IMPACT OF SOIL EROSION ON THE RUGEZI WETLAND ENVIRONMENT IN NORTHERN RWANDA

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By:

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DECLARATION

I, DUKUZIYATUREMYE Pierre, do hereby declare that this dissertation, submitted for the degree of Master of Science in Environmental Management of Kampala International University, has not been previously submitted by anybody in this or any other University, that it is my own work and that all referenced material in it have been duly acknowledged.

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APPROVAL

This work titled "Impact of soil erosion on the Rugezi Wetland Environment in Northern Rwanda." has been done under my supervision as the candidate's University Supervisor and was submitted with my approval for examination.

Sign: .....

Dr. TWAHA ALI BASAMBA

Date: 17.9.2010

DEDICATION

This dissertation is dedicated to:

My loving wife, NYIRAKABERA Dative for the guidance and encouragement throughout my studies.

My daughter DUKUZE-IHIRWE Charitine Curie

My son DUKUZE – GIFT Galilee

My Parents MBWIRABUMVA Appolinaire and BARAYAGWIZA Gaudence

My brothers and sisters for having given me moral support.

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My thanks go to all my classmates and friends with whom we interacted while in school and shared constructive ideas. May the Lord bless them.

Last, but not least, I want to give all the glory, honor and praise to God.

ABSTRACT

There is nothing in the whole of nature which is more important than or deserves as much attention as the soil. Truly it is the soil that makes the world a friendly environment for mankind. It is the soil which nourishes and provides for the whole of nature; the whole of creation depends on the soil which is the ultimate foundation of our existence Soil erosion removes valuable top soil which is the most productive part of the soil profile. This results in lower yields and higher costs of production. Accelerated erosion and excess runoff are connected with deforestation of fragile zones, denudation and compaction of soil through overgrazing, exhaustion of soil through intensive cropping without compensation from applications of organic matter and nutrients. The soil that is detached by accelerated water or wind erosion may be transported considerable distances. This gives rise to 'off-site problems'. Water erosion's main off-site effect is the movement of sediment and agricultural pollutants into water courses. This can lead to the silting-up of dams, disruption of the ecosystems of lakes, wetlands and contamination of drinking water. In some cases, increased downstream flooding may also occur due to the reduced capacity of eroded soil to absorb water.
The overall objective of the study was to assess the impact of soil erosion on Rugezi wetland environment. To achieve this objective and answer the research questions, questionnaires, interviews, photography and observation check lists were employed to collect data. These were analyzed qualitatively and quantitatively.

Results show that the major causes of soil erosion in the study area are related to human population activities such as deforestation, political economy explained by reduction of landholding size and the extension of agriculture into marginal areas. Technology and culture also cause soil erosion because farmers use traditional methods in agriculture without crop rotation. None used tractors and other agricultural machinery due to the relief of the area.
The study also found out that the sediments carried away by erosion have impact on wetland functions; these impacts affected transport, the socio economics environment, culture, hydrology and ecology.

Finally, it was observed that the activities of local communities in the wetland, their awareness on wetland management and their participation in wetland protection, explain their attitudes towards wetland management.

Because the wetland is misused, the recommendations are addressed to the policy makers, to the administrators, and to the local community.

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LIST OF ACRONYMS

ADB: African Development Bank

CVI: Content Validity Index

DRC: Democratic Republic of Congo

KIU : Kampala International University

MINAGRI : Ministère de l'Agriculture et Elevage

MINITERE : Ministère de l'Environnement, des Forets, de l'Eau et des Ressource Naturelles.

REMA : Rwanda Environment Management Authority

RRAM: Ruhengeri Resources Analysis and Management

EIA : Environmental Impact Assessment

MINITRANSCO: Ministère de Transport et de Communication.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Human activities often cause or exacerbate soil problems, including erosion and mineral depletion of the soil, both of which occur worldwide. Water, wind, ice and other agents promote soil erosion, the removal of soil from land. Water and wind are particularly effective in removing soil. Rainfall loosens soil particles, which can then be transported away by moving water. Soil erosion is a national and international problem that rarely makes the headlines. To get a feeling for how serious the problem is, consider that approximately 4.0 billion metric tons of topsoil are lost each year from US croplands and pasturelands as a result of erosion. The US department of Agriculture estimates that approximately one-fifth of US cropland is vulnerable to soil erosion damage (Raven et al., 1998).

As large quantities of soil materials are carried away on a daily basis unnoticeably, soil quality depreciates significantly. Soil that erosion carries off now totals 22 billion tons a year worldwide. In Europe, 12% of the soil is threatened by water erosion alone. Similarly, 95 million and 500 million hectors of land are badly affected by soil erosion in North America and Africa, respectively. Economic losses from soil erosion in South Asia are said to have currently accumulated to 6.9 billion dollars (Hanyona, 2001).

Soil erosion and land degradation threatens the food security of 2.6 billion people worldwide. The situation is particularly dire in East and Sub-Saharan Africa where per capita food production has declined over the past 45 years (Sanchez, 2002). Erosion and the resultant loss of fertile soil is a key socio-economic and ecological problem in Kenya, affecting all important sectors of its economy (agriculture, production of hydro-power, fisheries, tourism) and damaging marine and terrestrial ecosystems (Fleitmann et al., 2007),

Soil erosion has impact on other resources as well. Sediment that gets into the streams, rivers, lakes, and wetlands affects water quality and fish habitats. If the

sediment contains pesticide and fertilizer residues, is further pollutes the water (Raven et al., 1998).

Wetlands are defined as areas of marsh, peat land or water, natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty including areas of marine water, the depth of which at low tide does not exceed six meters as stipulated under the Ramsar Convention (Davis, 1993).

Wetland goods comprise of fish, wild foods medicine, pasture and thatch material, among others (Gilman, 1994). Wetlands are so vital and useful for their ecological attributes, functions and services that include climate modification, water purification, flood control and storm protection. Wetlands can also be used for agricultural, industrial and leisure purposes. Various population groups attribute them to cultural, aesthetic and bequest values. Although some wetlands provide more benefits than others, all wetlands are considered to be important and are in need of sustainable management (Goretty, 2004).

In Rwanda, before the colonial period, the role of wetlands was unknown because they were considered as marginal land. Since the 1980s, the perception of wetlands has changed; they became considered as reserve land in order to respond to demographic pressure. As a result, many development schemes were launched and implemented in wetland areas without taking into account their hydrological and environmental aspects.

There are 860 mashes in Rwanda, 37 of which are vulnerable and must be protected. Among them is Rugezi wetland which is located in the Northern Province. This wetland covers an area of 7000 ha and touches on two districts, namely Gicumbi and Burera. Like other inland or coastal wetlands, it has played significant ecological, hydrological, socio-economic, historical and recreational roles. It is a very important habitat for endemic bird species and for the local population, it offers many opportunities as a source of fish, meat, honey and plant material such as papyrus that can be used in construction. After the decline of its water levels in 2000, however, a severe ecological crisis arose in Rugezi wetland (Hategekimana, 2005).

When water from Rugezi wetland and lakes Burera and Ruhondo was used for the production of hydro-electricity, the wetland dried up. This coupled with expansion of agricultural activities into the wetland, was the most serious threat to the survival of the many environmental resources in this wetland. Following this crisis, efforts have been undertaken to counter the drying up of the wetland and Rugezi was placed on the Ramsar list of Wetlands of International Importance in 2005 and due to its value on the international level, it has been protected under the Ramsar Convention (Hategekimana, 2005).

1.2 Statement of the problem

Rwanda's high population has led to land degradation because of peasantry agriculture. This has resulted into lower agricultural production, hunger and poverty. Increased agricultural and livestock activities have led to deforestation and overgrazing which have exposed the soil to serious water erosion. Inappropriate cultivation methods on hill slopes have aggravated the situation and this has led to reduced agricultural productivity and soil fertility. Soil erosion remains a major threat to the agricultural lands of Rwanda and associated downstream areas, including wetlands.

Currently, the Rwandan government is mobilizing its people for soil erosion control and wetlands management. The economy of country has been negatively affected because of soil erosion which has led to reduced agricultural productivity and loss of biodiversity. It is therefore necessary to determine the causes of soil erosion and its impact on wetland resources in order to suggest appropriate method of soil erosion control and wetland management.

1.3 Purpose of the study

The purpose of this study was to find out the impact of soil erosion on the Rugezi wetland environment in Burera District. It is an attempt to find out the cause of soil erosion and its impacts on downstream Rugezi wetland. This study tried to establish

the reaction of the local communities towards the impact of soil erosion on the Rugezi wetland.

1.4 Research objectives

1.4.1 General objective

The general objective of this study was to assess the impact of soil erosion on the Rugezi wetland environment in Burera District.

1.4.2 Specific objectives

The specific objectives of the study were:

1. To establish the major causes of soil erosion in Burera District
2. To assess the consequences of soil erosion on the Rugezi wetland environment
3. To find out the attitudes of the local communities towards Rugezi wetland degradation.

1.5 Research questions

The study was guided by the following research questions:

1. What are the causes of soil erosion in Burera District?
2. What are the consequences of soil erosion on the Rugezi wetland environment?
3. What are the attitudes of the local communities towards Rugezi wetland degradation?

1.6 Significance of the study

Soil erosion remains a major threat to the wetland ecosystems in Rwanda. Downstream impacts include damage to roads, siltation of water courses and overall reduction in water quality, and wetland degradation.

By investigating the impact of soil erosion on Rugezi wetland, information will be valid to planners, national programmes, District administrators, trainers, both at the local and

national level, upon which decision making can be based in addressing the problem facing the area. Thus, the research will also guide other interested parties to carry out appropriate action to deal with wetland degradation problems caused by soil erosion and develop more efficient attitudes of people towards wetlands. The research being an area specific study, appropriate solutions are thought to be administered, unlike when the generalization approach is used. Community participation was highly encouraged. The information will be useful to both policy makers and planners who will take them to the policy implementation organizations and poverty alleviation projects in communities, with the aim of attaining sustainable development.

The results will guide non-governmental organizations (NGOs) which are preparing and mobilizing development plans for Burera District. The study will also provide additional data to widen the information base for content selection in the environment education syllabus in primary and secondary schools of Rwanda.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Types of soil erosion

2.1.1 Sheet erosion

Sheet erosion is the uniform removal of a thin film of soil from the land surface without the development of any recognizable water channels. This type of erosion is barely perceptible, but the loss of a single millimeter of soil from an acre of land, which can be easily lost during a single irrigation or rain event, works out to a total loss of up to 6.1 tons of soil (Pimentel, 2000).

2.1.2 Rill erosion

Rill erosion is an erosion process on sloping fields in which numerous and randomly occurring small channels of only several centimeters in depth with steep sides are formed by running water. Rills are small enough to be smoothed by normal tillage operations and will not form again in the same location. Together sheet and rill erosion account for most soil erosion in agricultural land (Pimentel, 2000).

