Research Article

Section: *Geography*

Published in Nairobi, Kenya by Royallite Global in the *International Journal of Research and Scholarly Communication*.

Volume 5, Issue 1, 2022

Article Information
Submitted: **5th January 2022**
Accepted: **17th March 2022**
Published: **6th April 2022**

Additional information is available at the end of the article

p-ISSN 2415-6949
e-ISSN 2707-2177

To read the paper online, please scan this QR code

How to Cite:

Gesora, E. K., Mamboleo, D., & Nyantika, D. (2022). Evaluating spatial and temporal changes in land cover in the riparian zone in Sironga wetland in Nyamira County, Kenya between 2009 and 2019. *International Journal of Research and Scholarly Communication*, 5(1). Retrieved from https://royalliteglobal.com/ijoras/article/view/763

Evaluating spatial and temporal changes in land cover in the riparian zone in Sironga wetland in Nyamira County, Kenya between 2009 and 2019

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Abstract

The purpose of this study was to assess the spatial and temporal changes in land cover in the riparian zones of Sironga wetland in Nyamira County, Kenya, between 2009 and 2019. A descriptive survey research design was used for the study. The study's target population consisted of 561 participants. This included 11 key informants and 550 households in Nyamira County whose land borders the riparian areas, from which 151 respondents were drawn. The sample size was 140 respondents chosen through simple random sampling and 11 chosen through purposive sampling. Data was gathered using questionnaires, interview schedules, observation schedules, satellite images, and document analysis. The quantitative data was sorted, coded, and analyzed using the statistical package for social scientists (SPSS) version 21. The qualitative data collected was analyzed using themes derived from the study objectives and content for each listed. The study findings are expected to help raise local awareness of the importance of riparian zones and foster positive perceptions among riparian communities. This research could help to provide data on riparian zones of wetlands in high agricultural potential areas of Kenya.

