

Wetland Based Ecotourism for Sustainable Conservation in Rwanda: A Case Study of Rugezi Wetland

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ABSTRACT

Wetlands are among the most productive and important ecosystems on the earth, yet they have been subject to repeated and dramatic historical losses, and until nowadays, they continue to be at high risk of degradation and total destruction. This study aimed at analyzing the wetland-based ecotourism for sustainable conservation in Rwanda particular Rugezi wetland as study area. In addition, the study centered on application of remote sensing technology, where three (3) Landsat images (1980; 2000; and 2020) were classified using supervised classification approach, with maximum likelihood technique, and served the analysis of Land Use and Land Cover (LULC) changes in Rugezi wetland. The study also focused on use of consultative approach consisted of Questionnaire survey addressed to local community and focused group discussion addressed to Burera youth Community whom in charge of Rugezi wetland conservation activities. The study findings revealed that the major ecotourism activities that are practiced within Rugezi wetland are highlighted to be Bird watching, research-based ecotourism, cultural preservation, nature walking, hiking, and visiting Rugezi waterfall. Secondly, it was also revealed that the measures and technique used to enhance sustainable conservation are highlighted to be Terracing around the wetland high slopes, Setting buffer of 50 meters from wetland, participation of local community in plastic removal from wetland through umuganda, Forbidding from collecting the grasses in wetland and give them the substitute, Afforestation and reforestation along the wetland, revenue sharing, Establishment of art and craft cooperatives, engagement of local community among wetland rangers. Moreover, to analyze the impact of Ecotourism in conservation of Rugezi wetland, the LULC changes have been analyzed

and result revealed that Rugezi wetland has greatly degraded in 2000s where 48.59% of Rugezi total area was degraded for agriculture compared to 26.76% in 1980. At the same time, the forest cover as measure to conserve the wetland, has increased to 10.34Km² in 2000 from 7.62Km² in 1980. In 2020, the wetland has restored and reached to 47Km² out of 66.19Km² which is 71.01% of total wetland. Based on this, such contribution of ecotourism is based on revenue sharing as ecotourism-based activity generated income. The study suggest that the relevant stakeholders must put more efforts in road contribution so that to help the arrival Eco tourist and the development of ecotourism which will contribute to the sustainable conservation.

Key words: Ecotourism, sustainable conservation

I. INTRODUCTION

Wetlands are ecosystems in which water covers the land. They provide economical, ecological, societal and recreational benefits to humans (Menbere & Menbere, 2018). In fact, wetlands are commonly used as areas of agricultural and grazing lands, in addition to their various benefits they support human wellbeing by offering food, fodder, fiber, fuel wood, timber and non timber forest products, wetlands also play an essential role in the ecological condition of the environment and they are important in maintaining natural cycles, water purification, climate regulation, flood regulation and coastal protection (Menbere & Menbere, 2018). In this period of rapid global development, riparian and wetland ecosystems have been terribly deteriorated with the rise in human demands for more available places for cultivation, water management, lodging, and infrastructure development (Bhatt, S, 2020).

Wetland conservation through ecotourism is mainly key in developing countries, where governments lack enough funds to manage their natural resources including wetlands, which are now threatened by human activities (Chaikumbung et al, 2016). Through this approach of ecotourism wetlands ecosystem conservation is promoted and the same time the local community livelihood is economically improved through employment income. Wetlands represent a significant part of the worldwide tourism experience and are expected therefore also to be a crucial part of the growth in demand for tourism locations. The natural beauty of wetlands attracts people and this reflects the strong connection between the unique aesthetic appeal of wetlands and people (UNWTO, 2012).

On worldwide extent, wetlands have deteriorated by 87% over the last 300 years and 54 % since 1900 (Wiberg et al., 2020). Wetlands are among the most productive and important ecosystems on the earth, yet they have been subject to repeated and dramatic historical losses, and until nowadays, they continue to be at high risk of degradation and total destruction as it was estimated that 50% of salt marshes and 35% of mangroves have been either lost or degraded with the proportion exceeding 90% in some areas (Gibson et al., 2015). In fact, the world has lost 64 to 71% of its wetlands during 20th and 21st centuries, and those losses have been larger and faster than other previous centuries (Kharel, 2011).