2.1.3 Gully erosion

Gully erosion occurs in areas where water runoff is concentrated and as a result, cuts deep channels into the land surface. Gullies are incised channels that are larger than rills.

Small, ephemeral gullies can be removed by tilling, but they will form again in the same location on the landscape. Gullies actually represent less soil loss than sheet or rill erosion, but they pose added management concerns such as damage to machinery, barriers to livestock and equipment, and increased labor costs to repair eroded areas (Pimentel, 2000).

2.1.4 Ephemeral erosion

Small channels eroded by concentrated flow that can be easily filled by normal tillage, only to re-form again in the same location by additional runoff events constitute ephemeral erosion (Pimentel, 2000).

2.2 Causes of soil erosion

2.2.1 Human population

Population growth has been thought to be the chief anthropogenic cause of recent soil erosion in much of the Andes (Brown, 1981). Soil-conservation crusader William Vogt, Chief of the Conservation Section in the Pan- American Union, claimed that the "dangerously overpopulated" conditions in Venezuela's Andean area had led to its erosion crisis. Highland Peru and Bolivia similarly suffer soil erosion due to the "devastating consequences" of recent population growth according to Eckholm (1976). Although population pressure on land resources has likely played a role in recent Andean soil erosion, existence of dense rural populations alone cannot be taken as sufficient evidence of demographic causes.

2.2.2 Political economy

Political economy explanations of recent Andean soil erosion emphasize that peasant farmers and herders usually possess small farms (minifundia) and that these farms are often located in erosion prone, marginal environments (Ashby, 1985). But small farm size and marginal environments alone are not necessarily causes of soil erosion. Indeed, environmentally sound farming in erosion-prone mountain environments and in small plots has been long practiced worldwide (Blaikie and Brookfield, 1987). The reduction of landholding size and even the extension of agriculture into marginal areas might induce erosion but does not necessarily do so. One concrete example of how these factors can exert erosion inducing pressure on

farmers is provided by a case study of peasant smallholders in the Colombian Andes (Ashby, 1985).

2.2.3 Technology and culture

Explanations that emphasize the role of technology and land use practices in recent Andean soil erosion tend to link these conditions closely to culture. Many attribute erosion-inducing farm technologies and techniques to the culture of peasant farmers. Lack of technological sophistication and lack of awareness about erosion have been pointed to as the chief culprits (Zimmerer, 2002). But numerous studies show that local technologies and techniques developed by Andean peasants include much that is well-suited to conservation (Godoy, 1984). Following these findings, several accounts of Andean erosion that link technology and culture have shifted to a perspective that emphasizes the Westernization of local cultures. According to this interpretation, the cultural domination of Andean peoples by Westerners has resulted in loss of local knowledge and associated introduction of such non-Andean technologies as tractors.

2.3 Effects of soil erosion

There is a pronounced relationship between rate of runoff and incidence of erosion. Runoff water has the energy to detach soil particles by scour and transport of soil materials either in suspension or by pushing or rolling larger particles. In this way, overland flow causes erosion. Erosion by scouring accounts for less than 10% of the erosion process, the rest being caused by raindrop impact. Secondary forms of erosion resulting from the transporting effects of runoff are more damaging and are usually classified as rill, gully and stream channel erosion according to increasing concentration of runoff and the degree of damage caused to land. Runoff erosive capacity is a function of its volume and velocity; as the volume and velocity increase, so does the energy to scour away soil particles and the load-carrying capacity or transportability. Doubling the velocity of runoff increases its scouring capacity and transportability to the fifth and sixth powers, respectively. The consequences of runoff and erosion are the

impairment of the quality and productivity of the land. Erosion results in the decline of soil fertility as a result of loss of topsoil and nutrients, loss of organic matter and clay and the consequent loss of the soil's capacity to retain nutrients and water. It can also result in the compaction and sealing of soil surface, giving lower infiltration rates and increased runoff. There are many areas in the world where erosion has led to serious land degradation and rendered it unusable for crop production. Erosion is a major cause of concern in the developing world as a whole. Runoff, wherever it occurs, results in washing away of crops and fertilizer inputs, loss of soil moisture and recharge capacity. Consequently, there is frequent drought stress in crop production. Runoff, as it increasingly concentrates in drainage lines, can build up and cause severe physical damage down-slope, including the washing away of roads, bridges, buildings and the development of dangerous gullies. The effects of extreme runoff are usually visually emphasized by the development of gully systems along which the erosion is concentrated (Shaxson et al., 1989)

Deposition of particles carried by runoff causes channel sedimentation, silting up and pollution (by nutrients, pesticides and toxic chemicals) of dams and reservoirs and flooding and sedimentation of bottom lands.

2.4 Impacts of off-site sediments on wetlands

Sediments carried in storm water runoff from parking lots, roads and other urban structures may contain petroleum-based contaminants, such as oil, gasoline or grease. In agricultural areas, sediments may also contain fertilizers, insecticides and pesticides. The introduction of sediments and their associated pollutants into a wetland may affect any of the functions provided by the wetland, such as water quality protection, flood storage, and hydrophilic vegetation.

Wetlands can improve water quality by removing sediments and other pollutants from surface waters. There is a limit, however, to the amount of sediments and pollutants individual wetlands can receive before the natural biological, chemical and physical processes are overloaded. Many wetlands occur along streams or lakes. When these

wetlands become overloaded with sediments and pollutants, the excess will flow directly into the adjacent water bodies, resulting in decreased water quality downstream. Eroded sediments can also affect the natural plant community that occurs in wetlands. Excessive sediments and their associated nutrients can change the environment and encourage the growth of aggressive, nuisance species such as purple loosestrife. These species can out compete native plants, form monocultures and reduce habitat complexity. (http://www.anr.state.vt.us/dec/waterq/stormwater/htm/sw_cgp.htm)

Mugisha et al. (2007) found out that sediment, nutrient and toxin retention impedes the growth of wetland vegetation and the absorption and ion exchange capacity of the wetlands substrate. Sediment carried in flood flows is stripped from the water, dissolved nutrients and toxins are retained by the matrix of slowly decaying plant material and the substrate.

2.5 Techniques to control off-site sediments

When doing construction work in a wetland or buffer zone, it is important to divert surface water runoff away from areas with exposed soil. Water diverted around exposed soil can reduce the potential for transport of sediment to surface waters. Probably the most common method for sediment control in areas of soil disturbance is the use of a sediment barrier. Barriers also need to be regularly maintained to ensure their effectiveness. Sediments need to be cleaned out when they have reached half the height of the fence, and before major predicted rainfall events. Removed sediments should be disposed of in a stable, upland area where further transport is unlikely. Vegetation and mulch are the most effective means of controlling sediment transport when minimal runoff is expected. Plant material binds the soil through its roots; leaves and mulch absorb much of the energy of falling rain, discouraging the dislodging and transport of soil particles. If vegetation cannot be quickly established, periodic mulching is recommended on exposed areas. Frequently, side slopes for work in wetlands or buffers are made as steep as possible to minimize impacts. These steep slopes are more susceptible to erosion than flatter slopes, so temporary mulch and quick

establishment of vegetation are extremely important. Temporary mulching also saves maintenance time; barriers down slope are much slower to fill and need less frequent cleaning. Jute mats, or similar devises, may be used on steep slopes until the vegetation has become established to prevent erosion.
(http://www.anr.state.vt.us/dec/waterq/stormwater/htm/sw_cgp.htm)

2.6 Activities of the population that affect wetlands

Dugan and Jones (1993) observed that water system regulation and drainage for agriculture and urban development have been the major causes of the loss of over 50% of the wetlands in countries such as the USA, New Zealand, Australia, Pakistan, Thailand, Niger, Chad, Tanzania, India, Viet Nam, and Italy. This happened at a time when there was little knowledge and recognition of two important factors. The first is that in making decisions about water use, the environment itself is an important user of water. The second factor that has affected wetlands has been widespread ignorance about the multiple and beneficial functions that they perform in the basins and coastal areas where they are located.

According to Frazier (1996), the direct causes of wetland loss often result from a combination of ignorance, social and economic forces, and political decisions. The global rise in urbanization exemplified by the growth in population of the 30,000 or so medium sized cities in developing countries is accompanied by dramatically increasing pollution loads to the environment. Although a wetland might itself remain, in a degraded state, many of its benefits are lost (Frazier, 1996). Population growth, coupled with inequitable distribution of resources and access rights has increased the demand for land which in turn has put pressure on wetlands. For example, the human carrying capacity of the Sahel region is already matched or exceeded by population density; dry land agriculture or large scale migration to other parts of the region are unlikely to be able to relieve the situation. As a result, wetlands will be more sought after, and pressure for conversion of wetlands to rice fields is on the increase due to increasing urbanization in West Africa and its demand for rice.

Droughts also tend to increase pressure on wetlands because they affect the migration patterns of population in the area. During the severe droughts of 1975 to 1988, the number of villages on the Nigerian section of Lake Chad increased from 40 to more than100. Similarly, the use of the Hadejia-Nguru wetlands in Nigeria for agriculture has increased due to drought (Frazier, 1996).

Dugan and Jones (1993) listed drainage as the primary historic cause of degradation of the state's wetlands. Many of Florida's marshes have been drained in response to the growing demand for farming and cattle grazing and to create dry land for new homes for Florida's increased population. Draining dries up wetlands, swamps and marshes, or disrupts natural water level fluctuations in them, thereby altering their native plant and animal communities.

Kavari (2006) noted that sand mining is one of the main threats to the rich biodiversity supported in Namibian wetlands particularly alongside Namibian perennial rivers and ephemeral watercourses. This process can destroy riverine vegetation, causes erosion, pollutes water sources and reduces the diversity of animals supported by these woodland habitats.

2.7 Historical and political background of wetlands management in Rwanda

Rwanda is a country whose geological history has permitted a succession of valleys, hills, plateaux and mountains. The current geological aspects were inherited from tectonic activities and erosion. Therefore, it is imperative to make distinction between highland and lowland marshes. Highland marshes are peaty and are located in Para Appalachian relief in the north, while lowland marshes, sometimes made up of mineral and peaty soils, are located in the southern and eastern parts of the country.

In the Rwandan context, the term "marsh" is often used to define all types of wetlands, either peat bogs of high altitude like Rugezi or complexes of big valleys of peaty soils of Bugesera or Akagera or group of valleys of mineralized soils used for agriculture or pasture (MINITERE, 2003). Nevertheless, the 1971 Ramsar Convention on Wetlands defined wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or

salty, including areas of marine water the depth of which at low tide does not exceed six meters (Mistch and Alii, 2000). The lack of spatial planning policy and distinction about wetland types in Rwandan context has complicated their management in terms of their resources allocation; agriculture, conservation, tourism etc. In this context, wetlands management, since the independence period, was a responsibility of the Ministry of Agriculture and Livestock (MINAGRI) whose objective was drainage so as to avail land in response to demographic pressure and food security (Hategekimana, 2005). In that period, the hydrological and ecological importance in terms of water quality and quantity management, wildlife habitat and recreation were unknown. The term marsh drainage prevailed until it became replaced by marsh development. Therefore, MINAGRI, with support from international donors, adopted the marsh development schemes equipped with water regulation structures to avoid the drying up of soils observed during implementation of marshes drainage scheme.

