000	1,791,253	306,000	18,133	54,000	30	
iii) c.yams	480,000	28,444	26,311	253,086	1,159,420	611,318	240,000	14,222	240,000	30	
iv) s.pota-toes	192,000	11,377	11,022	166,996	768,000	667,984	96,000	5,688	96,000	30	
b) sugar cane	288,000	2,000	1,923	140,512	2,846,553	1,388,802	244,800	1,700	43,200	12	
c) eucalyptus	1,280,000	14,065	12,197	755,809	1,280,000	755,809	1,264,000	13,890	16,000	17	

People consulted.

Name	**Office**	**Organisation**	**Contact**
1.GASHUGI Laurent	Assistant Representative	FAO	Tel:+250583719/20 Mob:08304125 Fax:+250583726 B.P.1502 KIGALI, RWANDA. E-mail:Laurent.Gashugi@fao.org
2.BAYINGANA Rigobert	Head Office Rwamagana, Eastern Province, Inland Lakes Management Project.	Ministry of Agriculture	Mob:08468556
3.DUSABEMUNGU Gregoire	Coordinator: Technical Department Fishery and Aquaculture	Ministry of Agriculture: Inland Lakes Integrated Development and Management Support Project (PAIGELAC).	P.O.Box 621 KIGALI Tel:+25055100158 Mob :+25008865653 e-mail :gregoiredusabe@yahoo.fr / paigelac @yahoo.fr
4.SENDAMA Antoine	Regional Coordinator	Nile Equatorial Lakes Subsidiary Action Programme (NELSAP)	P.O.Box 6759 KIGALI Mob:08307299 Fixe :08307334 Fax :580043
		Kagera Transboundary Integrated Water Resources Management and Development Project (KTIWRMDP).	KTIWRMDP/NELSAP/NBI P.O.Box 7054 Kigali Rwanda. Tel :+250 584424 Fax :+250 584425 Website : www.nilebasin.org E-mail:kagera-pmu@nilebasin.org
5.GISHINGE KASAVUBU Medard			RWANDA e-mail : gishinge@yahoo.fr
6.Dr.RUTAZIBWA Gerard	National Socio-economist Analyst	Government of Rwanda MIFOTRA Comparaive Study for salaries in Public and Private sector.	Alain Molens & Assocites Centenary House 5th. Etage P>O>Box 6077 Kigali-Rwanda Tel:+250 08415263 E-mail :grutazibwa@gmail.com
7.BIZIMANA Clude	Socio-economist		National University of Rwanda
8.Dr. ODANGA Jethro	Principal	Kitabi Conservation Training Centre.	P.O.Box 330 Huye, Rwanda Mob : +250 08 307887 E-mail :jodanga@yahoo.com ; kctc@rwandatourism1.com
9.RUSINGIZANDEKWE Antoine	Executive Secretary	Ruhuha Sector	P.O.Box Mob :08438534 08863437.
10.MUNYAMBAGAZA Zacharie	Secretary : Etat Civil	Ruhuha Sector	
11.SEHABANA John	Secretary : Social Affairs	Ruhuha Sector	Mob : 08475861
12.MUTABAZI Alfred	Sectary : Agronomist	Ruhuha Sector	Mob :08475209.
13.Ms.NIWEMUNI Chanital	Secritary : Accountant	Ruhuha Sector	