By referring to the case of Africa, African continent has high population growth with 32 countries with highest growth rate world-wide, as result of this fact the services that wetland provides continue to be degraded considerably (Mitchell, 2013). The population pressure on fragile wetland ecosystem has created various problems such as decline and extinction of wild flora and fauna, loss of natural soil nutrients, shrinking of water level and the associated reduction of their benefits (Menbere&Menbere, 2018). For the sustainable conservation of wetlands, several studies have recommended the use of ecotourism or nature-based tourism as the efficient wetland's conservation strategy. Ecotourism wetland conservation strategy emphasis on conserving wetland ecosystem and can also be a way to make wetlands economically viable, and can provide employment and income for local people (van der Duim&Henkens, 2007).

On case of Rwanda, before the colonial period, the role of wetlands was not clearly known because they were considered as marginal land. It

is since 1980s when, wetlands became land reserves in order to get solutions to the problem of demographic pressure. However, many wetlands development schemes were introduced and implemented without considering their hydrological and environmental traits (Hatege kimana& Twarabamenye, 2007).

It was in 2004 that Rwanda made different intervention to restore and rehabilitate Rugezi wetlands, and in 2006 Rugezi wetland was gazette as a Ramsar site by the Government of Rwanda (Nile Basin Initiatives, 2019). The restoration of Rugezi wetland had an impact on local community that lost access to the wetland and the livelihood of the local population that used to have benefit on ecosystem services provided by the wetland in the past was challenged. Fortunately, the restoration efforts appear to have started to provide some benefits and new opportunities such as ecotourism were introducing in area in order to improve local population livelihood (Hategekimana&Twarabamenye, 2007).

II. MATERIALS AND METHODS

2.1. Study area description

The research will be conducted on "Rugezi wetland", the only Ramsar site in Rwanda, located in Northern Province, Burera District, where it is surrounded by six sectors: Butaro, Ruhunde, Kivuye, Gatebe, Rwerere, and Cyeru, within the Buberuka highlands. Most of the residents around the wetland are farmers who domesticate animals at home and feed them on the planted grass.

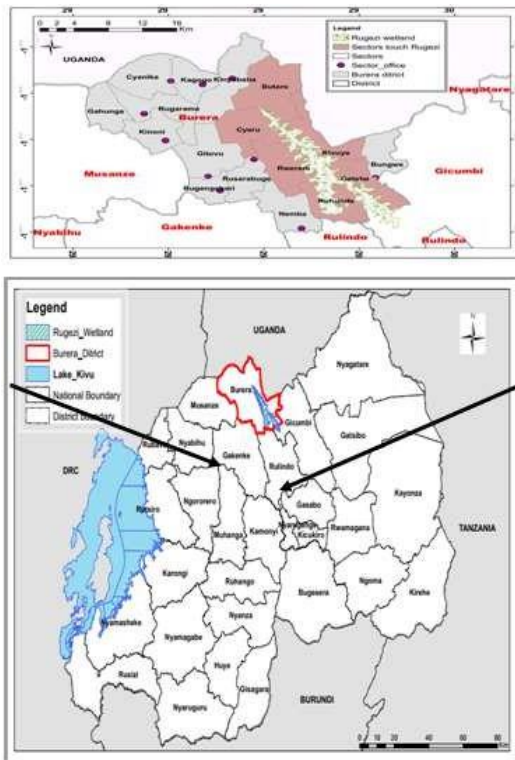


Figure 2.1 map showing location of Rugezi wetland

2.2 Sample and data collection techniques

This research used simple randomly sampling technique to select the population to represent the population by randomly sampling because local community who lives around the wetland is concerned with the research case because they were considered to have some information related to the wetland. Random sampling was applied in selecting participants to local community questionnaire survey. Focus group was used on Burera youth community because the Researcher found it wise to have important information as long as they are in charge of wetland conservation and ecotourism activities. The secondary data that used in this research were documents analysis and spatial datasets, Remote sensing because of its capability of synoptic viewing and repetitive coverage provides useful information on land use/ cover dynamics. Remotely sensed data was used in order to observe and compare changes in land use/ cover due to natural and human activities. The remotely sensed data was important to compare with the primary sources of data such the questionnaires and field observations to enhance validity and reliability of the results.

