Feasibility Study for an Integrated Watershed Management Program for the Kagera River Basin

Grant No. TF095177

Annex B: Wetlands Management

10 December 2012

Clockwise from top left: farmed wetland near Lake Muhasi, Rwanda; urban smallholder farming in Nyabugogo River floodplain, Kigali, Rwanda; harvesting reeds, Akagera River, Rwanda. All photos: Helen Houghton-Carr, CEH.

Contents

1. Introduction 1
1.1 The Kagera river basin 1
1.2 Wetland values, functions and attributes 2
1.3 Approaches to wetland management 3
1.4 Structure of report 4
1.5 Comments on the Terms of Reference 4
2. Wetlands in the Kagera river basin 5
2.1 Values, functions and attributes of Kagera wetlands 5
2.1.1 Wetlands in Burundi 5
2.1.2 Wetlands in Rwanda 7
2.1.3 Wetlands in Tanzania 7
2.1.4 Wetlands in Uganda 10
2.2 Importance of wetlands in the Kagera river basin 10
2.2.1 Maintenance of biodiversity 11
2.2.2 Provision of food, fuel and fibre 12
2.2.3 Water supply, purification and regulation 12
2.3 Wetland degradation 13
2.3.1 Population growth and related issues 14
2.3.2 Agriculture and aquaculture 14
2.3.3 Pollution 16
2.3.4 Climate change 17
2.3.5 Water demand change 17
2.4 Frameworks for wetland management 18
3. Wetlands sectoral analysis and technical assessment 19
3.1 Experience from past initiatives in Kagera river basin and lessons in wetland conservation 19
3.1.1 Integrated Management of Critical Ecosystems (IMCE) (Rwanda) 19
3.1.2 Conservation and integrated management of the Rugezi Marshland (Rwanda) 20
3.1.3 Lesson learned 21
3.2 Ongoing and proposed activities 27
3.2.1 Bugesera Natural Region Rural Infrastructure Support Project (Bugesera PAIR) (Burundi, Rwanda) 27
3.2.2 Decentralisation and Environmental Management Project (DEMPII) (Rwanda) 27
3.2.3 Extending Wetland Protected Areas through Community Conservation Initiatives (COBWEB) (Uganda) 28
3.2.4 Inland Lakes Integrated Development and Management Support Project (PAIGELAC) (Rwanda) 29
3.2.5 Transboundary Agro-Ecosystem Management Programme (Kagera TAMP) (Kagera basin) 30
3.2.6 Issues arising 30
3.3 Institutional analysis 36
3.4 Legal position 39
3.4.1 Burundi 41
3.4.2 Rwanda 42

3.4.3 Tanzania 43
3.4.4 Uganda 44
4. Wetland project selection criteria 46
4.1 Rationale behind proposed wetlands management framework 46
4.2 Wetland project selection criteria 49
5. Prioritised wetlands management and restoration project plan 52
5.1 Proposed projects 53
5.1.1 Approach 54
Monitoring and evaluation framework 57
5.2 Indicators 57
5.3 Issues 58
6. References 59
Appendix A – List of consultations 64
Appendix B – Example of wetland risk/vulnerability assessment 66

1. Introduction

1.1 The Kagera river basin

Located in the Great Lakes Region of Africa, the River Kagera drains a basin area of 59,800 km^2, distributed among Burundi (22%), Rwanda (34%), Tanzania (34%) and Uganda (10%) (DWD/WWAP, 2005). The River Kagera provides the largest volumetric contribution to Lake Victoria, the second largest freshwater lake in the world (Sene & Plinston, 1994). The Kagera basin is characterised by the existence of many lakes and marshlands (Figure 2.1). The lakes and marshlands attenuate river flows, and the Kagera has a high baseflow component resulting from the water storage in these lakes and marshlands (Sutcliffe and Parks, 1999). The marshlands along the river valleys are inundated during floods in the peak rainfall months of April and May, whilst the lowest water levels are in August-October.

In this report, the term "wetlands" include both marshlands, also referred to in the region as bogs, fens, marshes (called marais in French), and swamps, and open waterbodies i.e. lakes and rivers, according to the wider Ramsar (1971) usage. In this report, wetlands are defined as areas of land permanently or temporarily flooded by surface water or regularly saturated by groundwater and characterised by vegetation adapted to life in saturated soil conditions. The Kagera wetland vegetation is predominantly papyrus grass and floating mats of sedge (BRL, 2008). The wetlands support a rich biological diversity with many endemic species and rare flora and fauna, including 180 species of birds, restricted ranges of species and globally threatened species (FAO, 2000).

Wetlands play an important role in the food web and supporting biological diversity, and humans benefit socio-economically from wetlands in terms of the ecosystem services they provide. Water is vital for people, livestock and industries, as well as hydropower generation, agriculture, water-based transport, fisheries, waste discharge, tourism and environmental conservation. Wetlands, therefore, are of immense value to local and national economies, and thus poverty alleviation.

Marshlands cover 2.9% of the area of the Kagera basin and open water bodies another 1.6%, which does not reflect their significant importance to the basin as a whole. The lakes, marshlands and rivers are closely related as the Kagera basin is comprised of two principal types of marshland ecosystems. The first are lacustrine (associated with lakes) marshlands such as those around Lakes Cyohoha, Ihema and Rweru, and at Sango Bay where the Kagera river enters Lake Victoria. The second are riverine (associated with rivers) marshlands such as those along the Akagera, Akanyaru, Kagera, Mugesera, Ngono and Nyabarongo rivers.

As shown in Figure 2.1, the main tributaries of the Kagera are the Akanyaru and Nyabarongo (which join to form the Akagera) from western Rwanda and the Ruvubu from Burundi, all of which have flatter cross sections where lakes and marshlands have formed. The Akagera and Ruvubu join to form the Kagera at Rusumo Falls where the channel drops 30 m over 1 km. Below Rusumo Falls, the Kagera is flanked by lakes and marshlands up to 15 km wide for approximately 200 km, before turning east towards Lake Victoria. The Mwisa and Ngono rivers from western Tanzania flow through lakes and seasonal marshlands for most of their length before joining the Kagera near its mouth where there are permanent wetlands.

1.2 Wetland values, functions and attributes

Wetlands can fulfil a number of ecosystem functions. For example, they may provide breeding or resting grounds for migratory species of birds, a source of water for drinking and livestock watering, indigenous plants for food, medicinal or fuel use, and a source of fertile soil for planting crops and irrigation water. Furthermore, they may be important for mitigating the effects of flooding and for buffering the impact of changes in water quality and sediment. These functions deliver ecosystem services to people that can be categorised as:

- *Provisioning* services i.e. harvestable goods and products obtained from ecosystems, such as timber, firewood, grasses (for construction and artisanal use), fodder, fish, land, vegetation, medicinal plants, water, drinking water supply, etc.
- *Regulating* services i.e. the benefits obtained from the maintenance of natural processes and dynamics, such as water filtering, dilution of pollutants, sedimentation/siltation reduction, flow regulation, flood attenuation, drought alleviation, soil water storage capacity, groundwater recharge capacity, biological diversity, etc.
- *Carrying services* i.e. services that make the ecosystem suitable for different purposes, including human settlement/livelihoods (e.g. fishing, cultivation, livestock grazing, etc), leisure/tourism activities, nature conservation, etc.
- *Cultural* services i.e. non-material benefits obtained from ecosystems, including artistic, aesthetic, religious and spiritual experiences, recreation, scientific enrichment, etc.
- *Supporting* services i.e. services necessary for the production of all the other ecosystem services, such as soil formation, photosynthesis, nutrient recycling, etc.

There are other ways of classifying ecosystem services. For instance, the Millennium Ecosystem Assessment (2006) does not explicitly include the carrying services mentioned above.

Some services are synergistic and reinforcing e.g. maintaining wet conditions supports wetland birdlife that maintains biological diversity, attracts tourists and reduces CO_2 emissions. Other services are potentially conflicting e.g. raising water levels may reduce potential floodwater storage and increase methane emissions. Most ecosystem services are, unsurprisingly, dependent upon wetlands being wet. Trade-offs between ecosystem services arise from management choices made by humans, which can change the type, magnitude and relative mix of services provided by the ecosystem. Trade-offs occur when the provision of one ecosystem service is reduced as a consequence of increased use of another ecosystem service (Swallow et al., 2009).

The Millennium Ecosystem Assessment (2006) showed that human activities have changed most ecosystems and threaten the Earth's ability to support future generations. For instance, the degradation of wetlands means a gradual disappearance of these environmental functions which are necessary for the well-being of humans and wildlife and would be expensive and/or impossible to replace. Costanza et al. (1997) made a first attempt to value the world's ecosystems and proclaimed a figure of around 33 Trillion USD; this figure will no doubt have increased some 15 years later.

1.3 Approaches to wetland management

In international law, the 1971 Ramsar Convention on Wetlands of International Importance is the primary legal instrument relating to wetlands. The aim of the Convention is to halt the worldwide loss of wetlands and conserve them through wise use and management. Wise use is the "sustainable utilisation for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem". Although the Convention's early focus was on protection of migratory birds, in recent years, and in recognition of the links between environment, poverty and economic development, the "wise use" concept has broadened to include the need to integrate wetland management into national land use and water management strategies.

In establishing criteria for designating wetlands under this Convention, a number of social factors were taken into account such as tourism, outdoor recreation, education and scientific research, agricultural production, grazing, water supply, fisheries production and cultural values and functions (e.g. archaeological sites, historical associations and/or religious significance, including its significance to indigenous people). Some of the Kagera basin's wetland ecosystems are used by migratory birds and could be considered as ecosystems of international importance in line with the Convention.

The following Ramsar documents have formed an important element of our methodology under this task:

- Handbook 7 River Basin Management: Integrating wetland conservation and wise use into river basin management (2007)
- Ramsar Convention Manual, 4th edition (2006a)
- Technical Report No 2 Low-cost GIS software and data for wetland inventory, assessment and monitoring (2006b)
- Technical report No 3 Valuing wetlands: Guidance for valuing the benefits derived from wetlands ecosystem services (2006c)

All of the Kagera basin countries are party to the Convention: Burundi in October 2002, Rwanda in April 2006, Tanzania in August 2000 and Uganda in July 1988. However, currently only two wetlands in the basin are Ramsar sites, namely the Rugezi Marshland in Rwanda and SAMUKA (Sango Bay-Musambwa Island-Kagera Wetland and Floodplain) in Uganda (although the latter is a transboundary wetland, only the Ugandan side has Ramsar status at time of writing). This obliges the governments of Rwanda and Uganda to maintain the ecological character of these two wetlands.

Another important driver for wetland management is the Convention on Biological Diversity's ecosystem approach (http://www.cbd.int). This is an international legally binding treaty which has three main goals: conservation of biological diversity (or biodiversity); sustainable use of its components; and fair and equitable sharing of benefits arising from genetic resources. The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993. This forms a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Again, all the Kagera basin countries are party to the Convention: Burundi in 1997, Rwanda and Tanzania in 1996 and Uganda in 1993.

Also of relevance is the Global Water Partnership's Principles of Integrated Water Resource Management (IWRM, http://www.gwp.org/en/The-Challenge/What-is-IWRM), defined as "a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". This integrated approach recognises the links between water, land and other natural resources, and results in more complete solutions that address more of the factors causing wetland degradation through management of the wetland watershed. It involves the participation of multiple stakeholders from different elements of society including central government, local government, communities, extension staff and NGOs. Many wetlands in the Kagera basin are transboundary, where integrated management of wetlands requires involvement of, and coordinated planning by all the countries involved. Groundwater systems are an important component of shared water resources and should also be incorporated in transboundary water management (Heyns et al., 2011).

Other critical guidance is provided by the Nile Basin Wetlands Management Strategy (2011-2016; NBI, 2010), the EAC Protocol for the Sustainable Development of the Lake Victoria Basin (EAC, 2004), the EAC Protocol on the Environment and Natural Resource Management (EAC, undated) and the draft EAC Transboundary Ecosystem Management Bill (EAC, 2010). In addition, we have utilised all relevant studies undertaken in the basin including good management practices and the utilisation of indigenous knowledge.

1.4 Structure of report

This report corresponds to Task 3 "Preparation of wetlands management sub-projects" in the Terms of Reference. After this introductory section, Section 2 focuses on wetlands in the Kagera river basin in terms of their values and functions and the ecosystem services they provide, and also the threats to wetlands causing their degradation. Section 3 examines past, present and upcoming initiatives in wetland management, both conservation and development activities, as well as the institutional organisation, policies and laws in the four riparian countries, in order to learn lessons to inform future projects. Section 5 presents priority wetland management project proposals selected according to the criteria set out in Section 4. Finally, Section 6 outlines a monitoring and evaluation framework to assess the impact of management interventions.

1.5 Comments on the Terms of Reference

The outputs of the study specified in the ToR include "an integrated watershed management action and investment plan" and "a community-based wetlands management and investment plan". Experience from past and current projects, summarised in Sections 3.1 and 3.2, has demonstrated that wetlands cannot be isolated from their watersheds, and that management interventions must apply to the whole catchment in which a wetland lies. Thus the requirement of the ToR to output separate wetlands management and watershed management plans is not an ideal approach. The two principal threats to wetlands in the Kagera basin are siltation due to soil erosion and conversion to agricultural land; the soil erosion itself caused by deforestation of hillsides (to produce cultivable land) and poor farming practices. Therefore, potential wetland projects must address these watershed issues. Therefore a strategic management framework for wetlands is proposed. The framework establishes management objectives that can be translated to site-specific level by individual wetland management plans. Thus, the wetlands projects proposed in Section 5 contribute to this strategic management framework.

2. Wetlands in the Kagera river basin

2.1 Values, functions and attributes of Kagera wetlands

There are many thousands of wetlands (lakes, marshlands and rivers) in the Kagera basin which provide the different ecosystem services described in Section 1.2. The typical uses of Kagera wetlands by humans are presented in Table 2.1. Some of the principal wetlands are listed in Table 2.2 complied from Hughes and Hughes (1992), FAO (1998), Tounkara and Diaw (2003) and REMA (2009), and shown in Figure 2.1 (REMA, 2008). While many of them lie within one of the four basin countries, many make up or are associated with the borders between countries, hence, are transboundary wetlands. Ideally these require joint management as the effects of mismanagement on one side of a wetland can affect the whole wetland. However, transboundary management can be particularly complex. Some marshlands occur along the boundaries of National Parks and Reserves and form buffer zones between the protected areas and the neighbouring land and people. Other marshlands, especially the high altitude and/or peat soil ones, are often the sources of major rivers or of water supply for people or industry, and changes to the hydrological functioning (such as drainage or peat extraction) can cause major impacts downstream e.g. the Rugezi marshland in Rwanda. Wetland ecosystems often contain specific, sometimes endemic flora and fauna which may be protected by national or international law. Again changes to such wetlands can result in the reduction or loss of biodiversity.

Table 2.1 Typical direct and indirect uses of Kagera wetlands

Direct uses	Indirect uses
Clay and sand mining	Water regulation, storage and recharge
Commercial and subsistence fisheries	Water quality and purification
Communal grazing	Aesthetic value
Fuel wood and construction materials	Conservation and preservation
Horticulture and plantation	Cultural and/or historic significance
Medicinal plants	Ecotourism
Navigation and traditional boating	Environmental and educational value
Papyrus harvesting	Natural research area
Recession agriculture and cultivation lands	Recreation
Settlement	Scientific research and monitoring
Small and large scale irrigation	Spiritual significance
Urbanisation and infrastructure development	
Waste dumping	
Water supply for drinking	

2.1.1 Wetlands in Burundi

Burundi's topography is dominated by hills and mountains interspersed with permanent and seasonal marshlands in the low-lying areas, particularly along many of the rivers, including the Ruvubu tributary of the Kagera. Burundi has six significant lakes comprising Lake Tanganyika (8%), which is not in the Kagera basin, four lakes in the Bugesera complex on the border with Rwanda, including Lakes Cyohoha and Rweru, and Lake Rwihinda. In addition there are numerous small lakes in the hills and mountains.

Marshlands cover 1180 km^2 or about 5% of the land area (Hobbs and Knausenberger, 2003). The Malagarasi marshland is the largest wetland and the most diverse, with over 140 bird species recorded. Some 6% of Burundi's marshlands are protected or identified for protection, and only 22% not yet exploited; 69% are used for agriculture, 1.8% for clay and sand harvesting and 1.2% for peat extractions. The effective management of wetlands and marshes has been difficult in Burundi due to ill-defined management responsibility, which is divided among various departments and ministries (Section 3.3).and land tenure rights.

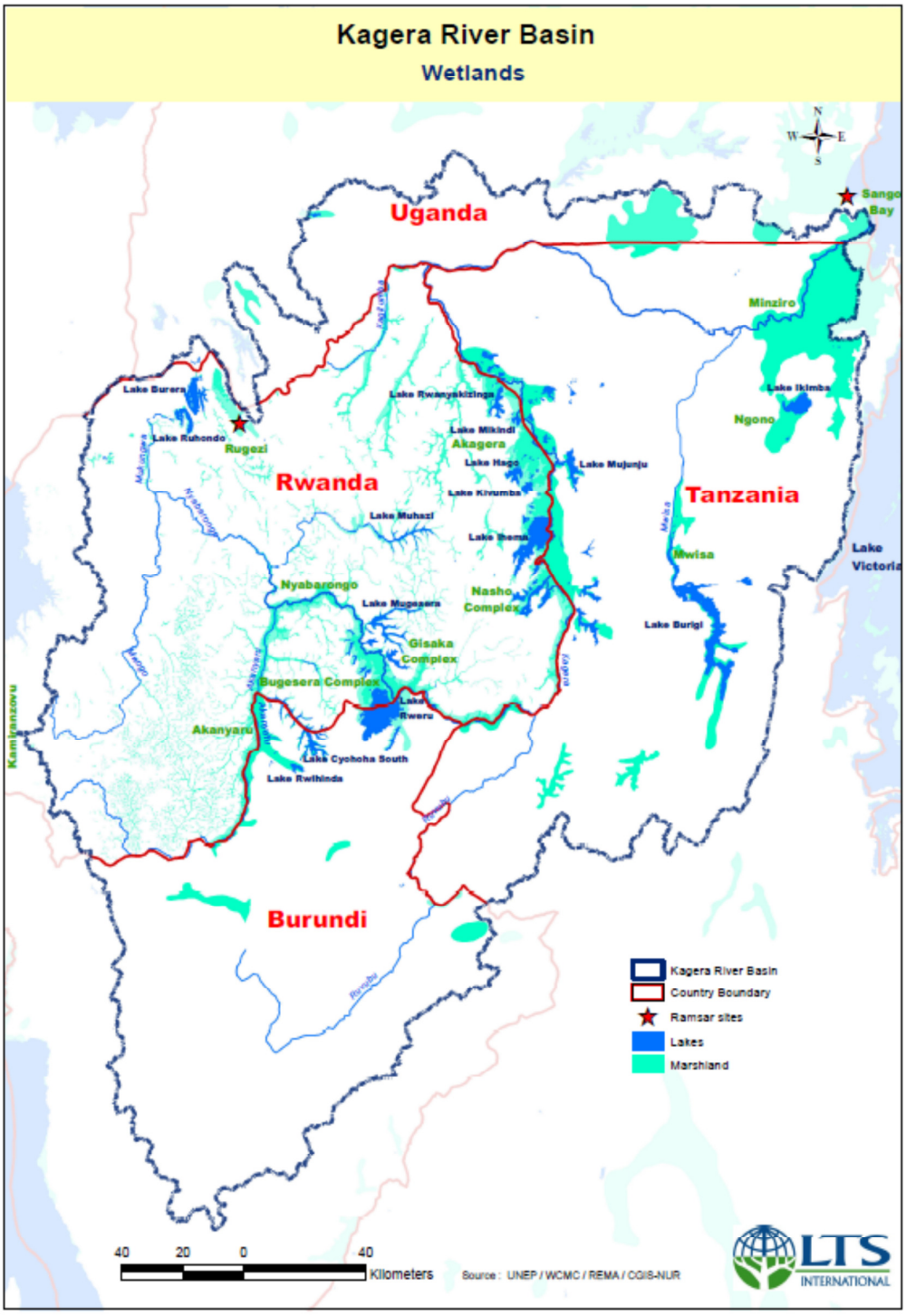

Figure 2.1: Principal wetlands in Kagera river basin

2.1.2 Wetlands in Rwanda

A recent inventory of wetlands in Rwanda identified 101 lakes covering a total surface area of 1495 km^2, 860 marshlands covering 2785 km^2 (10.6% of the country's surface) and 861 rivers totalling 6482 km in length (REMA, 2008). Of the marshlands, the largest of which are clustered around rivers, 41% were covered by natural vegetation and 59% had been or were being cultivated. However, some of these 1822 wetlands fall in the Congo basin which drains to the west, rather than the Kagera/Nile basin. The two largest marshlands are the Akagera complex along the Tanzanian border to the East and the Rwero-Mugesera complex in the south (Hughes and Hughes, 1992). There are other smaller marshland areas in flat places in the valleys and extensive marshlands on the high central plateau. Rwandan marshlands have been classified in several ways by REMA (2008):

- By marshland type identified on the basis of relief, altitude, size, soil type, vegetation type, hydrological function, slope of watershed and population density, giving seven different classes.
- By vulnerability criterion identified on the basis of the ecosystem services provided, namely biodiversity, presence of peat, hydrology, proximity to a National Park or Reserve, whether a cross-border marshland and current usage, giving eight different classes. This classification was designed to facilitate management.
- By protection criterion i.e. fully protected, exploited under conditions including a full EIA, or exploited after a basic EIA. This classification was also designed to facilitate both management and protection.

2.1.3 Wetlands in Tanzania

It is estimated that there are some 54,390 km^2 of lakes and marshlands In Tanzania, representing 5.8% of the total surface area of the country, but this does not include seasonally inundated floodplains (Hughes and Hughes, 1992). The principal wetland systems comprise the lakes of the Western and Eastern Rift Valleys, Lake Victoria, numerous minor lakes, riverine floodplains and permanent swamps, tidal swamps at the coast, and a number of artificial impoundments.

There are four Ramsar sites, none of which are in the Kagera basin; these are not strictly protected areas because wise use to enhance livelihoods is promoted; three of these are "active" supported by external donor funding (Lake Natron, Kilombero Valley and Malagarasi-Muyovozi) and one inactive due to a lack of external donor funding (Rufiji-Mafia-Kilwa). Some 25% of the country is protected in National Parks or Game Reserves, many of which are centred on wetland systems, such that a proportion of the country's wetlands are indirectly protected.

There is recognition at a high level that many wetlands in Tanzania may already have been lost. It is an ambition of the Ministry of Water to have a comprehensive inventory of Tanzanian wetlands (sites, status, threats and protection level) but to date this comprises an incomplete database of basic information submitted by the River Basin Water Offices. There is not yet any classification of wetlands in Tanzania, other than lakes and permanently or seasonally flooded marshlands.