In 2001, MINAGRI developed a master plan of marshlands development, soil conservation and watershed protection. This scheme led to wetland classification in accordance with their hydrological aspects, their level of degradation and recommended the conservation of highland wetlands as integral part in water resources management (MINAGRI, 2001). In 2003, the Ministry of Environment, Lands and Mines (MINITERE) with support from Global Environment Facility (GEF), finalized the Action Plan on environment and biodiversity conservation. This study showed that, although wetlands play an important role in water management and biodiversity conservation, they were still threatened by agricultural encroachment, plant and fish resources overexploitation. In May 2003, the same ministry recommended a study on the assessment of biological diversity of wetlands. This study came up with a classification of wetlands of international importance classified as Ramsar sites. It recommended that those sites should get the status of conservation by implementation of an ecosystem approach. These observation have shown that the knowledge, political and public awareness in wetlands management have been late. Indeed, two year after producing the report, the Ramsar convention was ratified by the Government of Rwanda. Therefore, due to the delay in wetlands management and conservation, wetland degradation reached a critical level, a situation which did not spare the Rugezi Marsh.

2.8 The state of Rugezi wetland degradation

According to Hategekimana and Twarabamenye (2006), the consequences of wetland degradation are related to the loss of hydrological and ecological function which it provided in terms of water resources management. The impacts include alteration of the hydrological balance, the drying up and compaction of peat, loss of water purification functions, fluctuation of water levels, and the river bed erosion. The indicators of wetland degradation include the drying up and decline of social and environmental uses of its natural resources (Mistch and Alii, 2000). Rugezi wetland is divided into 5 zones:

- The Southeast zones which was degraded from 1960-1983 due to dynamite effect of the rock wall to create fells outlet, which sent the water to tea plantations in Mulindi. As result, the water level fell rapidly and the whole part was reclaimed for agriculture (RRAM, I988). The outlet was dammed; consequently the water level got raised. The zone has been restored; the restoration reached not only rewetting but also created water bodies. The water is now at 0.50m above the soils level. Activities like transportation in canoes and fishing have resumed.
- The southwest zone is still water logged. The peat is very old. There are no water bodies but the water level is 0.40 m above the soils level.
- The central zone is evolving towards drying. During the dry season, the water level falls to 0.5m under peat layer, a situation that has led to drying of *Miscanthus species*. Due to drawdown of water level in the canal, the bed vegetation has disappeared. The central part is not completely reclaimed but the water table very strongly has considerably dropped. Due to insufficient water level for the crossing of the boat, the local population constructed raised way (levees) for pedestrians to connect both banks. In the southern part, typical vegetation includes *Erica spp, Vaccinum stanley,* and *Xyllis valida.*
- The Northern part which corresponds to the northern catchment was already reclaimed before the developments executed from 2000. It is probably the zone most seriously degraded. It was completely cultivated so that today breeding and the raised

bed cultivation became permanent there. The soils are compact, which reduces the water storage capacity.

- The marsh of Kamiranzovu was drained in 1980s and lost all the values of storage and purification of the water. Today, the Kamiranzovu inflow in the Rusumo stream is insignificant. The flow of Kamiranzovu is characterized by points of high floods during the rainy season while the height of water decreases appreciably during the dry season. Its water is very strongly loaded with sediments.

CHAPTER THREE

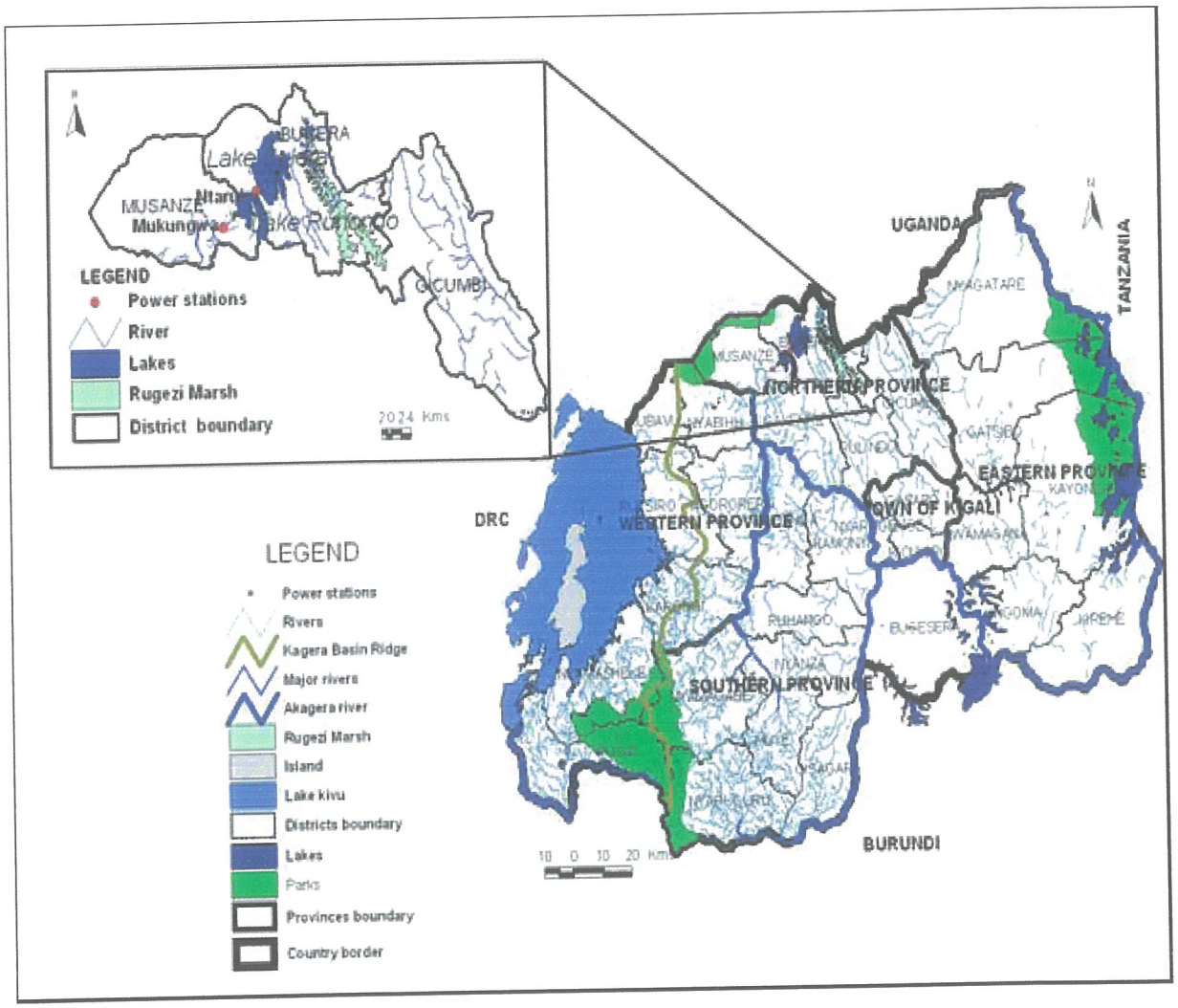
3.0 MATERIALS AND METHODS

3.1. Description of the study area

3.1.1 Geographical location

The Rugezi wetland is located in the Northern Province of Rwanda, spanning Gicumbi and Burera Districts, extending between 1° 21'30"and 1°36'11"of south latitude and 29°49'59"and 29°59'50" east longitude (Fig 1). It covers an area of 6,735ha. It is a highland peat bog whose spatial configuration appears as a homogeneous unit of peat bogs and marshes perched at an altitude of 2050m (Hategekimana, 2005). The Rugezi wetland is a drawn valley left at high altitude after the uplift of Buberuka highlands. These rounded and heavily eroded hills are composed of older metamorphic rocks. The wetland appears as a large flooded valley surrounded by a quartzitic ridge. In its natural state, the Rugezi wetland formed a dense mat over floating peat formation in its deeper waters (Hategekimana, 2005).

Figure 1: Map of Rwanda showing the location of the study area



3.1.2 Socioeconomic environment

Rwanda's population growth over the last four decades has been unprecedented from approximately 2.6 million in 1960 to 8.2 million in 2002. In 2007, it was estimated at 9.3 million, and is likely to reach 10.8 million in 2012. Annual population growth rate was 3.1 percent in 2002, one of the highest in Sub-Saharan Africa, but declined to about 2.6 percent in 2007. The population density is about 343 people per km^2, the highest in Africa, but in some districts like Burera it exceeds 500 people per sq km.

About 56.9 percent of the population lives below the poverty line and cannot meet their basic human needs.

At the national level, female constitute 55% of the total population while the male make up 47% of this population. The 2002 census data reveals that almost half the Rwandan population (48.6 percent) is under the age of 16. The youthfulness of the population combined with its high population growth rate and density has had a significant impact on the use of natural resources, the environment and all public services from health care to education.

