Striving for restoration of wetlands functions and values in the City of Kigali

Nizeyimana Alexis

Department of environmental and development studies, University of Lay Adventists of Kigali (UNILAK), Rwanda

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Abstract— *This work aimed to present the commitment of the Government of Rwanda of relocating all illegal activities from wetlands in the framework of environmental protection; to highlights human activities established into wetlands of Kigali City and their categories; and to mention some initiatives of restoration. Its scope is limited to governmental policies presentation and analysis, to the presentation of different activities that degrade wetlands in the City of Kigali and to highlight some initiatives for restoration.*

Documentation, camera and field survey were used in data collection and ArcGIS 10.2 was used as software for spatial analysis and presentation and the survey covered all districts of the City of Kigali. Activities that harm wetlands include: residential home, commercial activities, industrial activities, parking, garages, ware houses, carpentry and welding workshops, dumping sites, bricks burning, petrol stations, carwash, schools, health centers, worship houses, domestic animal growing and play grounds.

Relocation of these activities is the enforcement of the environmental law and the government commitment to environment management. Some of these activities were legally established and their relocation has to be compensated and those illegally established will not be compensated. Many of these wetlands will be left into conservation in order to recover their functions of storing and releasing water and buffering the impacts of floods; providing habitat for plants and animals; providing water storage, improve water quality and reduce pollution, etc. Some few other will be made up into recreational areas like Nyandungu Recreational Park, Kimicanga Entertainment Center and Gikondo wetland parks.

Keywords— biodiversity, ecosystem, Kigali, restoration, wetlands.

I. INTRODUCTION

Wetlands are aquatic ecosystems with plants, animals and soils that are adapted to wet conditions which often require and can survive permanent or periodic inundation. Water in wetlands can be still or flowing; it can be fresh, salty or brackish. Wetlands do not have to be continuously wet; some wetlands can remain dry for years at a time [1].

Wetland functions and values are the roles that a wetland performs resulting from specific characteristics of the wetland and the wetland's watershed. Functions are self-sustaining properties of a wetland ecosystem that exist in the absence of society without regard to subjective human values. Values are the worth, merit, quality, or importance of a wetland to society based on either one or more functions and physical characteristics associated with the wetland [2].

Wetland ecosystems represent 4% of Earth's surface, yet comprise approximately 45% of the realized value of natural ecosystems. Wetlands provide important functions such as filtering contaminants, removing nutrients and sediment from runoff, contributing to groundwater recharge, storing floodwater, stabilizing shorelines, and providing habitat for numerous fish and wildlife species [3].

In particular, urban wetlands provide a variety of benefits and services to the community. In addition to providing habitat for plants and animals, wetlands provide water storage, improve water quality and reduce pollution. Wetlands also protect against natural hazards, slowing floodwaters, reducing the risk of fire and protecting against erosion of river banks and coastlines. Wetlands and associated vegetation can provide a cooling effect to surrounding areas in summer and also moderate strong winds.

Wetlands also contribute to the well-being of the community by acting as urban green spaces which provide aesthetic appeal, landscape diversity and recreational opportunities. They also contribute to cultural heritage, spiritual values and they provide easily accessible educational opportunities to learn about the environment [4].

As a beautiful place to live and work in, over 13% (8,740ha) of the City of Kigali is covered by wetlands [5]. Kigali has contributes unique attractiveness of landscapes. The City of Kigali; the Capital of Rwanda is built on hilly area, sprawling across about four ridges and the valleys in between. These Wetlands are Kigali's key hydrological features. These wetlands have important environmental functions, such as storing and releasing water and buffering the impacts of floods. They have been threatened by human activities including the conversion to agriculture, human settlements and industrial uses, and when used for livestock activities and sand quarries. As a result of such impacts, by 2006, only 24 per cent of Kigali's original wetland areas remained [5].