The number of local communities who participated in the survey was selected using the

following sampling formula, which is applied in the finite population (Krishnaswamy, Sivakuma, Mathirajan, 2006) as follows:

It is computed as $n = N / (1 + Ne^2)$.

Whereas:

e = the tolerable error (10% in this study).

N = population size

So, $n = 117205 / (1 + 117205 * 0.1^2) = 99.9$

n=100

In every sector, 17 populations have been randomly selected and 16 populations in two sectors.

2.3. Data Analysis and Interpretation

This research was principally based on use of consultative approach and Remote sensing (classification of satellite images) it is mainly comprised of both qualitative research approach and quantitative research approach. Also Remote Sensing was more privileged techniques because the research analyzed the sustainable conservation measures through referring to wetland degradation perspectives. Data analysis involves presenting the collected data in the analytical framework. This was focused on editing, coding and tabulation all relevant information for easy understanding and interpretation. The Editing was conducted in order to guarantee accuracy, consistency, completeness and uniformity of the collected data for better coding

III. RESULTS AND DISCUSSIONS

3.1. Main ecotourism activities that are practiced in Rugezi wetland

This section presents the findings on main ecotourism activities that are practiced within Rugezi wetland. Based on field observation findings the main ecotourism activities that is practiced in Rugezi wetland are highlighted as visiting Rugezi waterfall, nature walking or wetland touring, bird watching, hiking, research-based activity and visiting culture preserved center controlled by Burera youth community. All those ecotourism activities are in details based on its specification as it is computed based on respondents' answers where among 100 respondents there is a certain number that estimate the ecotourism activities taken place at Rugezi and at which percentage tourists do these tourists activities.

Table 1.1: Known ecotourism activities that are practiced in Rugezi wetland.

Known ecotourism activities that are practiced in Rugezi wetland	Number	Percentage
Rugezi waterfall	15	15%
Nature walking	25	25%
Bird watching	10	10%
Research based ecotourism	15	15%
Cultural preservation in cultural center.	30	30%
Hiking	5	5%
Total	100	100%

(Source: Primary data, 2022)

Based on respondent the most known ecotourism activity in Rugezi wetland is cultural preservation in cultural center because of curiosity to know the elements that kept in the cultural center and the history behind them.

3.2. Terracing around the wetland high slopes, Buffer of 50 meters and Plastic removal from wetland through community work known as umuganda

As Rugezi wetland is mainly found on high slope of Buberuka highland, the practice of making terraces on the side slope of wetland is among the key measure used to control such tremendous soil erosion that cause flooding inundation in wetland.

This table shows the Wetland conservation measure that local community intervene within, where they participate in Terracing around wetland high slope, Afforestation and re-afforestation on buffer of 50m from wetland, Grabbing plastic and other hazardous material in wetland through community work.

Table 3.2: Local community participation in conservation activities

Wetland conservation measure that local community intervene within	Number of respondents	percentage
Terracing around wetland high slope	10	10%
Afforestation and re-afforestation on buffer of 50m from wetland.	20	20%
Grabbing plastic and other hazardous material in wetland through community work	70	70%

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(Source: Primary data, 2022)

According to the table, respondents highlight their contribution on sustainable wetland conservation through intervening in practice of making terraces on side of Rugezi wetland, other 20 respondents highlight their participation in sustainable wetland conservation under practice of afforestation and re-afforestation along 50m buffers zone from wetland and remaining 70 respondents intervene in community work through practice of plastic removal in wetland. Based on the findings from questionnaire survey addressed to local community, community work known as „Umuganda“ is key measure that is participated by many respondents for sustainable wetland conservation practice.