Table 1: Population growth of sectors surrounding Rugezi wetland (1978-2002)

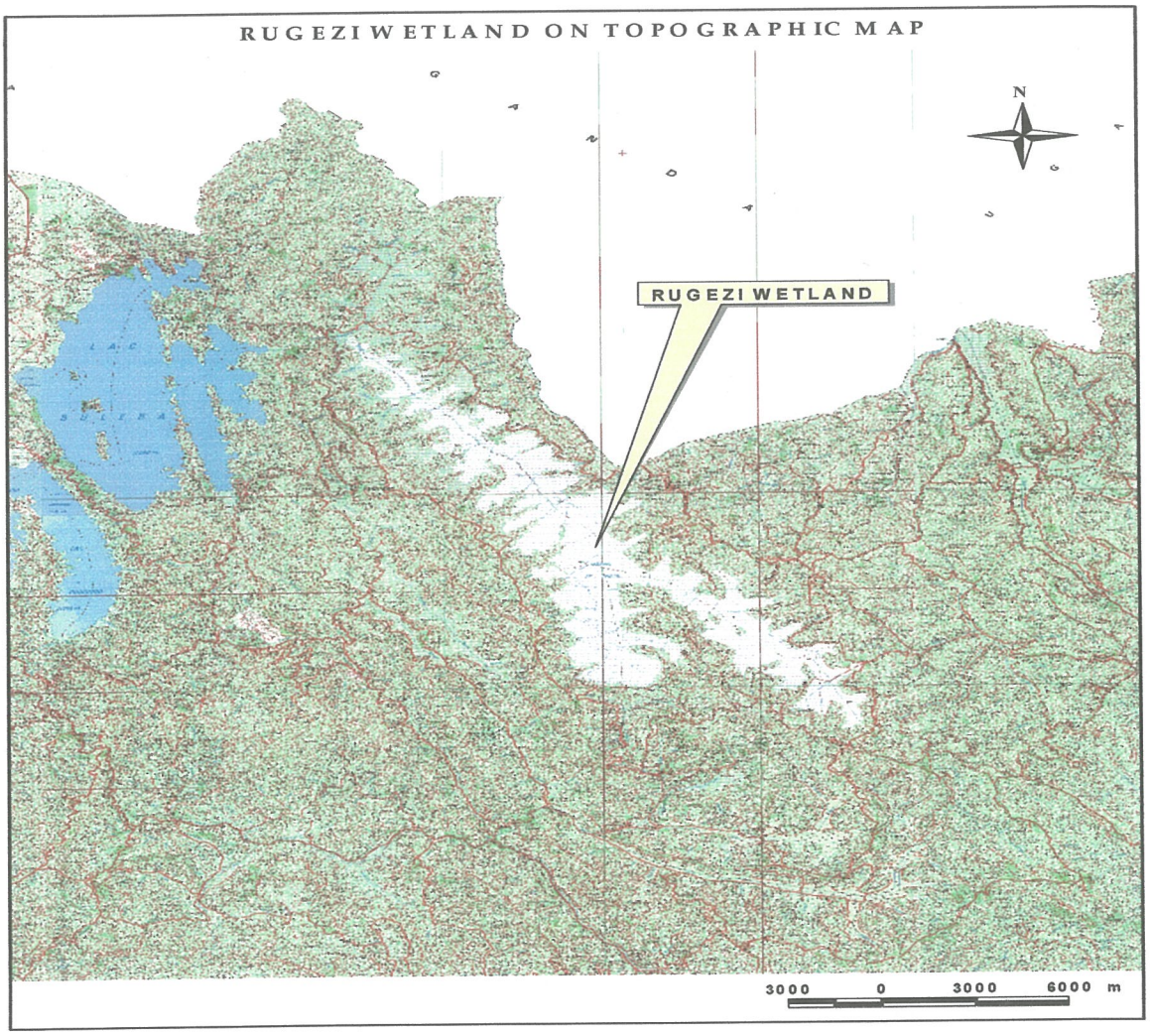
Ancient sector	Ancient District	1978	2002	T.A:1978-2002	Population density(Persons per km^2)
Kindoyi	Butaro	5281	9004	2.2	434
Musama	Butaro	3438	9004	4.9	595
Bukaragata	Butaro	3012	5145	2.25	496
Buhita	Butaro	2975	4357	1.6	406
Kayange	Butaro	5770	10597	2.5	696
Kabona	Cyeru	3698	6762	2.54	493
Ruhanga	Cyeru	3384	4429	1.1	450
Rwerere	Cyeru	5036	8745	2.3	343
Gaseke	Nyamugali	3254	4333	1.2	248
Gitovu	Kinihira	2211	4700	3.1	464
Ruhunde	Kinihira	3772	7856	3.1	495
Miyove	Kinihira	4579	8874	2.7	537
Nyankenke	Kisaro	3878	6383	2.1	631
Yaramba	Byumba Town	3097	4531	1.5	504

Musenda	Bungwe	5508	9114	2.1	474
Gatebe	Bungwe	2750	4587	2.1	468
Rwasa	Bungwe	1871	3052	2.0	320
Shanja	Bungwe	3022	3929	1.0	350

Source: MINECOFIN, 2002

3.1.3 Climate

Figure 2: Rugezi wetland and its surroundings



Source: GIS Satellite image

According to its position and latitude, Burera District has tropical climate, but due to the altitude of the region, the climate is rather temperate. There are two rainy seasons around October-December and April-Jun and two dry seasons around January-March and July-September.

Table 2: Rainfall average in Rugezi wetland region from 1959 to 1987

Month	J	F	M	A	M	J	J	A	S	O	N	D	Total
Ruhunde	87.0	110.6	143.6	234.3	143.2	37.0	18.1	46.6	113.2	119.0	148.8	100.8	1309.9
Rwerere Hill	76.3	99.9	140.7	192.4	122.4	32.2	23.2	51.4	117.0	123.8	140.6	93.5	1211.7
Rwerere Marsh	73.7	92.5	140.9	186.8	110.8	34.9	20.1	47.7	113.8	116.4	126.6	85.8	1142.3

3.1.4. Vegetation and Soils

Most of the land mass of Rwanda is very rugged and broken up, with steep mountain slopes and deep valleys. The exposed materials are weathered Precambrian rocks and outcrops or sedimentary deposits derived from such materials. Soils of the valley in the north including Rugezi wetland have organic soils, but much of the Central Plateau is dominated by lateritic soils on the hillsides and alluvial soils in the valley, with occasional pockets of organic soils.

Table 3: Soil and vegetation in Rugezi wetland

Soil	Vegetation	Ecological zonation
Organics soil, partially decomposed and poorly drained	*Miscanthus violaceus* *Cyperus latifolius* *Thypha sp.* *Pycreus nitidus* *Vaccinium stanleyi* *Erica sp.* *Sphaignes* *Xyris valida*	Principal non cultivated valley

Organic soil, partially decomposed and poorly drained	Anthropic vegetation of *Cyperus latifolius* and *Cyperus papyrus* accompagned with *Juncus oxycarpus, Crassocephalum sp., Dicrocephala, Spilanthes*	Principal cultivated Valley
Organic soil highly decomposed and poorly drained	*Cyperus latifolius* or *Typha sp*	Peat bogs of deeper valley
Minerals soil and cambique development poorly drained and texture varied.	Dominated by *Cyperus latifolius* and other plants like *Helichrysum sp., Ranunculus multifidus; Dicrocephala integrifolia.*	Marsh of deeper valley.

3.2 Research Design

This study employed both qualitative and quantitative methods. Qualitative information provided a more holistic picture of causes and impact of soil erosion on Rugezi wetland environment. The quantitative methods were logically used when dealing with tabulation, presentation and analysis of data.

3.3 Sampling procedure

The ideal practice in research is to obtain information from the entire population. This would ensure maximum coverage of the population concerned in research.

However, due to resource and time limitation, this study used probability sampling. The probability sampling procedure involves selecting a sample in such a way that all elements in population have the probability of being selected (Bailey, 1978 and Crano & Brewer, 1986). Two cells out of four were selected randomly. The study was confined to Gaseke and Gatare cells where the wetland is affected by soil erosion.

According to Krejcie and Morgan (1970), from a population of 7883 a sample of 367 people was used in this study.

Table 4: Population of Ruhunde Sector

Cell	Males	Females	Total
Gaseke	1759	2064	3823
Gatare	1868	2192	4060
Gitovu	2129	2498	4627
Rusekera	1757	2061	3818
Total	7513	8815	16328

Source: Good Governance officer in Burera District, October 14, 2009

3.4 Data collection

The methods that were used in data collection include field observation, interview and documentary sources.

3.4.1 Observation and photography

Observation is the process in which one or more persons look at what is happening in some real life situation and then classify and record pertinent issues according to some planned schedule categorized into physical things and social class interaction. They should be valued quantitatively or qualitatively.

By this method, I will observe the destructed ecosystem in Rugezi wetland, the techniques used in soil erosion control, the techniques of Rugezi wetland management and taking photographic of animals and vegetation in Rugezi wetland

3.4.2 Interview

Bailey (1978) denotes that an interview is a special case of social interaction between two persons. Interviews will be conducted where necessary to obtain the relevant required data on the impact of soil erosion on Rugezi wetland. With this method, selected respondents will be asked questions to find out what they do, think or felling about soil erosion and wetland management.

3.5 Data processing and analysis

During data processing, relevant data to the objectives of the study was considered and transformed into meaning information for easy interpretation and understanding. This was done through tabulation.

Tabulation refers to the orderly arrangement of data in a table or other summary format achieved by counting the frequency of responses to each question. Tabulation was considered and involved putting data into statistical tables such as percentage and frequency to show the number of result to particular questionnaires.

According to Bailey (1978) not all data can be presented in their entirety. The variables to be presented are those most central to the goals of the study, generally variables includes specifically in the research questions. The contents of these tables are usually percentages, frequencies or some summary statistical measures. This is reduction of data gathered to some torn suitable for analysis and is done by the help of data processing that uses tabulation. Therefore, data was processed and findings were presented in form of tables, for which recommendation and conclusions were based. The photographs and pie charts were used to present the findings from the questionnaires, observation and interview. Qualitative and quantitative data obtained

were statistically analyzed using Microsoft Office Excel package to generate pi-charts, graphs and frequency tables.

3.6 Ethical issues

The ethical issues in research are related to value conflicts. According to Gillespie (2009) in research, ethical considerations involve conflicts value such as individuals' rights to privacy, the undesirability of manipulation, confidentiality, consent of respondents, plagiarism and so on. Therefore, the researcher must try to minimize the above risks to respondents and the society as a whole and at the same time endeavor to maximize the quality of information he/she gathers. Individuals' rights to privacy and confidentiality have been addressed by keeping anonymous all respondents. Respondents have not been asked their names. The consent o f respondents was sought, in that before interview or discussion; respondents were briefed on the purpose of the research and asked to freely give correct answers. In a nutshell all the interactions of the researcher with respondents was governed by the advice given by Vayena(2006) that "in research on man, the interest of science and society should never take precedence over considerations related to wellbeing of the subject". To avoid plagiarism, the researchers followed the good rule-of-thumb given by Gillespie (2009) and which mainly consists of properly mentioning the sources of information either by making citations or paraphrasing the author and mention him/her.

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1. Demographic Information

With regard to gender of respondents in this study, 176 out of 367 respondents (46.8%) were women, the remaining number (53.2%) that is 191 out 367 being composed of men. Concerning the occupation of respondents, the majority of them (92.55 %) claim to be farmers, 3.73 % are unemployed, 2.48 % of them are retailers and 1.24 % of respondents are students (Table 5).

Table 5: Occupation of respondents

Occupation	Masculine	Feminine	Total
Farmers	176	164	340
Unemployed	8	6	14
Retailers	4	5	9
Students	3	1	4
Total	191	176	367

In terms of age, 0.62 % of respondents are under 18, while the majority of respondents (86.96%) are between the age of 18 and 65. The number of respondents above the age of 65 is 12.42 % of all respondents (Table 6).