Keywords: Nyamira County, riparian zones, spatial, Sironga wetland

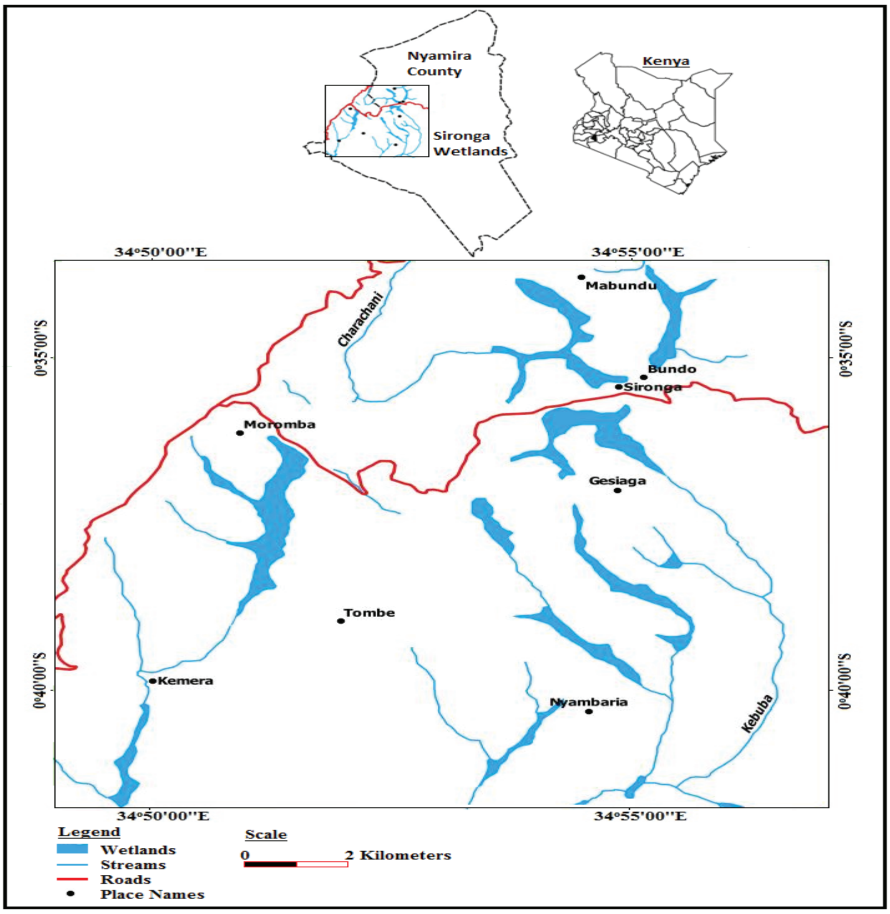
Public Interest Statement

The finding of this study may go a long way in promoting local awareness of the importance of riparian zones and create positive perception among the riparian communities. This study could contribute in provision of data on riparian zones of wetlands in high agricultural potential areas in Kenya. In the field of research, the findings of the study may add to the existing literature on the existing riparian zones in Sironga, protection of wetlands, plant and animal species found in the wetlands as well as effort made to protect those habitats. The study could contribute in provision of data on riparian zones of wetlands in high agricultural potential areas in Kenya. This study could also be of immediate benefit to county government of Nyamira, National Environment Management Authority (NEMA) the Ministry of Education (MOE) and policy makers in the formation of future conservation and education policies aimed at protecting the riparian zones from encroachment and destruction. By availing the research findings to local people and extension workers, this study will assist to improve local awareness of the importance of riparian zones and create positive perception among the riparian communities.

1.0 Introduction

1.1 Background of the study

Sironga wetlands are found in Nyamira County. The county is one of the forty-seven counties in Kenya. The County borders Homabay County to the north, Kisii County to the west, Bomet County to the south east and Kericho County to the east. The study areas covered wasSironga wetlands in Nyamira division of Nyamira County, Kenya. Nyamira division lies between latitude 0°30′ south and 0°45′ north and longitude 34°45′ and 35°00′east. The area covers approximately 112 Km^2, (Nyamira -CIDP 2013).



Location of Sironga Wetlands in Nyamira County
Source: Topographic Sheet for Kisii (130/2)

1.2 Spatial and temporal changes in land cover in the riparian zone

Riparian zones of wetland biomes are very sensitive to any form of interference emanating either from human activities or natural causes. For a very long time, they have been perceived as biomes of little ecological value or wastelands (Schuyt, 2005). This ideology has contributed significantly to the continuous loss of more than half of the global riparian zone of wetlands' acreages even though they provide diverse ecological and hydrological services (Urama and Ozor, 2010; FAO, 2011). Many of the global riparian zones of wetlands have been drained to pave way for the emerging human activities like agricultural and infrastructural developments which has led to declining of species diversity in these ecosystems (MacLean, 2004). Between the years 1993-2007, approximately 6% of the global species diversity on riparian zones of wetland was lost due to encroachment (Geist and Lambin, 2002). Urbanization has also contributed significantly to encroachment issues like in the case of Jinja-Uganda where a study by Mironga (2005) found out that industries established in Jinja had been discharging raw effluents into a nearby wetland which negatively impacted the health status of the riparian zone of the wetland and its biodiversity. The short-term benefits accrued from most of the economic activities carried out within riparian zone of wetlands like crop cultivation have never surpassed goods and services accrued from such ecosystems (Strange and Bayley, 2008; UNEP, 2011).

The riparian zones of wetlands are the new frontiers of development and thus threatening their very existence as natural ecosystems of value to humans and the environment at large. Even though the Ramsar Convention has been in force in Kenya since 1990, an environment-friendly Constitution was promulgated in 2010 and contains provisions on proper environmental stewardship as a basic human right. This includes sustainable management of ecosystems such as riparian areas of wetlands. The Environmental Management and Coordination Act (1999) and its by-laws contain a number of innovative wetland provisions. The prolonged absence of a national riparian areas policy and a sector-specific wetlands law has impeded to the sustainable management of these vital but fragile ecosystems (MEMR, 2012) and contributed immensely to their degradation.

Human societies have been faced with land scarcity, demographic growth, rising poverty, severe economic stresses (Dugan, 1992) and precarious weather patterns in a drying up climate (Urama and Ozor, 2010; FAO, 2011). Consequently, communities and their various development institutions have continued to view wetland ecosystems as a panacea for addressing these challenges. Wherever riparian zones of wetlands are seen in the landscape, they are largely valued in terms of their potential to provide farmland for food. This normally results in the alteration of the natural physical and biochemical processes of these ecosystems. Such practices often leads to an unprecedented change of use, degradation and loss of wetlands in space, their quality and ability to perform their functions over time (Dugan, 1992; Barbier, *et al*., 1997; Kairu, 2001; Kipkemboi, 2006).

The primary drivers of this loss include the pressure arising from population growth; increasing economic development for wealth creation and poverty alleviation; infrastructure development; effects of invasive species; conversion to and reclamation for agriculture; increased pollution including silt loading; over-exploitation; unclear government policies and even more recently; the advent of global climate change (Geist and Lambin, 2002; Dixon, 2005; Millennium Ecosystem Assessment, 2005; Grünbühel, 2005; Mironga, 2005a; Hecky, Bootsma and Odada, 2006; Hierl, Loftin, Longcore, McAuley and Urban, 2007; Wood and van Halsema, 2008; Odada, et al., 2009; Tomer, et al., 2009). These works have sketched compelling evidential framework that depicts a gloomy future for riparian zones of wetlands worldwide.