The Kagera basin forms only a small part of Tanzania but there is concern, not only about the impact on land, water and wetlands of development activities in Tanzania, but also of the impacts on both the quantity and quality of river flow of upstream activities in Burundi and Rwanda. The now-defunct Kagera RBO provided a useful platform for communication between the riparian countries.

Table 2.2: Principal wetlands in Kagera river basin (sources: Hughes & Hughes (1992), FAO (1998), Tounkara and Diaw (2003), REMA (2009))

Name (country*)	Component lakes/marshlands	Area (km^2)	Comment
Akagera complex (Rw/Tz)	Lakes Hago, Ihema, Kivumbo, Mihindi, Rwakibara, Rwanyakizinga, Rweshikana Marshlands Akagera	146	National Park status (a third of original size due to land pressure), tourist destination. 1200-1500m altitude. Organic soil with less developed peat. More than 500 bird species, 9 of amphibians, 34 of reptiles, several CITES-listed fish species, large mammals. L. Ihema vegetation dominated by giant marsh grass which is important source of detritus in Kagera river; other grasses and herbaceous plants provide important habitat and source of nutrients for fish.
Bugesera complex (Bu/Rw)	Lakes Cyohoha North, Cyohoha South, Gaharwa, Gashanga, Kanzigiri, Katshamirinda, Kidogo, Kilimbi, Mirayi, Rumira, Rweru Marshlands Akanyaru, Nyabarongo	1200	1200-1500m altitude. Organic soil with less developed peat, though extensive peat deposit found in Akayaru valley near Boyongwe in Burundi used for fuel.
Lakes Bugiri, Ikimba (Tz)		195	Both lakes 1200 m altitude. L. Burigi is surrounded by papyrus swamps and patches of forest, and partly lies within Burigi Game Reserve. Neither lake has an outflow (Kassenga, 1997)
Lakes Burera, Ruhondo (Rw)		83	High altitude, deepest lakes in Kagera basin at 165m, 68m deep, respectively (majority are 3-7m depth), low biodiversity and phytoplankton. Tourist destination.
Gisaka complex (Rw)	Lakes Birira, Mugesera, Sake	80	L. Mugesera is principal habitat of several endemic species, some of which are protected, can experience great variation in water level when papyrus barriers are breached.
Kamiranzovu Marshland (Rw)		13	2300m altitude. Tourist destination in Nyungwe Forest Reserve.
Lake Mohasi (Rw)		34	Tourist destination.
Nasho complex (Rw)	Lakes Cyambwe, Mpanga, Nasho	43	
Lake Rwihinda (Bu)		92	1480m altitude. 12 km^2 lake with 80 km^2 marshland to west. May be referred to as the “bird lake”. Habitat of some endemic species, some of which are protected.
Minzaro Forest (Tz)			Seasonal swamp forest reserve. Home to many rare species of birds. The ecosystem is at threat from tree cutting, plant extraction, wood collection and charcoal making.

Name (country*)	Component lakes/marshlands	Area (km^2)	Comment
Mwisa and Ngono Marshland s(Tz)			Marshlands along Mwisa and Ngono tributaries to Kagera. Dominant vegetation is papyrus and water hyacinth.
Rugezi Marshland (Rw)		67	Ramsar wetland. High altitude marshland >1800m. Peaty soil. Tourist destination. Important for biodiversity with 51 vegetation species including several CITES-listed grass species, many animal species considered to be endangered and in need of protection, more than 10,000 bird species some of which also CITES-listed.
Ruvubu Marshland (Bu)	Marshlands Kayongozi, Luvironza, Ruvubu	460	1500m altitude. Permanent and semi-permanent marshlands dominated by papyrus in valleys of Ruvubu tributaries. Wetlands in lower valleys have National Park status, tourist destination. Over 400 bird species, 98 mammal species, 20 insect species, 8 bat species, 10 primates, 6 arthropods. Some of mammals on IUCN red list. Numerous indigenous tree species of socio-economic importance.
Sango Bay-Musambwa Island-Kagera Wetland and Floodplain (SAMUKA) (Tz/Ug)		551	Ramsar wetland on Ugandan side. Seasonal papyrus swamp forest reserve where Kagera river enters L. Victoria. Biodiversity of global significance and high conservation value; important bird area, endemic species of fish, dragonflies, butterflies and endangered hardwood species (Davenport and Howard, 1996). Wetland significantly reduces the amount of water entering L. Victoria from R. Kagera (Haskoning, 2001).

* Bu Burundi, Rw Rwanda, Tz Tanzania, Ug Uganda

2.1.4 Wetlands in Uganda

Uganda's wetlands cover about 18% of the total surface area of the country (DWD/WWAP, 2005), composed of 5% lakes and 13% marshlands and swamp forest. There are many lacustrine and riverine marshlands, some seasonal floodplains at the heads of the large Rift valley lakes, and several small lakes. The marshlands are mainly dominated by papyrus. Patches of swamp forest occur around the Ugandan lakeshore e.g. Sango Bay. However, even though Uganda was the first African country to have a National Wetland Policy and a National Wetland Programme to implement it, most of its wetlands face reclamation and degradation (NEMA, 2001). Between 1990 and 1992, Ugandans converted 7.3% or 2376 km^2 of the total original wetland area (National Wetlands Programme, 2004).

Currently, wetlands are simply classified as: vital (have unique function, includes Uganda's Ramsar sites), critical (have important function, but not unique) and variable (of benefit to the wider community). A new classification is being developed based on Ramsar where the emphasis is on ecosystem services. The total value of Uganda's wetlands in economic terms is difficult to determine because some of the values are regarded as free public goods. However, wetlands are believed to supply direct or subsistence employment for 2.7M people (almost 10% of the population) and about USD 100,000 per year is estimated to accrue from wetland resources through crop cultivation, papyrus harvesting, brick-making and fish farming (DWD/WWAP, 2005). Apart from SAMUKA (Sango Bay-Musambwa Island-Kagera Wetland and Floodplain), the majority of Uganda's wetlands lie outside protected areas.

2.2 Importance of wetlands in the Kagera river basin

The Kagera is a transboundary river and, as such, each of the riparian countries are faced with the challenge of making maximum use of the water resources within its territory for its own socio-economic development, whilst not compromising the legitimate right of its neighbours to the same shared resources. Downstream, the Kagera wetlands are important to Lake Victoria because the wetlands regulate flows and treat water entering the lake; degradation of the Kagera wetlands could reduce these important ecosystem services. The outflow from Lake Victoria is the White Nile, which flows through several important lakes and the Sudd wetland in Southern Sudan before joining the Blue Nile from Ethiopia and flowing north to Egypt; changes in the Kagera basin could have a range of regional impacts. The challenge is to ensure that all shared waters are managed optimally and equitably to derive mutual benefits for all the riparian countries. Cooperative management and development of shared water resources through basin-wide planning and implementation of "win-win" projects can serve as a catalyst for a broader range of cooperation and economic integration, reflected in the significant number of regional water resources management and development initiatives (Sections 3.1 and 3.2).

Wetlands in the Kagera basin are used in many different ways and play an important role in the national economies of the four basin countries. Human well-being is closely linked to the state of ecosystem services which make valuable contributions to livelihoods, particularly for rural households which face food insecurity, poverty and vulnerability. In addition, millions of people have been displaced by civil war in the region, and having lost their ancestral lands often depend on wetlands for a living (BRL, 2008). The reality is that without protecting ecosystem services, development will be hindered, but without alleviating poverty and providing a means of development, environmental protection will be more challenging (Andrew and Masozera, 2010). UNEP/IISD (2005a; 2005b; 2005c) identified three critically stressed ecosystem services in Rwanda, Tanzania and Uganda that affect human well-being, namely maintenance of biodiversity, provision of food, fuel and fibre, and water supply, purification and regulation. Hobbs and Knausenberger (2003) identified the same issues in an overview of key trends in Burundi's environment and natural resource sector, and the primary threats and opportunities.

2.2.1 Maintenance of biodiversity

The wetlands of the Kagera basin provide habitats for many plants, insects, birds, fish and other animals which may be a combination of their ecological condition, their size and/or their protection status. The wetlands support a number of globally threatened species and restricted range species, such as water turtles, crocodiles, monitors, snakes, otters and a large variety of water birds including herons, egrets, ducks, warblers and weavers.

Many endangered species are on the IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1963, which is the world's most comprehensive inventory of the global conservation status of plant and animal species. Also drafted at the 1963 meeting was the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, also known as the Washington Convention). CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33000 species of animals and plants.

In the Kagera basin, the high altitude marshlands tend to host greater numbers of vegetation species compared to the lower altitude ones (REMA, 2009). For example, Burundi's fauna includes 716 bird species, 215 fish species, 163 mammal species, 56 amphibian species and 52 reptile species, and its flora includes 2909 species, some of which are endemic at higher altitudes (Beck et al., 2010). Fifty species of Burundi's flora and fauna are currently threatened with extinction: two critically endangered, 15 endangered, and 33 vulnerable. Another 39 are considered near threatened (Beck et al., 2010). The majority of species are considered to be most at risk from extinction by habitat alteration or degradation e.g. deforestation and conversion of land to agriculture or grazing. Other reasons include the targeted removal and over-exploitation of flora and fauna e.g. by destructive fishing methods and overfishing, the introduction of invasive species e.g. water hyacinth, and poor land practices e.g. hillside erosion, pollution from fertilisers. Most at-risk flora and fauna can be found in protected areas (MINATE, 1997). Burundi has 14 protected areas, managed by INECN and covering 5.6% of the country's land area. Creation of the protected areas did not recognise the rights of use by local communities (e.g. 3000 people were forcibly resettled from Ruvubu National Park (Hobbs and Knausenberger, 2003), or their participation in the management, resulting in high levels of conflict and tension between the surrounding population and the protected areas (Beck et al., 2010).

Some 180 bird species have been identified in the wetland habitats of Rwanda, including 6 European migrants. A number of these migrating bird species and other endangered species are protected by CITES and/or on the IUCN red list (REMA, 2009). Fish diversity in Rwanda is decreasing along with the loss of wetland biodiversity and habitat, though exact data are lacking (World Bank 2004).

In Tanzania, declining fish diversity in the Ngone river is reported (Baijukya et al., undated).

Uganda's marshlands are home to a very rich diversity of plants and animals that constitute part of the country's natural resources. This includes 43 species of dragonfly (of which eight only occur in Uganda), 8 species of mollusc, 52 species of fish, 48 species of amphibians, 243 species of birds, 14 species of mammals, 19 species of reptiles and 271 species of macrophytes (DWD/WWAP, 2005). All these species are of conservation importance. In recent years, there has been an observed decline in aquatic biodiversity in most of waterbodies. This is attributed to reasons such as destructive fishing habits, increasing eutrophication as a result of pollution, degradation of riparian watershed and deforestation, more frequent algal blooms, and the spread of water hyacinth. Ten sites have been identified as biodiversity hotspots requiring immediate attention (DWD/WWAP, 2005).

Tourism in the basin primarily concerns attractions that are linked to the natural environment (flora and fauna) present in the region. Despite the good potential for tourism in the basin, with some exceptions, it has been negatively affected by inadequate tourism organisation, poor publicity about the region, security, lack of infrastructure and the relative remoteness of the Kagera region from the main tourist circuits. The development and management of ecotourism requires an integrated approach in order to optimise opportunities for poverty alleviation for the benefit of inhabitants of the Kagera basin.

2.2.2 Provision of food, fuel and fibre

Wetland ecosystems contain numerous plants and animals that can be directly harvested to provide food and medicines, materials for daily living and fuel for local people. Water supports healthy vegetation growth and can be used for consumption by humans, livestock and other animals and for industrial activities. For instance, wetlands provide material for building and artisanal use e.g. basket-making. A household in rural Uganda has been estimated to get up to USD 200 per hectare per year from harvesting papyrus grass from a wetland area (NEMA, 2001).

The majority of the population of the Kagera basin are engaged in agricultural activities. Some farmers cultivate small plots for food production in the rainy season, others cultivate swamp and riverine banks of the Kagera in the dry season when they have no other water source. Many marshlands are under traditional cropping or have been modified through extensive drainage or irrigation, particularly for rice production and sugar cane growing (REMA, 2009). In Burundi, Tanzania and Uganda, wetland grasslands provide critical areas for livestock grazing, especially during the dry season.

Wetlands are also an important fish habitat and may support large populations of fish, which many local communities depend upon for their livelihoods.

2.2.3 Water supply, purification and regulation

Wetlands provide an important source of water, as well as water treatment and water regulation functions. Large amounts of water enter wetlands which purify this water and improve its quality as they remove sediment, nutrients and other pollutants, before it is passed onwards downstream. Pollution of watercourses is an increasing problem in areas where urban and peri-urban settlements are expanding without adequate planning and sanitation measures to keep wastes out of water supplies, and where the encroachment and drying up of wetlands is reducing the natural buffering and filtering capacity. In the Kagera basin, wetlands have been identified as performing a valuable role in sediment, retention, trapping sediment, which is otherwise transferred out of the basin into other parts of the river system. This is particularly important in parts of the Kagera basin where soil erosion is releasing large quantities of sediment to water courses. Wetlands also facilitate the movement of water into underground aquifers, thereby recharging the water table, though data on groundwater and aquifers in the basin is sparse. By storing large quantities of water, wetlands restrict surface runoff preventing flooding downstream and associated erosion. This stored water is useful for drought alleviation. Through stabilisation of the hydrological cycle, wetlands also help to maintain micro-climates.

It is estimated that 50% of Rwandans do not have access to clean drinking water, exacerbated by the conversion of wetlands into agricultural land, thereby destroying an inexpensive method of purifying water and necessitating substantially higher future investments to have clean water (UNEP/IISD, 2005a).

The Ngono wetland in Tanzania has a retention capacity of 50-80% for suspended solids and total phosphorus and 40-60% for total nitrogen.

In Uganda, wetlands have been found to provide potable water supplies valued at about USD 25 million per year (NEMA, 2001). Around five million people are estimated to consume at least 50 million litres of water daily from wetlands (Uganda National Wetlands Programme 2004). However, UNEP/IISD (2005c) reports that Uganda is expected to experience water stress by 2025 due to the continuing degradation of the country's wetlands which provide indispensable ecosystem and regulating services including maintenance of the water table, water filtration, flood control, groundwater recharge and microclimate regulation. The Nakivubo wetland in Kampala is estimated to contribute USD 1.7M per year to the economy as a wastewater treatment plant (DWD/WWAP, 2005)

The average annual fluctuation in water level in wetlands is around 1 m and the maximum some 3.5 m (Norconsult/Electrowatt, 1975). Water level is strongly influenced by the growth and disappearance of vegetation, particularly in the lower reaches (below Rusumo Falls) where wetlands have a particularly dominant effect on the water balance due to the storage and release of water. Above Rusumo Fall, the water depth of the Ruvubu river has decreased to the extent that it is possible to cross on foot for 8-10 months a year (Baijukya et al., undated). Indeed, the tributaries of the Kagera are increasingly drying out during the dry season due to the widespread problem of increased runoff and lack of water retention due to poor vegetation cover.

2.3 Wetland degradation

In recent years, enormous pressure has been put on the water and wetland resources of the Kagera basin through increasing uses driven by the rapidly expanding population (although this has been less in the Tanzania part), such as deforestation, agricultural intensification, pollution, overuse and inadequate institutional frameworks for management of these natural resources. These threats affect both the quantity and the quality of the water resources in the basin, and cause degradation of wetlands and loss of some or all the ecosystem services, such as decreased groundwater recharge, decreased buffering capacity of wetland against floods, the loss of filter functions to absorb and degrade pollutants and decreased water quality, and the destruction of natural habitats for wetland related organisms and loss of biodiversity including the disappearance of breeding grounds for fish leading to food scarcity and contributing to poverty. Climate change and water demand change may also threaten the hydrological regime of wetlands.

Significant wetland degradation has already occurred in the vicinity of several lakes in the Akagera complex (Lakes Hago, Ihema, Rweshikana) and upstream of Rusumo Falls. Lake Rwihinda in Burundi, which contains variety of migratory and sedentary birds, has been affected by agricultural activities leading to destruction of natural vegetation and some avifauna (BRL, 2008).

Limited awareness of and information on the importance of wetland ecosystem services underlies many of the threats to wetlands. A better appreciation of wetlands and their role in sustaining a range of economically important activities has called attention to environmental degradation as both a cause and a consequence of poverty. Poverty and food insecurity will be difficult to address if current degradation of the natural resource base (essentially forests, soils, water, wetlands, wildlife) continues unabated. Furthermore, escalating poverty leads, in turn, to further environmental degradation as people encroach on wetlands, steep hills and semi-arid areas, protected areas and other fragile ecosystems. Therefore environmental protection is crucial to poverty reduction. All four riparian countries have accepted environment-poverty linkages through the mainstreaming of environmental considerations in their PRSPs.

2.3.1 Population growth and related issues

The Kagera basin has one of the highest population densities in Africa at 248/km^2 with the highest densities in Burundi and Rwanda (BRL, 2008). In 2007, the basin population was 15M, with a 2.7% growth rate despite a relatively low life expectancy (BRL, 2008). This human population places many demands on water and other natural resources of the Kagera basin, such as medicinal plants, papyrus grass used for making mats and ropes, and also for roofing, peat extraction for fuel, and fish and animals for food. The expansion of human settlements and farming areas, road construction, landfill/waste disposal, increased demand for water for people and food, etc. all results in the overuse of existing water resources and the exploitation of new water sources.

The economy of the Kagera basin is predominantly based on agriculture, mainly subsistence farming generating very low per capita GDP, but there is limited availability of cultivable land. The mean cultivable area per household is 0.8ha (BRL, 2008) supporting low agricultural productivity and no income surplus. There is pressure to develop new lands for agriculture and grazing which manifests itself in two forms: firstly, the deforestation of hillsides which, badly managed, causes land degradation and soil erosion and increases the sediment input to wetlands and, secondly, the encroachment of agriculture onto marshlands which are necessarily drained and/or irrigated and causes marshland degradation. This is discussed further in Section 2.3.2.

Humans require power and the hydropower potential of the Kagera river basin has been estimated at about 490 MW of which only about 44 MW, or less than 10%, has been developed to date (BRL, 2008). Many possible schemes have been rejected due to current social and/or environmental concerns, but three schemes under consideration are Nyabarongo in Rwanda (28 MW), Rusumo Falls in Rwanda (90 MW distributed equally between Burundi, Rwanda and Tanzania) and Kakono in Tanzania (53 MW); construction is started for the first one, and ESIA presently ongoing for the latter two. Potential impacts of large dams include significant upstream flooding, with increased evaporation and GHG emissions from the reservoir, and a reduction in downstream flow which impacts wetland ecosystems. With the demand for power increasing all the time, there is a growing interest in small, mini and micro-hydro schemes which are run-of-river or have minimal reservoirs and minimal construction works, as well as relatively low environmental and social impacts compared to large hydro. In most cases, they may be developed using standardised, readily available equipment and with minimal environmental and licensing procedures. An example of this is the mini, run-of-river hydro scheme at Kikagati in Uganda (10 MW).

Navigation on the watercourses in the Kagera basin is in the form of small boats for fishing and access to remote areas, but could be affected if water levels in rivers and lakes drop significantly through increased abstractions and/or climate change. The increasing demand for water by the domestic and industrial sectors can threaten the rain-fed agricultural sector, as well as the environment.

2.3.2 Agriculture and aquaculture

The main threats to wetlands from agriculture are the increased sediment input to wetlands caused by soil erosion from deforested hillsides and the degradation of marshlands caused by their drainage and irrigation for agriculture. Livestock may also be put to graze on marshland areas. In Burundi, seasonal; marshlands were used as pasture for livestock, which helped increases the land's fertility, but as livestock numbers have decreased and the demand for cultivable land has grown, marshes and wetlands are increasingly being drained or used seasonally for agricultural production, particularly of rice (Hobbs and Knausenberger, 2003). In Rwanda, a zero-grazing policy is in force (REMA, 2009), whilst Tanzania and Uganda both permit livestock grazing in non-protected wetlands.

In the Kagera basin, land degradation is associated with high rate of deforestation on the upland parts of the basin and cultivation on steep slopes; combined with high rainfall and soil fragility, this leads to soil erosion. Forest clearing has exceeded sustainable limits, especially in Burundi and Rwanda (BRL, 2008). The problem of land degradation is also the result of exploitation and harvesting of forest products, mainly trees for fuel wood and/or construction. Soil erosion is significant and widespread in upper catchments due to intensive cultivation and livestock-keeping and a lack of soil erosion measures such as bench or progressive terracing (SHER, 2002). In addition to degrading wetlands, high sediment yields increase flood risk by filling in stream beds, reduce the productive capacity of farms where the soil erosion is occurring and the financial viability of downstream irrigation systems, and contribute to downstream sediment and nutrient loading (Swallow et al., 2009).

As the availability of suitable land for cultivation decreases and the population increases, extension of agricultural exploitation of marshlands is likely, particularly in the upper parts of the basin and/or in drought years. Farmed marshlands often form part of a production system contiguous with the neighbouring hillsides. Development in marshlands involves the digging of drains where the excavated soil is laid on the remaining islands to create land elevations which form the basis for future cultivated land plots. The drains are left open or blocked off as the planted crops require through their growing season. Small diversion dams and waterfalls may also be built in the main stream to provide additional water in the dry season and reduce the water velocity, respectively.

Physical modifications, such as drains and irrigation channels, can lower the water table and dry out parts of the marshland, leading to a loss of natural biodiversity. Inappropriate agricultural practices (e.g. excavation of soils, burning of vegetation) may cause soil erosion and application of chemicals can pollute the marshlands and connected water bodies. Cultivation on marshlands is often done haphazardly without consideration of the environmental impacts there or elsewhere. For instance, many marshland areas and valley bottoms in the basin are being cultivated for rice production where clearing of natural vegetation has resulted into changes in micro-climates (loss of humidity and misting) and a decrease in the groundwater resource, negatively affecting the hydrological cycle in those areas (BRL, 2008). Other common crops include flowers for export, eucalyptus for wood, sugarcane, and sweet potatoes (REMA, 2009).

The majority of cultivable marshlands in the Kagera basin lie in Burundi and Rwanda, where they account for 1200 km^2 and 1650 km^2, respectively, of which around 50% are cultivated (MINAGRI, 2008; Ndikumana, 2007; 1997 and 2005 Plans Directeur National de l'Eau du Burundi). However, it is estimated that less than 20% of farmed marshlands have developed drainage and irrigation infrastructure for improved farming practices. Many areas use poor farming methods, both on hillsides and in marshlands, without adequate soil and water conservation, resulting in low agricultural productivity.