Table 6: Age bracket of respondents used for the study

Age bracket in years	Percentages
Under 18	0.62
Between 18-65	86.96
Above 65	12.42
Total	100

4.2 Causes of soil erosion in Burera District

Rwanda has been facing a big challenge of arresting land degradation that leads to loss of soils and leaving infertile soils that are responsible for unproductive agricultural farming. Land degradation appears in form of deforestation and unsustainable use of forests, poor cultivation practices accompanied with overgrazing of rangelands that have led to unsustainable agriculture in the country.

Some 77% of all cultivated land in Rwanda have slopes between 13% and 55% and are classified under the category of "moderate to high erosion risk soils". In some cases, land with a slope of over 80% is put under cultivation as a result of land scarcity. In fact, 39% of all cultivated land in Rwanda fall under the high erosion risk categories, 37,5% in the middle risk category and only 23.4% are classified under the "low erosion risk" and "very low risk" categories (MINAGRI,2001)

The amount of plant nutrients lost annually is about 945,200 tons of organic matter, 41,210 tons of nitrogen, 280 tons of phosphorus and 3,055 tons of potash. The Strategic Plan for Agricultural Transformation estimates a total soil loss of about 15 Million tones per year, equivalent to loss of the capacity to feed 40,000 people annually (MINAGRI, 2001). Soil erosion causes denudation of mountain and hill tops, decreases the soil depth, alters the soil structure and decreases the soil organic matter resulting in reducing the water holding capacity with consequent leaching of nutrients and associated acidification of the soil. Heavy rains frequently occur in the mountainous regions of the country and cause serious erosion and subsequent soil sedimentation in the lower parts of the hillsides, often causing significant damage to crops and destruction of infrastructure such as roads and polluting the rivers and wetlands (MINAGRI, 2001)

Soil erosion has worsened due to continuous and uncontrolled cultivation, exploitation of marginal land that is unsuitable for agriculture and the lack of reliable soil conservation methods (National Land Policy, 2004)

As a result of the high population pressure, there is a rapid reduction of the size of farmland for families. Available cultivable land per family is about 0.6 ha. (MINAGRI, 2001).

4.2.1 Human population

Rwanda has been facing increasing urbanization. The urban population has increased from 7% in 1993 to 18% of total population in 2002. The urbanization is estimated to grow by 30% by year 2020 (EDPRS, 2007). The increase in urban population has been accompanied with urban environmental problems, particularly the problem of solid wastes, deforestation, water pollution and soil erosion.

Table 7: The activities of farmers causing soil erosion

Activities	Number of respondents	Percentage
Deforestation	192	52.3
Mining	40	10.9
Overgrazing	12	3.3
Fires	45	12.3
Urbanization	78	21.2
Total	367	100

The prior activity which leads on soil erosion in Burera is deforestation (plate 3). In our study it accounts for 27.2% of all respondents, the second is urbanization account for 21.2%, the third is fires of plants vegetation which has 12.3% and less activities to cause soil erosion are mining and overgrazing which have10.9% and 3.3% respectively (table 7).

Population growth has been thought to be the chief anthropogenic cause of recent soil erosion in Rwanda including Burera District through their activities.

According to Odada et al., (2003) human population increase, as well as increased rates of urbanization and agriculture in the region have increased the per capita demand for land, and hence more land is cleared to create the additional space, including wetlands, leading to increased sediment deposition in the rivers and lake.

According to Kayanja and Byarugaba (2001) forest and vegetation help avoid or reduce soil erosion. Forests help reduce runoff, topsoil loss and sedimentation. The loss of

protective vegetation through deforestation, over-grazing, ploughing, and fire makes soil vulnerable to being swept away by wind and water.

Figure 3: Deforestation as a cause of soil erosion

According to Leila et al. (2009), higher rates of erosion will occur when the vegetation cover is disturbed or removed. Once the vegetation is cleared, interception of rainfall will be greatly reduced. This will result in a drastic increase in surface runoff volume and velocity. Increase runoff (especially on hilly terrains) will certainly cause substantial soil erosion

According to Ongwenyi et al.1985, Soil erosion is accelerated by poor land management practices such as continued overstocking resulting in overgrazing of pastures, indiscriminate slashing, cutting and burning of natural vegetation and population pressure which leads to greater areas of land being opened up for cultivation.

Urbanization and the construction of house contribute to soil erosion and increased sediment production. The conversion of agricultural, forested, or rural land to highly urbanized land causes dramatic changes. During the house construction there is a tremendous increase in sediment production which may be accompanied by a moderate increase in runoff (Keller 2005)

4.2.2 Politics and economies

Another cause of soil erosion is the politics and economies of Burera District. The table 8 shows that more than a half of respondents (56.7%) declared that intensive agriculture caused by reduction of landholding size cause soil erosion. The small farms for cattle growing or keeping also causes soil erosion 16.1% of respondents affirm it. The extension of agriculture into marginal areas (small land size) is likely to cause soil erosion; this is declared by 27.2% of respondents (Table 8)

According to Cunningham and Saigo (2001) in many developing countries include Rwanda, the land continues to be cheaper than other resources and is still being brought under cultivation.

Table 8: Political economy as cause of soil erosion

Elements of political economy	Number of respondents	Percentage
Small farms for cattle growing or keeping	59	16.1
Extension of agriculture into marginal areas (small land size)	100	27.2
Intensive agriculture caused by reduction of landholding size	208	56.7
Total	367	100

To understand soil erosion we must be aware of the political and economic factors affecting land users. In South Africa apartheid policies ensured that 42% of the people lived on 13 % of the land (the "homelands"). This overcrowding has resulted in severe erosion. As the land became increasingly degraded and thus less productive, subsistence farmers were forced to further overuse the land. The intensive agriculture

and overgrazing on small farms caused land degradation; mono-cropping of marginal lands unsuitable for cultivation has led to soil erosion. (http://www.botany.uwc.ac.za).
In the past 50 years, soil erosion and overuse of soils caused by intensive agriculture have damaged about 10% of the world's best agricultural land (Keller 2005).
According to Ongwenyi et al., 1985 soil erosion is more pronounced in the marginal lands as a result of intensive cultivation.

Political and economy explanations of soil erosion in Burera District emphasize that peasant farmers and herders usually possess small farms and that these farms are often located in erosion prone, marginal environments. Environmentally sound farming in erosion-prone mountain environments and in small plots has been long practiced in that District. The reduction of landholding size and even the extension of agriculture into marginal areas, in other words, might induce erosion. Available cultivable land per family is about 0.6 ha (MINAGRI, 2001).

4.2.3 Technology and culture

Explanations that emphasize the role of technology and land use practices in recent Rwandan soil erosion tend to link these conditions closely to culture. Lack of technological sophistication as tractors machine, lack of awareness about land utilization, loss of local knowledge have been pointed to as chief cause of soil erosion in Burera District.

The culture of farmers in Burera District consists of burning before cultivate and severe soil erosion exists after a wildfire because as a fire burns it destroys plant material and the litter layer. Shrubs, forbs, grasses, trees, and the litter layer break up the intensity of severe rainstorms. Plant roots stabilize the soil, and stems and leaves slow the water to give it time to percolate into the soil profile. 2.2% of respondents agree that fire can destroy their soil protection (Table 9).

According to Cunningham and Saigo (2001) pressed by economic conditions, many farmers have abandoned traditional crop rotation; continuous monoculture cropping can increase soil loss.

In Burera District, continuous wheat production on the same land caused erosion because of loss of local knowledge in land management (Table 9). In addition, over-cultivation and compaction cause the soil to lose its structure and cohesion and it becomes more easily eroded. Also the slope gradient and length are naturally cause of soil erosion in Burera District; the steeper the slope of a field, the greater the amount of soil loss from erosion by water. Soil erosion by water also increases as the slope length increases due to the greater accumulation of runoff. Consolidation of small fields into larger ones often results in longer slope lengths with increased erosion potential, due to increased velocity of water.

Table 9: Technology and culture as source of soil erosion

	Number of respondents	Percentage
Lack of technological machines (tractors)	192	52.3
Loss of local knowledge in land management	22	6
Poor Cultivation Practice	108	29.4
Lack of information about land utilization	37	10.1
Burning before Cultivate	8	2.2
Total	367	100

Figure 4: Cultivation activities around Rugezi wetland

4.3 Impact of soil erosion on Rugezi wetland

Movement of sediment and associated agricultural pollutants into wetlands is the major off-site impact resulting from erosion. This leads to sedimentation in wetlands impacts on transport, water quality and quantity, and disruption of the ecosystems.

Table 10: Impact of soil erosion on Rugezi wetland

Impact	Number of Respondents	Percentage
Hydrographical impact	98	26.7
Socio-economics impact	102	27.8
Transport impact	27	7.4
Ecological impact	140	38.1
Total	367	100

4.3.1 Transport impact

Transport is an essential service for every human being. People are always in need to move for several reasons. They need to visit their friends and relatives. They all need to get services and goods offered by others such as health, education, official

documents for diverse purposes, etc. Hospitals, health centers and some schools are located on the sides of Rugezi. The boats are comfortable means of transport in that wetland; the people have created the channels that help the boat to navigate (Plate 5). The drying of the wetland caused by sediments affected the transport in the canoeing channels (Figure 5). The numbers of active channels has passed from 52 to 14 and the number of canoeists from 78 to 22, which means that 72 % of canoeists stopped their daily activity and thus lost the daily income which they gained from this activity. The riparian population crosses the marsh on foot because the marsh abounds no more in water everywhere (Hategekimana and Twarabamenye 2006).

For 367 respondents, 7.4% declared that the transport is impacted negatively by the sediments deposited in the channels which make the wetland to dry up (Table 10).

Figure 5: Transport in Rugezi wetland

4.3.2 Ecological impact

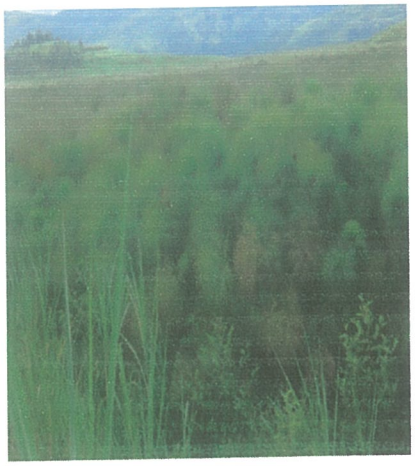
Plants

The plants species in Rugezi wetland are dominated by *Miscanthus violaceus, Thypha sp., Pycreus nitidus, Vaccinium stanleyi, Erica sp., Sphaignes, Xyris valida,* Anthropic vegetation of *Cyperus latifolius* and *Cyperus papyrus* accompagned with

Juncus oxycarpus, Crassocephalum sp., Dicrocephala, Spilanthes, Helichrysum sp., Ranunculus multifidus; Dicrocephala integrifolia.

Due to the sediments comes from soil erosion, some plants are disappeared and others can not grow properly.