Globally, 50% of the known riparian zones of wetland areas have been lost since 1900 (MacLean, 2004). Within Africa, especially in the upper Nile and the Congo basins, time series data show that more than 70% of swamps have been lost within a period of less than 20 years .A case study on four African wetlands has gone further to identify agriculture, which is an element of land use, as the main human activity that changes, modifies and creates immense pressure on wetland ecosystems across the continent. This leads to major losses of pristine characteristics of the ecosystems (Schuyt, 2005).

Kenya's case is however more grim with about 10% of the original national riparian zones of wetland area estimated to be surviving and still pristine (Mironga, 2005). Owino and Ryan (2007) have shown that about 50% of the papyrus riparian zone of wetland in the Kenyan part of Lake Victoria area, was lost over the period between the years of 1969 and 2000, largely, to human activities. Their work has attributed phenomenal losses of riparian zone habitats, to human activities. However, nothing much exists in terms of accurate spatial and temporal estimates. Where they exist, they are inconsistent and incomparable. As a result, an exact estimate of the total extent of riparian zones of wetlands as well as the magnitudes of changes taking place in space and time and factors driving the changes within them are grey areas for research.

The implications of riparian zones of wetlands' cumulative spatial and biophysical losses at the local, national, regional, continental and global scales are still the subject of critical research interests (Mironga, 2005). The interest is generated by the fact that the information is essential for effective management of riparian zones of wetlands, which, however, requires accurate and comprehensive spatial data on location, size, classification, and connectivity in the landscape (Mironga, 2005; Murphy, Ogilvie, Connor and Arp, 2007). Pereira (1991) and Sandstorm (1995) placed emphasis on the need for precise predictions of the nature of stresses and impacts that could be triggered by land use conversions, which lead to reductions in the area covered by such ecosystems.

The natures of stresses and impacts have over the years remained precarious and location specific. It has been noted that ecosystems undergoing such stresses are likely to be less stable and could fail to provide the necessary ecosystem services and resources in the long run (Dobiesz, *et al*., 2010; Davis, *et al.,* 2010). According to Whitlow (2003), there is evidence that human activities epitomized in changes in land uses on the landscape can disrupt environmental balances, especially in riparian wetland ecosystems. Such ecosystems could be irreparably destroyed within a matter of few years. This could affect, both directly and indirectly, the biodiversity of the riparian communities who benefit from the resources that these important ecosystems provide (Hollis, *et al*., 2000; Silvius, *et al*., 2000; Amezaga, *et al.,* 2002).

While, the values of riparian zones of wetlands are well-documented (Maltby, 1986, Mitsch and Gosselink, 2000), the extents of spatial damage to the riparian wetlands still remain as relative estimates, especially in developing countries. Unlike in the other parts of the globe, there are less scientific investigations and inconsistent mapping policies and practices in Africa, to determine where and when these losses occur and design intervention measures (Murphy, et al., 2007). A compelling scientific evidence of the changes that have been taking place in riparian zone of wetlands in Kenya (as in the study area) over the last ten years or so have been graphically presented in the Kenya Wetlands Atlas (MEMR, 2012).

Using satellite imagery, various kinds of changes in wetland ecosystems including agricultural encroachment, urban growth into wetland areas, altered hydrology, modified and degraded coastal areas and the impacts of climate change all over the country have been described. Unfortunately, limited efforts were made to quantify losses specific to individual wetland such as Sironga Wetland. This makes the information in the atlas largely useful for spurring initiation of management and conservation issues at the national level rather than at the unique ecosystem level. Degradation and loss is still a widespread problem that needs to be urgently addressed with a focus on individual riparian zone of wetland ecosystems level.

1.3 Research objective

The study was guided by the following objective:

To evaluate spatial and temporal changes in land cover in the riparian zone in Sironga wetland in Nyamira County, Kenya between 2009 and 2019.

2.0 Literature Review

Previous researches have shown that landscape spatial patterns, particularly those of riparian zone of wetlands, are often dynamic owing to intra-annual variations in ecosystem variables, whether driven by natural or human activities influences (Madulu, 2004; McWhinney and Angela, 2007). Change detection of land use and land cover changes provide a fantastic opportunity to learn more about complex and dynamic ecosystems such as riparian zone of wetlands Availability of precise and reliable land use and land cover change information is critical for environmental planning for sustainable development as it enhances understanding of the human activities influence on the terrestrial ecosystem (Mironga, 2005; Khisa, *et al.,* 2013, Rongei, *et al.,* 2013). Employment of Remote sensing technology has over time been adopted as a tool to detect, identify, measure, assess, and generate information on patterns of land use changes over riparian zone of wetlands in various parts of the world.