In Rwanda, the proportion of farmed marshlands improved with at least drainage infrastructure is increasing through support from the Ministry of Agriculture's Rural Sector Support Programme (RSSP) and other projects funded by international donors at a maximum rate of 10 km^2 per year (BRL, 2008). It is important that such activities are carried out with due care, minimising negative impacts and seeking to maintain ecosystem services where possible, in order to achieve long-term sustainability, and that farmers have the capacity and willingness to continue correct operation and maintenance procedures after the initial donor input (SHER, 2002). Furthermore, whilst project irrigation water requirements are relatively low compared to the water available within the Kagera basin and should not be a limiting factor, any downstream impacts (e.g. inflow to Lake Victoria) should be assessed to understand the implications of increased water withdrawals.

Marshland reclamation for paddy rice production is popular and increasing in parts of all four countries. In Uganda over 530 km^2 of marshlands have been reclaimed for both small-scale and large-scale paddy rice production (DWD/WWAP, 2005), some of it JICA-funded (see NERICA in Section 3.2). Land pressure in Tanzania is not so great as in the other countries that make up the Kagera basin, and so the majority of large-scale agricultural development is on flat plains rather than on hillsides or converted marshlands. Water harvesting for supplementary irrigation e.g. small farm dams, is actively encouraged, as are boreholes, most groundwater currently only being used for domestic water supply. However, smallholders do use marshlands for their livelihoods.

The numerous lakes, extensive wetlands and networks or rivers and streams are sources of fish for the local communities around them. Fisheries and aquaculture play an important role in poverty alleviation in the Kagera basin and offer great economic potential for the future. However, the industry faces a decline in fish catches due to unsustainable fishing methods (e.g. undersized nets, beach seines), a decline in species diversity in some wetlands due to introduction of non-native species (e.g. Nile perch, Nile Tilapia), a decline in fish size and weight due to increasing fishing pressure, and deterioration of water quality due to pollution and soil erosion. The dependence of aquaculture on the natural ecosystems must be recognised and appropriate guidelines and legal instruments to ensure sustainability of aquaculture established (DWD/WWAP, 2005; BRL, 2008).

2.3.3 Pollution

Water resources in the Kagera basin have been heavily polluted with untreated domestic and industrial waste, rendering the water unsuitable for direct consumption and increasing the costs of treatment before it can be used.

In recent years the focus of Millennium Development Goal (MDG) activity in the water sector has been on water supply rather than sanitation. In Burundi there are no national or local effluent standards for any waterbodies in the country (Beck et al., 2010). In Rwanda, most buildings in urban and peri-urban areas do not have wastewater disposal systems; instead the untreated waste is stored in usually unlined septic tanks which are regularly emptied, but which often leak to the surrounding land which contributes to groundwater contamination and may subsequently pollute downstream surface water. Many industries do not have any operational wastewater treatment facilities and often discharge their polluted effluent directly into watercourses.

Sand, clay and mineral mining industries can also cause water pollution through runoff of untreated waste water, poor management of tailings and stone waste, and increased land disturbance, dust and noise.

Increased waste loads of raw sewage and industrial effluents from rapidly expanding urban areas reduce the buffering and filtering capacity of wetlands. In Rwanda, domestic and industrial rubbish and other solid waste is generally stored in open sites from where it can be washed into water bodies during rainstorms. In urban areas, wetlands may be converted to other land uses such as residential and industrial areas, which affect their water treatment ability e.g. the Gikondo industrial area in Kigali, Rwanda (REMA, 2006).

Diffuse pollution can be caused by runoff from agricultural land where fertilisers, herbicides and pesticides have been used. For example, rice growing in reclaimed marshlands can result in heavy deposition of phosphorus and nitrogen in marshland waters which can be transported to other wetlands in the hydrological system (MINITERE, 2005). Enrichment of water bodies with phosphorus, nitrogen and other nutrients is also caused by atmospheric deposition (the main source for Lake Victoria) and untreated and partially-treated municipal sewage and industrial effluents. However, there is a lack of adequate scientific information on the spatial magnitude, dynamics and cumulative negative consequences of excessive eutrophication.

The most prolific of invasive species in the Kagera basin is water hyacinth which threatens many lakes and rivers along the Kagera river system, particularly at the eastern border (Moorhouse et al., 2000). It forms a dense mat of foliage on the water surface which negatively affects water supply, navigation, hydropower generation, fish breeding and fishing and tourism/recreational activities. It can also promote the incidence of water-related diseases such as malaria and bilharzia by providing breeding grounds for the vectors. Water hyacinth increases evapotranspiration causing more water to be lost from the waterbody. It also impedes light penetration to the water below, and decaying hyacinth reduces the oxygen available to other aquatic flora and fauna, both of which affect the growth of other aquatic plants and contribute to the loss of biodiversity.

Invasive species of fish are also a problem. The lung fish (Protopterus aethiopicus) was introduced into Lake Mohasi in 1991 to control bilharzias snails. However, it also preys on other fish (e.g. tilapia) and can reach 70 kg in weight, and is proving difficult to eradicate..

2.3.4 Climate change

Wetland formation and development is influenced by climate, some wetlands formed in wetter and cooler past climates may no longer be stable under current or possible future conditions. There is a lot of uncertainty in the Nile Equatorial Lakes region about how precipitation and temperature will change as climate changes. Whilst it is unclear how precipitation patterns might change, most models suggest an increase in average temperature, possibly causing more frequent drought, and an intensification of rainfall during the rainy seasons, potentially leading to increased flooding and erosion (SEI, 2009). However, in the region it is difficult to separate possible climate change impacts from the effects of natural climatic variability and consequences of overexploitation of natural resources.

2.3.5 Water demand change

Section 2.3.1 discusses how the hydrology of the Kagera river basins could be affected by increased water demand and abstractions, as well as by climate change. The Kagera river makes the largest contribution to Lake Victoria, figures ranging from 63% of the total inflow (WMO, 1974) to 37% (Sewagudde, 2009).

Total existing abstractions from tributaries to Lake Victoria are estimated at 843 Mm^3 per year (N. Mandeville, *pers. comm.*). Of these, 588 Mm^3 are taken by Kenya, 222 Mm^3 by Tanzania, 24 Mm^3 by Rwanda, 8 Mm^3 by Uganda and 1 Mm^3 by Burundi. Whilst the Burundi and Rwanda abstractions are all from the Kagera basin, only 19% of the Tanzania ones are for the Kagera Sugar Estate, and none of the Uganda ones. Thus, existing abstractions from the Kagera basin can be estimated at 67 Mm^3 per year, or 0.2% of the long-term (1901-1995) mean outflow from Lake Victoria at Jinja of 26,539 Mm^3 per year (Sutcliffe and Parks, 1999).

It can be anticipated that domestic and industrial water supply abstractions will increase for cities and major towns in Burundi and Rwanda. In Tanzania, a new nickel mine in the Kagera basin will draw water from a tributary of the Kagera.

Also in Tanzania, it is thought that Kagera Sugar Estate irrigation will expand from its present size of 80 km^2, but the future limit is given as 90 km^2 from one source or 120 km^2 from another; taking this larger figure, future abstractions may be as much as 63 Mm^3 per year. Currently, there are also some small schemes totalling some 3 km^2. However, in the coming 5-10 years many new irrigation projects are expected to commence in Tanzania where the 2010 Irrigation Policy encourages private-sector irrigation projects, and this will be the main generator of increases in water use, though it is difficult to predict by how much. An 80 km^2 scheme is proposed at Ngono just south of the Kagera Sugar Estate which may have a water demand of the order of 42 Mm^3 per year. The best estimate by the Mwanza Zonal Irrigation Officer is a 50% increase over existing irrigation demand during the next 30 years. Plains irrigation in the Kagera basin is mainly confined to the lower part of the basin, which is located in Tanzania; there is minimal plains irrigation in Burundi and Rwanda, and information on future developments is sparse (SWECO, 2010).

Several large multi-purpose schemes located in the Kagera basin, which could be developed in future, have been identified (SWECO, 2010), including the Kakano, Nyabarongo and Rusumo Falls schemes (Table 3.2). Total consumptive water use at Nyabarango is estimated at 442 Mm^3 per year.

Thus, future abstractions from the Kagera basin can be estimated at around 550 Mm^3 per year, or 2.1% of the long-term flow of the Nile river at Jinja.

2.4 Frameworks for wetland management

In recent years, the challenge for sustained economic growth and poverty alleviation to meet the Millennium Development Goals (MDGs) in the region has focused, understandably, on water supply in both rural and urban areas, rather than sustainable use of natural resources and better management of the environment. There have been few concerted efforts targeting the quantity and quality of the overall water resource, particularly in Rwanda and Burundi.

However, where such frameworks for water resource and/or wetland management do exist, restructuring of government departments and changing mandates have affected their implementation and effectiveness. There has been a lack of enforcement to restrict development activities and lack of coordination between key organisations, and sometimes conflicting national policies and priorities (BRL, 2008). Furthermore, because wetland ecosystem functions have previously been considered free of charge, wetlands tended to be ignored in the economic calculations that decided whether they should be conserved or developed, resulting is a systematic bias that has favoured development and, hence, wetland degradation (Kassenga, 1997).

There are several socio-economic mechanisms increasingly used in basin management that have potential for promoting more sustainable and rational practices for hillsides, wetlands and agricultural development that are of relevance to the Kagera basin. Application of the polluter pays principle will help ensure all polluting industries take responsibility for their actions and a more positive attitude towards the reduction of pollution in water resources and the environment as a whole. Trade-offs between short-term costs and long-term benefits have potential for sustainable and rational use of land and water/wetland resources. Payment for ecosystem services (PES), integrated with other rural development initiatives (e.g. see TAMP in Section 3.2) provide a means to increase incomes with particular emphasis on restoring or maintaining ecosystems and raising awareness of the importance of ecosystem services (Andrew and Masozera, 2010).

3. Wetlands sectoral analysis and technical assessment

3.1 Experience from past initiatives in Kagera river basin and lessons in wetland conservation

There have been several past initiatives in the Kagera river basin which have relevance to wetland management. These are summarised in Table 3.1 and some key projects are discussed in more detail below. The outcomes of the projects are analysed in terms of their success in maintaining or enhancing the ecosystem functions of wetlands and their contribution to overall basin management in Section 3.1.

3.1.1 Integrated Management of Critical Ecosystems (IMCE) (Rwanda)

The background to the Rwandan IMCE project (REMA, 2008) was that the existing policies related to the development of marshlands and their surrounding drainage basins were not generally being put into practice. Buffer zone distances along rivers of 10 m for crops and 20 m for housing were not always respected. Around some marshlands, buffer zones of 50 m had been delimited and agroforestry species had been planted, but crops often continued to be inserted between trees and encroach onto the marshland. This negated the erosion reduction and flood protection functions of the buffer zone. There are several reasons for this: firstly, the lack of departmental orders to that effect; secondly, lack of awareness of the policies; and thirdly, lack of enforcement.

The IMCE project (2006-2011) was funded by the World Bank and implemented by the consortium SHER/WES Consult/I-MAGE. The technical components were: development of a policy and regulatory framework for sustainable wetland and natural resource management; capacity building and institution strengthening for integrated ecosystem management; and development and implementation of community-based integrated ecosystem management plans for critical ecosystems. A major output from the project was an inventory of wetlands in Rwanda. This identified 101 lakes covering a total surface area of 1495 km^2, 860 marshlands covering 2785 km^2 (10.6% of the country's surface) and 861 rivers totalling 6482 km in length. Some 41% of the marshlands were covered by natural vegetation, 53% were under cropping, and 6% were fallow fields. Most of the cropped marshlands are under traditional cropping, but some had been improved with irrigation and/or drainage. Only a few marshlands were found to host significant biodiversity: Akagera complex, Akanyaru-Nyabarongo complex, Kamiranzovu (part of Nyungwe Forest) and Rugezi marshland (a Ramsar site). The higher altitude Kamiranzovu and Rugezi marshlands hosted a greater number of vegetation species than the lower altitude marshlands. Outside of the National Parks which are formally protected, the Rweru-Mugesera complex hosted the most diverse mammal species. The Akagera and Akanyaru-Nyabarongo complexes were rich for birds, hosting many migrating birds and CITES-protected species.

The IMCE project also developed a new marshland classification for four major wetland complexes considered critical ecosystems: Akagera, Kamiranzovu, Rugezi-Ruhondo and Rweru-Mugesera. The classification was based on the functions of and services provided by marshlands (e.g. size, current use, proportion of residual natural vegetation), with recommendations about the status of the different marshlands classes in terms of protection or the conditions under which they can be exploited. Rwanda's marshlands are classified into 38 marshlands covering 561 km^2 (20% of total marshland area) for full protection, 475 marshlands covering 2067 km^2 (74%) for exploitation under condition of a full EIA, and 347 marshlands covering 1569 km^2 for exploitation after a basic EIA. However, the point is made that each marshland is unique in its own way and a general classification cannot adequately reflect this.

The underlying database of marshland information goes down to a district level and is linked to a GIS enabling production of detailed maps. The information and project outcomes can assist marshland stakeholders to implement sustainable management measures, and to date 53 local watershed management committees have been established and community-based management plans developed.

3.1.2 Conservation and integrated management of the Rugezi Marshland (Rwanda)

In 2004, a steep decline in generation capacity at the 11.25 MW Ntaruka HEP station resulted in an electricity supply crisis that adversely affected Rwanda's economic and social development prospects. The decline was caused by a significant drop in water level in Lake Bulera, which was attributed to poor management of the Rugezi marshland in the headwaters, degradation of the densely populated drainage basin due largely to agricultural development or livestock grazing without adequate soil and water conservation measures, and a perceived reduction in precipitation in recent years, as well as poor maintenance of the HEP station (Hove et al., 2010). The drainage basin also had water hyacinth infestations and eucalyptus plantations, both of which increased water loss from the basin. The wetland degradation impacted on other livelihood activities such as fishing, handicrafts and transportation.

The Rugezi marshland is recognised as a Ramsar wetland of international importance, and is currently only one of two with this status in the Kagera basin (see Table 2.2). Ecosystem services provided by the Rugezi marshland include regulating the quantity and quality of flow into Lake Bulera, where it is subsequently used for HEP generation.

The government initially responded by halting on-going drainage activities in the Rugezi marshland and banning agricultural and pastoral activities within and along its shore , as well as around Lake Bulera and downstream Lake Ruhondo. The government then implemented a suite of agricultural and basin management measures to offset adverse impacts of these policies on rural livelihoods. These included the construction of erosion control structures such as terracing, the establishment of a belt of bamboo and Pennisetem grass around the Rugezi marshland, the reforestation of the surrounding hillsides, the distribution of improved cooking stoves, the promotion of integrated and environmentally-friendly farming practices, the promotion of other income-generating activities such as bee-keeping, and awareness-raising in the local communities and involving the population in remedial works, the establishment of a local watershed management committee and development of community-based management plans, and NGO-funded projects aimed at restoring the marshlands. (Hove et al., 2010; MALDCAS, 2004).

The impacts of the interventions included the restoration and longer-term sustainability of livelihoods and new income opportunities from tourists attracted to the increased biodiversity in the Rugezi marshland. However, the problem may have been resolved more easily and quickly, or have been less serious, had there been better coordination between the ministries responsible for agriculture, energy, environment, compounded by the continual restructuring of these ministries and Rwanda's environmental policy in recent years (Sections 3.3 and 3.4). The lack of institutional capacity, and the seemingly conflicting policy to convert marshland to agricultural land, also contributed to a lack of enforcement of the buffer zone rules in some regions and the cultivation of marshlands. Another issue of relevance was the lack of hydro-meteorological data which made it difficult to monitor and evaluate the impact of the interventions, and adapt management interventions accordingly.

3.1.3 Lesson learned

In the countries of the Kagera river basin, addressing economic and social issues are as important as addressing environmental issues. Often, local people are very conscious of the benefits they draw from a wetland the issues involved in maintaining its longevity, but poverty, the overwhelming need for cultivatable land and lack of alternatives, forces them towards unsustainable modes of exploitation (MALDCAS, 2004). However, interventions that contribute to promoting economic development, reversing catchment/environmental degradation and eradicating poverty can become drivers to conserve and/or sustainably develop wetlands. The lessons in wetland conservation and development from this review of past initiatives in the Kagera river basin are:

- Sustainable solutions require an integrated approach involving economic, environmental and social aspects and participation of all relevant stakeholders.
- Effective interaction and cooperation across ministries (horizontal) and through the various levels of government (vertical), and harmonisation of policies, is necessary to facilitate solutions to problems.
- There is a lack of institutional capacity to monitor, plan and manage water resources in (parts of) the Kagera basin effectively and sustainably.
- Participatory management frameworks involving local groups made up of key local stakeholders e.g. watershed management committees are important to ensure appropriate operating practices, adaptive management and continued maintenance.
- Interventions to improve management practices should be accompanied by awareness raising, information dissemination and environmental education targeted at several levels in society and vice versa i.e. awareness-raising should be accompanied by demonstration activities.
- There are insufficient long-term data for the design of water-related schemes and for the integrated management of the transboundary Kagera basin.
- Trade-offs between short-term costs and long-term benefits have potential for sustainable and rational use of wetland resources.
- Incentives such as payment for ecosystem services and the polluter pays principle have potential to facilitate implementation of sustainable management practices.

Table 3.1 Past* projects involving wetland management

Details	Objective	Wetland-related activities and outcomes
Biodiversity conservation in the marshes of the river Malagarasi (Bu) 2008, 10000 USD	• To develop a workplan for a project on biodiversity conservation in the Malagarasi marshlands.	• NGO implemented project in association with the local community to identify the main threats to the wetland and to develop a conservation strategy. Management experiences from the adjacent Tanzania Ramsar wetland of the same name to be incorporated. • Aims included establishing a Malagarasi Floodplain Forum to engage stakeholders in management and conservation activities, lobbying and negotiating with sugarcane industry regarding wastewater treatment and best practice to improve the sustainability of sugarcane production, and initiating the process of Ramsar certification of the Burundi side of the wetland. • Outcomes include a proposal for a 90km^2 protected area encompassing the wetland and a follow on project of Work on Protected Areas that will investigate the involvement of indigenous and local communities in conservation and incentives that support the integrity and maintenance of protected areas.
Conservation and Integrated Management of the Rugezi marshland (Rw) – *See also main text* 2004-2010 (MALDCAS, 2004; Hove et al., 2010)	• To formulate a programme for the conservation and integrated management of the Rugezi marshland and its drainage basin by rehabilitating the drainage basin, improving land and agricultural management practices and enhancing the sustainability of local livelihoods.	• The problem manifested itself as a decline in water levels in the Rugezi marshland and downstream Lake Bulera which had an impact on HEP generation, and was attributed to poor management of the marshland, degradation of the drainage basin due to human activity (i.e. agricultural development) and reduced precipitation in recent years, as well as poor maintenance of the HEP station. • Interventions to restore the marshland included: awareness-raising in the local communities and involving the population in remedial works; initiatives at improving agricultural production, protecting hillsides and diversifying incomes in the basin; establishment of a local watershed management committee and development of community-based management plans; and NGO-funded projects aimed at restoring the marshlands.
FIRI-Swiss Ecotone Project (Ug) 1997-2000 (Kasoma, 2003)	• To undertake an interdisciplinary and development orientated project in the Jinja wetlands	• Inventory identified about 50 medicinal plants used to cure a variety of diseases including diarrhea, measles, yellow fever, malaria and snake bites. • Point sources of pollution found to include food processing, chemical, textile, metallurgy, beverages, pulp and paper industries; papyrus showed to take up large quantities of nitrogen so harvesting of wetland plants is an effective process of nutrient removal. • Outcomes include formation of Jinja Urban Wetland Women Organisation (JUWWO) which was given custodianship of the wetland on the basis of their EIA-approved environmentally sound wetland activities such as gathering, fishing, construction of fishponds, gardening and cattle grazing.

Details	Objective	Wetland-related activities and outcomes
Integrated Management of Critical Ecosystems (IMCE) (Rw) - S*ee also main text* 2006-2011 (REMA, 2008)	• To develop of a policy and regulatory framework for sustainable wetland and natural resource management; capacity building and institution strengthening for integrated ecosystem management; and to develop and implement a community-based integrated ecosystem management plans for critical ecosystems.	• Rwanda's wetlands area classified into 101 lakes, 860 marshlands and 861 rivers. 59% of marshlands are being or have been cropped. The marshlands are classified into 38 marshlands requiring full protection, 475 for exploitation under condition of a full EIA, and 347 for exploitation after a basic EIA. • The project developed an inventory of marshlands associated with four critical ecosystems and made recommendations as to their level of protection or conditions of use. • Rwanda has established local watershed management committees and community-based management plans to promote sustainable and rational use of marshlands.
Kigali City Master Plan (Rw)	• To work with stakeholders to ensure that development in Kigali is guided by the key principles of urban sustainability: social harmony, economic enhancement and environment friendly development	• The plan specifies measures to ensure wetland conservation such as clearing developments within wetland boundaries, providing buffer zones to all natural watercourses, and ensuring measures to control the quantity and quality of discharge into watercourses. • The Gikondo wetland hosts the Kigali industrial area comprising 98 industries. A survey to assess the damage to this wetland revealed severe degradation and prompted a decision to rehouse the industrial area in a different location and restore the wetland.
Lessons and constraints for water PES in Tanzania (Tz) (Fisher et al., 2010)	• To assess potential implementation of PES for water in the Pangani and Rufiji river basins where ecosystem services play a role in regulating flow and implications for using PES as a management tool	• PES as a management tool is facilitated by: (i) small areas i.e. watersheds may be too large for easy implementation; (ii) small stakeholder groups and interdependencies (lack of conflicts); (iii) proximity of service receivers to service providers i.e. to verify effectiveness of scheme; (iv) transparent governance rules, with local stakeholders involved in design and monitoring of scheme; (v) overlap between the service and the factors which affect it and the governance rules i.e. to verify effectiveness of scheme; and (vi) understanding of external factors which help build more resilient management e.g. climate change.