14.NSANZIMANA Albert	Project Officer	PAPSTA (Ruhaha & Ngeruka Sectors)	
15.RUNGISABA Guimagine	Chief for Production	Usine Eau Portable of Ngenda	
16.MUSHINZIMANA J.M.V.		AEP Bugesera Sud.	
17.Ms.UMUTESI Ephride	Lab. Technician.	Usine Eau Portable of Ngenda	
18.SEBURINDI Ephrim	Executive Secretary	Nyarugenge Sector	Mob: 08613623
19.NZABONIOECEKA Nolephonse	Secretary: Agronomist	Nyarugenge Sector	Mob: 08730260
20.KARANGAMWA Junocent	Executive Secretary	Ngeruka Sector	Mob: 08515680
21.NYABIYUMVA Jean Marie	Planner	Kirundo Province	Mob.+257 79 973760
22.NIKIGIYIMANA Dieudonne	Environment & Nature Conservation Officer	Kirundo Province	Mob. +257 79 989202
23. KAREMANZIRA Pascal	Social Adviser	Kirundo Province	Mob. +257 77 743 454 22 30 4682 22 30 4714
24.MURE KATETE Racheal	Mapping Officer	CGIS - National University of Rwanda	Mob. 08874570 E-mail: racheal@cgisnur.org
25. UWIMANA Maule Francoise	Refearehie	CGIS - National University of Rwanda	Mob. 08211414 E-mail: mariefrancise.uwimana@cgisnur.org
26.MUKASHEMA Adrie		CGIS - National University of Rwanda	Mob. 08581595 E-mail: adrie.mukashema@cgisnur.org
27.McArd Joseph MLOTHA	Head of Unit	CGIS Environment & DNRM.	P.O.Box 212 HUYE Rwanda. E-mail : joseph_mloth@yahoo.com
28.NDUWAYESU Jean Baptiste	Director General	Institute of Science and Technology Research (IRST)	P. O. Box 227 BUTARE Rwanda. Mob. +250 08302752 Tel. +250 530395 Fax. +250 530939 E-mail: jbuwayezu@yahoo.co.uk nduwayezujb@irst.ac.rw website : www.irst.ac.rw
29.MUNYABURANGA Edward	Executive Secretary	Bugesera District	P.O.Box 1, NYAMATA. Rwanda. Tel. :+250 5611265 Cell :+25008351500 e-mail : edwmutana@yahoo.com e-mail: bugeseradistrict@minalac.gov.rw
30. MPAMBARA Benoit.	Planning Officer	Bugesera District	e-mail: mpabenoit@yahoo.fr
31. MUSANGO KARUMIYA Jacqus	Environment Officer	Minitere.	Cello : +25008692216 E-mail : moussangho @yahoo.fr Website : www.minitere.gov.rw
32. SHIMIYIMANA Audace		Burundi	
33. NDAYISABA Dieudonné		Kagenge	
34. NKUNDABENZE Samuel		Kagenge	
35. KARANGWA Karori		Kagenge	

36. MUNYANTWALI Elisaphan		Kagenge	
37. HABYARIMANA J. Baptiste		Kagenge	
38. HABINSHUTI Janvier		Kagenge	
39. MBARUSHIMANA Felicien		Kagenge	
40. NIYONGERE Francois		Kagenge	
41. SENTORE Samuel		Kagenge	
42. HAKIZIMANA Celestin		Kagenge	

TABLE 9.19: Appreciation of biodiversity by the people of Kagenge - Ngeruka sector

Knowledge**	**Plants:**			**Invertebrates:**			
	Foods	Fuels	Medicines	Insects	Mollusc	Worms	Acarina
Local species Mentioned	Many & ranked:	Limited to:	Many, eg:	A no.& ranked:	?	?	Mentioned:
(have local names describing what the species do)	Beans	Gravellia	*umuwivumba*	bees		earthworm	ticks,
	Sorghum	Eucalypitus	*umubirizi*	butterfly			many spiders.
	S.potatoes	Ephobia	*igikakambumba*	house fly			
	Cassava	Cassia	*ikicamahirwe*	mosquitoes			
	Maize	Calliandra	*umubogona*	termites/w.ants			
	Banana	etc.	*umukuzanyara*	grain bittles			
			inturusu yakinuku	grasshopper			
			igitunguru	wasps			
				dragonfly			
Species habitat:							
:dry land	x	x	x	x	x	X	x
:man's house				x			x
:gardens			x	x	x		x
:bush			x	x	x		x
:wetlands	x		x	x	x	X	x
:lake/water				x			
Species food:	fertile soil	fertile soil	fertile soil	>flower juice & pollen		>plants	>animal blood
	water (rain)	water (rain)	water (rain)	>rotting materials			>flies/ insects
	light	light	light	>human blood			
				>water			
Any liking for species	Support to life	Support to life		>Bees for: honey,		>used as	>spiders

(importance)				income, medicine.		fish baits.	insects in h'se
				White ants for food;			
				>Grasshoppers for			
				food;			
				>Butterfly for beauty;			
Any disliking for species				>Termites destroy			>ticks weaken
(importance)				food crops or plants			dom. animals
				>Mosquitoes cause			
				malaria/ weakness/			
				death.			
Any cultural belief on species							
(cultural attachment)							