Figure 6: Plant species in Rugezi wetland



Papyrus (urufunzo)

Typha (umuberanya)

Miscanthus (ibigege)

Animals

Any suspension of primary production from sedimentation would be expected to negatively impact wetland invertebrates. The loss of standing vegetative structure generally makes wetlands less productive of invertebrates. Loss of algal biomass especially periphytoton and phytoplankiton make wetlands less productive of invertebrates. Direct impacts of sedimentation may include covering of invertebrates eggs and covering of organic substrates important in aquatic food chains (http://www.npwrc.usgs.gov/resource/wetlands/sediment/hydro.htm)

The Rugezi wetland does provide a spawning habitat for vertebrates and invertebrates animals. For Ornithological communities, 19 species are identified.

Table 11: Birds species in Rugezi wetland

Scientific nouns	Common nouns in French
Ardea melanocephala	Heron melanoceephale
Ardea idae	Crabier blanc
Bubulcus ibis	Heron garde boeuf
Scopus umbretta	Ombrette africaine
Bostrychias hagedash	Ibis hagedash
Threskiomis aethiopicus	Ibis sacre
Platalea alba	Spatule d'Afrique
Balearica regulorum	Grue royale
Vanellus crassirostris	Vanneau a ailes blanches
Hirundo angolensis	Hirondelle de l'angola
Psalidoprocne albiceps	Hirondelle a tete blanche
P.holomelas	Hirondelle de Ruenzori
Riparia paludicola	Hirondelle paludicole
Motacilla flava	Bergeronnette printaniere
Anthus richardi	Pipit de Richard
Euplectes axillaries	Euplecte a epaules oranges
E. afer	Euplecte vorabe
Serinus atrogularis	Serin a gorge noire
Bradypterus graueri	Fauvette de Grauer

Source: MINITERE, 2003

Figure 7: Birds in Rugezi wetland

The *Bradypterus graueri* account for 3000 pairs of that species where worldwide account for 10000 only (MINITERE, 2003).

The ichthyologic community in that wetland is scarcity because of the P^H conditions ranging from 4.6 to 6.2 (Hakorimana, 2006). The sediments from soil erosion in Rugezi wetland reduce the water level in which the animals (amphibians) depend on it. Also the salt in sediment transported by erosion has negative effect on production of habitats. The organic matter (a threat to the oxygen essential to wetland fauna) resulting, for example, from intensive stock farming (liquid manure), as well as nitrogen and phosphorus (from mineral fertilizers used by farmers), can lead to eutrophication of ponds (invasion by algae which will in turn asphyxiate the *Clarias liocephalus*).

Draw-dawn of the water level combined to the destruction of the high vegetation has led to the disappearance of habitat of the animal species which used to populate the swamp. Consequently, the population of fish species like *Clarias liocephalus Haplochromis* which populated the water bodies and in breeding spaces knew a catastrophic decrease. The fishing activity fell by 87% (Hategekimana and Twarabamenye, 2006)

The local government affirms that the production of *Clarias liocephalus* reduced in 5years ago and some birds are migrated such as ducks.

The table 9 indicates that 38.1% of respondents consider the sediments of soil erosion to be negative impact on ecology of Rugezi wetland.

4.3.3 The impact on Socio-economics and culture

Rugezi Wetland used to have a lot of economic advantages for the local people living near it. However, the degradation has affected their transport system; food sources from the wetland; fishing and materials for weaving. The fishing activities were very important especially to the poor and landless. In 1999, before the more severe degradation of Rugezi, the local fishermen were exporting fish to Tanzania. Hategikimana (2005) found that 2 percent of surveyed sample were able to buy livestock from fishing. He further found that fishing was no longer dominating the poorest communities' time occupation as in the past, but now only a few fishermen who are relatively well off. Rugezi is composed of homogeneous peat soil with patches of water areas and many canals and water flows that have always been helpful for local boats owners. Before the more severe degradation, the Wetland played a capital role in the economic life of the communities living around it, including transport. There were about twenty small ports where travelers could for a modest sum travel with the boats. This service also provided transport of food and building materials especially from Uganda. The southern side of the wetland benefited more from this transport system because it has always been poor in agricultural production. The main food and cash crops transported were wheat and tobacco, which were shipped to Rusumo, Kirambo, Miyove, Gitanga and Base markets. The boats owners were grouped in associations and they could earn up to Rwf 1,500 each per day. Today the boat transportation in Rugezi is limited and it is only practiced in the southern part of the Wetland, which is less degraded. Economic losses have been sustained by the local communities in terms of lost transport opportunities.

There are a lot of vegetal species that are valuable to local people especially the poorest communities living near Rugezi.

Studies carried out in the watershed area in the past showed that vegetal collection activities were mainly carried out by widows and people, who had no land for cultivation. Many women from villages far away from the Wetland used to come to harvest weaving materials. With degradation, weaving activities have been reduced considerably and this has also affected the poorest in the villages surrounding the area (Hategikimana, 2005). The Batwa community has not been spared by the degradation of Rugezi. They used to collect perennial grass (Miscanthus) and sold it in bundles to relatively rich families. This grass as well as other grass species were used as building materials, but are now no longer available in the valley. This has naturally had a negative economic impact on the Batwa community.

Pottery activities, which traditionally are the main income source for the Batwa, have been totally prohibited due to degradation. This has also affected other social groups in the region because the majority of the population cannot afford iron pans use pots. The reduction in livestock fodder has also affected livestock keeping in the region and contributed to increase in poverty.

According to Hakorimana (2006), The Rugezi wetland is useful as a source of raw materials e.g. collection of papyrus leaves for making handcrafts (uduseke), nap, and mats which are sold in the markets of Gitanga, Base, Kirambo, Miyove and provide money for local people in order to satisfy their needs; from it, the residents should pay fees for their students and they can afford money to dress their children. Other plants are used as traditional medicine.

Wetlands are socially important for: education, scientific research, recreation and tourism, cultural and heritage values, landscape and aesthetic values.

Tourist attraction in the area is the Rusumo Falls. Rugezi Wetland is located upstream from the beautiful tectonic lakes of Burera and Ruhondo that are easily accessible by road. It is easy for tourists to visit Rugezi on their way to the Volcano National Park to see the mountain gorillas.

Tourists interested in the historical and cultural values of Rwandan people could be served as well. For hundreds of years the local Batwa communities have lived in a

symbiotic way with the Rugezi Wetland and have also played a very important role in Rwandan history. Rugezi derives from a traditional name of 'Urugezi rwa Basebya ba Nyirantwari'. Rwandans used to come from all over the country to worship God at Rusumo falls and at the famous Kayange Hill where traditional houses were built for that purpose.

Some flowers collected in that wetland are used in the marriage ceremonies and in the churches.

Figure 8: Flowering plants in Rugezi wetland

The sediments carried by erosion have impact on papyrus in quantity and quality resulting in reduction of raw materials and the values of wetland.

In our study, 27.8% of respondents claim that the sediments of soil erosion on wetland have socially and economically effect (table 10), and the local authority affirm that in recent 3 years the production of papyrus and typha plants is considerably reduced.

4.3.4 Impact on Hydrologic functions

According to Leila et al. (2009), sediment can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment. The deposition of sediment in water bodies can lead to the premature filling of impoundments, burial of habitat for mussels and other benthic

aquatic life, exertion of large oxygen demands on water, and alteration or destruction of aquatic ecosystems. Sediment also acts as a vehicle which, through adsorption or absorption, transports other possibly more environmentally damaging pollution including wetland.

The Wetlands play an important role in water quantity and quality management; they contribute to water resources regulation to downstream water courses and water resources retention (Hategekimana and Twarabamenye, 2006). Located in a highland area where floods and sedimentation are potential threats to water resources management, the Rugezi wetland was regulating, retaining and filtering the water resources that flow into Lakes Burera and Ruhondo downstream. In its natural state, the Rugezi wetland formed a dense mat over floating peat formation in its deeper waters (Hategekimana, 2005). From its hydrological aspects, this complex plays major role in the regulation of water flow to Lake Burera and Ruhondo and Mukungwa River.

According to Helpage Rwanda (2004), Rugezi Wetland and the Volcano National Park are of international importance because they are water sources for both Lake Victoria and the White Nile. Ntaruka, located between Lake Burera and Lake Ruhondo, and Mukungwa situated downstream Lake Ruhondo have been the main sources of hydro power generated electricity in Rwanda. Recent energy shortages have been attributed to considerable fall of the water level in the lakes. After the land reclamation of the wetland, the water level of the lake Burera, supplied in 50 % by the Rusumo stream (emissary of Rugezi Marsh), fell from 1864.5 to 1859.5 m between 1997 and 2000. Thus the hydroelectric production of the Power plants of Ntaruka and Mukungwa very strongly declined. The failure in the hydropower generation resulted in frequent power shortages and blackouts that affected citizens, industries, and therefore leading to negative effect on the national economy. A principal cause, among a number of others has been the sediments deposited in Rugezi Wetland.

Another major hydraulically impact results from the agricultural chemicals that often move with eroded sediment. These chemicals move into, and pollute, downstream

watercourses and water bodies. Where inputs of agricultural chemicals are high costs of removing such pollutants from drinking water can be considerable.

With the passing years, the Rugezi wetland was degraded by diverse activities: agriculture, fire, and plants species overexploitation. Currently, it is affected by an environmental crisis related to water level fall and sedimentation. All the downstream and central parts are now dried up. This is confirmed by the local authorities and 26.7% of respondent argue that the sediments carried by soil erosion are one of causes of water level reduction in that wetland (Table 10).

Figure 9: The hydrology of Rugezi wetland

4. 4 Attitudes of local communities towards Rugezi wetland management

Rwanda's population growth has put pressure on the limited resources in wetlands which do not match with high demand of the population needs. This has led to misuse and over exploitation natural resources which in turn leads to the wetland degradation. The population must participate actively in wetland management because they are the first one benefit from it. Their attitudes on wetland management are explained by their activities, believes, emotions, etc towards wetland management.

4.4.1 The Information of local communities on wetlands conservation

Population of Burera District are informed on wetlands conservation, this is explained by how they try to buffer the sediment produced by erosion from being deposited in wetland. 41.7% of respondents affirmed that they had been informed on Importance of wetlands. 16.9% have the information on wetland policies, 27.2% they know the consequences of sediments on wetland, and 14.2% have the information on Wetland management (Table 12).

Table 12: The Information of local communities on wetlands conservation

Types of Information	Number of respondents	Percentage
Importance of wetlands	153	41.7
Consequences of sediments on wetlands	100	27.2
Wetland policies	62	16.9
Wetland management	52	14.2
Total	367	100

4.4.2 The media helps local communities on wetlands conservation

Two communication channels present opportunities for increased understanding of population at wetland conservation (Melissa, 2009).