For many years, remote sensing techniques have been used in riparian zones of wetland research around the globe. Synthetic-aperture radar (SAR)-based change detection approach utilizing Sentinel-1 time series was applied in studying landscape changes in two riparian zones of wetlands in Spain and France (Khisa, *et al.,* 2013). The study concluded that it was effective in providing a precise characterization of areas with a lot of fluctuation as well as those with slow and steady changes.

Using Landsat imageries, a combination of NDVI and NDWI indices were applied in land cover change detection of Tanguar Haor wetland, a Ramsar site in Bangladesh, in which it was established that about 40% of land cover under forests and highland vegetation had been converted to residential and agricultural land over 30 years period (Whinney and Angela, 2007).In Iran, pixel-based change detection was to evaluate land cover changes in the Hamoun Wetland from 1987-2016. Fluctuations water, which is a response to both climatic and human activities factors, was found to be a major determinant of land cover changes (UNFPA, 2012; Zuberi and Thomas, 2012). Multispectral ASTER images, classified through artificial neural networks and support vector machine algorithms, were used in performing land use and land cover change detection at Sultan Marshes wetland in Turkey for the period between 2005 and 2012 (Zuberi and Thomas, 2012). The study observed that between 2005 and 2012, marshes and steppe lands shrank, while water and agricultural areas increased.

Landsat imageries were used in mapping wetland dynamics of Isimangaliso Wetland Park in South Africa. According to their findings, alterations in vegetation and water body extents had exacerbated the Isimangaliso Wetland Park's dramatic decrease in recent years (Khisa, *et al.*, 2013). In Kenya, remote sensing techniques have been used to assess land use and land cover change detection in Rumuruti (Thuku, Gachanja and Obere, 2019). These studies cumulatively indicated that the landscape of Kenya's riparian zone of riparian zone of wetlands is actively transforming due to human-induced factors.

Kenya's riparian zones of wetland areas are estimated to cover a landmass of between 3% - 4% which translates to about 14,000 km^2 (Khisa, *et al*., 2013). The National Environment Management Authority (NEMA-Kenya) reported that Kenya's wetland areas have declined from 4% cover to 2% mainly due to population pressure (MEMR, 2012). The rapidly increasing population in Kenya has led to the competing land uses and over-utilization of these fragile ecosystems through wetland reclamation for construction of infrastructural facilities, commercial forestry establishment and agricultural operations among others (Thuku, Gachanja and Obere, 2019). Over the last fifty years, these human activities impacts have hastened ecological change and exacerbated land degradation challenges to the existing wetland resources in Kenya, putting their ability to continue providing essential ecological services under substantial threat (Khisa, et al., 2013).

Future protection and sustainable management of these fragile ecosystems require insights that can inform policy and decision-makers (Creel, 2003; AFIDEP and PAI, 2012). However, information on the scale of ecological changes in riparian zone of wetlands in Kenya is still inconclusive since previous research and management efforts were majorly focused on urban-based riparian zone of riparian zone of wetlands, those along major watercourses and designated Ramsar sites, neglecting the community-based riparian zone of wetlands (Mironga, 2005, Rongei, *et al*., 2013) such as the Sironga which mostly support rural livelihoods.

To conserve and safeguard Kenyan riparian zone of wetlands resources, it is necessary to monitor all riparian zone of wetlands and their associated land features. Therefore, this study aimed at assessing the trends of land use and land cover changes in riparian zones of Sironga Wetland between 2000 and 2019 and their driving forces. This research is designed to provide insights that can aid decision-making for effective restoration and conservation of this wetland resource.

Land is a fundamental factor of production, and through much of the course of human history, it has been tightly coupled to economic growth (Richards, 2010). It is therefore important as a key and finite resource for most human activities including agriculture, industry, forestry, energy production, settlement, recreation, and water catchment and storage for human progress. Land is thus a finite resource and its use and management is normally constrained by environmental factors such as soil characteristics, climate, topography, and vegetation and socio-political and economic considerations (Schimel, *et al.,* 1991). As a result, control over land and its use is often an object of intense human interactions with ecosystems in the environment.