TABLE 9.20: (continued)

Knowledge**	**Vertebrates:**						
	Amphibians	Birds:		Fish?	Mammals:		Reptiles
		Domestic:	Wild		Domestic:	Wild:	
Local species Mentioned (have local names describing what the species do)	A few, eg:	Few:	Many??:	Now limited:	Few:	Many:	Snakes (imira):
	tree frogs	chicken	ducks	tilapia	cows?	mice	pythons?
	(imitubu)		owls *(ibihuna)*	*kamongo*	goats	edible rats	s.cobra
	big frog		weavers *(isandi)*	*mamba*	sheep	antelops	
	(ibikeri)		g.c.cranes:		rabbits	hippos (invubu)?	Crocodiles?:
			(umusambi)		dogs	monkeys	*(ingora)*
			agakoko k'amazi		cats	otters	
			lily trotter			bats+	Lizards:
			egrets			mongoose	(umuserabanya)
			ibis				
			sunbird:				Chemillions?
			(umununi)				
			kingfisher:				
			(umurobafi gahuga)				
			y.vented bulbul:				
			(isiryo)				

Species habitat:							
:dry land	X		x			x	x
:man's house		x			x		x
:gardens	X		x			x	x
:bush	X		x			x	x
:wetlands	X		x	x		x	x
:lake/water	X		x	x		x	x
Species food:	insects esp.	>insects	>other birds	plants	plants	plants	rats
	mosquitoes&	>grains	>fish	worms	food	grains	small mammals
	Crickets.	>grass	>grains	small frogs	any meat	nuts	insects
			>insects	insects		fish	
			>flower juices				
Any liking for species (importance)		>Food	>Egrets clean cows	>Food	>Food	Antelops,	>Snakes eat vermins esp.
		>Manure	>Food		security:	ed.rats for:	rats.
		>Wealth/ bank			.give food	food;	>Lizards eat insects.
					.give manure	Some have	>Croc. & pythons provide
					>Wealth	medicines.	skins for sale.
					>Security		
Any disliking for species (importance)	>small frog	>destru ction	>quills eat rice			>Antelops,	>Snakes kill;
	for fish baits	of crops.	>weaver birds eat			hippos,	>crocodiles kill;
			food grains			monkeys	
						destroy crops.	
Any cultural belief on species (cultural attachment)							
	>Not to killed		>owls' cry is				>if one kills a lizard, no
	>Their crook		associated with bad				children;
	announces		omen.				>if lizard passes near,
	rain.		>W.b. coucal's cry				go/see a fortune teller.
			announces rains				

Contributors

Dr Henry Busulwa (Chapter 1)

Henry Busulwa Ssebuliba is an Environmental Ecologist specialised in Freshwater, Wetlands and Fisheries environments. He has a lot of practical experiences of active research at Makerere University, Uganda Wildlife Authority (UWA), the former Uganda National Parks and the Wetlands Inspection Division, and the Nile Basin Initiative. He has been involved in ecosystem management and planning for the last twenty years, and has managed and technically guided a number of scientific outputs including lakes and rivers, fisheries, wetlands, water, forests, wildlife, mountains and dry land ecosystems. He is currently the Lead Specialist for Wetlands and Biodiversity at the Nile Transboundary Environmental Action Project (NTEAP), guiding the technical implementation of the component activities. He has published several books and scientific papers.
He holds a PhD in the Fisheries and Aquatics, a MSc in Zoology majoring in Hydrobiology, a post-graduate diploma in Limnology, a post-graduate diploma in Education, and a BSc in Zoology.

Prof. John Bosco Gashagaza Mukwaya (Chapter 2)

Prof. Gashagaza was Associate Professor in the Department of Animal Science, Faculty of Agriculture at the National University of Rwanda (NUR). He is actually retired from NUR and works as an Independant Consultant in SODEGE Society. He taught Limnology, Fisheries and Aquaculture, Apiculture and Applied Animal Ecology. He has participated in several regional research and scientific expeditions, and is widely published. He holds a B.Sc and M.Sc in Environment Conservation, and a PhD in Fish Biology and Ecology. He is a member of the International Society of Limnology (SIL), Japanese Society of African Studies, and Association Rwandaise de Biosciences.