Traditional forums

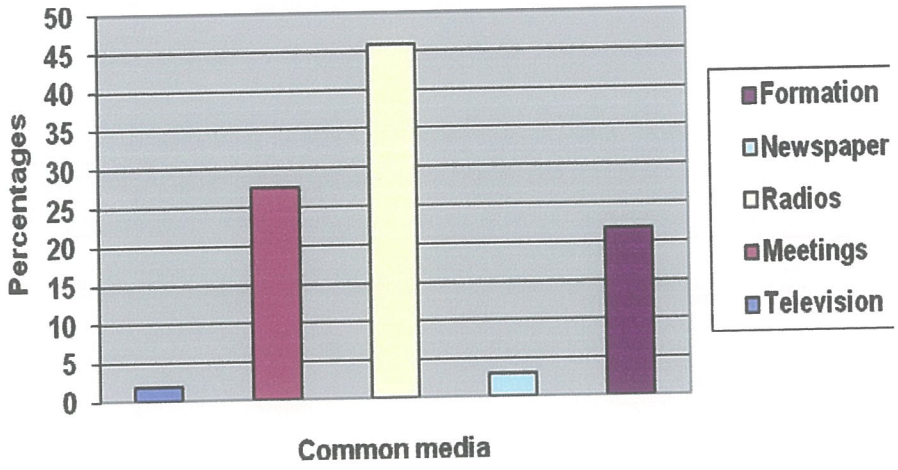
Dialogues about program objectives, processes, and communities' needs on wetlands conservation took place within special community-level meetings, such as a monthly countrywide community-service obligation (*umuganda*), participatory planning meetings (*ubudehe*), and national dialogue sessions (*urugwiro*). With adequate planning and preparation, the wetland conservation theme could be introduced and discussed.

Media

The media also provides opportunities for communicating wetlands issues and integrated approaches. In Rwanda, state control over the media has loosened considerably since its divisive campaign during the genocide, and independent media is growing quickly. Literacy rates are still low in Rwanda, with only 60 percent of women and 71 percent of men able to read and write; but most Rwandans listen to radio regularly. During the last three years, more than 10 additional private and community radio stations have sprung up in Kigali and around the country, several newspapers have begun publishing in different languages, and Internet infrastructure is expanding beyond the capital. These diverse media provide opportunities for wetland conservation messages to reach local and national target groups.

In our study, 27.5% of respondents get information from the traditional forums (meeting), 45.8% on the radio, 3% in the newspaper, 21.8% in the formation and 1.9% from television. This shows that the radio is most frequently used medium, the less used is television because many residents of Burera District do not possess the television. The role of government to facilitate the people on wetland management; organize the formations and do provide the journals and newspapers related to wetland management in Rwanda. The benefits form information's are to know how the wetland must be conserved in order to increase its potential values of a country.

Figure 10: Media helps local communities on wetlands conservation



4.4.3 Attitudes toward wetland conservation

4.4.3.1 Activities of local Communities on wetland conservation

In relation to the Ministerial order n°2 of 24 September 2001, relating to the utilization and management of wetlands in Rwanda, the introduction into wetlands of non indigenous species likely to harm the environment is prohibited; hunting and fishing in those sensitive areas are prior authorization. The introduction of sediments and their associated pollutants into a wetland may affect any of the functions provided by the wetland, such as water quality protection, flood storage, and hydrophytic vegetation. The conservation of wetlands in Rwanda is vital to protect and promote wetlands normal functions.

Table 13: Activities of local communities on wetland conservation

Activities		
Buffer of sediment	126	34.3
Growing nursery trees(trees planting around wetland)	190	51.8
Training population on wetlands conservation	18	4.9
Wetland restoration	33	9
Total	367	100

Because the populations know the importance of wetland in their daily life, they participate in all activities of wetland conservation. In our survey, all respondent 100% participate in wetland conservation. 34.3% of respondents buffer sediment, 51.8% growing nursery trees (trees planting around wetland), 4.9% are the trainers of community on wetlands conservation, and 9% participate in wetland restoration (Table 13).

4.4.3.2 Feeling of local communities on wetland conservation

The first stage in the policy development process is to review sector policies as they relate to wetland utilization and conservation. Agriculture should make positive contribution towards conservation of wetland while achieving the wise use of wetlands resources. There should be coordination between other agencies of wetlands resources (MINAGRI 2001). To strength the attitude of population in wetland conservation, there must be representation of member institutions and legal entities in the management of wetland and government has the responsibility to train the local community on skills in the management of wetland, and participation in regional and international efforts of conserving and utilizing wetlands need to be enhanced.

Table 14: Feeling of local communities on wetland conservation

Policy of wetland management	Number of respondents	Percentage
I don't mind	2	0.5
I support it	55	15
I don't support it	0	0
I strongly support it	310	84.5
Total	367	100

Engaging various levels of people in wetland conservation, ensure a holistic approach of the issue of wetland management. All authorities concerned have proper coordination of activities concerning wetland management a fact which leads to efficiency implementation of policies. The table 14 shows that a big proportion of respondents (84.5%) strongly support the policy of wetland management, 15% supports it, only 0.5% they don't mind about the policy of wetland management.

4.4.4. Awareness towards wetland conservation

Very often wetlands are degraded because the publics is either not fully aware or do not appreciate the diversity of values and functions of wetlands. Public is therefore essential in creating a commitment and positive attitude towards conservation and sustainable utilization of wetland resources.

Table 15: Awareness of local communities towards wetland conservation

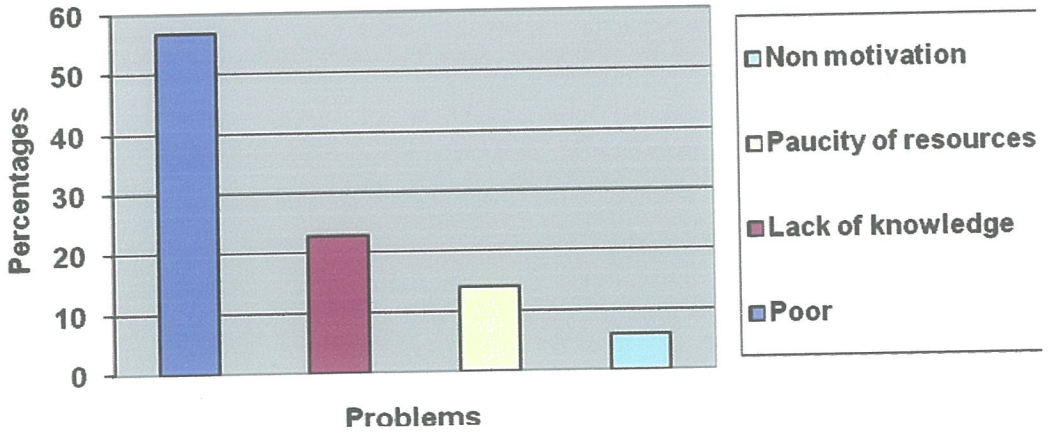
Awareness from	Number of respondents	Percentage
Mass media	257	70
Formal education	72	19.6
Seminars/workshops	38	10.4
Total	367	100

The findings from the study reveal that the majority of people are aware of wetlands conservation. The intensive seminars/workshops has increased the population's awareness towards wetlands management so that 10.4% of respondent claim to be aware of wetland management/conservation through seminars. Increased also of mass media in local community has contributed to the Knowledge of people on wetland conservation, as shown in the table 14 where 19.6% rely on schooling to be aware of wetland conservation , and many people thought how to conserve or manage wetland from mass media; this was supported by 70% (Table 15).

4.4.5 The problems associated with Rugezi wetland conservation.

The population of Burera District has the problems associated with wetland conservation such as poor, limited knowledge in wetland management, non motivation, and paucity of resources. The consequences of this, is the misuse of wetland explained by overexploitation in terms of getting different types of building materials such as poles, materials for handicrafts such as mats, and bricking, grazing, over cultivation and so on. When the respondents were reacting to the possible causes associated with wetland degradation, 57% reclaim to be poor so that they exploit wetland on maximum, 22.9% they have insufficient knowledge on wetland conservation so that they need to be informed and trained, 6% they are not motivated, and 14.1% looking at paucity of resources caused by sediments on wetland (figure 11).

Figure 11: The problems associated with Rugezi wetland conservation



4.4.6 Protection of Rugezi wetland

The wetland in Burera district are protected, the implication of resident ,organization such as REMA, the government through ministry of Agriculture and Ministry of mine and natural resources has increased the potentiality of that wetland.
To avoid further exploitation of the resources, Rwanda Government has established rules governing wetlands in the country. This is done by subjecting any acts concerned with water and its resources like watering plants, the use of swamps to prior environmental impact assessment which will be examined and approved by Rwanda Environment Authority, or any person given written authorization by REMA. In collaboration with Ramsar Convention Secretariat, Rwanda held a workshop as part of the environmental week with the theme of Conservation and management of wetlands of Rwanda. This shows the implication of every body in wetland protection (Table 16).

Table 16: Protection of Rugezi wetland

Participants	Number of respondent	Percentage
Residents	59	16.1
The government	48	13.1
NGOs	14	3.8
All those mentioned	246	67
Total	367	100

4.4.7 Importance of Rugezi wetlands

The wetlands ecosystems play a key role in water quality and quantity management, and vice versa the water resources quantity and quality provide key services to ecosystem health. They water quality and quantity that they provide maintains the habitat for animal and plant biodiversity (Uluocha, 2004).
The Rugezi Marsh is an important element in Akagera River watershed. It serves as a link between land and water resources and it is the most important water tower of

Burera and Ruhondo lakes. The runoff from Rugezi Marsh contributes to 50% of inflow in the Lake Burera. The Rugezi Marsh is situated in the region of high mountains where the risks of erosion and flood are very high. On the hillsides of the marsh, soil loss due to erosion is estimated to 13.7 t / ha a year (RRAM, 1987). This erosion is associated, either with the fragility of the arable layer of soil developed from quartzite and schistous soils or with the absence of soil conservation techniques. Therefore, the Rugezi Marsh, by its floating vegetation of *Miscanditium*, and *Sphagnum* and its peaty soils, filters all the sediments from the steep slopes. The sediments are transported, either by runoff, or in suspension or gravitation by streams. The sediments retention by the marsh is of a big importance for the ecology of Lake Burera and the good running of the hydropower plants of Ntaruka and Mukungwa. Peat bogs like other types of wetlands play an important role by maintaining the quality of water, and its hydrological integrity, because they are excellent sensors and storing parts of sediments.

Apart from the hydrological functions, the availability of water in Rugezi Marsh enabled the existence of socio-economic and ecological activities. The availability of sufficient water level above the peat level was a habitat for fish and other endangered species like *Bradypterus Graueri*. Therefore the fishing activity was very proper within the marsh. Many local communities have bought big cattle from fishing revenue. A part from fishing activities, the availability of water at the surface enabled the population to create perpendicular canals in the marsh to allow the crossing of canoes. The transport in the canoes was an activity to occupy a big number of populations. The daily mean revenue for each canoeist was estimated at 1000 Rwandan francs per day. The picking of vegetation species for handcraft was also another activity for women. They were using it in the confection of local mat and other handcraft activities. The most harvested plant species were the *Mscanthus Violaceus, Xris valida, Cyperus latifolius, Typha spec, Junctus oxycarpus, Papyrus* (RRAM, 1987).