Human activities that make use of, and hence change or maintain, attributes of land cover are considered to be the proximate sources of change. They range from the initial conversion of natural forest into cropland to on-going grassland management (Turner, 1989; Hobbs, et al., 1991; Schimel, et al., 1991). Gils, Huizing, Kannegieter and Zee (1991) term the expression of man's management of various ecosystems for the welfare of human populations as land use. Land use is further more elaborately defined by Liverman and Cuesta (2008) as the human activity that occurs on land such as agriculture or grazing. This may include additional social characterizations such as subsistence or commercial agriculture. Land cover on the other hand is defined as the physical and biological cover on land including vegetation of various types such as papyrus or grassland, water or bare soil. Land cover normally indicates the kind of activity to which the specific location on the ecosystem is assigned by human reasoning. Such human reasoning leads to various land use decisions, which therefore modify the land characteristics in ways that often introduce new uses, (Bronsveld, *et al.*, 1994).

The conversions from one cover type to another are referred to as land use changes. The changed uses cannot be measured directly but are often estimated through the observation and measurement of indicators of use such as the predominant land cover types on the affected land areas (Bronsveld, *et al*., 1994 and Duram, Bathgate & Ray, 2004). Land use and land cover changes are therefore important phenomena that define the relationship between humans, the economic system and the environment such as a wetland ecosystem. It needs to be measured, monitored and wisely managed for the sustainability of such ecosystems. This is to ensure that current and future human actions take into account effects on the environment, economy and society; and that what is done today should not compromise the well-being of future generations (Strange and Bayley, 2008; UNEP, 2011).

Several studies such as those of Dixon and Wood (2003), Walters and Shrubsole (2003) and Houlahan, Keddy, Makkay and Findlay (2006), examined the issue of riparian zones of wetland connectivity to adjacent land uses in connection with the changes as cover type conversions expand. They concluded that differences in the land-use-diversity relationships among different plant functional groups suggest that adjacent land uses affects wetland plant communities. These studies focused on relative relationships without spatial and temporal considerations. The cultural inclinations and practices that are often a function of the human populations that live around these riparian zones of wetland ecosystems have also received limited attention.

Mironga (2005) and Makalle, Obando and Bamutaze (2008) found out that some of the cultural inclinations and practices lead to unsustainable land use practices that drive the processes of loss and degradation not only of other ecosystems but also of riparian zones of wetlands. Consequently, changes in land use in a wetland ecosystem cannot be examined in isolation of the riparian human institutions, perceptions and attitudes as they exploit the wetlands (Mironga, 2005). Those who live in areas where riparian zone of wetlands play an important role in the sustenance of livelihood support systems are highly dependent on the services that wetlands render to humanity. They are directly harmed by changes to land uses that degrade riparian wetlands and are therefore part of these ecosystems and its sustainable management (Hollis, et al., 2000; Amezaga, et al., 2002; Schuyt, 2005).

Unfortunately, riparian zones of wetland benefits that accrue from these relationships such as the fertile land with water all-year-round that attract agricultural land uses, are regarded as a type of public good since they display characteristics of non-excludability and non-rivalry in consumption (Hodge and McNally, 2000; Wood and Halsema, 2008). The tragedy is therefore that communities have for centuries generally treated wetlands such as the sironga Wetland ecosystem as common property resources. Each community has had its own traditions and practices in their utilization and management based on their indigenous knowledge. However, as noted by Gordon (1954) and Hardin (1968), an asset that is everyone's property, as is the case in most wetland ecosystems such as the Sironga is in essence no one's property and they are often mismanaged or overused to the detriment of the very users.

This results in both a decline in quantities and deterioration in the quality of these ecosystems (Gustard and Wesselink, 1993; Fruhling, 1996; Sahin, 1996; Schuyt, 2005). Orwa, Raburu, Njiru and Okeyo-Owuor (2012), has shown that human disturbances of this nature have reductive consequences on habitat quality and compromises species richness in the Sironga ecosystem over time and space. They however did not quantify the spatial and temporal extents of these disturbances, largely agricultural land uses, in the wetland. Past research on the relationships between these riparian land users and wetlands (Wilson, 1996), is also rather limited in Kenya and internationally (Mironga, 2005; Khisa, *et al*., 2013, Rongei, *et al*., 2013).

A close association has been inferred between population growth and land use changes in riparian landscapes. Ben-Edigbe (2009) did some work on population growth and land use change and found that they are interdependent, with population growth being a function of land use change. This is because population is sustained by food, shelter and clothing, all of which are derivatives of the manner in which land is used and a source of pressure on the ecosystem. Hence the expanding world population is seriously increasing demands on the earth's resources on riparian zones of wetlands (Benedick, 2000; Liverman and Cuesta, 2008).

