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IMPACT OF SEDIMENTATION ON WETLAND FUNCTIONSIN BURERA DISTRICT. AN ASSESSMENT

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Abstract

All wetlands in Rwanda are currently facing an economic dilemma; either they quickly become a development factor for populations or they will progressively deplete. Due to deposition of eroded soil, many wetlands have been suffered functional degradation, although it is difficult to calculate the magnitude of the degradation. Land crisis and land use in Rwanda is clear that there is challenging need to protect wetlands to ensure that they will continue to fulfill its essential goods and services. This paper was carried out to assess the impact of sedimentation from soil erosion on wetland in Burera District, Northern of Rwanda. The study conducted through personal in-depth interview, observations and questionnaire. The data have been collected from primary and secondary sources. The analysis was based on data collected from a survey of 367 farmers and descriptive statistics were used for analysis.It was found that the deposition of sediment into wetlands disturb it fulfillment functions.

Keywords: Wetland, Transport, Socio-economic, Burera, Sediment.

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Introduction

Before moving into a discussion of the impacts of soil erosion on function and role of wetlands, it is important to understand the different definitions of wetlands. The U.S. Fish and Wildlife Service defined wetlands as "Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface." This definition does not include areas with permanent standing water greater than two m deep. Such areas would be defined as aquatic or marine habitats (Cowardin et al., 1979). The Canadian Wetland Classification System defines a wetland as a "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment" (Warner and Rubec, 1997). According to Ramsar definition, Wetlands are areas of marsh, peat land or water, natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed six meters (Davis, 1993, Navid, 1989).

Wetland ecosystems have been recognized to provide various services (de Groot et al., 2002; Zedler and Kercher, 2005; Verhoeven et al., 2006). Services often performed/provided by wetlands (although not all at the same time or to the same degree) include storm water detention, flood protection, water quality enhancement, freshwater fisheries, food chain support, biodiversity, carbon storage, climate modification, wild foods medicine, fire woods, building poles, pasture and thatch material, retention of soil and the cycling of nutrients (Hassan et al., 2005, Gilman, 1994). These services are therefore also indicated as wetland functions(Maltby et al., 2009). Functions provide a benefit for human societies indicated as services, but its value is sometimes underestimated. Although some wetlands provide more benefits than others, all wetlands are considered to be important and are in need of sustainable management (Goretty, 2004).

Wetlands have been used for agriculture for thousands of years and xpansion of agricultural activities, mining and grazing into the wetlands were the most serious threat to the survival of the many environmental resources in it (Hategekimana, 2005).The natural wetland ecosystems reclaimed have lost much of their original character, leading to reduced biodiversity and reduced

performance of function other than crop productivity (Hassan et al., 2005). Although wetland protection is officially a priority for the 159 nations (as of 2009) that have ratified the Ramsar Convention, wetlands continue to be under threat of being drained and reclaimed.

Wetland change may occur so slowly and it appears unnoticeable over a single human lifetime. However, the processes of sedimentation and organic deposition are constantly at work. Many wetlands occuralong streams or lakes; when these wetlands become over landed with sediments and pollutants, the excess will flow directly into the adjacent water bodies, resulting in decreased water quality downstream. Numerous studies have reported that increased soil erosion and nutrients export from land hills are threatening wetland functions. In agricultural areas, sediments that get into the streams, rivers, lakes, and wetlands may contain fertilizers, insecticides and pesticides which in turnaffectanywetland's function such as water quality protection, waterways for transport, flood storage, and fish habitats water (Raven et al., 1998). 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 and phragmites. These species can out competes native plants form monocultures and reduce habitat complexity. 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. 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 Na and Italy.

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 been 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 roles and functions aspects.Much of wetlands in Rwanda especially mashes are vulnerable and must be protected. Like other inland or coastal wetlands worldwide, Rwandan's wetland played significant ecological, hydrological, socio-economic, historical and recreational roles. They are habitat for endemic bird species and for the local population; they offer many

opportunities as source of fish, meat, honey and plant material that can be used in construction (Hategekimana, 2005).

Methodology

Burera District is located in northern of Rwanda and bordering with Uganda. It has temperate climate characterized by two rainy seasons around October - December and April - Jun and two dry seasons around January - March and July – September with annual average temperature of 22 ° C. High temperatures are observed in August where they reach 28 ° C in the middle of the day. Rainfall normally reaches 1,208mm per year on average.

Table 1: Rainfall average in some regions of Burera District 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

This study was carried out from January to July 2010 and implemented a case study research design. Both qualitative and quantitative data from primary and secondary data sources were collected to present a description of the phenomenon or the experience from the perspectives of the respondents. The primary data were collected from a stratified multistage sample of 367 population located in two sectors of Burera District, namely Nemba and Ruhunde. Instruments used included a questionnaire guide, an interview guide and a field observation guide. The questionnaire contained both close ended and open ended questions in order to solicit information.

3. Data Presentation and Interpretation

3.1 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%) are farmers, 3.73% are unemployed, 2.48% of them are retailers and 1.24% of respondents are students.

Table 2: 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

Source: Fieldwork

In term 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 3: 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

Source: Fieldwork

3.2. Impact of soil erosion on wetland

Movement of sediment and associated agricultural pollutants hills land into wetlands is the major off-site impacts. Sediments harm wetland functions such as transport, water quality and quantity, disruption of the ecosystems and socio-economic status.