3.3 The contribution of wetland-based ecotourism to the sustainable wetland conservation

3.3.1. Rugezi wetland: Land Use Land Cover; 1980, 2000 and 2020

Maximum likelihood technique in Supervised classification was used for preparing LULC map of Rugezi wetland for 1980, 2000 and 2020. The user accuracy, the producer accuracy, overall accuracy and kappa coefficient for each year are calculated.

Table.1: Rugezi wetland LULC classes, 1980

Classes	Area in sq.km	Percentage (%)
Wetland	36.87	55.70
Agricultural land	17.71	26.76
Water body	2.72	4.11
Forest	7.62	11.51
Built-Up	1.27	1.92
Total	66.19	100.00

According to Table above, the spatial distribution of LULC of 1980; the part of wetland that was not deteriorated was most dominant class among other LULC classes in 1980 which occupied 36.87km² out of total wetland area of 66.19Km², it means it was 55.7% of the total wetland area that was not deteriorated.

Likewise, Agricultural was the second dominant LULC class in 1980, where it covered 17.71Km² out of 66.19Km² which is 26.76%. the third LULC class was the forest cover with 11.51% of total wetland area, it means 7.62Km² out of 66.19Km². The fourth one was the water bodies with 2.72Km² out of 66.19Km². The least LULC class was the built-up area in 1980. Built up area covered 1.92% of total wetland area.

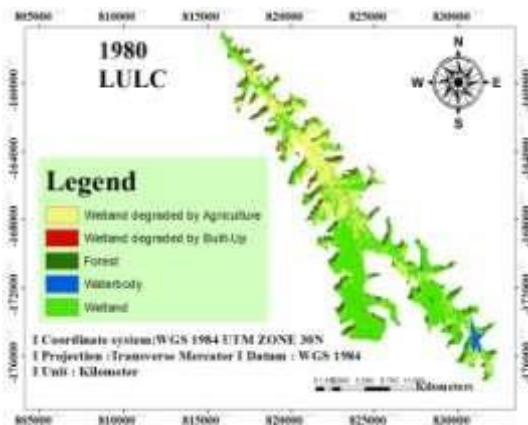


Figure 3.3.1. Rugezi wetland LULC map, 1980

The ecotourism in the area was started in 1983 with only one activity which is research and no known institution which was in charge of this ecotourism. The reason one to elaborate the status of Rugezi wetland in the period near the ecotourism was started.

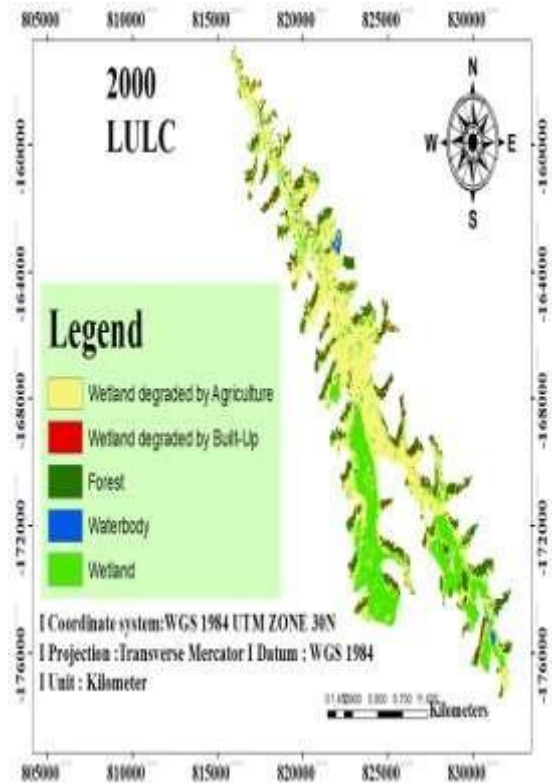


Figure 3.3.2: Rugezi wetland LULC classes map, 2000 Resources (Primary data, 2022)

Table.2 Rugezi wetland LULC classes

Classes	Area in sq.km	Percentage (%)
Wetland	19.43	29.35
Agricultural land	32.16	48.59
Water body	2.74	4.14
Forest	10.34	15.62
Built-Up	1.52	2.30
Total	66.19	100.00