Consequently, the primary cause of land use conversions in most locations on the earth's surface remains the need to meet the demands of the ever-increasing human population. Similar observations have been made within the Lake Victoria basin, where the study area is found, by Pereira (1991) and ICRAF (1986). Benedick (2000) indicated that many of the trends of global environmental problems affecting riparian zones of wetlands are influenced directly or indirectly by demographic dynamics such as population size, population growth rates, population densities, and migration of people. Changes in the size, composition and distribution of human populations affect these areas by changing land use and land cover (Creel, 2003; AFIDEP and PAI, 2012). Hopfenberg and Pimentel (2001) showed that human population growth, like those of other animal species in an ecosystem, is subject to the same dynamic processes.

They vary according to food availability, which influences the extent of use of their environmental resources. An increase in the population causes a decline in those of other species diversity whose habitats are interfered with in favour of food production. They vary in spatial and temporal trends and face a variety of increasing human activities pressures. According to Pereira

(1991), human populations have doubled in the last three or so decades in most developing countries; but with a continued heavy dependence on subsistence agriculture over the same period as the source of food.

The UN population projections predicts that the populations of developing countries will rise to about eight billion by 2025 and nine billion by 2050 (Young, 1999). This growth is expected to be much faster in Africa whose population has been increasing rapidly and will add 1.0 billion to rise from 13 to 20 per cent of the world's population during the period (The United Nations, 2009). This is due to the fact that several countries in Sub-Saharan Africa are experiencing high rates of population growth, at varied population sizes (UNFPA, 2012; Zuberi and Thomas, 2012). For instance, while the population increases for Tanzania mainland and Zanzibar are 10,163,585 (30.4%) and 321,814 (32.8%) respectively since 2002, Nigeria's population size increased by 57 million from 1990 to 2008, a 60% growth rate in less than two decades (Agwanda and Amani, 2014; United Nations, 2015).

Kenya is no exception from these population growth trends. High fertility, combined with declining child mortality, gave Kenya one of the world's fastest population growth rates in the 1970s and 1980s (Thuku, Gachanja and Obere, 2019). The total population rose from about 10 million at independence in 1963 to 15 million by 1978 and to about 40 million in 2009 (Republic of Kenya, 1989; Republic of Kenya, 2019). While various government interventions such as family planning and education and awareness campaigns have ameliorated the growth levels, there is still concern that the expansion, which is rapid will exert undue pressure on riparian land and water resources (Thuku, et al., 2013). It has been suggested that population related pressures on ecosystems will continue to intensify in the future in direct proportion with the rapidly expanding population in the study area (ICRAF, 1986; Oucho, 1993).

The increasing population needs clothing, food and shelter that have to be met from the natural resource base including the wetlands. The responses to these pressures have traditionally been to increase land area under agriculture (Hopfenberg and Pimentel, 2001). Future major problems are therefore predicted for vulnerable habitats such as wetlands. Already, horizontal agricultural expansion activities have spread to these marginal areas which are too fragile to support sustainable crop production (Schuyt, 2005). Thus the consequences of the rapid increases in human populations is expected to bear serious effects (Madulu, 2004; McWhinney and Angela, 2007) on catchment hydrology and natural resources including wetland resources of the study area.

The combined effects of population growth and environmental changes precipitated by the accompanying land-use changes are increasing environmental degradation, including riparian zones of wetland depletion and poverty. Unfortunately, they are not usually prioritized, analyzed and addressed together in Kenya's strategies for development (AFIDEP and PAI, 2012). The role of population growth and attendant effects on climate change has been recognized in Kenya's Vision 2030, which is the long-range development blue print covering the government's 19 development intentions over the coming years. The document, nevertheless, fails to link population growth to the decline of areas of wetlands at the countyand regional levels in the country. The issues have only been marginally included in the Vision's Second Medium Term Plan for 2013-2017. Although, major efforts have been made towards the formulation of a policy on wetland conservation to address the wetland issues, this has remained in a draft form since the 1998 (Republic of Kenya, 2013). It is only recently that the policy was passed through the National Environment Council, the cabinet and received parliamentary approval in 2014 as sessional paper number 12 of 2014. However, strategies for its operationalization are yet to be developed which may require substantial amount of information as inputs from studies such as the present one.

3.0 Research designs and methods

The study adopted a descriptive survey research design. Surveys design can be used for explaining or exploring the existing status of two or more variables at a given point in time. Survey design also enables the researcher to collect original data for the purposes of examining the effects of land use on species diversity in riparian zones of Sironga wetland in Nyamira County, Kenya. The design was considered appropriate as it enabled the researcher to reach many subjects within limited time (Kothari, 2003). Sironga wetland is a fairly wide area and hence this design was convenient in soliciting views from respondents. A descriptive survey study helps to gather data at a particular point in time with the intention of describing the nature of existing conditions, identifying standards against which existing conditions can be compared and determining the relations that exist between specific events Mugenda (2003).So at Sironga, it was appropriate because the researchers was able to observe and collect data through interviews and questionnaire on land use practices, species diversity and spatial and temporal changes in land cover in the riparian zone.