Details	Objective	Wetland-related activities and outcomes
Mapping a better future: spatial analysis to benefit wetlands and reduce poverty (Ug) (WMD et al, 2009)	• To integrate efforts to reduce poverty while sustaining ecosystems • To combine information from the National Wetlands Information System with poverty location maps to help policymakers classify wetlands by their main uses, conditions and poverty profile and identify areas with the greatest need of pro-poor wetland management interventions	• Detailed mapping of previously unused data confirmed that wetlands provide multiple benefits in every district, and to every citizen of Uganda; the diversity of products obtained from wetlands in specific locations ranges widely, from a handful to up to 24 products; levels of harmful impacts on wetlands by people also vary greatly across the country. • Spatial analyses of selected poverty-wetland indicators revealed no clear pattern at the sub-county level, despite popular belief that the poorest areas are always the most degraded. • The overlay analyses of poverty and wetland maps are most useful for identifying sub-counties that share similar poverty and wetland characteristics, and thus may lend themselves to similar wetland management approaches and intervention strategies; economic studies that quantify the value of wetland ecosystem services can be linked to poverty and wetland maps to gauge the economic potential of specific wetland uses in reducing poverty.
Nile Transboundary Environmental Action Project (NTEAP) 2003-2009, 43.6M USD	• To develop a framework of actions on environmental issues in the Nile basin by: providing a forum to discuss development paths for the Nile, improving understanding of the relationship between water resources management and the environment, and enhancing cooperation on environmental issues among the Nile basin countries	• Key specific wetland-related outputs included: enhanced regional cooperation and improved capacity for conservation and management of wetlands and their biodiversity; improved awareness and understanding of the importance of wetlands in supporting sustainable development; wetlands education and awareness programmes developed; pilot initiatives in support of capacity-building and wetland management plans implemented; and regional working groups for water quality monitoring and wetlands established. • As a result recognition of the need for coordination of wetland and biodiversity management across the Nile basin increased – leading to the Wetlands Management Strategy (NBI, 2010)
Quick Wins Marshlands Development (QWMD) (Rw) 2011, 2B RWF (3M USD)	• To improve drainage/irrigation infrastructure on marshlands to increase agricultural productivity and contribute to poverty reduction	• Quick-win means no long EIA studies so farmers can soon benefit from improved land. • Selected marshlands are already traditionally farmed i.e. converted to agricultural land. Target is to develop 20 km^2 over 20 small (20-239 ha) marshlands in 6 months. • Follow-on for capacity building in phase I marshlands and scaling out to further marshlands. • Local Marshland Development Committees formed to oversee operation and maintenance.
Restoration of the	• To work with stakeholders to cease	• Nakayiba marshland provides drinking water for and processes wastewater from human

Details	Objective	Wetland-related activities and outcomes
Nakayiba marshland (Ug)	destructive activities and protect the Nakayiba marshland, mainly as a source of water, and for sewerage/wastewater purification and storm water storage	population, is frequented by crested cranes, Ibises, white egrets and others, and has important social and cultural values as source of raw material for crafts and mulching. Its regulating services include effluent/sewerage purification, storm water storage, water table discharge/recharge for the surrounding wells and sediment trapping. • In 2005, the marshland was threatened by changes in land-use and major development projects (cultivation in the core wetland area, settlements, soil erosion from deforestation in the river basin). The government and other stakeholders embarked on a successful restoration initiative associated with a Community-Based Wetland Management Plan.
Rural Sector Support Project I (RSSPI) (Rw) 2001-2005, 39M USD in 3 phases (MINAGRI, 2008)	• To revitalise the rural economy and improve the quality of life of the rural poor through increased transfer of technical and financial resources for sustainable rural development • To increase agricultural production and marketing in marshland and hillside areas targeted for development in an environmentally sustainable manner	• Activities included marshland/hillside development i.e. expansion of irrigated area in cultivated marshlands and increase in use of sustainable land management practices on associated hillsides to accelerate the pace of intensification of agriculture. • Focus was on raising basic institutional and technical capacities to provide a foundation for subsequent productivity-raising interventions in the areas of small-scale rural infrastructure development and maintenance, rehabilitation of marshland and hillside farming, and diversification of economic activities. • Impacts of both localised and cumulative impacts on biodiversity, wetlands, soils and water quality were identified and mitigated using appropriate measures.
Tradeoffs, synergies and traps amongst ecosystem services in Kenya (Ke) (Swallow et al., 2009)	• To apply ecosystem approach to assess trade-offs and synergies in ecosystem services and traps in the Nyando and Yala tributaries to Lake Victoria	• Farmers with low and medium quality land had low income, made few investments in their land, and had declining soil quality i.e. were in poverty traps; farmers with higher quality land were able to make land-improving investments, maintain soil quality through the use of organic and inorganic supplements, and generate higher levels of income. • Appropriate agricultural development and land and water management practices are main route to synergies between economic development and environmental conservation; this may require assistance to help farmers over critical production-asset-investment thresholds.

Details	Objective	Wetland-related activities and outcomes
Watershed Management Project (PABV) (Bu) 2006-2010, 10.44M USD (Dagamaissa et al., 2005)	• To contribute to food security through protecting watersheds, increasing forestry, increasing agro-livestock production, restoring soils and rebuilding institutional capacities, in order to increase rural incomes.	• Wetlands are recognised as an important component of the watershed and subject to environmental degradation and loss of biodiversity. • Outputs from the project include: capacity building at a range of levels from smallholders to Ministry officials, a forestry policy document, development of forestry management plans in conjunction with rural populations, creation of community forests, improved land use practices and soil conservation measures, and product diversification.
Still to be reviewed: LVEMPI and other projects		

* Projects completed by 30th June 2010

Key Bu Burundi, Ke Kenya, Rw Rwanda, Tz Tanzania, Ug Uganda

3.2 Ongoing and proposed activities

3.2.1 Bugesera Natural Region Rural Infrastructure Support Project (Bugesera PAIR) (Burundi, Rwanda)

The Bugesera PAIR project (2010-2016) is funded by the African Development Bank (47M USD). The overall objective of the project is to help reduce poverty in the Bugesera region through improving food security (SWECO, 2010). The project area is the Burundi-Rwanda cross-border region encompassing Lakes Cyohoha and Rweru and the Akanyaru marshlands and their watersheds. High population density and growth, resulting in an ever increasing need for agricultural land, have driven deforestation leading to soil erosion and siltation in lakes and marshlands. Combined with irregular and insufficient rainfall, this has contributed to falling agricultural output. The PAIR project will build irrigation infrastructure, access roads and storage facilities, and implement measures to increase agricultural production and conserve soil and water.

As well as the wetland focus, the bilateral character of the project is also of interest. The project recognises that the lakes and marshlands are shared resources which must be used in a concerted and joint manner, and that the soil and water conservation works to be implemented will only be effective if they are carried out on all the watersheds concerned i.e. on both sides of the border. That is, the impact of ecosystem protection and conservation actions can only be significant if such works are conducted in a concurrent and synchronised manner by the two countries. Both countries have prepared and signed an agreement to implement the project, thereby demonstrating their commitment to ensure joint and concerted use of cross-border waters. This provides a model for other transboundary initiatives in the Kagera basin.

3.2.2 Decentralisation and Environmental Management Project (DEMPII) (Rwanda)

DEMPII (2008-2013) in Rwanda's Eastern Province is funded by the African Development Bank (6.0M USD) and implemented by the Rwanda Environmental Management Authority (REMA; www.rema.gov.rw). The project aims to contribute to poverty reduction and economic development through sustainable use and management of natural resources. It will integrate environment with development and promote sustainable livelihoods using decentralisation as a delivery mechanism. Through the proposed initiatives, Districts should have the capacity to plan, manage and ultimately benefit from environmentally sound development activities. The project follows the end of DEMP phase I in Western Province, and seeks to build on the successes of that phase in order to consolidate the achievements within the project area and scale-up some of the success initiatives to other areas.

The project has three components. Firstly, the project will enable MINIRENA/REMA to fulfil its mandate and effectively implement environmental policies, as well as develop management and operational tools such as EIA guidelines and procedures, SEA training, and environmental awareness educational materials, in addition to in-house capacity building e.g. GIS. Under this component, the project will also support the decentralisation and coordination of quality delivery of environmental services at District level. Secondly, the project will strengthen District capacity for environmental management by encouraging Districts to integrate environmental issues into the development process through District Development Plans and budget processes. Under this component, Districts will undertake collaborative planning and management of environment and natural resources of Lake Kivu and Lake Mohasi, associated river basins, islands, and marginal and fragile ecosystems. Important mechanisms will be up-scaling environmental protection investments, adopting community-based resource management capabilities, and strengthening advocacy and social resilience around natural resources management. Finally, the project will support sustainable livelihoods initiatives by implementing environment priorities identified in the

District by using innovative practices (e.g. improved cooking stoves, soil conservation technologies, etc.), and by building public-private-civil society sectors in integrating conservation and development and targeting communities in/ around protected areas where degradation threatens livelihoods sustainability.

3.2.3 Extending Wetland Protected Areas through Community Conservation Initiatives (COBWEB) (Uganda)

This is a small-medium sized GEF project (3.8M USD, including co-funding from UNDP and the Ugandan government) implemented by IUCN, three Ugandan NGOs (Uganda Wildlife Society and Nature Uganda) and the Ugandan government (Wetlands Management Department, NEMA, Uganda Wildlife Authority and local government). The project aims to strengthen the Uganda protected area network by expanding the coverage to include the country's biologically important wetland ecosystems which are currently under-represented. This will establish and strengthen community-based regulation and sustainable use within wetlands with important biodiversity.

Involving both NGOs and the government helps bridge the legal gap in enforcement with a civil society approach. The project is creating a network of specifically designated wetland management protected areas adjacent to existing terrestrial protected areas: the Pian-Upe-Bisina-Opeta wetland in north-east Uganda and the Mburo-Nakivale wetland in south-west Uganda. Both wetlands are Ramsar sites (though only part of the south-west one). The north-east site is in conflict over resource use where crop cultivation has failed because of drought and nomadic cattle tribes have moved in and are overgrazing the land. The south-west site is near the Kagera basin and is surrounded by a refugee camp so the wetland is under intense pressure for water supply and cultivation (using non-sustainable farming methods), and is not acting as a silt trap so silt continues to Lake Nakivale where it has reduced lake capacity. At both sites there have been biodiversity losses. The project will improve the ecological representation of the protected area network by including wetland ecosystems, buffer the terrestrial protected areas from threats by local communities through community wise use of wetland resources, and provide opportunities for enhancing community and local government participation in management of protected areas in Uganda.

Sustainable (wise use) management strategies are being developed and implemented by local communities. Biodiversity in the wetlands will be conserved within community conservation areas by: raising community awareness about wetland biodiversity, linking wetland and biodiversity concerns into local level planning processes, developing and implementing site-specific management plans, and creating appropriate bylaws to support wetland management. Wise use strategies for biodiverse wetlands will be implemented without loss of biodiversity by: taking inventories and mapping biodiversity and socio-economic services of wetlands, assessing sustainability of wetland use with respect to biodiversity value and function, and developing, testing and promoting best practices for sustainable use.

In the north-east site, community-based ecotourism is being developed whilst efforts are being made to regulate the number of livestock; this is a slow process. In the south-west site, soil and water conservation measures in the watershed have reduced sediment yield and improved fishing practices have been implemented in the wetlands; this has had a more immediate effect. Communities can see the livelihood benefits of the interventions which, accompanied by awareness raising, enhance the potential for long-term sustainability. In the final stage, community conservation models for wetland biodiversity will be integrated into national wetland planning processes and national protected area network by: documenting, disseminating, accepting, implementing, integrating and proliferating lessons learned and best practices.

3.2.4 Inland Lakes Integrated Development and Management Support Project (PAIGELAC) (Rwanda)

The PAIGELAC project (2002-2012), which is funded by the African Development Bank and implemented by the Rwandan Ministry of Agriculture and Animal Resources, aims to contribute to strengthening food security by improving incomes in the fisheries sector in a sustainable manner. The expected outputs include building of the institutional capacities of fisheries sector, integrated management of 2500 km^2 of water bodies and protection of 3500 km^2 of watersheds, increase in the national fish production by 10,000 tonnes per year, associated animals (ducks and pigs) by 1000 tonnes per year and the diversification of the activities of fishermen, and improvement in the basic infrastructure, equipment and services for the development of fishery and fish farming products (Tounkara and Diaw, 2003). PAIGELAC has links with DEMPII and RSSP (see elsewhere in this section).

The technical components are institutional capacity building, and improvement of production and marketing. The institutional capacity building component aims to build the intervention capacities of the various actors in the fisheries sector and improve the living conditions of the communities. This will entail: training of operators in the sector, NGOs, workers and executives of the fishery administration and local communities; putting in place a framework for participatory management of fish resources; and implementation of a health education programme. These activities have relevance for other sectors where there is a need to improve institutional capacity. The improvement of production and marketing component aims to reconstitute fish stocks, protect the lake catchment areas and control water hyacinth, improve the marketing of fish products and diversify activities.

The formulation and implementation of the integrated development and management plans will help harmonise the various interventions at the level of each lake. Other benefits of the project include rebuilding fish stocks, empowering the communities in the management of the resources, and better protecting sensitive areas, notably spawning grounds. The physical and biological developments on the watersheds will help protect the lakes from silting and croplands from erosion. With the popularisation of appropriate fish smoking ovens and the promotion of the marketing of fresh fish, the project will contribute to reducing the pressure on the increasingly scarce wood used for smoking fish. The associated livestock rearing will help improve the fertilisation of the lakes and hence their productivity.

However, the project activities will also generate a few negative impacts related to the construction of the landing piers, the development of fish farm ponds and bays for cage fish culture, and the processing of fish products which generates wastes that need to be disposed of. The temptation to introduce exotic species carries significant risks for the biodiversity and the environment, and the high densities of fish in the ponds or cages could foster the development of certain diseases. Furthermore, the fertilisation of ponds could result in the eutrophication of the water. The low motivation by the communities for the management and surveillance of lake and river fishing could lead to an uncontrolled increase in fishing, and the growth of development activities around water bodies could result in the degradation of the local sanitary conditions and an increase in the prevalence of water-borne diseases. Mitigation measures are in place to reduce or remove these threats.

The project focuses on 17 lakes in Rwanda, where a new strain of tilapia has been imported from Lake Albert to reconstitute fish stocks. However, for the two large lakes shared with Burundi, Cyohoha and Rweru, the project is only undertaking the institutional capacity building component because the laws and policies of the two countries are not harmonised across the border and the improvement of production and marketing component would need a fuller partnership with Burundi (see Bugesera PAIR in Section 3.2 for movement in this direction).

3.2.5 Transboundary Agro-Ecosystem Management Programme (Kagera TAMP) (Kagera basin)

Kagera TAMP is one of the component projects of the TerrAfrica Initiative for Sustainable Land Management in Sub-Saharan Africa. Sustainable land management means the adoption of land use systems that, through appropriate management practices, enable land users to maximise the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources. Kagera TAMP (2010-2014), which is co-funded by GEF (6.3M USD), basin governments and partner organisations and FAO (total approximately 24M USD) and implemented by FAO (www.fao.org/nr/kagera), aims to adopt an integrated ecosystems approach for the management of land resources in the Kagera basin that will generate local, national and global benefits. These include improved agricultural production, restoration of degraded lands, agro-biodiversity conservation and sustainable use, and carbon sequestration. This will contribute to improved food security and rural livelihoods, the protection of international waters in the Lake Victoria and Nile basins, and climate change adaptation and mitigation. Kagera TAMP has links with LVEMPII and Kagera TIWRMP (see elsewhere in this section).

The project has a clear relevance to wetlands in a river basin where unsustainable land use and management practices impact on wetlands and reduce the ecosystems services they provide. The project will provide the basis for sustainable transboundary management of the Kagera basin and its land resources and agro-ecosystems, which will generate significant environmental benefits through restoration of well-functioning ecosystems and maintenance of their services. The activities will take into account gender issues, access to resources and conflict resolution in four components: enhanced regional collaboration, information sharing and monitoring; enabling policy, planning and legislative conditions; increased stakeholder capacity and knowledge at all levels for promoting integrated agro-ecosystems management; and adoption of improved land use systems and management practices generating improved livelihoods and environmental services.

Of particular interest to natural resource management elsewhere, Kagera TAMP will explore the payment for ecosystem services mechanism of providing incentives to rural communities to preserve ecosystem services. These might include public funds (e.g. government grants for watershed management, biodiversity conservation, etc.), markets (e.g. for carbon sequestration, biodiversity offsets, upstream-downstream water quantity and quality, certified quality products, etc.), and non-monetary payments (e.g. land tenure, tax exemption, etc.).

3.2.6 Issues arising

Several of the reviewed projects are of particular relevance to the Kagera basin. For instance, the Bugesera PAIR, Kagera TAMP and LVEMP illustrate the benefits of transboundary cooperation in reaching a more successful and sustainable outcome than would have been achieved had the separate countries acted independently, as well as providing a model for similar bilateral or multilateral initiatives elsewhere. Hence, it is encouraging to see links between ongoing projects e.g. PAIGELAC with both DEMPII and RSSP, and Kagera TAMP with both LVEMPII and Kagera KTIWRMP.

From a different aspect, the Rwandan decentralisation project DEMPII demonstrates the effectiveness of managing natural resources at local level where degradation occurs. The decentralisation policy and strategy, which Rwanda has implemented since 2001, presents a major opportunity to empower the population (who are primarily affected by environmental degradation), local government leaders (who are responsible for planning and management of development programmes) and other local actors, to better and more sustainably manage natural resources.

The lessons in wetland conservation and development from this review of ongoing initiatives in the Kagera river basin and observations from the field and stakeholders are:

- Wetlands cannot be isolated from their watersheds: management interventions must apply to whole catchment. Similarly, transboundary wetlands must be managed as a single entity, with investments benefits all local communities.
- Participation of all key stakeholders, particularly beneficiaries, is important however costly or time consuming.
- Local communities are more motivated to protect and sustainably use natural resources if they are directly involved in the planning and decision making process.
- Local communities are more knowledgeable about and have bigger stake in the natural resources in their areas, and the demands and pressures on them, than higher governmental authorities and external stakeholders.
- Momentum for change, once built up, must not be lost otherwise communities loose interest.
- Focused, motivated management and interest of local institutions can help overcome barriers in technically complex and politically sensitive projects, and sustain local actions.
- Thorough preparation and community mobilisation is critical, as is coordinating multiple interests, and understanding of social relations is important.
- If locally relevant, simple innovations can deliver significant and sustainable results and sustainable livelihoods can be achieved with cost-effective technologies; however, awareness raising must be accompanied by practical demonstrations of potential improvements in livelihoods.
- Often, the solutions are already known; the challenge is scaling-up to make a real difference to people in longer duration projects.
- Capacity building is a process that requires continuous commitment; however, certain basics must be in place for capacity building to happen successfully.
- Management decision-making lacks technical information: research on environmental, biological and socio-economic aspects of wetlands is crucial to address some of the gaps in wetland knowledge, a key gap being economic valuation of wetland services
- Targeted use of incentives can help to develop investments for natural resources conservation where the proposed interventions are new or where there is likely to be resistance.

Table 3.2 Present and future projects involving wetland management

Details	Objective	Wetland-related activities and outcomes
Bugesera Natural Region Rural Infrastructure Support Project (Bugesera PAIR) (Bu/Rw) - *See also main text* 2010-2016, 47M USD (SWECO, 2010)	• To reduce poverty in the cross-border Bugesera region through improve food security • To build irrigation infrastructure, access roads and storage facilities, to increase agricultural production and to conserve soil and water	• The project focus is the basin areas around transboundary Lakes Cyohoha and Rweru and the Akanyaru marshlands where deforestation of hillsides, soil erosion and silting of wetlands contribute to falling agricultural output. • The project recognises that Lakes Cyohoha and Rweru and the Akanyaru marshland are shared resources which must be used in a concerted and joint manner. The impact of ecosystem protection and conservation actions can only be significant if such works are conducted in a concurrent and synchronised manner by the two countries.
Decentralisation and Environmental Management Project (DEMPII) (Rw) – *See also main text* 2008-2013, 6.0M USD (www.rema.gov.rw)	• To contribute to poverty reduction and economic development through sustainable use and management of natural resources • To integrate environment with development and promote sustainable livelihoods using decentralisation as a delivery mechanism • To provide Districts with the capacity to plan, manage and ultimately benefit from environmentally sound development activities	• Support for the decentralisation and coordination of quality delivery of environmental services at District level, and strengthening of District capacity for environmental management by integrating environmental issues into the development process. • Support for sustainable livelihoods initiatives by implementing environment priorities identified in the District, building public-private-civil society sectors in integrating conservation and development, and targeting communities in/ around protected areas where degradation threatens livelihoods sustainability. • Districts will undertake collaborative planning and management of environment and natural resources of Lake Kivu and Lake Mohasi, associated river basins, islands, and marginal and fragile ecosystems.
Extending Wetland Protected Areas through Community Conservation Initiatives (COBWEB) (Ug) – *See also main text* Date 2009-2013, 3.8M USD (www.natureuganda.org)	• To strengthen Uganda protected area network by expanding the coverage to include the country's biologically important wetland ecosystems • To develop sustainable (wise use) management strategies to be implemented by rural communities in two pilot wetlands (Pian-Upe-Bisina-Opeta and Mburo-Nakivale)	• Biodiversity in wetlands is conserved within community conservation areas: community awareness about wetland biodiversity raised, wetland and biodiversity concerns linked into local level planning processes, site-specific management plans developed and implemented, appropriate bylaws to support wetland management created. • Wise use strategies for biodiverse wetlands are implemented without loss of biodiversity: biodiversity and socio-economic services of wetlands inventoried and mapped, sustainability of wetland use with respect to biodiversity value and function assessed, best practices for sustainable use developed, tested and promoted. • Community conservation models for wetland biodiversity are integrated into national wetland planning processes and national protected area network: lessons learned and best practices documented, disseminated, accepted, implemented, integrated and proliferated.

Details	Objective	Wetland-related activities and outcomes
Farm Income Enhancement and Forest Conservation (FIEFOC) (Ug) 2006-2010, 77M USD	• To improve incomes, rural livelihoods and food security in the country through sustainable natural resources management and agricultural enterprise development, thereby contributing to poverty alleviation • Conservation through tree planting and watershed management.	• Tree-planting aims to provide an adequate enabling environment for effective community and private sector participation in forest plantation establishment and forest resources management on degraded areas towards increased wood and timber supply and improved environmental conditions among other positive impacts. • Watershed management includes: small-scale irrigation development to make better use of the existing water resources; apiculture to increase household economic returns from conservation-orientated tree planting; agricultural marketing to enable smallholder farmers to compete effectively; and soil fertility improvement initiatives to address the restoration, management and improvement of soils presently under cultivation.
Inland Lakes Integrated Development and Management Support project (PAIGELAC) (Rw) - *See also main text* 2002-2012 (Tounkara and Diaw, 2003)	• To contribute to strengthening food security • To improve the incomes in the fishing sector in a sustainable manner through building institutional capacities, increasing national fish production, and diversifying activities of fishermen among other activities	• Focus is 17 lakes in Rwanda; integrated management of 2500 km^2 of water bodies and protection of 3500 km^2 of watersheds. • Positive impacts include the formulation and implementation of integrated development and management plans, rebuilding fish stocks, empowering the communities in the management of the resources, and better protecting sensitive areas. • Negative impacts include the risk to biodiversity and the environment from the introduction of exotic species, the development and spread of disease from the high densities of farmed fish in ponds or cages, and the risk of eutrophication from fertilisation of ponds.
Irrigation Development and Watershed Management Project in the Lake Victoria Basin in Tanzania (Tz) 2011-2012 (NELSAP, 2011)	• To sustainably improve the living conditions and incomes of rural populations in five proposed irrigation sites (Bugwema, Isanga Valley, Manonga, Mara Valley, Ngono) and their surrounding watersheds. The Ngono scheme is in the Kagera basin. The total area of all proposed schemes is 216 km^2	• ToR require particular attention to be paid to environmentally sensitive areas such as wetlands and river/lake water environment vulnerable to development generated water quantity and quality regime changes, unstable or steep slopes that may not be suitable for irrigated agriculture, and water related diseases whose incidence may change due to development etc. • This will contribute to scheme specific environmental and social profiles which will include possible mitigation measures, to serve as a guide for addressing these issues, and any necessary environmental monitoring and management plans.
Kakono multi-purpose scheme (Tz), Feasibility stage (BRL, 2008)	• HEP generation (53 MW) to Tanzania • Irrigation water to Tanzania and Uganda	• Part of the Minzaro Forest Reserve which includes seasonal swamps and is home to many rare species of birds is predicted to be affected. • Water levels and flows are anticipated to differ from their natural regime 75% of the time.