Table 4: Impact of soil erosion on 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

Source: Fieldwork

3.2.1 Transport impact

Transport is an essential service for every human being. People are always in need to move from both sides of wetland for several reasons. They need to visit their friends and relatives, to get services and goods offered by others such as health, education, official documents, markets, etc. In some wetlands, the boats are comfortable means of transport where people created the channels that help the boat to navigate. An example isRugezi wetland located in Burera District, the drying of this wetland caused by sediments for soil erosion affected the transport in the canoeing channels and 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 income which they gained from this activity. The riparian population crosses the marsh on foot because the marsh abounds no more in water everywhere (Haegekimana and Twarabamenye 2006). For 367 respondents, 7.4% declared that the transport is impacted negatively by the sediments deposited in wetland surface and channels.

3.2.2 Ecological impact

Plants

The plants species in many wetlandsof Rwanda are dominated by *Miscanthusviolaceus, Thypha sp., Pycreusnitidus, VacciniumStanleyi, Erica sp., Xyrisvalida,* Anthropic vegetation of *Cyperuslatifolius and Cyperus papyrus* accompagned with *Juncusoxycarpus, Crassocephalum sp., Dicrocephala, Spilanthes, Helichrysum sp., Ranunculus multifidus; Dicrocephalaintefrifolia*.Due to the sediments comes from soil erosion, some plants are disappeared and others cannot grow properly.

Figure 1: Plant species in wetland

Source: Fieldwork

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.Consider the Rugezi wetland, It does provide a spawning habitat for vertebrates and invertebrates animals. For ornithological communities, 19 species are identified.

Table 5: Birds species in Rugezi wetland

Scientific Nouns	Common nouns in French

Ardeamelanocephala	Heron melanoceephale
Ardea idea	Crabierblanc
Bubulcus ibis	Heron garde boeuf
Scopus umbretta	Ombretteafricaine
Bostrychiashagedash	Ibis hagedash
Threskiomisaethiopicus	Ibis sacre
Platalea alba	Spatule d' Afrique
Balearicaregulorum	Grueroyale
Vanelluscrassirostris	Vanneau a ailes blanches
Hirundoangolensis	Hirondelle de l'angola
Psalidoprocnealbiceps	Hirondelle a tete blanche
P. holomelas	Hirondelle de Ruenzori
Ripariapaludicola	Hirondellepaludicole
Motacillaflava	Bergeronnetteprintaniere
Anthusrichardi	Pipit de Richard
Euplectes axillaries	Euplecte a epaules oranges
E. afer	Euplectevorabe
Serinusatrogularis	Serin a gorge nore
Bradypterusgraueri	Fauvette de Grauer

Source: MINITERE, 2003.

The *Bradypterusgraueri* account for 3000 pairs of that species where worldwide account for 10000 only (MINITERE, 2003).The ichthyologic communities in that wetland are scarcity because of the P^H conditions ranging from 4.6 to 6.2 (Hakorimana, 2006). The sediments from soil erosion inwetland 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 *Clariasliocephalus).*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 *ClarialiocephalusHaplochromis* 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 Clariasliocephalus reduced in 5 years ago and some birds are migrated such as ducks. 38.1% of respondents consider the sediments of soil erosion to be negative impact on ecology of wetlands.

Figure 2: Animal species in wetland

Source: Fieldwork

3.2.3 The impact on Socio-economics and culture

Wetlands used to have a lot of economic advantages for the local people living near it. However, the degradation affected their transport system, food sources, fishing and materials for weaving. In 1999, before the more severe degradation of wetlands, the local fishermen were exporting fish to Tanzania. Hategikimana (2005) found that 2 percent of surveyed sample were able to buy livestock from fishing. In addition, the wetland played a capital role in the economic life of the communities living around it, including transport where the boats owners are grouped in associations and they could earn up to Rwf 1,000 each per day. Wetlands vegetal species are valuable to local people especially the poorest communities. 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). 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 and provide money for local people; 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. The Batwa community has not been spared by the degradation of wetlands. 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.Wetlands are socially important for: education, scientific research, recreation and tourism, cultural and heritage values, landscape and aesthetic values (Hakorimana, 2006).Wetlands attract tourists for their beautiful environments especially when they are connected to lakes that are easily accessible by road. Also, tourists interested in the historical and cultural values of Rwandan people. For hundreds of years the local Batwa communities have lived in a symbiotic way with the wetland and have also played a very important role in Rwandan history. Some flowers collected in wetland are used in the marriage ceremonies and in the churches.

Figure 3: Flowering plants in wetland

Source: Fieldwork

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 effects 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 function

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 management, the Rwandan wetlands were regulating, retaining and filtering the water resources that flow into downstream lakes (Hategekimana, 2005). Wetlands of Rwanda are of international importance because they are water sources for both Lake Victoria and White Nile (Helpage Rwanda 2004). The deposition of sediment in water bodies can lead to the alteration or destruction of aquatic ecosystems(Leila et al., 2009). Sediment also acts as a vehicle which, through adsorption or absorption, transports other possibly more environmentally damaging pollution.Recent energy shortages have been attributed to considerable fall of the water level in the lakes due to sedimentation. Hydroelectric production of the Power plants 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. Another major hydraulically impact results from the agricultural chemicals that often move with eroded sediment is the pollution of downstream watercourses and water bodies; where inputs of agricultural chemicals are high cost of removing such pollutants from drinking water.With the passing years, the wetlands were degraded by diverse activities: agriculture, fire, and plants species overexploitation. 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 wetland.

Figure 4: The hydrology of wetland

Source: Fieldwork

5. Conclusion

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 cannot 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.

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