In 2000, wetland degradation was very high and visible. Among the activities that compensate this degradation, agriculture is the most contributor where it shifts from 17.71Km² in 1980 to 32.16Km² in 2000. This was very noticeable and very visible degradation because the undisturbed wetland was only covering 19.43Km² out of total wetland of 66.19Km². According to the study of Hategekimana & Twarabamenye (2007), they revealed that the degradation of the Rugezi wetland began to be evoked from 2000s. In other words, the appearances of this degradation were almost sudden. However, information from scientific report done by RRAM, pointed out that this degradation was noticed to have occurred gradually

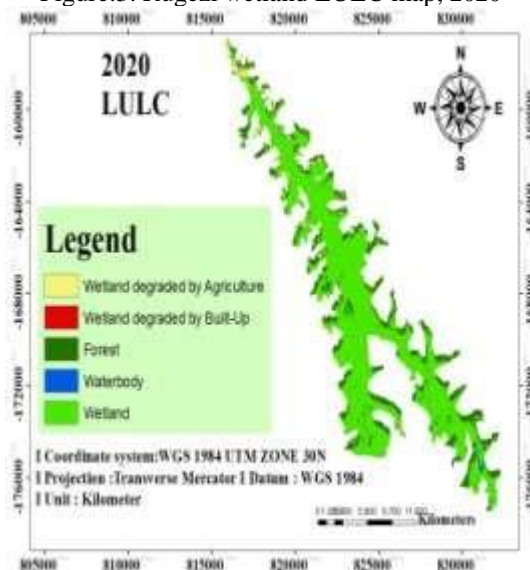
by different anthropogenic activities led by different stakeholders (government projects, authorities and population).

The forest cover also has increased to 10.34Km² in 2000 from 7.62Km² in 1980. This was good measure to conserve the wetland but afforestation around the wetland alone was not enough without other measures like limiting from exploiting the wetland. Water bodies did not change much; it means it was not disturbed. Built up also did not affect the wetland too much.

In the study of Hategekimana & Twarabamenye (2007), stated that the southeast zones which was degraded from 1960-1983, due to the dynamiting effect of the rock wall to create Fels outlet, which sent the water to tea plantation project in Mulindi. As result, the water level fell rapidly and the whole part was reclaimed for agriculture (RRAM, 1998). The outlet was dammed; consequently, the water level got raised. The zone has been restored, the restoration reached not only the rewetting but also created the water bodies. The Northern part was most seriously degraded part as it was completely cultivated and the effects was started to be noticeable in 2000s

Until that time, we can say that, the hypothesis set at the beginning of this research is true. There is no contribution of Ecotourism in conservation of Rugezi wetland, because the ecotourism was started in 1983 but the wetland degradation continues instead of reduction after ecotourism.

Figure.3: Rugezi wetland LULC map, 2020



Classes	Area in sq.km	Percentage (%)
Wetland	47.00	71.01
Agricultural land	3.19	4.82
Water body	1.85	2.79
Forest	13.81	20.86
Built-Up	0.34	0.51
Total	66.19	100.00

Table 3: Rugezi wetland LULC classes, 2020

The wetland in 2020, based on the LULC analysis was restored at the highest level as demonstrated by an increase in the undisturbed wetland from 19.43Km² in 2000 to 47Km² in 2020. Also the forested area as measure of conservation was increased from 10.34Km² in 2000 to 13.81Km² in 2020. The agriculture in wetland also reduced in 2020 to 3.19Km² from 32.16 in 2000. And finally the built up area around the wetland has reduced from 1.52Km² in 2000 to 0.34Km² in 2020. **The factors that contributed to this high level conservation** are the following, reclamation of wetland and declared as RAMSAR wetland in 2006 has had a great impact in the wetland restoration, the development of Ecotourism and establishment of Burera youth community initiative, as NGO who initiate to conserve the Rugezi wetland ecosystem with purpose of ecotourism development and the local community participation in wetland conservation.

3.4 Discussion

Wetlands play a vital role to the community, such as fresh water provision, flood prevention, aesthetic and recreational benefits, etc. However, Wetlands should be recognized as a critical component of long-term livelihood and natural resource management strategies, rather than as resources to be utilized as quick fix solutions to address food and water shortages, as has been typified by Rugezi wetland.