Benoit Nzingazidera (Chapter 3)

Nzigidahera Benoît specialized in botany. He has been involved in research and teaching at the University of Burundi, and as consultant with the National Institute for Environment and Nature Conservation (INECN) in Bujumbura. He has published many books and scientific papers.

Prof. John B. Kaddu (Chapter 4)

Kaddu is Professor of Zoology at Makerere University, Kampala. He teaches Entomology and Parasitology and has managed/participated in several regional research projects. He has worked as research scientist at the International Centre of Insect Physiology and Ecology (ICIPE) – Nairobi , at the Kenya Trypanosomiasis Research Institute (KETRI), with World Health Organisation Trypanosome Cryobank and at the East African Trypanosomiasis Research Organisation (EATRO), Tororo, Uganda. He holds a BSc in Zoology, Botany and Chemistry, MSc in Applied Parasitology and Entomology, and PhD in Entomology.

Prof. Gaspard Ntakimazi (Chapter 5)

Ntakimanzi is Associate Professor at University of Burundi, and Visiting Professor at the University of Ngozi (Burundi) and the National University of Rwanda (Butare). He teaches Environment Protection and Nature Conservation, Limnology, Inland Fisheries and Aquaculture, Ecotoxicology, Animal Ethology, Vertebrate taxonomy, Animal physiology, among others. He has been involved in various regional research studies in aquatic ecology and is widely published. He holds a B.Sc in Zoology, a post-graduate diploma in Ecotoxicology and Environmental Chemistry, and a PhD in Environment Sciences

Domnick Victor Wasonga (Chapter 6)

Wasonga is a Herpetologist at the National Museums of Kenya Department of Herpetology, Nairobi. He has participated in several regional research projects and is widely published. He holds a B.Sc in Wildlife Management, and a M.Sc in Dryland Biodiversity. He is a member of the Ecological Society of Eastern Africa (ESEA); the Herpetological Association of Africa (HAA); the East African Natural History Society (NatureKenya) and Chair of Kenya Herpetofauna Working Group (KHWG).

Ronald Kale Mulwa (Chapter 7)

Mulwa is a Research Scientist and head of Ornithology Section, within the Zoology Department of National Museums of Kenya. He is also the National co-ordinator for Important Bird Areas monitoring program in Kenya and the National Species Action Plan Co-ordinator for the African Bird Species Working Group – Kenyan chapter. He has participated in various regional research projects and consultancies among them: Developing ecological monitoring tools and a databases for the Mount Elgon Ecosystem, Mau forest complex, Kakamega and Arabuko Sokoke forests, Bird surveys in Kenya, Tanzania, Madagascar and, in this study, Rwanda and Burundi, he trains bird guides and is a contributor to the Avi-tourism training manual for Kenya. Mr Mulwa is an Ornithological Ecologist who holds a B.Sc in Wildlife Management (Moi University), M.Sc in Animal Ecology (Kenyatta University) and is currently a PhD Candidate at Johannes Guttenberg University, Mainz – Germany.

Robert M. L. Kityo (Chapter 8)

Kityo is the Principal Assistant Curator of the teaching and research Museum of the Department of Zoology at Makerere University, Kampala. He in addition teaches courses in Animal Taxonomy, Vertebrate Biology, Curatorial practices and Biogeography. He is involved in a wide array of field studies ranging from Vertebrate Paleontology, Vertebrate biology and ecology, to environmental impact assessment studies. He worked as a Research Biologist on Tropical Forest Research Project in Mabira Forest (Uganda) before joining Makerere University initially as an assistant lecturer. He also worked as a Research Biologist for the National Biodiversity Data Bank project. He is a member of NatureUganda, an affiliate of the East African Natural History Society, Chair of the Mammals working group of NatureUganda, and a member of the IUCN Chiroptera Specialist Group. He holds a B.Sc in Zoology, an M.Sc in Zoology (Wildlife ecology) and a PhD in Zoology.

Fredrick Williams Kiwazi (Chapter 9)

Kiwazi is currently the Regional Wetlands Coordinator for Central Region in Uganda's Ministry of Water, Lands and Environment. He is also a Gazetted Environment Inspector with Uganda's National Environment Management Authority (NEMA) and has worked in the Uganda National Wetlands Programme, Wetlands Inspection Division. He holds a B.Sc in Chemistry, diploma in Environmental Management and is currently pursuing M.Sc in Environmental Science at Makerere University, Kampala.