Details	Objective	Wetland-related activities and outcomes
New Rice for Africa (NERICA) (Ug) www.warda.cgiar.org	• To promote rice growing in Uganda, which depends on rain-fed cultivation, using NERICA, a hybrid rice that combines high yields of Asian rice with strong disease and drought resistance of African varieties • To provide technical assistance to Sustainable Irrigated Agriculture Development Project in Eastern Uganda	• Rice, which is growing in popularity in Uganda, can be sold at higher prices than other staple crops, so its production enables farmers not only to secure their own food, but also to earn valuable cash income needed for educational and other expenses. • The JICA Rice Promotion Program encourages the cultivation of both paddy rice cultivated in paddies (whilst ensuring sustainable use of wetlands) and upland rice cultivated in fields. • Upland rice growing is suitable for regions which lack sufficient rainfall or do not have irrigation facilities. However, upland rice growing also helps to save the fragile wetland ecology of the country from further damage caused by paddy rice production.
Nyabarongo Dam (Rw) Under construction 2008-2012 SWECO (2010)	• 363 Mm^3 capacity reservoir on Nyabarongo river for future water supply to Kigali • HEP generation (28 MW) to Rwanda • Irrigation water to Rwanda	• 98M USD project to build 49m high dam; 5750 km^2 contributing basin, reservoir and proposed irrigated areas all lie within Rwanda. • Storage represents around 25% of annual flow and so permits high degree of downstream flow regulation with associated potential impacts on ecosystems. • Total consumptive water use is 442 Mm^3 per year which is 1.6% of the long term flow of the Nile river at Jinja, so will also have impacts beyond the Kagera basin.
Rural Sector Support Project II (RSSPII) (Rw) 39M USD in 3 phases (MINAGRI, 2008)	• To revitalise the rural economy and improve the quality of life of the rural poor through increased transfer of technical and financial resources for sustainable rural development • To accelerate agricultural intensification and promote the emergence of a vibrant, commercially-oriented rural economy • To increase agricultural production and marketing in marshland and hillside areas targeted for development in an environmentally sustainable manner	• Activities include: expanding irrigated area in cultivated marshlands and increasing use of sustainable land management practices on associated hillsides to accelerate the pace of intensification of agriculture, upscaling up successful activities of RSSPI (Table 3.1), broadening the scope and range of interventions to support small-scale commercial enterprises, involving local communities in decision making processes that impact their livelihoods, and supporting government decentralisation strategy by building capacity within the public institutions at the District level. • Target is to develop 400 km^2 of marshland by 2020; marshland development must be accompanied by catchment management and EIA is mandatory. • Risk of both localised and cumulative impacts on biodiversity, wetlands, soils and water quality; environmental/social screening tools will be used to identify and mitigate impacts.

Details	Objective	Wetland-related activities and outcomes
Rusumo Falls (Bu/Rw/Tz) Undergoing ESIA (SWECO, 2010; SNC-Lavalin/HydroQuebec, 2005)	• ≤496 Mm^3 capacity reservoir on Kagera river for HEP generation (90 MW) to Burundi, Rwanda and Tanzania • Irrigation use may be added in the future	• Several design options still under consideration at ESIA stage; anticipated to be relatively small dam ≤ 6.5 m high; (K. Abdulla, *pers. comm.*) • Maximum upstream flooding estimated of the order of 386 km^2, including 125 km^2 existing lake, 250 km^2 existing wetland and 15 km^2 valley slopes. • Turbine water will re-enter the river 300m downstream; compensation flow proposed at 20 m^3s^{-1} or 10% of the mean daily flow (K. Abdulla, *pers. comm.*); no plan to make artificial flood releases to replicate natural flow regime to benefit downstream wetlands in Akagera NP.
Transboundary Agro-Ecosystem Management Programme (Kagera TAMP) (Bu/Rw/Tz/Ug) – *See also main text* 2010-2014, 30.3M USD (www.fao.org/nr/kagera)	• To adopt an integrated ecosystems approach for the management of land resources in Kagera basin that will generate local, national and global benefits • To contribute to improved food security and rural livelihoods, protection of international waters in Lake Victoria and Nile basins, and climate change adaptation and mitigation	• Component project of TerrAfrica Initiative for Sustainable Land Management in Sub-Saharan Africa, aiming at sustainable transboundary management of the Kagera basin and its land resources and agro-ecosystems, which will generate significant environmental benefits through restoration of well-functioning ecosystems and maintenance of their services. • Project benefits including improved agricultural production, restoration of degraded lands, agrobiodiversity conservation and sustainable use, and carbon sequestration. Project will explore the payment for ecosystem services mechanism of providing incentives to rural communities to preserve ecosystem services.
Still to be reviewed: KTIWRMDP, LVEMPII, Mara, NTEAP, Pangani, RIPARWIN/SMUWC, Sio-Malaba-Malakisi, Sio-Siteko and other projects		

Key Bu Burundi, Ke Kenya, Rw Rwanda, Tz Tanzania, Ug Uganda

3.3 Institutional analysis

The NBI was formed to create a legal framework for cooperation for joint management of the water resources from the Nile, through a Shared Vision Programme and Subsidiary Action Programmes: ENSAP and NELSAP. NELSAP's focus is poverty alleviation, economic growth and reversal of environmental degradation in the equatorial lakes region which includes the Kagera basin and the Sio-Malaba-Malakisi. Around the same time, the Protocol for the Sustainable Development of the Lake Victoria Basin was concluded and signed in November 2003 by the governments of Kenya, Tanzania and Uganda under the provisions of the EAC Treaty. The Protocol provides for the establishment of LVBC i.e. an institutional framework to manage the lake basin. One of the articles relates to "promotion of development and management of wetlands". Rwanda and Burundi became members of the LVBC through their membership of the EAC. The EAC and LVBC evolution is consistent with IWRM principles of integration of the management and development of the physical ecosystem in synergy with the regional political and economic governance mechanisms.

Whilst there may be a basin-wide aspiration concerning the development and management of wetlands, realising this is more complex with the four basin countries having different national policies and priorities concerning management of the environment. Table 3.3 compares the institutional responsibilities for managing water, wetlands and the environment generally. It must be remembered that these national institutions have responsibilities over their whole country, not just the Kagera basin which, in the case of Tanzania and Uganda, forms only a small part of their total land area.

Table 3.3 Institutional responsibilities for environment, water and wetland management

Wetland management	
Burundi	• National Institute for the Environment and the Conservation of Nature (INECN)
Rwanda	• Rwanda Environmental Management Agency (REMA)
Tanzania	• River Basin Water Offices, Ministry of Water (MOW) • Wetlands Unit, Wildlife Division, Ministry of Natural Resources and Tourism (MNRT)
Uganda	• Wetlands Management Department (WMD), Ministry of Water and Environment (MWE)
Environmental management, environmental policy	
Burundi	• Ministry of Water, Environment, Land Management and Urban Planning (MEEATU) • National Institute for the Environment and the Conservation of Nature (INECN)
Rwanda	• Ministry of Natural Resources (MINIRENA) • Rwanda Environmental Management Agency (REMA)
Tanzania	• Division of Environment, Vice-President's Office • National Environmental Management Council (NEMC)
Uganda	• **Directorate of Environmental Affairs (DEA), Ministry of Water and Environment (MWE)** • **National Environmental Management Agency (NEMA)**

Water resources management, hydrological monitoring	
Burundi	• Geographic Institute of Burundi (IGEBU) • Ministry of Water, Environment, Land Management and Urban Planning (MEEATU)
Rwanda	• Ministry of Natural Resources (MINIRENA)
Tanzania	• River Basin Offices, Ministry of Water (MOW)
Uganda	• Directorate of Water Resources Management (DWRM), Ministry of Water and Environment (MWE)
Water supply and sanitation	
Burundi	• Institute for Waste Management (SETEMU)
Rwanda	• Ministry of Infrastructure (MININFRA)
Tanzania	• Semi-private companies
Uganda	• Directorate of Water Development (DWD), Ministry of Water and Environment (MWE)
Water for agriculture – hillside & marshland development, drainage & irrigation, livestock, aquaculture	
Burundi	• Ministry of Agriculture and Livestock (MINAGRI)
Rwanda	• Ministry of Agriculture and Animal Resources (MINAGRI) • Rwanda Agricultural Board (RAB)
Tanzania	• Ministry of Agriculture and Food Security (MAFS) • Ministry of Livestock and Fisheries Development (MLFD) • National Irrigation Commission (NIC)
Uganda	• Ministry of Agriculture, Animal Infrastructure and Fisheries (MAAIF)
Water for energy – HEP generation	
Burundi	• Ministry of Energy and Mines (MEM)
Rwanda	• Ministry of Infrastructure (MININFRA)
Tanzania	• Ministry of Energy and Minerals (MEM)
Uganda	• **Ministry of Energy and Minerals (MEM)**

Uganda is perhaps the most advanced in terms of wetlands, being the first African country to have a National Wetland Policy and a National Wetland Programme to implement it - now promoted to a Wetlands Management Division. In Burundi, Rwanda and Tanzania, wetlands tend to be grouped with environment or natural resources issues generally. Whilst Tanzania has a designated Wetlands Unit in the Ministry of Natural Resources and Tourism, its focus is the country's four Ramsar sites, with management of the many other wetlands falling under the River Basin Offices of the Ministry of Water. To recognise the importance of wetlands, it is recommended that there should be a designated wetland management agency, or single institution with responsibility for wetlands, in each country.

Water management in these countries has tended to focus on water supply and sanitation issues, rather than integrated management of water and other natural resources. It may be unclear where the responsibilities for water resources management lie within each country when government ministries may be frequently restructured, and where different aspects of water management may be split over several government ministries or departments with a lack of coordination between them. This has certainly been the case in Burundi and Rwanda where their ministries with responsibility for water resources management have had, respectively, three and two incarnations in recent years and where the agricultural sector has objectives which conflict with the environmental sector.

In Burundi, the development and implementation of national policy in the fields of water, environment, forests and land management have been the responsibility of the Ministry of Water, Environment, Land Management and Urban Planning (MEEATU, previously called MINATE, MINATET, MINEATP) since 2005. Within MEEATU, a General Directorate of Water is currently being established (Beck et al., 2010). Also under MEEATU are the Geographic Institute of Burundi and the National Institute for the Environment and Nature Conservation (INECN) which both have some water-related functions. INECN is the institution responsible for Burundi's Ramsar commitments. The Institute for Waste Management is responsible for water supply and sanitation. Water for agriculture and aquaculture fall under the Ministry of Agriculture and Animal Resources.

Reform of the Rwandan water sector in 2008 lead to the water supply and sanitation functions being held by the Ministry of Infrastructure, and the water resource management and regulation functions being held by the Ministry of Natural Resources (MINIRENA, previously called MINELA and MINITERE) which also has responsibility for environment, forests, land and minerals. Water for agriculture falls under the Ministry of Agriculture and Animal Resources and its implementing agency the Rwanda Agricultural Board (RAB, previously called RADA), which have responsibility for hillside and marshland development and irrigation. The Rwanda Environmental Management Agency (REMA) was formed in 2006 to implement MINIRENA's national environmental policies and legislation, and is the institution responsible for Rwanda's Ramsar commitments.

Responsibility for wetlands in Tanzania falls between two institutions. Ramsar sites are managed by the Wetlands Unit in the Wildlife Division of the Ministry of Natural Resources and Tourism, where the focus is wise use to enhance livelihoods and conserve the environment. Other wetlands are managed by the River Basin Water Offices of the Ministry of Water (MOW); the Ministry having an overall policy and coordination role but delegating day-to-day implementation of activities to the individual basin offices. The Kagera basin lies under the jurisdiction of the Lake Victoria Basin Water Office based in Mwanza. Two relevant environmental institutions sit in the Vice President's Office: the Division of Environment with responsibility for developing and enforcing environmental policy, and the National Environmental Management Council (NEMC) with responsibility for coordinating, monitoring and supervising environmental resources. The locations of these two bodies reflects the importance that Tanzania gives to environmental issues. Water for irrigated agriculture falls under the Ministry of Agriculture and Food Security, while livestock and aquaculture fall under the Ministry of Livestock and Fisheries Development. A National Irrigation Commission is in the process of being conceived.

The structure of the water sector in the Ugandan government has remained relatively stable in recent years, with the last, relatively minor, set of changes in 2007. All water matters sit under the Ministry of Water and Environment which has three directorates: Water Development (DWD, predominantly water supply and sanitation), Environmental Affairs (DEA) and Water Resources Management (DWRM, predominantly management and regulation of water resources). A designated Wetlands Management Department is in DEA, with sole responsibility for all aspects of wetlands, including Ramsar. The Wetlands Management Department arose from the 1989-1994 National Wetlands Project, becoming first the Wetlands Inspection Division and, in 2007, its own department. The National Environmental Management Agency (NEMA) nominally also sits under the DEA umbrella, with responsibility for coordinating, monitoring and supervising environmental resources including use of wetlands.

In all countries, the administrative structure for environmental management adopts a decentralised approach. This may variously comprise, from the top, principal ministries, sectoral ministries, regions, districts, sub-counties, municipalities, parishes and, at the bottom, villages. At regional, district, sub-county and municipality levels, there will usually be an environmental officer with responsibility for wetlands, though this may be just one of many roles that they have to perform in their day-to-day tasks. At village level, there will usually be water user groups, etc. The typical composition of such groups varies from country to country with Rwanda and Uganda preferring good representations of women, youth and minorities. A bottom-up approach means that, in theory, local priorities are fed up into the various levels of local government strategies and work programmes.

There is a basin-wide drive to encourage effective community participation and increased private sector participation in all waters sector activities (DWD/WWAP, 2005). The number of environmental NGOs and interest groups in the basin is increasing. The groups are engaged in environmental impact assessment, environmental research and environmental education activities, and are largely funded by external donors. In Uganda, the NGOs involved in water sector activities have formed a network for improved coordination of their activities, to provide a platform for constructive engagement with government and donors in the water sector, and to promote sharing of experience between members (DWD/WWAP, 2005).

Wetlands mean different things to different users: a farmer sees them as an area for growing crops, a fisherman as a source of food, a water company as a source of drinking water and/or as a sink for wastewater disposal, and a doctor as a source of water-borne disease. These different perceptions require an integrated approach for the effective management of wetland resources, both within a country and also between countries in the case of transboundary wetlands. The successful cooperation and coordination of lead institutions, as well as continued efforts of lower level institutions, and community and interest groups, is essential for long-term sustainable use of wetlands.

3.4 Legal position

The objective of this task is to examine the legislation, policy and any related management instruments which direct or otherwise influence management both within and adjacent to a wetland. As a sub-basin of the Lake Victoria basin, the White Nile and the Nile, the policies and regulations influencing the development and management of water resources and wetlands in the Kagera river basin range from national to regional to international. Some are archaic historical legal frameworks signed between 1891 and 1959 designed to restrict upstream developments and guarantee water to Egypt and Sudan, despite the impact on the upstream countries. Whilst these agreements were declared incompatible with national sovereignty when Kenya, Tanzania and Uganda achieved their independence in the early 1960s, there remains the opposing concepts of natural rights of the upstream countries and acquired rights of the downstream countries.

International water law principles (Stockholm, 1972; Dublin, 1992; Rio, 1992; Johannesburg 2002) aim to determine each country's entitlement to the benefits of the use of an international watercourse and to establish certain requirements for the country's behaviour while developing the resource (Wouters et al., 2005). The 1997 UN Convention on the Law of the Non-Navigational Use of International Watercourses is the most recent and authoritative legislative instrument relating to international water law with key principles on: equitable and reasonable use; avoidance of significant harm; prior notification of works which may affect co-riparians; information sharing; community interest in an international watercourse; EIA and environmental audits; precautionary principle; and polluter pays principle.

Cooperation between the basin countries is essential for the sustainable and equitable management of water and other natural resources. Several regional and Nile initiatives aimed to encourage the sharing of information and cooperation but did not lead to any basin-wide agreements e.g. Hydromet (1967-1977); UNGUDU (1983); TECCONILE (1992). However, in 1977, an agreement between Burundi, Rwanda and Tanzania formed the Kagera RBO, which Uganda joined in 1981. The Kagera RBO aimed to address all matters relating to the activities carried out in the Kagera basin in the fields of agriculture, electricity production, fisheries, industry, mining and tourism. The Kagera RBO was dissolved in 2005. Mbaziira (2005) considered that the development and management of water and other natural resources were not considered high priorities compared to other issues within the basin at that time, and that a more strategic approach involving local stakeholders was necessary. The two current institutional and legal entities supporting integrated management of the Kagera basin are NELSAP and the EAC.

NELSAP is a Subsidiary Action Programmes of the NBI, with a focus on poverty alleviation, economic growth and reversal of environmental degradation in the equatorial lakes region, which includes the Kagera river basin. The development objective of the NELSAP Kagera project is to develop tools and a permanent cooperative institution for the joint, sustainable management of the water resources in the basin in order to prepare for sustainable development-oriented investments to improve the living conditions of the people and to protect the environment (SIWI, 2005).

In 1994, Kenya, Tanzania and Uganda established the successful Lake Victoria Environmental Management Programme Phase I. This was followed in 1999, by the re-creation of the EAC by Kenya, Tanzania and Uganda to widen and deepen economic, political, social and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investment. LVBC was founded in 2003 when Kenya, Tanzania and Uganda signed the Protocol for Sustainable Development of the Lake Victoria Basin, and became operational in 2005. Rwanda and Burundi joined the EAC, and hence LVBC, in 2007. The EAC vision is that LVBC manages the entire basin including the Kagera basin, using the principles of IWRM. Its aim is to define strategy to harmonise the sectoral policies affecting each country's water resources and to establish action plans for the development and sustainable management of the basin. LVBC is also responsible for Lake Victoria Environmental Management Programme Phase II (Section 3.2).

The following sections review the national laws and policies relating to water resources and wetland management in Burundi, Rwanda, Tanzania and Uganda. Wetland management strategies need to be developed for all the four countries: only Uganda has developed one to date. A coherent and consistent approach to wetland management within the Kagera basin will require commitment to the cooperative development of shared water resources and the formulation of appropriate national and regional policies which also incorporate the transboundary aspects of water, supported by capacity building. Whilst a long-term aspiration may be for the countries to agree basin priorities with regard to water resources and wetlands and harmonise their national policies, in the short-term, project-oriented development activities and plans must operate within the national framework of laws and respect social and technical constraints.

3.4.1 Burundi

A number of legal documents provide a statutory basis for the management and use of Burundi's natural resources, including wetlands. However, many of these texts are in conflict with one another, or are outdated, presenting obstacles to sound management (Hobbs and Knausenberger, 2003). This applies to two of the texts most relevant to wetlands, namely the National Environmental Strategy (MINATE, 1997) and the National Environmental Code (RdB, 2000). Indeed, the Environmental Code itself recognises this and calls for the harmonisation of all legislation and regulations in conflict with the code to be undertaken within a period of five years. These include the Land Code (1986) which promotes active use of land for cultivation. In Burundi, wetlands are state-owned property but can be ceded to private individuals. For example, Beck et al. (2010) report that small plots, from which an estimated 80 kg per year of rice could be harvested, were being "rented" to individuals for rice cultivation for a nominal fee (equivalent to 20 US cents) at Kirundo.

The National Environment Strategy is intended to resolve conflict between the interests of development and those of environment, and proposes a coherent and cooperative set of complementary structures for better management of national and global environment, such as the improvement of intersectional coordination for better management of environment for sustainable development, the adoption of a participative approach and principles of good environmental management in the planning and implementation of actions, and the emergence and operation of associations, NGOs and groups defending environment. The National Environmental Code deals, amongst other issues, with water resources management and conservation, and the development and protection of catchment areas and soils The Environmental Code is progressive in many of its articles, such as participatory management of local resources, mandatory environmental impact assessments for land management activities, simplified mechanisms for classifying threatened habitats for protection. However, most of these concepts are stated broadly, and refer to the need for complementary texts to clarify and define their implementation (Beck et al., 2010).

More recently, the National Water Policy (2009) presents the government's vision for the water sector as "A State where water is available in quantity and quality sufficient to meet the needs of present and future generations and used as efficient and fair for sustainable socio-economic development without compromising environment". The policy proposes strategic directions for good governance of water, water-related disaster management, integrated water resources management, drinking water and basic sanitation, water for socio-economic development, and environmental resources management. It specifically mentions marshland management by coordinated and participative processes. It also sets out a shared vision and cooperative framework for transboundary water management. A new Water Code, intended to ensure the rational and sustainable management of water resources, the conservation and protection of water resources against all forms of degradation and pollution, and rational use and exploitation of the resource according to different needs and priorities of the State, local communities, and the people of Burundi, has

been drafted and is awaiting adoption. Another draft law is that for the Creation and Management of Protected Areas and is intended to correct conflicting prior laws in harmony with the Environment Code and the Convention on Biodiversity. It describes different measures to protect species of fauna and flora found in protected areas and specifies different types of protected area governance mechanisms.

The Burundi PRSP (2006) has a number of strategies that address environmental issues. It recognises the impact of rapid population growth and damaging land use practices on the environment, and the need to adapt its productive system to the demographic pressures. The strategy gives priority to rural development and protection of the environment through decentralisation and rationalisation of natural resource management and environmental protection.