4.0 Results, Findings and Discussion

4.1 Ecological roles of riparian land as a habitat to species diversity in Sironga wetland in Nyamira County, Kenya.

Residents who were sampled had riparian land in their farms or their farms boarded the riparian lands. When they were asked to describe the riparian land that appears on their farm, they gave the following responses on table 1.

Table 1.0 The Wetlands in Sironga

Response		N	%
Valid	Vegetation along Permanent waterlogged area in narrow valley with impeded drainage or in the lowest part of the wide valleys. Riverine vegetation, along floodplains of rivers. It is temporarily flooded during high flow periods	9	6.9
		32	24.4
	Vegetation along a flat or slightly sloping land, temporarily waterlogged, due to seepage from surrounding slopes	90	68.7

Field data: 2021

Table 4.5 gives a description of the riparian lands that appears in the farms of the residents. 9(6.9%) described the riparian land to have vegetation along a permanent waterlogged area in a narrow valley with impeded drainage or in the lowest parts of the wide valleys.32(24.4%) described vegetation along their riparian land as riverine vegetation, along floodplains of rivers. It is temporarily flooded during high flow periods. On the other hand 90(68.7%) of the respondents described the riparian land in their farms to be coved with vegetation along a flat or slightly sloping land, temporarily waterlogged, due to seepage from surrounding slopes. From the results in table 4.5, riparian land in most parts of Sironga wetlands in Nyamira County can be described as to having vegetation along a flat or slightly sloping land, temporarily waterlogged, due to seepage from surrounding slopes. In order to establish if the residents knew the role played by the wetlands, the respondents were asked to state the roles of the riparian zones played in their farm. Table 4.6 presents the responses from the respondents

Response		N	%
Valid	Providing food and shelter for aquatic habitat Limit stream degradation from land use activities in the uplands.	9	6.9
		4	3.1
	Life cycle of many native animals and plants; it provides wildlife corridors as well as being a refuge for animals in times of drought or fire.	12	9.2
	Wildlife habitat	1	0.1
	for wildlife Vegetation	87	66.4
	Riparian areas are important for common as well as rare species	23	17.6

Table 2.0: Role of the Sironga wetlands
Field data:2021

Table 2.0 presents that 9 (6.9%) of the respondents believe that the riparian zones in their lands played the role of providing food for the aquatic habitats as well as sheltering then.4 (3.1%) of the respondents stated that the wetland areas in their farms played a role of limiting steam degradation from land use activities in the uplands. Also, as pertains wetlands providing for life cycle of many native animals and plants; it provides wildlife corridors as well as being a refuge for animals in times of drought or fire, 12 (9.2%) supported the idea. Additionally, 1 (0.1%) believed that wetlands in their lands provided for wildlife habitat. But concerning wetlands providing wildlife vegetation, 87 (66.7%) of the respondents supported it.23 (17.6%) of the respondents were of the view that riparian areas in their farms were important for common as well as rare species.

The results from table 2.0 reveals that majority of the respondents had different views of the role the wetlands played in their farm. Majority of the respondents however, believed that the riparian lands provided for wildlife vegetation. This view agrees with Harris, & Kirkpatrick, (2011) who posits that wildlife foods (seeds, buds, fruits, berries and nuts) are found in abundance within naturally vegetated riparian areas. As a majority held view based on the study results, this may be a benefit the residents draw from the riparian zones. Those who conserve them may be doing so for the wild fruits, herbs and vegetable that grow in the area.

The finding that only 1 (0.1%) of the residents believed that wetlands in their lands provided for wildlife habitat may suggest the early existence of human wildlife conflict which have led to the extinction or migration of wildlife in their riparian land. Unlike Sattler & Creighton (2002) assertion that the high value of riparian areas are wildlife habitat is also due to the abundance of water combined with the convergence of many species along the edges and ecological transition zones between aquatic/wetland, aquatic/upland, wetland/upland and river channel/backwaters habitats, Sirongo wetland may not be harboring higher animals in the wild.

Additionally, as it pertains for the role of wetlands, 23 (17.6%) of the respondents were of the view that riparian areas in their farms were important for common as well as rare species. Although, small in numbers but still significant in the sense that they appreciated the role of the wetland as home for rare species. Since most residents did not believe that the wetlands in their farms were home for wild animals, the rare species may refer to insects and amphibians. These insects and amphibians may be common in Sironga wetlands. The data of this study are in agreement with Wenger (2009) who maintained that naturally vegetated riparian area is considered to be significant rare species especially migratory ones that makes it their homes.