For instance, the urbanized sections of the River Nyabugogo system have been found to be high in heavy metals, such as lead and chromium, and nutrients from organic material and soil runoff [6]. Polluted water exposes households to the risk of contracting diarrheal and other water-borne diseases, especially since 30.2 per cent drink this water without any prior treatment (NISR, 2012a). The prevalence of diarrheal disease in children in urban areas is 9.8 per cent [7].

This work aims to present the will and commitment of the government of Rwanda for relocating all unnecessary activities from wetlands across the country and in Kigali particularly in the framework of environmental protection especially for conservation of the existing swamps; to highlights different human activities established into wetlands of Kigali City and their categories; and to mention some initiatives of restoration that have started.

The scope of this work is limited to governmental policies presentation and analysis, to the presentation of different activities that pollute or destroy wetlands in the City of Kigali and their categories and to highlight some initiatives for restoration. The analysis will be based on the survey outcomes; the mentioned survey has been conducted in July – August 2017.

II. MATERIALS AND METHODS

The survey covered all wetlands in the three districts of the City of Kigali: Nyarugenge, Kicukiro and Gasabo; and it took 35 days with 3 teams from different public institutions. Data collected on every activity were concerning, in addition of location, activity owner, year of establishment, material in which the stuff is made, the document related, number of the parcel, etc.

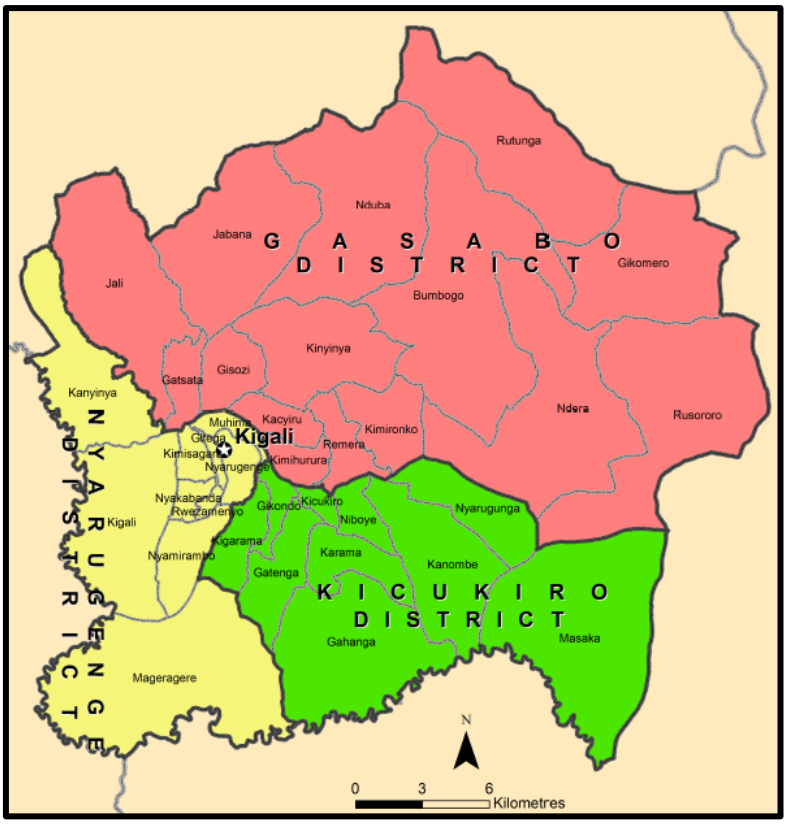

FIGURE 1: Administrative Districts and Sectors of Kigali

In addition of the form for identification, in this work we used the Kigali Master Plan in order to identify limits of wetlands and the planned land use for inventoried activities. We also used cameras for taking some photos that will illustrate what we saw. The ArcGIS 10.1 software has been used for producing some illustrative maps of the work.

Field survey has followed these steps: Physical checking on swamps to highlight the unlawful activities conflicting with the map of swamps, record them and propose a solution in order to relocate them.

III. RESULTS

The conducted data collection has shown that at least 13.8% of the surface area of the City is covered by swamps. The following table indicates the statistics for swamps situation in each District of the City of Kigali. The big number of parcels is to be found in the swamps buffer because it is easy to subdivide land in swamp buffer than the one completely falls within the swamp. The other reason behind should be the way an area was occupied before the systematic land registration of 2010.