3.4.2 Rwanda

The Constitution of Rwanda (2003) states that all citizens are entitled to a healthy environment. Rwanda's National Environment Policy (MLRE, 2003) contains a series of policy statements for the restoration of the natural environment through improved land and natural resource management, including a section devoted to wetlands and commitments to establish measures to protect wetlands and prevent their further degradation and establishment of wetlands as state-owned property. These principles were later promulgated to the Environmental Organic Law (2005) and Land Law (2005). These protect, safeguard and promote the environment, provide the main principles for water resources management, and recognise the importance of wetlands. Buffer zones along rivers of 10m for crops and 20m for housing, and 50m around marshlands and lakes are intended to control erosion and protect against flooding. It is also illegal to construct houses in wetlands. However, these laws are not always respected and crops often continue to be planted in the buffer zones and in the marshlands (REMA, 2009).

Wetland management is prioritised in some District Development Plans (REMA, 2009). MINIRENA's current 5-year plan anticipates increased utilisation of water resources for human settlement (including recreation and tourism), irrigation, energy (HEP) and industry (MINIRENA, 2008). Some level of modification from their original state for some wetlands is to be expected given the increasing pressures upon land and wetlands. However, this should be in the form of wise use, ensuring the maintenance of essential ecosystem functions and minimising the negative effects on transboundary waters. Sustainable management of the environment requires an integrated management plan for water and other natural resources. Rwanda has formulated a Marshlands Development Master Plan which, among other things, provides for the protection of water catchments and soil conservation based on hydrology, pedology, environment, agro-economy and sociology studies. Its target is to develop 400 km^2 of marshlands by 2020 (MINAGRI, 2008).

The Economic Development and Poverty Reduction Strategy (June 2002) considers environment as a cross-cutting issue and recognises natural resource degradation (of land, water and biomass) as a key impediment to agricultural transformation, rural development and poverty alleviation. The strategy requires the government to support positive interventions to ensure environmental protection measures are integrated within other sectors to promote sustainable economic development. For example, the continued decline in environmental protection works since the 1990s has resulted in an absence of soil conservation practices in farming systems by the local communities; to reverse the trend and promote sustainable agricultural development, soil erosion control methods such as restoration of terracing and bunding, better management of marshlands, water catchments and reforestation on the hillsides must be carried out. The involvement of the local communities in labour intensive environmental infrastructure development activities is another strategy to protect environment and create employment.

A new water policy and wetland policy are being drafted but are not yet law. The water policy covers the utilisation, conservation, protection and management of water resources, introduces the concept of IWRM by basin, and facilitates cooperation to manage and utilise water resources that are shared with neighbouring countries. The wetland policy follows on from the IMCE project (described in Section 3.1) which carried out an inventory of wetlands in Rwanda and categorised them into those that need protection and those that can be managed. The law aims to improve wetland governance in Rwanda by strengthening the legal status of wetlands and determining the conditions of their management and use in a sustainable manner. However, any initiatives for improved and sustainable wetland management must be long-term processes in parallel with capacity building at all levels from local communities to government departments (i.e. continued professional development). Furthermore, regular monitoring of water levels in lakes and marshland and flow in rivers, and of water quality, is necessary as data from key sites are essential to support water and wetland management and address water pollution. In an attempt to engage different government ministries in wetland conservation and ensure a holistic approach to wetland management, a National Wetland Conservation Program (2002-2030) is in place (MINAGRI, 2008).

3.4.3 Tanzania

The importance of environmental issues has long been known in Tanzania, with the 1995 National Land Policy 1995 (revised 1997) highlighting the importance of protecting environmentally sensitive areas and the 1997 National Environment Policy 1997 proposing a framework for environmental legislation and strategic plans for environmental management at all levels, including a call for the "improved management and conservation of wetlands". However, no strategic framework for implementing this policy objective was provided. The 2002 National Water Policy recognised need to respond to the challenges of sustainable water development and use through a water management system that protects the environment, ecological system and biodiversity, as well as to honour the country's obligations towards shared watercourses.

More recently, the 2004 Environmental Management Act set out principles for the protection and management of river beds and shore. This included for the first time, promoting environmental assessment practices; prior to this EIA was rarely conducted leading to a process of voluntary compliance. However, Sosovele (2011) argues that lack of enforcement of the Act renders the EIA process ineffective. For example, ministries are being encouraged to change conflicting laws to align with the Act, but this is proving to be a slow process. Under the Act, there will be specific regulations relating to wetlands but development of these is still ongoing. One of the objectives listed in the 2006 National Water Sector Development Strategy is the preparation of national inventories on the condition and extent of wetlands, floodplains and riparian ecosystems, as a basis for ensuring their long term protection, but little progress has been made to meet this goal. The 2007 Wildlife Policy includes a clause that "the government is committed to ensure that wildlife and wetlands areas remain pristine to safeguard in-situ biodiversity and tourism products" and the 2009 Wildlife Conservation Act includes a clause that "makes provision with respect to management and conservation of biodiversity and wildlife…….and their constituent habitats and ecosystems found on or in land or water".

Whilst the intention to promote good wetland management practices exists, the strategic frameworks for implementing this are not yet in place. For instance, like the other Kagera basin countries, protective buffer zones are proposed along rivers (60m) and around lakes (500m), but these are still proposals. Similarly, EIAs are mandatory and the polluter pays principle is law, but the legal instruments to enforce them are not yet in place. There is a risk that individual wetland management decisions may be made which pre-empt objectives of plans and policies that are still preparation. Development of a National Wetlands Strategy is long overdue.

The Tanzania PRSP (February 2000) acknowledges the heavy dependence of the poor on environmental resources for income generation. The strategy requires the government to incorporate environmental quality indicators in the poverty monitoring systems in order to identify levels of dependence and linkages between environment and poverty. Ultimately, it should be possible to identify areas of interventions during implementation of poverty alleviation programmes to ensure environmental protection and sustainable economic development.

3.4.4 Uganda

In 1980s Uganda, it was government policy to increase food production and many marshlands were drained and converted to land for agriculture or livestock grazing. However, by 1986, it was recognised that the marshland drainage was having unforeseen impacts and also that the climate was changing with unknown implications. A decision was made to halt wetland drainage and research the problem. The original National Wetland Project, which has been influencing government policy since 1995, became the Wetlands Inspection Division in 1998 and the Wetlands Management Department in 2007, demonstrating the increasing importance that the government attaches to wetlands.

The main goal of the water sector in Uganda is "to manage and develop the water resources of Uganda in an integrated and sustainable manner so as to secure and provide water of adequate quantity and quality for all social and economic needs for the present and future generations with full participation of all stakeholders" (DWD/WWAP, 2005). To meet emerging water sector challenges, the 1995 Water Action Plan identified issues and recommended policy directives and management strategies. As a result the government put in place a comprehensive policy and legal framework for the development and management of the water sector, the most relevant of which in a water and wetlands context being: the 1995 Water Statute which established NEMA, provided a framework for the use, protection and management of water resources and water supply, and made mandatory EIA for any activity likely to have a significant effect on the environment; the 1995 National Environment Act for sustainable management of the environment including wetlands through the 1995 National Policy for the Conservation and Management of Wetland Resources; the 1998 Land Act which provides that the government holds lands in trust for the people and protects environmentally sensitive areas such as wetlands and any other lands reserved for ecological or tourist purposes for the common good of the citizens of Uganda; the 1999 National Water Policy to manage and develop water resources in a sustainable and integrated manner, and the 2000 Forestry Policy covering the rehabilitation and conservation of forests that protect the soils and water in the country's key watersheds and river systems.

The second Wetlands Sector Strategic Plan (2011) has eight strategic objectives: increase knowledge about wetlands; raise awareness; construct decentralised institutions for wetland management; develop appropriate legal and policy instruments; manage wetlands sustainably, including transboundary wetlands; protect vital wetlands by functions and services; empower communities to manage resources through Community Based Wetland Management Plans; and win funding and resources at all management levels. A specific wetlands management law is (still) in preparation (DWD/WWAP, 2005).

The 1997 Poverty Eradication Plan shows that the water sector has long been recognised as a priority instrument in fighting poverty. The PRSP (2000) identifies soil fertility loss and deforestation as the major causes of environmental degradation and threats to the livelihood of the poor people, particularly women, who depend on forest products. The strategy addresses environmental concerns through a sector-wide approach e.g. private sector participation in the forestry activities, on-going programmes geared at protecting wetlands and wildlife resources, etc. It seeks to empower the poor on land ownership through land reforms and, therefore, ensure environment and natural resource protection. It relates rapid economic growth with increasing stress on the environment and natural resource base, resulting into environmental degradation and considers the declining quality and quantity of natural resources to have implications for sustainable economic growth and poverty reduction.

Being both a downstream and upstream country in the context of the Nile river, the Ugandan government has long been an enthusiastic proponent of IWRM to ensure sustainable water resource management and development.

4. Wetland project selection criteria

4.1 Rationale behind proposed wetlands management framework

Past and current experience (e.g. Rugezi in Section 3.1, COBWEB in Section 3.2) has demonstrated that wetlands cannot be isolated from their watersheds, and that management interventions must apply to the whole catchment in which a wetland lies. Major cumulative impacts on wetlands have resulted from agricultural practices in the uplands and in the wetlands themselves. The two principal threats to wetlands in the Kagera basin are siltation due to soil erosion and conversion to agricultural land; the soil erosion itself caused by deforestation of hillsides to produce cultivable/grazing land and poor farming practices. Whilst human activities, both direct and indirect, are the principal contributors to wetland degradation and loss, other factors include inadequate planning and management of resources, and lack of basin information and public – and institutional - awareness of wetland values. Wetlands are also degraded or lost because of policy deficiencies, planning deficiencies and institutional weaknesses.

All of countries of the Kagera basin are making progress in environmental management and many of these issues are being addressed, albeit slowly in some cases and within the pressures imposed by population growth and land demand. Indeed, it can be argued that it is because of these pressures, and acknowledgement of the links between ecosystem services and economic development, that efforts should be increased and the wetland resources of the Kagera river basin should be carefully managed to enable their sustainable utilisation now and in the future.

Within the riparian countries there are many examples of best practice that can be transferred, and an excellent Nile Basin Wetlands Management Strategy 2011-2016 exists and is about to be implemented. This study presents an opportune moment to influence the processes to facilitate a coherent approach to wetland management and wetland policies across the Kagera basin through harmonisation of existing efforts and identification of information gaps not yet covered by other studies for the better management of the basin.

Degradation of the ecosystems for short-term gain will compromise medium- and long-term sustainable development (REMA, 2006); hence, the link between economic development and poverty reduction and wetland ecosystem services. Based on the wetland sectoral analysis and technical assessments described in previous sections, stakeholder interviews and literature surveys (e.g. NRE, 2002; Ramsar, 2007; NBI, 2010) a 10-point wetland strategic management framework is proposed in Box 4.1. The goal of the framework is to maintain the character and ecosystem services of Kagera wetlands through conservation and wise use and, thereby, contribute to the Nile Basin Wetlands Management Strategy (NBI, 2010) and sustain the livelihoods of wetland and other communities.

Box 4.1 Wetland Strategic Management Framework

1. Increase scientific understanding of wetlands and their management requirements
2. Maintain, or where appropriate restore, suitable hydrological regimes in wetlands
3. Address adverse processes and activities causing wetland degradation
4. Manage wetlands within an integrated watershed management framework
5. Manage wetland resource utilisation on a sustainable basis
6. Protect, and where appropriate enhance, wetland ecosystem services
7. Encourage strong partnerships between wetland management agencies
8. Promote community awareness and opportunities for involvement in management and sharing of benefits
9. Ensure recreational use of wetlands is consistent with protection of other services
10. Develop appropriate monitoring and evaluation programmes for wetlands

The framework enables management agencies and stakeholders to make rational decisions regarding the use and development of wetlands and their watersheds with full regard for wetland ecosystem services, the risk or threats to these services and interventions that can eliminate the risk or threats or mitigate the impacts, as well as highlighting existing strategies and actions that are consistent with the principle of wise use. Examples of potential activities and interventions are listed in Table 4.1, though this list is generic and for illustrative purposes; it is by no means comprehensive and many activities will be specific to an individual wetland.

Table 4.1 Management objectives and examples of potential activities and interventions

1. Increase scientific understanding of wetlands and their management requirements
• Funded research into hydrology (including surface water-groundwater interactions) of wetlands and most appropriate flow regimes based on hydro-ecological requirements of lakes and marshlands
• Funded research into economic valuation of wetland ecosystem services
• Inventories, monitoring and surveys of key flora and fauna and their habitat requirements and threats, hydroecological character of wetlands, impacts of wetland users e.g. fisherman, tourists, livestock, etc.
2. Maintain, or where appropriate restore, suitable hydrological regimes in wetlands
• Implement appropriate environmental flows to address water quality and biodiversity protection
• Determine how much water can be sustainably extracted from surface and groundwater sources without impacting on the environment
• Introduce water abstraction and waste discharge licences or permits for both surface water and groundwater
• Investigate options for optimising flood/water storage through appropriate management practices
3. Address adverse processes and activities causing wetland degradation
• Conduct wetland risk assessment
• Maintain livestock populations within prescribed limits agreed between all relevant stakeholders
• Ensure development of catchment and adjacent lands is consistent with conservation of ecological character of wetland and aspirations for its future status
• Conduct environmental impact assessment prior to any developments in wetland catchment
• Implement soil and water conservation measures in watershed to reduce soil erosion e.g. terracing, reforestation, etc.
• Ensure all waste and sewage discharges within catchments surrounding wetlands are appropriately licensed and that licences are complied with
• Improve quality of waste and sewage discharges entering wetlands
• Revegetate/reforest priority areas to prevent erosion; use indigenous species on public land
• Control priority invasive plants and animals
• Undertake predator control programmes to protect resident waterbirds and other significant species
4. Manage wetlands within an integrated watershed management framework
• Develop integrated management plan for wetland and its watershed together
• Implement appropriate soil and water conservation measures to reduce soil erosion in wetland catchment
• Implement appropriate measures to reduce nutrient and chemical pollution of watercourses
• Coordinate invasive plants and animal control with adjacent landowners and management agencies
• Incorporate wetland management objectives in local and regional management plans

5. Manage wetland resource utilisation on a sustainable basis

- Funded research into thresholds for sustainable use of wetland resources and enforcement of thresholds
- Manage agricultural development in accordance with sustainable land use management principles and minimise loss of ecosystem services
- Invest in and maintain drainage and irrigation infrastructure in agricultural wetlands to optimise production
- Ensure timber resource utilisation is conducted in accordance with ecologically sustainable forest management principles and minimises loss of ecosystem services
- Where practicable, construct fences to prevent access by livestock to areas of significant environmental value; ensure fence design is developed in conjunction with all relevant stakeholders; if fencing is not practicable, manage grazing regimes to minimise impact on the most sensitive environmental areas
- Instigate/review grazing licences and develop grazing management strategies for licensed areas in consultation with all relevant stakeholders
- Develop routine assessment process to assess ecological conditions of grazing areas to improve ability to manage livestock numbers if ecological requirements dictate
- Manage commercial and recreational fishing and hunting in line with principles of ecologically sustainable development
- Manage apiculture in accordance with standard licensed conditions
- Investigate feasibility of sustainable urban drainage systems (i.e. artificial wetlands) to improve quality of waste water from urban areas entering watercourses

6. Protect, and where appropriate enhance, wetland ecosystem services

- Determine and implement appropriate strategies for long-term restoration of indigenous plant communities and habitats
- Protect roosting, nesting and breeding sites of endangered and migratory bird species
- Manage and, where appropriate, enhance habitats of threatened flora and fauna species
- Manage flora and fauna, including threatened, migratory and indigenous species, to encourage existence
- Investigate the feasibility of reintroduction of indigenous species no longer present in wetlands
- Adopt ecological burning and manipulative fire regimes where it can be demonstrated to be of value to wetland's natural ecosystem services
- Use incentive schemes such as polluter pays and payment for ecosystem services to encourage conservation and sustainable management practices

7. Encourage strong partnerships between wetland management agencies

- Establish appropriate communication and links between all relevant stakeholders and management agencies to improve management of both wetland and watershed as a whole
- Involve local communities in all aspects of wetland management and ensure that wetland management strategies do not conflict with or otherwise impact upon cultural and similar uses of wetland

8. Promote community awareness and opportunities for involvement in management

- Promote local community participation in habitat protection and enhancement works
- Encourage involvement of local communities in all aspects of wetland management and sharing benefits
- Establish wetland visitor centres with information, interpretation and educational programmes to promote natural ecosystem services of wetlands
- Promote community-based ecotourism and traditional craft opportunities
- Identify opportunities and encourage local community involvement in ecological monitoring activities

- Consult with local communities to ensure that wetland management strategies do not conflict with or otherwise impact upon cultural and similar uses of wetland
- Promote greater understanding, awareness and protection of wetland in extension and voluntary programmes to landowners and local communities through provision of educational and promotional material

9. Ensure recreational use of wetlands is consistent with protection of other services

- Protect cultural and similar uses of wetland in consultation with local communities
- Maintain and develop appropriate visitor facilities and services consistent with protection of natural, cultural and similar values of wetland
- Develop and, when appropriate, implement visitor management strategies
- Encourage visitors to practise minimal impact techniques and to adhere to recreational codes of conduct
- Monitor use of wetland for fishing and hunting and enforce regulations to control illegal practices
- Restrict boat use in environmentally sensitive areas to non-motorised or electric-powered craft

10. Develop appropriate monitoring and evaluation programmes for wetlands

- Develop ongoing consistent programme to monitor ecological character of wetlands, measured in a statistically sound way and recorded in appropriate databases; factors such as frequency of flooding, water level, salinity, nutrients, algae, macroinvetebrates, flora and fauna should be measured
- Monitor effectiveness of conservation, restoration, revegetation and habitat protection interventions
- Record fauna species usage of wetlands and provide data to relevant databases
- Liaise with local communities regarding impacts of management interventions on cultural and similar values of wetlands

Ramsar (2007) purports that a certain degree of sequencing is required between planning and management activities at river basin level and between management and user activities at individual wetland level. Difficulties in implementation of wetland management plans often occur when higher-level water resources planning, management and water allocation issues have not been adequately addressed prior to the design and implementation of wetland management plans. This reiterates the need for a fully integrated approach.

4.2 Wetland project selection criteria

Taking account of the critical issues raised by stakeholders and others during the review of past, present and future projects, set out in Sections 3.1 and 3.2, the following project selection criteria, in no particular order, are suggested:

- The project activities contribute to the wetland strategic management framework presented in Section 4.1.
- The project recognises that much wetland degradation is caused by activities, not solely in the wetland, but also in the watershed. Activities apply to the whole catchment in which a wetland lies, or an explanation of why this approach is unnecessary is provided.
- The project complements or links with existing initiatives and programmes in the Kagera basin (e.g. LVEMP, PAIGELAC, PAIR, TAMP) in order to develop synergies and generate mutual beneficial outcomes.
- The project outputs contribute to the information base that informs management decision and provide best practice guidelines for transfer to other wetlands.

- The project seek opportunities to integrate wetlands with the curriculum of course on water management, engineering and agriculture fund PhD and MSc places at universities in the region as part of the overall project activities in order to build regional research capacity.
- The project has a clear dissemination plan. This includes a designated budget for "clustering" activities (e.g. coordination of use of wetland sites, sharing of data and information, attendance at cluster project meetings and major conferences, preparation of common publicity material and web linkages, joint presentations to national policymakers and NELSAP, general coordination activities, etc.) with other Kagera projects to increase and extend project impact.
- The project includes awareness-raising, capacity building and training initiatives - in environment generally and wetlands specifically - at all levels from national government to local community and schools.
- The project contributes to the harmonisation of national policies, laws and institutional mandates.
- The project has an appropriate strategy for dealing with ethical issues, such as the storage and use of stakeholders' personal information, and for ensuring that women and minority groups are represented and actively involved in project activities.
- The project aligns with NELSAP primary objectives of poverty reduction, reversal of environmental degradation and economic development. The project meets the additional project selection criteria proposed by NELTAC (NELSAP, 2006): defined goals and anticipated measurable results, demonstrable benefits at a regional level, ability to be upscaled, demonstrable sustainable use of water resources, commitment to significant public consultation and stakeholder involvement, and economic and financial viability and sustainability.

Of the last criterion, it is proposed that the point "ability to be upscaled" should be modified to "outputs include costed recommendations for upscaling" or similar. This will address the sentiment from some key stakeholders that the challenge which will bring sustainable results is the upscaling. This is usually planned for after the original project funds have finished, by which time the momentum is lost and new projects are always starting again from the beginning, rather than building on previous achievements.

On the issue of upscaling, Ramsar (2007) believes that many countries are still grappling with the policy and regulatory reforms needed to recognise ecosystems as legitimate users of water, which is the first step in formalising the status of wetland ecosystems in water allocation and management. Whilst many countries have achieved good results in integrating wetland management and water resources management at the local, site or sub-basin level, successful upscaling of these approaches to the basin level has generally proved more difficult.

Key stakeholder interviews also revealed some dissatisfaction with the traditional project lifecycle and funding arrangements. There were two main issues. Firstly, that sustainable outcomes could not be realistically achieved in a typical 3-4 year project, and that 12-16 years would be more reasonable: in many cases, the solution is known and the challenge is not demonstrating it works to the people concerned, which often takes 3-4 years, but rather the horizontal and vertical extension of that solution to other areas (the upscaling referred to in the previous paragraphs). Secondly, the funding structure with outputs from the start of the project is not efficient: A typical development project takes 6-9 months to set up and get going once funds are available and it is unreasonable to expect the first outputs after just a few months. Instead, development projects needs to have a year 0 (or half year 0 for small projects) which would involve spend but enable all the logistical arrangements to be made so that a committed team was in place to work effectively from the start of year 1.

Therefore, it is proposed that a mix of short and long projects is considered, each with an appropriate start-up period.

Whilst projects meeting the criteria above will contribute to the objective of reversing environmental degradation, each project must also be considered in terms of the additional objectives of economic development and poverty reduction. However, to date, relatively little work has been done quantifying the economic value of wetland ecosystem services, the benefits that derive from them, and the benefits accruing from different wetland interventions, and so this very issue is proposed as one of the projects in Section 5.2.

5. Prioritised wetlands management and restoration project plan

The wetland project selection criteria propose that the project activities contribute to the wetland strategic management framework presented in Section 4.1. However, there must be some flexibility because not all management objectives will be appropriate for all wetlands: in some cases, deliberate decisions may be made to enhance some ecosystem services at the detriment of other i.e. trade-offs. Therefore, it is unreasonable to insist that all projects contribute to all aspects of the framework. It is also important not to have too ambitious aspirations with complex sets of tasks. Thus, two different types of wetland project are proposed:

- Projects involving integrated watershed and wetland management plans for stakeholder-nominated, preferably transboundary, sites. For these "plan" projects, efforts would be made to develop a bespoke risk or vulnerability assessment and a management plan for the site, involving all aspects of the wetland strategic management framework presented in Section 4.1. Through broad coverage of a range of issues, these projects will aim to develop a rational step-wise process for managing a wetland and its catchment, transferable to other sites, whilst at the same time improving collaboration, communication and cooperation both between the relevant stakeholder groups and institutions within a country, and between countries. See Section 5.1.
- Projects investigating specific wetland management objectives at demonstration sites. For these projects, priority issues would be investigated, each in least two sites in at least two countries, though preferably at one site in each riparian country. Through in depth coverage of key issues, these projects will aim to develop knowledge about wetlands, raise awareness about wetlands at all levels, and develop and build regional research capacity into wetland issues. The latter will be achieved by funding PhD and MSc places at universities in the region as part of the overall project activities, another of the project selection criteria. See Section 5.2.