Table 17: Importance of Rugezi wetlands

Importance	Number of respondents	Percentage
Transport	18	5
Tourism and recreation	9	2.5
Wetlands are a home to many animals and plant species	116	31.6
Wetlands aid pour economy	54	14.7
Wetlands are a source of food	109	29.7
Wetland control floods	16	4.3
Wetlands store water	29	7.9
Wetlands purify water	16	4.3
Total	367	100

Our respondents agreed that wetlands should be conserved because they provide for their needs. Conservation of Rugezi wetland is an assurance of income, health, and safety of the people who live near Rugezi.

The sediments help bury any pollutants and the natural decay of plant material helps to convert the toxic substance into harmless ones. Therefore wetlands ensure that the water leaving it is free of pollutants and is clean enough for human consumption. In our study, 30% of respondents agree that wetland purify water (Table 17). Wetlands have special ability to retain water and release water slowly and gradually. This is water we use in industries, households, irrigation and for animals to drink during times of drought. Some wetlands maintain the flow of rivers throughout the year as well as ensuring constant flow of water from boreholes and wells as 7.9% of our respondents' reclaimed (Table 17) Their ability to retain water enables them to control floods by

storing the collected water and releasing it slowly. Food can be grown at the banks of wetland. Besides, wetlands provide abundance of fish which provide high grade proteins for our people 29.7 agree. Because Wetland aids pour economy, must be used wisely if we are to economically benefit from them. From them, we get different types of building materials such as poles, materials for handicrafts such as mats, medicinal plants and bricks all of which improve on family income and government revenue. Finally, wetlands are a home to many animals and plant species; this attracts tourists to our country, in this way; the country can get the much needed foreign money. Some people use wetlands for recreation while scholars go there to study nature (Table 17).

4.4.8 Wetland usage

Wetlands degradation in Rwanda is closely linked to development in urban centers countrywide. Many construction activities being carried out require inputs from wetlands such as bricks and sand, a factor that has led to over exploitation of the resources. High demand for brick making coupled with sand mining due to current development construction in the country has led to misuse of wetlands in the country. Such commercial gains are practiced by people to make ends meet regardless of environmental degradation.

The booming industry of hand crafts currently in the country could be a long-term environmental challenge as most raw materials used for making final products such as Agaseke, mats and other products are exploited from the wetlands (Table 18).

Table 18 : Wetland usage

Usage	Number of respondents	Percentage
Garages sites	0	0
Raw material collection	174	47.4
Cultivation	106	28.9
Brick making	80	21.8
Cattle grazing	7	1.9
Total	367	100

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Soil erosion is a natural process, it involves detachment of material by two processes, raindrop impact and flow traction; and transportation either by saltation through the air or by overland water flow. The main causes of soil erosion are: human population through their activities on top soil, the political economy explained by farmers and herders usually possess small farms and that these farms are often located in erosion prone, marginal environments; technology and culture also cause soil erosion because of using traditional methods in agriculture without terracing, and burning the plant cover before cultivation.

The sediments in wetlands impact on transport, ecology, socio economy, and hydrology. When it rains, the sediments are accumulated in the wetland and reduce the water level in which the animals (amphibians) depend on it. Also the salt in sediment transported by erosion has negative effect on production of habitats, some plants are disappeared and others can not growth properly. Increased wetland destruction means more biodiversity loss and decreased of economy and needs of human being.

Engaging various levels of people in wetland conservation ensures a holistic approach of the issue of wetland management. All local community, authorities and government are participate in the activities of wetlands conservation a fact which leads to efficiency implementation of policies
Even if they participate massively, some problems are considered as the barriers on the wetland conservation such as poor, limited knowledge in wetland

management, non motivation, and paucity of resources. The consequences of this, is the misuse of wetland explained by overexploitation.

5.2 Recommendations

All wetlands in Rwanda are currently facing an economic dilemma including Rugezi wetland; either they quickly become a development factor for populations or, they will progressively deplete, by unavoidable conversions into lands for agriculture for most of them. If wetland does not significantly participate in local development they will disappear. Land crisis and poor land use in Burera District is clear that there is challenging need to protect Rugezi wetland to ensure that it will continue to fulfill its essential goods and services. To achieve this, the following recommendations are made.

-Facilitate and encourage campaigns for making the general public aware of the importance of wetland

-Establish national objectives for conserving wetland. Such national objectives should, among others, specify the mission of conservation wetland in the country, and give particular attention to the important positive role that can played by local communities. These objectives should be established by the highest level of authority in the country such as Parliament, the constitution, and international treaties.

-Support the implementation of national plans for conserving wetland, involving the full range of government, commercial, and private institutions with an interest in the subject. -A national plan identifies critical areas in need of immediate protection, and this can lead to fundamental changes in the ways that costs and benefits of both exploitation and conservation are allocated. The plan should also include mechanisms to assign priorities to various actions, and to ensure that at least the highest priorities receive the necessary funding.

In 1971 in the Iranian town of Ramsar, world countries signed a convention on wetland. It gives guidelines on the protection and wise use of wetlands, watersheds, lakes, rivers, etc. To implement Ramsar convention, the public must be informed about the importance and management of wetland.

-Develop new and more productive approaches for using conserved wetland with minimum loss of resources, and for enlisting local people as the main beneficiaries of managing these areas

-Establish working relations with institutions managing adjacent lands, with a view toward harmonizing management procedures for the benefit of conserving wetlands.

-The communities concerned must be closely associated in the exploitation of the natural resources of the territories under their control. The conservation of the wetland must first be able to integrate local demand. This demand is either carefully considered independently by local communities or it is just outlined under various request.

-Extensive mass education should be embarked upon to make the general public sufficiently aware of the nature, as well as the socio-economic, historical aesthetic and recreational value of Rugezi wetland.

-A system of monitoring the hydro-climatic parameters in Rugezi wetland should be set up into follow up environmental changes in the wetland and their impact on the water resources management.

-Socioeconomic incentives and disincentives must go hand in hand with legislative measure to convince the people to invest in a sustainable wetland. Activities that favor incentives for the rational use and sustainable management of wetlands must be given priority. Opportunities for communities and individuals to sustainable manage their wetlands must be facilitated.

Both government and public awareness and understanding of wetlands issues must be promoted.

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APPENDICES

APPENDIX I. Questionnaires

Dear Respondent,

I am a university's student, undertaking a master degree of science in Environmental Management and Development. As part of the partial fulfillments of this course I am undertaking a study on **"impact of soil erosion on the Rugezi wetland environment in northern of Rwanda"**

.

A.1 Background information

1. District
2. Sector
3. Cell
4. Sex: Male Female
5. Age <20 years 20-40 years
   40-65 years >65 years
6. Highest Education Level
   None Primary
   Secondary College/University
7. Main Occupation

A.2 Information tools on wetland conservation

2.1 Do you receive information on wetland conservation in your area?

Yes No

2.2 If yes, what type of information do you mainly receive?

Importance of wetlands Consequences of sediments on wetlands
Wetland policies Wetland management

2.3 What is the most common media (means of communication) through which you receive information?

Television Radios Formation

Newspaper Any other Specify...

B. Attitudes toward wetland conservation

3.1 Do you participate in wetland conservation?

Yes No

3.2 If yes, which activity do you participate in?

Wetland restoration Training members

Growing nursery trees Buffer of sediments

3.3 How do you feel about reducing the size of the wetland for other activities?

I don't mind I don't support it

I support it I strongly support it

3.4 Environmental awareness should be increased through?

Mass media Seminars/workshops

Formal education Other.....

C. Awareness towards wetland conservation

4.1 What are the major problems associated with wetlands conservation?

Non motivation Paucity of resources

Poor Lack of knowledge

4.2 Who basically protects the wetlands in your area?

Residents The government

NGOs All those mentioned

4.3 Are wetlands of any importance in your area?

Yes No

4.4 If yes, what is the main importance of wetlands in your area?

Wetland aids pour economy Home of animals Transport Tourism

Water purification Control floods

D. Wetland usage

5.1 Are involved in wetland usage going?

Yes No

5.2 What is the usage of wetlands?

Garage sites Brick making Cattle grazing

Raw material collection Cultivation

APPENDIX II: Interview

Questions for executive secretary of sector, agronomist of sector, and executive secretary of cells.

1. What are the consequences of soil erosion on Rugezi wetland?
2. Describe people participation activities in soil erosion control and Rugezi wetland conservation?
3. What are the common problems facing in implementation of soil erosion control and Rugezi wetland management?
4. Has any action been taken to motivate the people for reduction of impact of soil erosion on Rugezi wetland?
5. What are your contributions to reduce the impact of soil erosion on Rugezi wetland?
6. The local community is associated in decision making related to the soil erosion control and wetland management?
7. Do local community knows the role they should play to reduce the impact of soil erosion on Rugezi wetland?
8. The participation of local community in soil erosion control and wetland management is voluntary?

APPENDIX III: Sample size(s) required for the given population sizes (N)

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	256	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

APPENDIX IV: Researcher's curriculum vitae

1. PERSONAL PARTICULAR

Surname: Dukuziyaturemye
Fist name: Pierre
Cell: +250788447358 / +256779826287
E-mail: dukuze2@yahoo.com
Date of Birth: 01/01/1975
Marital status: Married
Nationality: Rwandan

2. ACADEMIC QUALIFICATION

2009-2010: Registered at Kampala International University (KIU) for Masters of Sciences in Environmental Management and Development.
2003 – 2007: Registered at Kigali Institute of Education for Bachelor of Sciences with Education. Award of Bachelor's degree.
1990-1997: Secondary Education at Musanze Sciences School. Certificate of Advanced Level in Primary Teaching.
1981-1990: Primary Education at Gaseke Primary School

3. PROFESSIONAL EXPERIENCES

2010: Teacher at Nyamugali Secondary School
2007-2008: Teacher at Nyamugali Secondary School
2000-2002: Teacher at Gaseke Primary School
1998: Teacher at Buberuka Baptist Institute

4. LANGUAGES

English: Fluent in writing and speaking
French: Fluent in writing and speaking
Kinyarwanda: Fluent in writing and speaking

5. OTHER SKILLS

Computer skills
Computer repairing and maintenance

6. REFERENCES

Dr Ngirabega Jean de Dieu: Medecine Director of Ruli Hospital
Tel: +250788650824
E-mail: moonhuro@yahoo.fr

I hereby certify that the information provided above is true.

Dukuziyaturemye Pierre