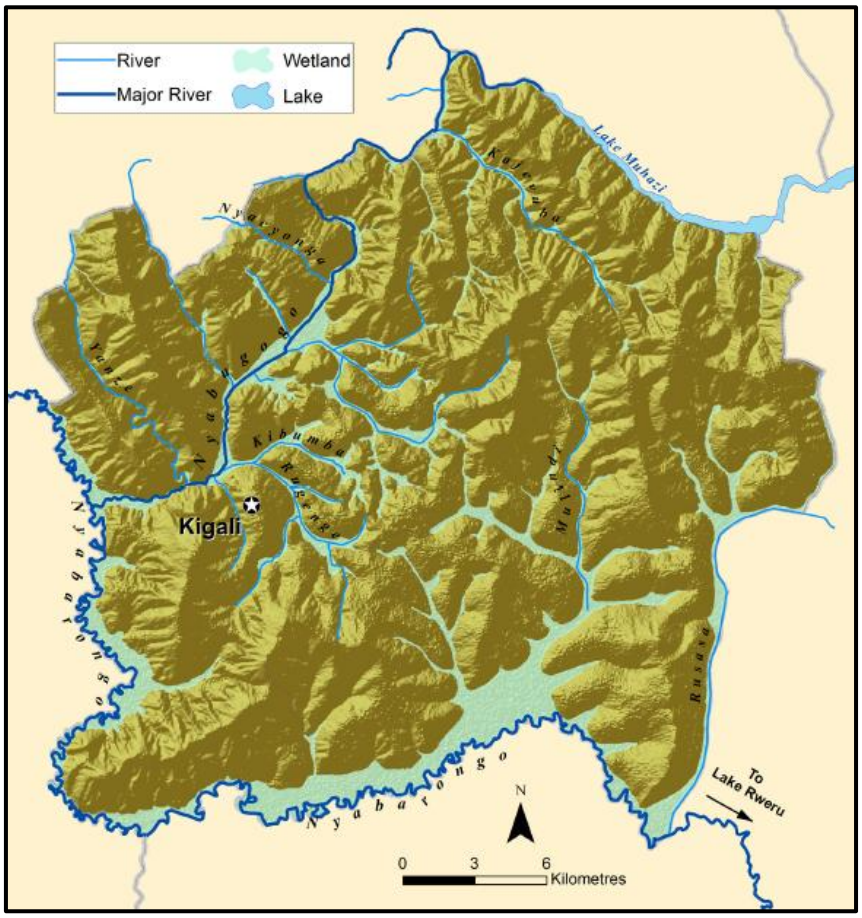

FIGURE 2: Kigali's network of rivers and wetlands

TABLE 1
THE CITY OF KIGALI URBAN SWAMPS PER DISTRICT

No	Kigali City Districts	Land area (Ha)	Wetlands (Ha)	Wetland Buffer (Ha)	Percentage
1	Gasabo	429,146	2,826	736	8.28
2	Kicukiro	133,147	2,880	190	18.3
3	Nyarugenge	167,213	1,970	138	15
	Total/CoK	729,506	7676	1064	13.8

Source: Kigali Master Plan 2013

All activities have been grouped into 17 categories: residential home, commercial activities, industrial activities, parking, garages, ware houses, carpentry and welding workshops, dumping sites, bricks burning, petrol stations, carwash, schools, health centers, worship houses, domestic animal growing and play grounds.