Dissemination to maximise impact is a key element and each project will present a dissemination plan that includes a range of diverse actions to ensure that maximum benefit is derived from the project. The dissemination plan will include a dynamic involvement of stakeholders at all stages of the project and planned knowledge dissemination activities targeting all relevant societal actors. Wider regional actions will be carried out to communicate project objectives, methods and achievements to other stakeholders in the Nile Basin, East Africa region and elsewhere. Actions could include, but are not limited to, the following:

- Disseminating results of the projects to sectoral networks and "clustering" activities with other Kagera projects;
- Preparing and distributing key policy briefs;
- Participation in major regional and international meetings, workshops, conferences etc.;
- Using regional networks and events for dialogue and dissemination;
- Training and exchange programmes across regional universities;
- Information events and exhibitions at local schools in the project areas;
- Maximising outreach through an up-to-date (possibly NELSAP-run) Kagera project website and social networks (Facebook, twitter, etc.);

- Media-based public awareness and information programme e.g. community radio; television programmes, etc.;
- Range of products and publications at all stakeholder levels e.g. posters, calendars, newsletters, papers in both scientific peer-reviewed and trade journals;
- Planning for post-project legacy and upscaling, including further dissemination.

Each of these activities aims to communicate the key objectives and outputs of the projects, mobilise wider stakeholder involvement in the projects, and promote the use of project outputs in future policy and practice. Where possible, awareness-raising and capacity building dissemination activities will be complemented by practical demonstrations of successful management interventions and the accrued benefits to both people and the environment.

Another of the wetland project selection criteria is that the project contributes to the harmonisation of national policies, laws and institutional mandates. Within countries, a multi-sectoral approach will be required as responsibilities for wetlands often cut across several sector ministries, requiring collaboration to facilitate wetland management. Given the decentralised model for environmental and wetland management adopted in the Kagera countries, institutional capacity building and strengthening at the district/sub-county/municipality/local level is essential to increase people's knowledge and understanding of the role of wetlands and develop the capacity to deal with integrated management of natural resources. Between countries, legal frameworks may need to be developed in order to be able to address the complexity of transboundary management of wetlands. All legal frameworks will need to be enforced and elaborated (new procedures and regulations for better conservation and sustainable management). Water, land tenure and access rights may also need to be clearly defined (Olet, 2008).

Although there are only four riparian countries in the Kagera basin, there is a large disparity between them in many areas related to their natural resource management. In particular, inadequate human and financial capacity is a major constraint when countries must participate in joint studies, management and development projects on an equal basis. International support to build capacity is an important component of joint planning and management in internationally shared river basins and can reduce conflicts emanating from the constraints faced by the weaker parties (Heyns et al., 2011).

5.1 Proposed projects

Integrated watershed and wetland management plans will be developed for a number of stakeholder-nominated wetlands. The preference would be for these to be cross-border wetlands involving two (or more) countries in order to contribute to best practice guidelines for countries operating under different institutional and legal arrangements whilst, at the same time, improving collaboration, communication and cooperation both between the relevant stakeholder groups and institutions within a country, and between countries.

The goals of the management plan will be two-fold: firstly, to maintain and develop existing wetlands and, secondly, to restore and improve some of the lost areas of wetlands. In both cases, the plan will likely impact on riparian communities and livelihoods. In the former, people with limited agricultural land may consider that extending landholdings into the wetlands would be appropriate. In the latter, it may be that families who have moved onto former wetlands would risk becoming displaced with uncertainty as to their future livelihoods. Hence, the first decision in developing an integrated watershed and wetland management plan would involve deciding what state the wetland should be in, that is whether the overall intention is to conserve, develop or restore a particular wetland. Conservation or restoration of hydrological and ecological functions in vital wetlands would maintain or improve the availability, productivity, value and diversity of wetland products for use by local communities. Development of wetlands would enable resource users to optimise and equitably distribute wetlands benefits, but it may be necessary to prioritise particular ecosystem services over other i.e. apply trade-offs.

5.1.1 Approach

An integrated watershed and wetland management plan will be based on an analysis of the requirements of the various wetland ecosystem functions for conservation, development or restoration scenarios, guided by current international best practice. As a result, the management plan will be both rigorous and unbiased, and provide a robust platform from which to take the process further.

One approach will be to identify the ecosystem service needs of all stakeholders, and the water and other natural resource management needs of each ecosystem service, individually. For instance, the reduction of sedimentation might be identified as a need, as is the case in much of the Kagera basin. The rationale might be that there is a large sediment input into the wetland from upstream, the sediment load has increased due to upstream deforestation, and the wetland is in danger of becoming silted up thereby reducing some of its regulating ecosystem functions. The management implications of this would be that the source of the problem should be addressed by promoting changes to the land management practices in the upstream areas; depending on the severity of the problem, other measures may involve actions to flush the excess silt through the wetland and out of stream channels The data requirements to make focused and successful interventions would include details of upstream farming and land use practices, quantification of sediment entering the wetland, and water level monitoring in the wetland and outflow channels.

Similar assessments would be done for other needs e.g. flood control, conservation in National Park, HEP generation, encouraging favourable fish habitats, optimising water for agriculture. In this way, each need is looked at without compromise before they are all brought together in an integrated management plan. The process is complex and necessarily involves a high level of stakeholder participation to reach a consensus, including agreement on any trade-offs.

Stratford et al. (2008) extended this approach during application to wetlands in the Himalayan region, to develop a simple and easy to use spreadsheet-based assessment tool suitable for application to a range of wetland types with differing values and experiencing a range of threats. The method itself involves a trade-off between certainty and accuracy, and practicality and ease of use, and includes an element of subjectivity, and an acceptance and balance of these conflicting factors has to be adopted to be able to apply the method successfully. Recognising that data availability is a common issue, the method is designed so that an assessment can still be produced in situations where data are limited or missing. In these cases, the assessment also highlights missing data and future data needs. The method comprises four stages:

1. *Assessment of wetland values*. The carrying, cultural, provisioning and regulating ecosystem services provided by the wetland are identified. For carrying services (e.g. agriculture, fisheries, tourism, etc) and regulating services (e.g. good quality water for drinking and irrigation, flood storage, maintenance of flows during droughts, etc), this would involve the monetary and community importance of the service. Regulating services can impact a large area downstream of a wetland, so the population affected by the presence or absence of a service could be greater than the community living directly around the wetland. For cultural services, this would include the importance and uniqueness of the wetland. For provisioning services, this would involve the presence of rare or endangered species or habitat and biodiversity.
2. *Assessment of threats to the wetland*. All threats are assessed based on the severity of the threat i.e. what would be the impact of the threat occurring, and the likelihood of the threat i.e. how likely the threat is to occur. This assessment does not have to be an onerous task. Based on risk assessment guidelines provided by Ramsar (1999), NRE (2002) and EPA (1997), a simple three-class system is proposed:
    - High threat – risks that currently or may potentially result in the significant loss of the wetland's character and ecosystem services, and/or where these features are unique to the wetland.
    - Medium threat – risks that currently or may potentially result in the moderate loss of the wetland's character and ecosystem services, and/or where these wetland features are locally or regionally important but not unique.
    - Low threat – risks that currently or potentially result in the minor loss of the wetland's character and ecosystem services, and/or where these wetland features are not remarkable.
3. *Links between threats to the wetland and wetland values*. The next stage involves establishing how each of the threats to the wetland will impact on each of the wetland values.
4. *Risk or vulnerability assessment*. The assessment tool analyses the data and highlights both the wetland values that are most under threat and the threats to the wetland that are impacting on the most values.

The output informs the wetland action plan which will identify the wetland values that are under threat, the steps that should be taken to address those threats, and the requirements for further data collection. An example of application of the method is provided in Appendix B. Much of the required data for the assessment of wetland values and threats should be available from existing national datasets, possibly supplemented with local datasets and indigenous knowledge, but may involve field collection of data in the wetland itself. This step may indicate that further data collection is required.

The Stratford et al. (2008) method brings consistency to the assessment process and, thereby, helps inform management plans and target where resources should be directed. This sort of assessment should mark the beginning of an ongoing process. Any management plan should be evaluated periodically and, in this case, the assessment revisited as conditions, values and threats change; suitable amendments to the management plan can then be made.

It is proposed that the method, or a similar type of approach, be applied to the nominated wetlands in the Kagera basin, so that the method can be tested and further developed.

Interviews with key stakeholders during the interim phase revealed a belief that research was needed into all aspects of wetlands to increase knowledge and understanding of their values and functions. Universities in Uganda already have quite an advanced wetland research capability, but this is less developed in Tanzania which is very strong in water resources generally, and hardly exists in Burundi and Rwanda. The proposed projects

investigating specific wetland management objectives at demonstration sites provide good opportunities to fund PhD and MSc places at universities in the region as part of the overall project activities, in order to establish and develop a regional wetland research capacity.

The intention is that these projects would use case study wetlands that demonstrate the benefits of taking an ecosystems approach, and would be small-scale community-based studies. The wetlands would be at least "paired", that is the same applied research would be conducted in wetlands in at least two countries, if not three or all four. Hence, the wetlands would not deliberately be transboundary wetlands, though the project could be carried out on the two sides of a single transboundary wetland. This form of implementation would enable experiences to be compared, and the case study wetlands could learn from each other as well as providing a more extensive knowledge base from which to develop best practice guidelines on specific aspects of wetland management.

There has been some work done to demonstrate the economic importance of wetlands (e.g. Constanza et al., 1997; Wilson and Carpenter, 1999; Emerton, 2005; Turner et al., 2009; Kuik et al., 2009). The challenges are, firstly, for it to become standard for values of ecosystem functions to be incorporated into economic cost-benefit calculations for development projects and, secondly, for downstream users to both acknowledge and recompense for the ecosystem services from which they benefit. It could be argued that this second challenge could be reversed, such that upstream users acknowledge and recompense for negative downstream impacts caused by their poor custodianship of ecosystem services. An important first step is to enhance the ability to measure and monitor water availability and water use before assessing if PES is legitimate and considering service receiver fees (Fisher et al., 2010).

The few PES schemes that currently exist in Africa are located in Kenya, South Africa and Tanzania (Ferraro, 2007; Fisher et al., 2010). Obstacles to their implementation include a lack of technical and market information, limited institutional experience, inadequate legal frameworks, limited successful models, suspicions of markets for public goods, and equity concerns, in addition to the financial health of the institutions benefiting from ecosystem services and the consumers ability to pay (Ferraro, 2007). In Rwanda, there is some movement in this direction through the revenue sharing scheme between the National Parks Service and local communities whereby 5% of the total gross revenue from each park is used to improve livelihoods in return for refraining from land conversion around and in the park.

Following the Stakeholder project Selection workshop in July 2012 – participants prioritised projects into priority 1 and priority 2 categories. The priority 1 projects were then developed into project fiches and subjected to a financial analysis. The proposed projects are presented together with the watershed management projects in Appendix A of this report as well as in summary in the main body of the report. Full costings and financial analysis are presented in Annex C of this report.

Monitoring and evaluation framework

There are two different, but related, types of monitoring of relevance to this task: monitoring to acquire basic data and information related to wetlands, and monitoring of the impact of management interventions. This activity will be executed in the second half of the current project, when the outputs from other tasks and the form of proposed projects has solidified, because the monitoring and evaluation framework must be integrated in the same way as the management plans. However, some initial ideas are presented below.

Monitoring and evaluation – and subsequent reporting – enhances transparency and accountability through improved information flow between the central government, donors, local government, NGOs and the private sector. All current monitoring by the various measuring agencies will be reviewed, and recommendations for continuation or addition to the existing monitoring networks will be made, in order that the data requirements identified by the prioritised ecosystem functions are addressed.

In order to further strengthen monitoring, evaluation and reporting, clear indicators can be defined against which performance can be periodically reviewed. Appropriate indicators (see Section 6.1) can be selected or developed based on an assessment of the critical environmental issues pertaining to management of wetlands. The data requirements of the indicators must also be considered. Therefore, the effects of management changes on wetlands can be assessed as part of a periodic evaluation of the effectiveness of management plans and adaptive management can be employed as necessary.

The monitoring system should be developed in close consultation with the various levels of stakeholders to enable them to provide feedback and observations.

5.2 Indicators

Some Kagera countries already produce a “State of the Environment” type report e.g. Tanzania. Therefore, these countries will have already started collecting and collating some of the necessary data. However, it will be important to have a standardised framework for monitoring and evaluation in all riparian countries in order to compare results and ensure that beneficial impacts of management interventions under the projects proposed in Section 5 are evenly distributed.

Some preliminary ideas for indicators are presented in Table 6.1.

Table 6.1 Examples of wetland indicators

Status of wetland ecosystem, including designation e.g. Ramsar sites
Capacity for providing ecosystem services
Degradation of wetlands (comparison of actual and potential ecosystem services)
Evidence of positive/negative changes in use of and management of wetland
Socio-economic indicators e.g. poverty index, agricultural productivity, income diversification, etc.
Capacity building index

There is also the issue as to how the results for the individual countries are combined and presented i.e. whether this is done at country level and statistics submitted to a central body (e.g. NELSAP) for publication (e.g. as a State of the Kagera river basin report) and dissemination. An alternative is that the monitoring and evaluation is carried out as a project in its own right until it is established and responsibility can be handed over.

5.3 Issues

In order to carry out monitoring and evaluation activities, some countries expressed an urgent need for appropriate facilities e.g. properly-equipped laboratories for water quality and soil analysis, etc. as they do not have the necessary tools to collect the information needed for their own environmental monitoring activities. There was also a call for training to address technical skills gaps e.g. surveying, GIS, etc. This could take the form of short courses under a continued professional development type programme for relevant personnel. In order to identify the scale of both these issues (facilities and training) it is recommended that an equipment inventory and a training needs assessment are carried out.

Guidelines for compliance monitoring of wetlands need to be introduced to monitor the adherence to laws related to wetlands and accompanying regulations, implications and penalties. The main target audience will be district/sub-county/municipality officials who are charged with the responsibility to uphold wetland laws and regulations. The need for capacity building at this level of government was raised by all four countries. To ensure that guidelines for compliance monitoring of wetlands are implemented and that abuses of wetlands are effectively curbed in order to contribute to the overall goal of sustainable management of wetland resources in the Kagera basin, a comprehensive sensitisation and awareness creation campaign on sustainable use and management of wetlands must be initiated.

6. References

Andrew, G. and Masozera, M. 2010. Payment for ecosystem services and poverty reduction in Rwanda. *J. Sustainable Development in Africa* **12(3)**, 122-139.

Baijukya, F., Kaihura, F. and Thomas, J. undated. Land degradation and opportunities for sustainable management of Kagera river basin – Tanzania. Kagera-TAMP.

www.fao.org/es/esa/pesal/attachments/Opport_for_SLM_in_Kagera.pdf

Beck, J., Citegetse, G., Ko, J. and Sieber, S. 2010. *Burundi Environmental Threats and Opportunities Assessment (ETOA)*. USAID.

BRL (BRL Ingénierie). 2008. *Kagera River Basin Monograph: Basin Development Report.* Kagera River Basin Transboundary Integrated Water Resources Management and Development Project.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P. and van den Belt, M. 1997. The Value of the world's ecosystem services and natural capital. *Nature* **387(6630)**, 253-260.

Dagamaissa, A., Diaw, A. and Traore, M. 2005. *The Watershed Management Project (PABV): Appraisal Report.* Agricultural and Rural Development Department, Central-West Region, Republic of Burundi.

Davenport, T.R.B. and Howard, P.C. 1996. *Sango Bay Forest Reserve: A Biodiversity Report.* Forestry Department, Kampala, Uganda.

DWD/WWAP (Directorate of Water Development/World Water Assessment Programme). 2005. *National Water Development Report: Uganda.*

EAC (East African Community). 2004. *Protocol for Sustainable Development of Lake Victoria Basin* (EAC Publication V). EAC Secretariat, Arusha, Tanzania.

EAC (East African Community). 2010. *Transboundary Ecosystem Management Bill (Draft).* EAC Secretariat, Arusha, Tanzania.

EAC (East African Community). undated. *Protocol on Environment and Natural Resource Management.* EAC Secretariat, Arusha, Tanzania.

Emerton, L. 2005. *Values and Rewards: counting and capturing ecosystem water services for sustainable development.* IUCN Water, Nature and Economics Technical Paper 1. IUCN, Gland, Switzerland.

EPA (Environmental Protection Authority). 1997. *Draft Guidelines for Ecological Risk Assessment.* EPA, Washington DC, USA.

FAO (Food and Agriculture Organisation). 1998. *Rwanda Rural Sector Support Project: Environmental Assessment. Final Report.* E804 Vol.1. FAO, Rome.

FAO (Food and Agriculture Organisation). 2000. *Wetland characterisation and classification for sustainable agricultural development.* FAO, Rome.

Ferraro, P.J. 2007. *Regional Review of Payment for Watershed Services: Sub-Saharan Africa: Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program* (SANREM CRSP).

Fisher, B., Kulindwa, K., Mwanyoka, I., Turner, R.K. and Burgess, N.D. 2010. Common pool resource management and PES: Lessons and constraints for water PES in Tanzania. *Ecological Economics* **69**, 1253-1261.

Haskoning Consulting Engineers and Architects/Community Management Services/Delft Hydraulics. 2001. *Lake Victoria Environment Management Project Cost Benefit Analysis of Wetlands Resources Uganda (Part I: Summary and Recommendations; and Part IV: Economic Analysis).* Final Report. Lake Victoria Environment Management Programme (LVEMP) / Wetlands Inspection Division, Entebbe, Uganda.

Heyns, P.S.V.H., Patrick, M.J. and Turton, A.R. 2011. Transboundary water resource management in Southern Sfrica: meeting the challenge of joint planning and management in the Orange River Basin. *Int. J. Water Resource Development* **24(3)**, 371-383.

Hobbs, M. and Knausenberger, W. 2003. *Burundi Environmental Threats and Opportunities Assessment (ETOA).* Supplement to the 2003-2005 USAID/Burundi Integrated Strategic Plan.

Hove, H., Parry, J.E. and Lujara, N. 2010. World Resources Report 2010 Case Study: Maintenance of Hydropower Potential in Rwanda Through Ecosystem Restoration. World Resources Report, Washington DC, USA. www.worldresourcesreport.org

Hughes, R.H.and Hughes, J.S. 1992. *A Directory of African Wetlands*. Ramsar, Gland, Switzerland.

Kabalisa, V.P. 2006. *Analyse contextuelle en matière de Gestion Intégrée des Ressources en Eau au Rwanda*. Document de Travail pour l'ONG Protos: Rapport Final.

Kasoma, P. 2003. *Wetland research in the Lake Victoria Basin, Uganda Part: Analysis and synthesis report.* Inter-University Council for East Africa.

Kassenga, G.R. 1997. A descriptive assessment of the wetlands of the Lake Victoria basin in Tanzania. *Resources, Conservation and Recycling* **20**, 127-141.

Kuik, O., Brander, L., Ghermandi, A., Navrud, S., Nunes, P., Schaafsma, M., Vos, H. and Wagtendonk, A. 2009. The Value of Wetland Ecosystem Services in Europe: an application of GIS and meta-analysis for value transfer. In: *17th Annual Conference of the European Association of Environmental and Resource Economists (EAERE)*, 24-27 June 2009, Amsterdam, Netherlands.

Lankford, B., Sokile, C., Yawson, D. and Lévite, H. 2004. *The River Basin Game: A Water Dialogue Tool*. Working Paper 75, International Water Management Institute, Columbo, Sri Lanka.

MALDCAS (Ministère de l'Administration Locale du Developpement Communautaire et des Affaires Sociales). 2004. *Mission d'etude de la conservation et de la gestion integree du marais de Rugezi et de son bassin versant.* Republique du Rwanda et Ambassade du Royaume des Pays-Bas, Kigali.

Mbaziira, R., Senfuma, N. and McDonnell, R. 2005. *Institutional development in the Nile Equatorial Lakes sub-basin: learning from the experience of the Kagera Basin Organisation*.

Millennium Ecosystem Assessment. 2006. *Ecosystems and Human Well-being: a Framework for Assessment.* Washington D.C.: Island Press.

MINAGRI (Ministry of Agriculture and Animal Resources). 2008. *Second Rural Sector Support Project (RSSP): Environmental and Social Management Framework*. MINAGRI, Kigali.

MINATE (Ministère de l'Aménagement du Territoire et de l'Environnement). 1997. *Stratégie Nationale de l'Environnement au Burundi.* MINATE, Bujumbura.

MINIRENA (Ministry of Natural Resources). 2008. *Five-Year Strategic Plan For The Environment And Natural Resources Sector (2009-2013)*. MINIRENA, Kigali.

MINITERE (Ministère des Terres, de l'Environnement, des Forêts, de l'Eau et des Mines). 2005. *Rapport du Projet de Gestion Nationale des Ressources en Eau.* Composantes D: Etudes Techniques. MINITERE, Kigali.

MLRE (Ministry of Lands, Resettlement and Environment). 2003. *Rwanda Environment Policy*. MLRE, Kigali.

Moorhouse, T.M. Agaba, P, and McNabb, T.J. 2000. *Recent Efforts in Biological Control of Water Hyacinth in the Kagera River Headwaters of Rwanda*.

http://www.cleanlake.com/rwanda_biological_control_program.htm

National Wetlands Programme. 2004. *Wetlands in Uganda.*

www.ugandawetlands.org/overview.htm

NBI (Nile Basin Initiative). 2010. *The Nile Basin Initiative Wetlands Management Strategy 2011-2016.* NBI, Entebbe, Uganda.

Ndikumana, G. 2007. *Baseline Assessment.* Nile Basin Initiative, Water Resources Planning and Management Project, Decision Support System, June 2007. 179 pp.

NELSAP (Nile Equatorial Lakes Strategic Action Programme). 2006. *Project Selection Criteria.* NELSAP, Kigali.

NELSAP (Nile Equatorial Lakes Strategic Action Programme). 2011. *Pre-Feasibility Studies for an Irrigation Development and Watershed Management Project in the Lake Victoria Basin in Tanzania: Request for Proposals Tender No: NEL-WRD/08.* NELSAP, Kigali.