This study presents the important results about how ecotourism has contributed to the sustainable conservation of Rugezi wetland. Currently, the ecotourism activities in Rugezi wetland are highlight to be bird watching, visiting Rugezi waterfall, cultural preservation and museum, nature walking, and research-based activity. The total area of 66.19Km² for Rugezi

wetland as was extracted from Rwanda national spatial data infrastructures were used in this research. The Rugezi wetland degradation and analysis has done based on changes detection from images classification (supervised classification using maximum likelihood) of three different years 1980, 2000 and 2020. The timeline of 20 years of analysis is enough to make any changes comparison on wetland. The ecotourism is said to be started in 1983, the reason why this research makes changes detection from 1980. The findings showed that Rugezi wetland has greatly degraded in 2000s where 48.59% of Rugezi total area was degraded for agriculture compared to 26.76% in 1980. The appearances of this degradation were almost sudden. However, information from scientific report done by RRAM, pointed out that this degradation was noticed to have occurred gradually by different anthropogenic activities led by different stakeholders (government projects, authorities and population). The southeast zones which were degraded from 1960-1983, due to the dynamiting effect of the rock wall to create Fels outlet, which sent the water to tea plantation project in Mulindi and the northern part was completely cultivated and the effects was started to be noticeable in 2000s. At the same time, the forest cover as measure to conserve the wetland, has increased to 10.34Km² in 2000 from 7.62Km² in 1980, this was good progress but forest increase only is not enough to say that the sustainable conservation of wetland.

In 2000, the conclusion can be that there is no strong contribution of ecotourism to sustainable conservation of wetland, because the ecotourism started in 1983 but the serious degradation noticeable in 2000.

In 2020, the wetland has restored and reached to 47Km² out of 66.19Km² which is 71.01% of total wetland-thank to reclamation of wetland and declared as wetland in 2006 together with the development of Ecotourism and establishment of Burera youth community initiative, as NGO who initiate to conserve the Rugezi wetland ecosystem with purpose of ecotourism development. Ecotourism has contributed much in wetland conservation but the important things ecotourism did, is to engage the local community in the conservation activities. The contribution of ecotourism is clearly visible and the hypothesis of this research said that there is no contribution of ecotourism in Rugezi wetland sustainable conservation is not true based on the findings.

Lastly, the study highlighted the key challenges and opportunities facing ecotourism-

based development for sustainable wetland conservation. The key highlighted challenge is lack of infrastructure development, limitation of weather condition, wetland soil type, and high rise of wetland destroyers known as Abarembetsi. The opportunities that are considered as booster of ecotourism related activity which result to sustainable wetland conservation are highlighted to be based on research-based practice with particularity that Rugezi wetland in a special niche for different kind of bird internationally.

IV. CONCLUSION

Wetlands play a vital role to the community, such as fresh water provision, flood prevention, aesthetic and recreational benefits, etc. However, Wetlands should be recognized as a critical component of long-term livelihood and natural resource management strategies, rather than as resources to be utilized as quick fix solutions to address food and water shortages, as has been typified by Rugezi wetland. Rugezi wetland were exploited by local people by doing different activities, including agricultural, collecting grasses, and others which were leading to the strong deterioration of the wetland since 2000, since 1983 there were a kind of ecotourism where there were research activities done by different researchers. From its deterioration it has been restored and In 2020, the wetland has restored and reached to 47Km² out of 66.19Km² which is 71.01% of total wetland-thank to reclamation of wetland and declared as wetland in 2006 together with the development of Ecotourism and establishment of Burera youth community initiative, as NGO who initiate to conserve the Rugezi wetland ecosystem with purpose of ecotourism development. Ecotourism has contributed much in wetland conservation but the important things ecotourism did, is to engage the local community in the conservation activities. The contribution of ecotourism is clearly visible and the hypothesis of this research said that there is no contribution of ecotourism in Rugezi wetland sustainable conservation is not true based on the findings.

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