FIGURE 3: Images of some illegal activities into the city of Kigali wetlands

TABLE 2
CATEGORIES OF ACTIVITIES DAMAGING WETLANDS IN THE CITY OF KIGALI

Activity	District			Total	Legal	Without legal Documents
	Gasabo	Kicukiro	Nyarugenge			
Residential home	1177	306	146	1629	703	926
Commercial activities	61	3	37	101	79	22
Industrial activities	6	73	5	84	78	6
Parkings	10	4	25	39	3	36
Garages	9	6	15	30	4	26
Ware houses	12	1	17	30	23	7
Carpentry and Welding Workshops	8	0	6	14	0	14
Dumping sites	4	2	10	16	0	16
Bricks burning	18	5	12	35	20	15
Petrol Stations	4	1	19	24	22	2
Carwash	2	0	4	6	0	6
Schools	2	2	2	6	2	4
Health centers	2	0	0	2	2	0
Worship houses	7	1	3	11	5	6
domestic animal growing	97	7	12	116	0	116
Play grounds	9	3	4	16	0	16
Garden centers	6	4	43	53	5	48

Source: Field survey

IV. DISCUSSIONS

Urban developments, including residential expansion and industrial and commercial activities, have contributed to the loss or degradation of Kigali's wetlands. The habitat's natural vegetation, dominated by C. Papyrus and a variety of Pennisetum, has been severely affected by industrial and household wastes. Industrial activities, such as brick making and sand mining, have contributed to the degradation of Kigali's wetlands.

For example, only parts of the Gikondo valley still fully function as a wetland because drainage and compaction from developments have degraded large parts of the area [8].