NEMA (National Environment Management Authority). 2001. *State of the Environment Report for Uganda, 2000/2001.* NEMA, Kampala, Uganda.

Norconsult/Electrowatt. 1975. Hydrology Report. *Kagera River Basin Development Phase II, Burundi – Rwanda – United Republic of Tanzania.* Technical Report volume 6.

NRE (Department of Natural Resources and Environment). 2002. *Management of Victoria's Ramsar Wetlands: Stategic Directions Statement*. NRE, Victoria, Australia.

Olet, E. 2008. *Integrated Management and Development of the Sudd Region: Experiences and Opportunities.* Nile Basin Initiative, Nile Equatorial Lakes Subsidiary Action Program, March 27-29 2008, Juba, Sudan.

Ramsar. 1999. *Wetland Risk Assessment*. Seventh Meeting of the Conference on the Contracting Parties to the Convention of Wetlands (Iran, 1971), San Jose, Costa Rica. Ramsar, Gland, Switzerland.

Ramsar. 2006a. *Ramsar Convention Manual*. 4th edition. Ramsar, Gland, Switzerland.

Ramsar. 2006b. *Low-cost GIS software and data for wetland inventory, assessment and monitoring.* Technical Report No 2. Ramsar, Gland, Switzerland.

Ramsar. 2006c. *Valuing wetlands: Guidance for valuing the benefits derived from wetlands ecosystem services* Technical report No 3. Ramsar, Gland, Switzerland.

Ramsar. 2007. *River basin management: Integrating wetland conservation and wise use into river basin management. Handbook 7.* Ramsar, Gland, Switzerland.

RdB (République du Burundi). 2000. *Portant Code de l'Environnement de la République du Burundi.* Loi No. 1/010 diu30 Juin 2000.

REMA (Rwanda Environmental Management Agency). 2006. *Economic Analysis Of Natural Resource Management In Rwanda*. REMA, Kigali.

REMA (Rwanda Environmental Management Agency). 2008. *Etablissement d'un inventaire national rapide des marais et élaboration de cinq avant projets d'arrêts ministériels relatives aux marais (4 modules)*. REMA, Kigali.

REMA (Rwanda Environmental Management Agency). 2009. *Rwanda State of Environment and Outlook: Our Environment for Economic Development*. REMA, Kigali.

SEI (Stockholm Environment Institute). 2009. *Economics of adaptation in Rwanda*.

www.rema.gov.rw/ccr/Final%20report.pdf

Sene, K.J. and Plinston, D.T. 1994. A review and update of the hydrology of Lake Victoria in East Africa. *Hydrological Sciences J.* **39(1)**, 47–63.

Sewagudde, S. 2009. Lake Victoria's Water Budget and the Potential Effects of Climate Change in the 21st Century. *African J. Tropical Hydrobiology and Fisheries* **12**, 22-30.

SHER (SHER Ingénieurs-Conseils SA and HYDROPLAN). 2002, *Schéma Directeur d'Aménagement des Marais, de protection des Bassins Versants et de Conservation des Sols.* Rapport de synthèse – Version définitive. Republic of Rwanda.

SIWI (Stockholm International Water Institute). 2005. Integrated Water, Sanitation and Natural Resources Initiative in the Lake Victoria Region. Paper 8. SIWI, Stockholm, Sweden.

SNC-Lavalin/HydroQuebec. 2005. *Strategic/Sectoral, Social and Environmental Assessment of Power Development Options in the Nile Equatorial Lakes Region: Synopsis Report Stage I - Burundi, Rwanda and Western Tanzania.* NBI/NELSAP, Kigali.

Sosovele, H. 2011. Governance practices in Tanzania's environmental impact assessment practices. *African Journal Environmental Science and Technology* **5(2)**, 126-130.

Stratford, C., Acreman, M., Rees, G. and Shilpakar, R. 2008. *A vulnerability assessment method for wetlands in the Himalayan region*. CEH Wallingford, UK.

Sutcliffe, J.V. and Parks, Y.P. 1999. *The Hydrology of the Nile.* Special Publication No 5. International Association of Hydrological Sciences.

Swallow, B.M., Sang, J.K., Nyabenge, M., Bundotich, D.K., Duraiappah, A.K. and Yatich, T.B. 2009. Tradeoffs, synergies and traps among ecosystem services in the Lake Victoria Basin of East Africa. *Environmental Science and Policy* **12**, 505-519.

SWECO International. 2010. *Development of Kagera Integrated River Basin Management and Development Strategy*. Report NBI/NELSAP/KAGERA-TIWRMDP/RFP01/2009.

Tounkara, S.B. and Diaw, A. 2003. *Inland Lakes Integrated Development and Management Support project (PAIGELAC): Appraisal Report.* MINAGRI, Kigali.

Turner, K., Brouwer, R. and Georgiou, S. 2009. Methodology for economics evaluation of wetlands and wetland functioning. In: Maltby, E. and Baker, T. (eds). *The Wetlands Handbook.* Wiley-Blackwell, Oxford, UK.

UNEP/IISD (United Nations Environment Programme/International Institute for Sustainable Development). 2005a. Connecting poverty and ecosystem services: Focus on Rwanda. UNEP, Nairobi.

UNEP/IISD (United Nations Environment Programme/International Institute for Sustainable Development). 2005b. Connecting poverty and ecosystem services: Focus on Tanzania. UNEP, Nairobi.

UNEP/IISD (United Nations Environment Programme/International Institute for Sustainable Development). 2005c. Connecting poverty and ecosystem services: Focus on Uganda. UNEP, Nairobi.

Wilson, M.A. and Carpenter, S.R. 1999. Economic valuation of freshwater ecosystem services in the United States 1971-1997. *Ecological Applications* **9(3)**, 772-783.

WMD (Wetlands Management Department), UBOS (Uganda Bureau of Statistics), ILRI (International Livestock Research Institute) and WRI (World Resources Institute). 2009. Mapping a better future: How spatial analysis can benefit wetlands and reduce poverty in Uganda. WMD, Kampala.

WMO (World Meteorological Organisation). 1974. *Hydrometeorological survey of the catchments of Lake Victoria, Kyoga and Albert.* WMO/UNDP, Geneva, Switzerland.

World Bank. 2004. *Environmental Assessment and Social Management Analysis*. Washington DC, USA.

Wouters, P.K., Vinogradov, S., Allan, A., Jones, P. and Rieu-Clarke, A. 2005. Sharing transboundary waters. An integrated assessment of equitable entitlement: the legal assessment model. Technical Documents in Hydrology, No. 74. UNESCO, Paris, France.

Appendix A – List of consultations

Kenya

IUCN

- Katharine Cross, Acting Regional Water and Wetlands Coordinator, Eastern and Southern Africa Regional Office (by email)

LVBC

- Raymond Mngodo, Director Lake Victoria Environmental Management Programme Phase II (by email)

Rwanda

FAO

- Joseph Anania, Regional Project Coordinator TAMP (17/05/2011)

Kitabi College of Conservation and Environmental Management

- Paul Scholte, Principal (16/05/2011)

Ministry of Agriculture and Livestock

- Jean Claude Musabyimana, Task Force for Irrigation and Mechanisation (18/05/2011)
- Jean Claude Ndorimana, Head of Technical Dept Fisheries and Aquaculture, PAIGELAC (19/05/2011)
- Mfashingabo Ntwali, Head of Rwamagana Outstation, PAIGELAC (19/05/2011)
- Harindintwali Reverien, Irrigation Engineer, Marshland Development, RAB (23/05/2011)
- Muhinda Otto Vianney, Director (Animal Health) (16/05/2011)

NELSAP

- Kabiruddin Rahin Abdulla, Project Manager, Regional Rusumo Falls Hydroelectric and Multipurpose Project (20/05/2011)
- Innocent Kabenga, Assistant Regional Project Manager (Planning and Management) (17/05/2011)
- Francoise Kayigamba, Environmental Management Specialist (20/05/2011)
- Godfrey Sengendo, Assistant Regional Project Manager (Water Resources) (17/05/2011)

Rwanda Development Board

- Faustin Karasira, Division Manager, Product Development and Planning (23/05/2011)

REMA

- Jean Claude Nkeramihago, Environmental Officer IMCE (18/05/2011)

Tanzania

Division of Environment, Vice President's Office

- Isakwisa Lameck Mwamukonda, Legal Officer (07/06/2011)

IUCN

- Abdalla Said Shah, Head of Office (06/06/2011)

Ministry of Agriculture

- Amandus David Lwena, Assistant Director of Irrigation Research and Technical Promotion (09/06/2011)

Ministry of Water

- Lister RE Kongola, Assistant Director, Water Resources (Monitoring and Assessment), NBI TAC (08/06/2011)
- Joseph Kubena, Environmental Officer (08/06/2011)
- George Lugemela (08/06/2011)
- Elizabeth Mkivi (08/06/2011)
- Ipyana Mwakalinga, Consultant (07/06/2011, 08/06/2011)
- Tumaini Mwamyalla, NFP Officer, Community Development Officer (08/06/2011)
- Hosea Sanga (06/06/2011, 08/06/2011)

University of Dar es Salaam

- Benaiah Lusato Benno, Department of Aquatic Science and Fisheries (10/06/2011)
- Richard Kimwaga, Department of Water Resources Engineering (10/06/2011)
- Orupa Tendwa, Department of Water Resources Engineering (10/06/2011)

Wetlands Unit, Ministry of Natural Resources and Tourism

- Herman Keraryo, Game Officer (08/06/2011)

Uganda

Directorate of Water Resources Management, Ministry of Water and Environment

- Jackson Kitamirike (30/05/2011)
- Eng. Mugisha-Shilling, Director (30/05/2011)
- Sowed Sewagudde (02/06/2011)
- Callist Tindimugaya, Commissioner (Water Resources Regulation) (31/05/2011)
- Jackson Twinomujuni (02/06/2011)

IUCN

- Robert Bagyenda, National Project Coordinator COBWEB (01/06/2011)

Makerere University

- Eseza Kateregga, Environmental Economist (02/06/2011)

Ministry of Agriculture, Animal Infrastructure and Fisheries

- Catherine Semakula, Ministry of Agriculture (31/05/2011)

NEMA

- Muwanga Lameck (01/06/2011)
- Oscar Masaba (01/06/2011)

Nile Basin Initiative Secretariat

- Tom Waako Baguma, Projects Officer (30/05/2011)

Wetlands Management Department, Directorate of Environmental Affairs, Ministry of Water and Environment

- Vincent Barugahare, Senior Wetland Officer (31/05/2011)

Appendix B – Example of wetland risk/vulnerability assessment

Wetland name: Gokyo, Nepal

Step 1: Assess wetland values

Table 1 Provisioning services/ecological values

Ecological Values	Endangered Spp/Habitat		Presence in region	
Aquatic Fauna	Data not available	U	Data not available	U
Aquatic Flora	Data not available	U	Data not available	U
Terrestrial Fauna	Snow Leopard (*Uncia uncia*) Musk deer (*Muschus chryogasterl*) *Gallinago nemoricola* (Wood Snipe)	H	The region is habitat for the endangered species listed in previous column	M
Terrestrial Flora	*Neopicrrohiza scrophulariifolia* (Rare) *Saussurea gossipiphora* (Rare) *Meconopsis horridula* (Vulnerable) *Swertia multicaulis*	M	Above 80 species of flowering plants have been recorded from Gokyo catchment including 4 endemic species of plants species.	M
Habitat	Data not available	U	Data not available	U
Biodiversity	Data not available	U	Data not available	U
Other ecological values – Presence of ethnobotanically useful plant species.	*Neopicrrohiza scrophulariifolia* (M) *Ephedra geradiana* (M) *Swertia multicaulis* (M) *Cortia hookeri* (M) *Selinum wallichiana* (M) *Rhododendron anthopogon* (M) *Rheum acuminatum* (M) *R. australe* (M) *Aconitum spicatum* (M) *Oxyria digyna* (P) *Rheum acuminatum* (P) *R. australe* (P) *Rhododendron anthopogon* (I) *Juniperous indica* (I)	M	A number of Ethnobotanically useful plant species are under threats some are due to excessive local use & some are naturally rare in occurrence.	M

Notes: H high, M medium, L low, N none, U unknown

Table 2 Carrying services/economic values

Economic Values	Economic Value		Community Value	
Tourism	- Gokyo is one of the major tourists destinations in SNP (average of 7,000 tourists visit every yr) - Pilgrims (about 500) visit each year during local festival (Janai Purnima) Due to Spectacular landscape, unique flora & fauna including cultural and lifestyle of local people, famous tourist destinations in Nepal.	H	Hotels and lodge are totally dependent on the tourist who visits the Gokyo lake. People are not much seen to be dependent on the daily livelihood directly, tourism based economy is partially dependent. Catchments used as grazing by yak-naks of locals.	H
Fisheries	No evidence of fish in the lake	N	No evidence of fish in the lake	N
Agriculture	No agriculture practice in the catchment	N	No agriculture practice in the catchment	N
Additional goods and services	Catchments seasonally serve grazing (about 100 cattle graze for 8 months) pasture land	M	Provision of grazing land.	M
Other economic values				

Notes: H high, M medium, L low, N none, U unknown

Table 3 Regulating services/hydrological values

Hydrological Value	Size of population affected		Feasibility of alternative provision	
Provision of water for HEP	None	N	None	N
Provision of water for irrigation	None	N	None	N
Reducing downstream flooding	Information unavailable	U	Information unavailable	U
Maintenance of flow during periods of low rainfall	Information unavailable	U	Information unavailable	U
Provision of potable water supply	The domestic water user's use for the drinking purpose. Lake water is used for bathing & washing clothes.	H	The hotels (Gokyo area has 8 hotels) use lake water	H
Other hydrological values – Sediment trapping	Sediment from the catchment is trapped in the lakes.	M	Provision of Clear & non turbid water to the D/S dwellers	M
Other hydrological values – Water for mills	Used by few traditional water mills	L	Major source of energy for running traditional water mills.	M

Notes: H high, M medium, L low, N none, U unknown

Table 4 Cultural services/social values

Social Values	Importance of site		Alternative provision of value	
Religious importance	-During Janaipurnima festival, about 500 people visit to take holy bath & perform puja. -Site is respected as place of lord shiva and visnu. -The faith of no harms to the birds in the lakes provides shelter to the wetlands birds.	M	Unknown	
Cultural importance	The people of Namche celebrates Janai Purnima festival in Gokyo, the snake god is celebrated by all the devotees any time they visit there.	M	Unknown	
Other social values				

Notes: H high, M medium, L low, N none, U unknown

Step 2: Assess threats to wetlands

Table 5 Sources of data for threat identification.

Threats	Drivers/Explanation		
Pollution - pesticides	No information	U	U
Pollution - nutrients	Pilgrimage offer flowers, leaves & grains which increases nutrients content	L	L
Pollution - industrial	Not at all	N	N
Pollution - urban/domestic	Domestic sewages from the 8 hotels	M	H
Pollution - organic waste	Garbage produced by tourists & their supporting team.	M	M
Siltation/sedimentation	Information Unavailable	U	U
Encroachment - urban/housing	One of the hotels has been reported to encroach the lake by erecting stone walls upto margins of lakes.	L	L
Encroachment - agricultural	Not at all	N	N
Flow regime change - reduced flows	Information Unavailable	U	U
Flow regime change - increased flooding	Information Unavailable	U	U
Invasive aquatic species - floral	Unknown (Not reported)	U	U
Invasive aquatic species - faunal	Unknown (Not reported)	U	U
Invasive terrestrial species - floral	Unknown (Not reported)	U	U
Invasive terrestrial species - faunal	Unknown (Not reported)	U	U
Other threat - Overgrazing	Overgrazing (about 100 cattle graze for about 8 months) reduces the palatable sps. & increase the colony of unpalatable leading to change in floral & faunal composition disturbing the natural succession process.	M	M

Notes: H high, M medium, L low, N none, U unknown

Step 3: Define links between threats and values

	Pollution - pesticides	Pollution - nutrients	Pollution - industrial	Pollution - urban/domestic	Pollution - organic waste	Siltation/sedimentation	Encroachment - urban/housing	Encroachment - agricultural	Reduced flows	Increased flooding	Invasive aquatic species - floral	Invasive aquatic species - faunal	Invasive terrestrial species - floral	Invasive terrestrial species - faunal	Overgrazing
Ecological Impact															
Loss of rare fauna (aquatic)	H	H	H	H	H	M	L	L	L	L	L	H	0	0	0
Loss of rare flora (aquatic)	H	H	H	H	H	M	L	L	L	L	H	M	0	0	0
Loss of rare fauna (terrestrial/avian)	M	M	M	M	M	L	L	L	L	L	0	0	L	H	L
Loss of rare flora (terrestrial)	M	M	M	M	M	L	L	L	L	L	0	0	H	M	M
Loss of important habitat	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Loss of biodiversity	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Loss of ethnobotanically useful plants	M	M	M	M	M	M	M	M	M	M	M	M	M	M	L
Economic Impact															
Loss of tourism	L	L	L	L	L	M	L	L	L	L	L	L	L	L	L
Loss of fisheries	H	H	H	H	H	M	L	L	L	L	L	H	0	0	0
Loss of agriculture	M	M	M	M	M	M	M	0	M	M	0	0	M	M	M
Loss of additional goods and services	M	M	M	M	M	M	H	M	M	M	M	M	M	M	M

	Pollution - pesticides	Pollution - nutrients	Pollution - industrial	Pollution - urban/domestic	Pollution - organic waste	Siltation/sedimentation	Encroachment - urban/housing	Encroachment - agricultural	Reduced flows	Increased flooding	Invasive aquatic species - floral	Invasive aquatic species - faunal	Invasive terrestrial species - floral	Invasive terrestrial species - faunal	Overgrazing
Hydrological Impact															
Loss of HEP	0	0	0	0	0	M	L	L	H	0	L	0	0	0	0
Loss of irrigation	M	M	M	M	M	L	L	L	H	0	L	0	0	0	0
Increase in downstream flooding	0	0	0	0	0	M	M	M	0	H	0	0	0	0	0
Reduced flows in lean period	0	0	0	0	0	M	M	M	H	0	0	0	0	0	0
Loss of potable water supply	H	M	H	H	H	M	L	L	M	0	L	L	0	0	0
Sediment trapping	0	0	0	0	0	M	M	M	0	M	0	0	0	0	0
Water for mills	0	0	0	0	0	M	M	M	M	0	0	0	0	0	0
Social Impact															
Degradation of religious site	L	L	L	L	L	M	L	L	L	L	L	L	L	L	L
Loss of cultural heritage	L	L	L	L	L	M	L	L	L	L	L	L	L	L	L

Notes: H high, M medium, L low, 0 none, U unknown

Step 4: Assessment

ASSESSMENT TABLE		Threats														
		*** Pollution - pesticides	Pollution - nutrients	Pollution - industrial	Pollution - urban/domestic	Pollution - organic waste	*** Siltation/sedimentation	Encroachment - urban/housing	Encroachment - agricultural	*** Flow regime change - reduced flows	*** Flow regime change - increased flooding	*** Invasive aquatic species - floral	*** Invasive aquatic species - faunal	*** Invasive terrestrial species - floral	*** Invasive terrestrial species - faunal	Overgrazing
Ecological Values	**Ecological Impact**															
/// Aquatic fauna	Loss of rare fauna (aquatic)	*/*	///	0	///	///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
/// Aquatic flora	Loss of rare flora (aquatic)	*/*	///	0		///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
Terrestrial/Avian fauna	Loss of rare fauna (terrestrial/avian)	***		0			***		0	***	***	***	***	***	***	
Terrestrial flora	Loss of rare flora (terrestrial)	***		0			***		0	***	***	***	***	***	***	
/// Habitat	Loss of important habitat	*/*	///	0	///	///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
/// Biodiversity	Loss of biodiversity	*/*	///	0	///	///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
Presence of ethnobotanically useful plant species	Loss of ethnobotanically useful plant	***		0			***		0	***	***	***	***	***	***	
Other ecological value	Other ecological impact															
Other ecological value	Other ecological impact															
Economic Values	**Economic Impact**															
Tourism	Loss of tourism	***		0			***		0	***	***	***	***	***	***	
Fisheries	Loss of fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	Loss of agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional goods and services	Loss of additional goods and services	***		0			***		0	***	***	***	***	***	***	
Other economic value	Other economic impact															
Other economic value	Other economic impact															
Other economic value	Other economic impact															
Hydrological Values	**Hydrological Impact**															
Provision of water for HEP	Loss of HEP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Provision of water for irrigation	Loss of irrigation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
/// Reducing downstream flooding	Increase in downstream flooding	*/*	///	0	///	///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
/// Maintenance of flow during periods of low	Reduced flows in lean period	*/*	///	0	///	///	*/*	///	0	*/*	*/*	*/*	*/*	*/*	*/*	///
Provision of potable water supply	Loss of potable water supply	***		0			***		0	***	***	***	***	***	***	0
Sediment trapping	Sediment deposition in downstream a	***	0	0	0	0	***		0	***	***	***	***	***	***	0
Water for water mills	Loss of mill production	***	0	0	0	0	***		0	***	***	***	***	***	***	0
Other hydrological value	Other hydrological impact															
Social Values	**Social Impact**															
Religious Importance	Degredation of religious site	***		0			***		0	***	***	***	***	***	***	
Cultural Importance	Loss of cultural heritage	***		0			***		0	***	***	***	***	***	***	
Other social value	Other social impact															
Other social value	Other social impact															

Notes:
red high impact, amber medium impact, green low impact, 0 no impact
*** unknown information about threat – collect data
/// unknown information about value – collect data
/ information about threat bad value missing but interaction identified – collect data
If a threat or value is shaded red, information is missing – collect data

Action Plan for Gokyo and associated wetlands, Nepal

The following values are under threat:

High	Provision of a potable water supply
Medium	Terrestrial flora Terrestrial fauna The presence of ethno-botanically important species Additional goods and services
Low	Tourism Sediment trapping Provision of water for water mills Religious importance Cultural importance

The following steps should be taken:

- A system of sewage collection and processing for the properties around the lake should be introduced.
- Proper facilities for litter disposal should be set up.
- Agricultural fertiliser application practices should be changed to minimise inputs to the lake.
- Planning regulation and monitoring of new building activities around the lake should be put in place to prevent further encroachment of the lake.
- Farmers should be encouraged not to overgraze the area, which could be implemented through a combination of education and enforcement.

The following areas require further data collection:

- The aquatic flora and fauna present in the lake.
- The habitat provided by the wetland area.
- The effect of the lake on the downstream hydrology (both reducing flooding and maintaining low flows).
- Pollution from pesticides.
- Sediment inputs to the lake.
- The potential for flow regime change either from natural or anthropogenic causes.
- The presence of terrestrial invasive species (both flora and fauna).