Sport check on majority of riparian zones revealed that most of the riparian zones were bare and lacked the required vegetation cover as is seen from figure 1, figure 2 and figure 3

Figure 1: A river bed that has been partially cleared

Field data:2021

Figure2: A swamp without large plants

Field data:2021

Figure 3: Exposed ground with soil visible

Field data:2021

Figure 1, figure2 and figure3 shows disturbed wetlands with exposed the soils. The Figures showed disturbed wetlands which may not be serving their intended ecological roles. According to Lee, Isenhart & Schultz (2003). The Streamside soils and vegetation regulate the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to streams. During floods, plant roots and fallen trees help stabilize the soil and stream banks. Additionally, Vegetation and organic debris slow the movement of flood waters and dissipate stream energy, allowing deposition of sediments on the floodplain. Vegetative protection of stream banks against erosion effectively reduces sediment delivery to downstream (Salemi *et al.*, 2012). The Sironga wetlands are exposed with no or limited vegetation cover hence cannot regulate the entry of groundwater, surface runoff, nutrients, sediments and other particulates, and fine and coarse organic matter to streams. Stream bank vegetation, especially dense overhanging root wads, sod, bushes, and undercut banks, provides cover for fish. Submerged vegetation and dead wood contribute to the structural complexity of underwater habitat. For many years, removal of vegetative cover and related physical damage to stream banks by livestock has been considered one of the main impacts causing the decline of trout in upland streams of western states (Medin & Clary, 2009).

4.2 Land use practices among households whose land border riparian zone in Sironga wetland in Nyamira County, Kenya.

In order to establish the land use practices in Sironga wetlands. Households were given questionnaires to respond to various items, Key informants were interviewed and the researcher conducted direct observation to establish the happenings in the Sironga wetlands.

4.3 Land use practices by Sironga households

Table 3.0 presents data obtained from the residents of Sironga on various activities they practiced in the Wetlands

Table 3.0 Land use practices by Sironga households

Response		N	%
Valid	Crop farming	129	98.5
	Cattle grazing	104	79.4
	Brick making	122	93.1
	Tree planting	51	38.9
	Deforestation	107	81.7
	Riparian areas conservation	83	63.4

Field data:2021

Table 4.7 presents that, 129(98.5%) of the respondents participate in crop farming in the riparian zones. Cattle grazing is an activity engaged in by 104(79.4%) of the respondents. Additionally, brickmaking is done by 122(93.1%) of the respondents. Moreover, 51(38.9%) of the respondents stated that they planted trees in the riparian zones.107 (81.7%) admitted to cut down trees in the riparian zones. While, 83(63.4%) participated in various conservation measures in the riparian zones.

4.4 Land use practices among households whose land border riparian zone in Sironga wetland in Nyamira County, Kenya according to Key informants

The key informant interviewed pointed out that majority of the residents had encroached the riparian zones despite knowing that the wetlands were gazette and protected. Respondent 1 stated that

"Extension of land use by local farmers next to the swamp is common during dry spell seasons"

The same respondents also stated that

"Seasonal fluctuation of water flow a times leads to local communities extending some activities to the

swampy areas of Sironga"

The admission by key informants who are tasked with the protection of Sironga wetlands shows that the destruction of the wetlands is ongoing despite their knowledge on the importance to conserve the. The conservation efforts by the authorities in the area was limited to distribution of seedlings to farmers to plant in the riparian zones as staked by key informant3 who stated that;

"County government has provided seedlings to students as well as farmers living next to riparian lands (swamps) - Bamboo. It's the government regulations to salvage the watershed areas from destruction by invasion of eucalyptus (blue gum species) in those areas".

5.0 Conclusion

The findings of the study showed that, higherplants and animals have been affected greatly by the human activities in the Sironga wetlands. The species of plants that have remained are warbugia*ugan* , *Crotonmact* , *Erythrinaabys*. *Truimfettamact* and *Albiziagrain* and are facing extinction as demand for firewood,charcoal and timer continue to grow.Trees provide shelter and home for most of birds such as eagles and weaverbirds.The cutting down of trees have denied them a home hence they have migrated to other areas.Animals,reptiles and other wild animals have not been spatred either, hunting and continued human conflict have let to most of the animals been killed while others have migrated to the areas which may have forests.What remains in Sironga wetlands are stories of the plants, birds and animals that were once upon a time inhabited the area. As photos show the land is bare and is no longer home for birds, animals and other rare species of animals and plants.

6.0 Recommendations

The study recommends that both the County and National government should reclaim, restore and fence all the wetland areas where possible and this will be achieved by deliberately setting aside funds in the budget for its conservation.

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