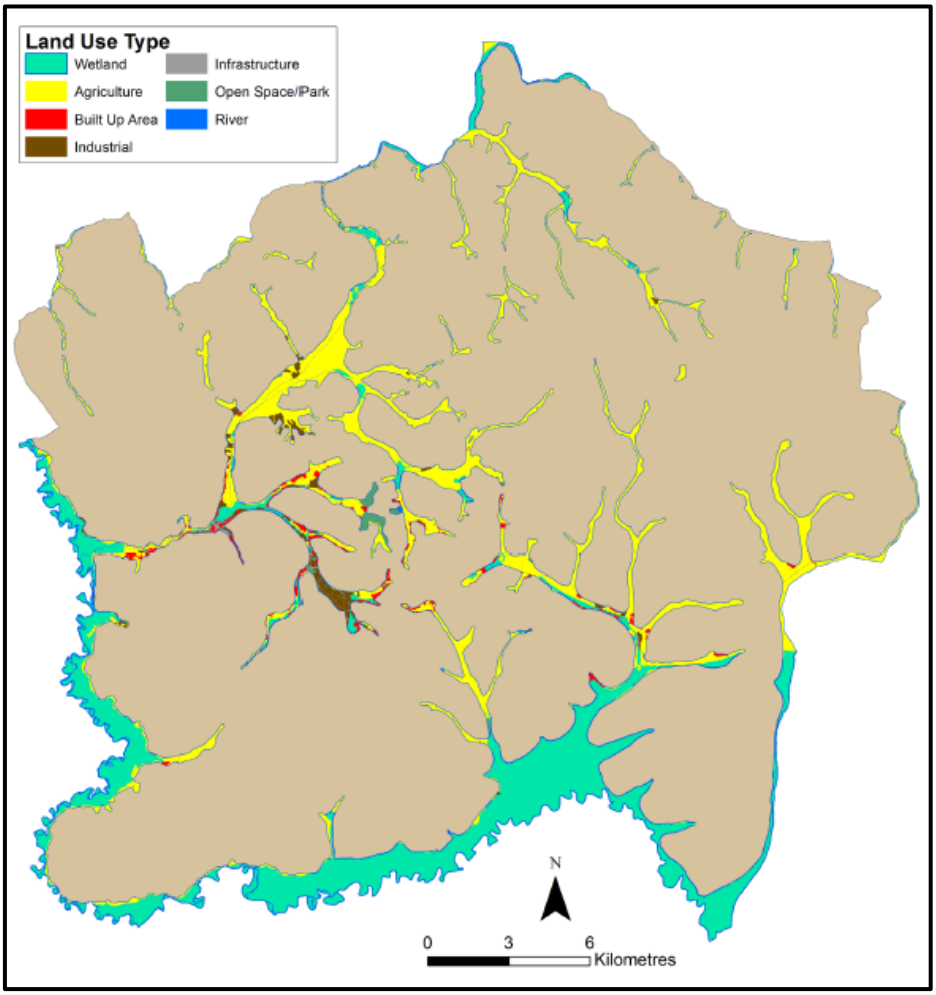

FIGURE 4: Types of land use currently in wetlands

Approximately 50 per cent of the wetlands in Kigali function as something other than a wetland (Fig. 3). Agriculture takes place in slightly over 39 per cent of wetlands. Built-up areas consisting of commercial buildings, public facilities and residences make up 2.7 per cent of wetlands. Green spaces, such as parks and rivers, account for less than 1 per cent. Over time, as sustainable city plans become implemented and constructed installations are removed from them, wetlands will start to regenerate [5].

Based on above findings, urban wetlands of the City of Kigali degraded drastically and their functions faced pressure from these activities. The consequences that are used to people of Kigali are several floods and the water pollution.

For years, a group of garages in Gatsata Sector, Gasabo District, known as the 'Gatsata Garages' were responsible for hazardous oils and heavy metals directly entering the Nyabugogo wetland because they lacked the proper infrastructure for waste disposal. Furthermore, most of the garage operators did not have toilets, making them dangerous to the natural environment and the health of members of the cooperatives operating in the neighborhood [9]. The garages' negative impacts on the wetland were so visually striking that the government moved quickly to relocate them to higher ground. Also, several garages that were affecting the wetland ecology, and whose businesses suffered during flooding events.

The article 19 of the Law N° 43/2013 of 16/06/2013 governing Land in Rwanda states that Swamp land belongs to the State. As stipulated by Article 116 of the Organic Law N° 04/2005 Of 08/04/2005 determining the Modalities of Protection, Conservation and Promotion of Environment in Rwanda states that the owners of the existing activities that do not respect the requirements in this organic law are obliged to respect the requirements of this organic law in a period not exceeding two (2) years from the day it comes into force [10].

The article 87 of the same law states that it is prohibited to construct houses in wetlands (rivers, lakes, big or small swamps), in urban or rural areas, to build markets there, a sewage plant, a cemetery and any other buildings that may damage such a place in various ways. All buildings shall be constructed in a distance of at least twenty (20) meters away from the bank of the swamp. But the law promulgated in 2005 was not respected.

As a result, people who have activities which were set up in an illegal way should relocate them to the suitable locations without compensation but those whose activities were set up in a legal way will be compensated for their relocation.

The relocation of all these activities from wetlands is imperative. Even if the operation would take long time but the political will is there, the law is clear and some activities started to be relocated like Gikondo Industrial Park that relocated to Kigali Special Economic Zone and Gatsata Garages that finished to be relocated.

After relocation of these activities, wetlands will be rehabilitated and surely, their recovery will be quick as some signs shown it at Gatsata.

Other wetland will be developed into recreational areas like Nyandungu that is being developed into recreational park.

FIGURE 5: some layout designs of Nyandungu recreational park (above is the Pope visit commemoration garden)

Some other projects for recreational purposes are being undertaken to preserve wetlands within the City of Kigali. Among them there is Kimicanga Entertainment Center in Gasabo District and Gikondo wetland parks.

V. CONCLUSION

The aim of this work was to present the will and commitment of the government of Rwanda for relocating all unnecessary activities from wetlands across the country and in Kigali particularly in the framework of environmental protection especially

for conservation of the existing swamps; to highlights different human activities established into wetlands of Kigali City and their categories; and to mention some initiatives of restoration that have started.

From our findings laws and regulations have been in place and this important as the government will. I addition, the action of identification of all activities into wetlands of the City of Kigali shows the high commitment in laws enforcement by the government. The potential polluters of wetlands have been identified and their implications in wetlands degradation.

All these activities will be relocated for the purpose of environmental protection in general, especially for conservation of the existing wetlands and protecting lives and businesses affected by the negative impact of their degradation. In this framework, people who have activities which were set up in an illegal way should relocate them to the suitable locations without compensation but those whose activities were set up in a legal way will be compensated for their relocation.

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