Impacts of Anthropogenic Activities and Climate on Wetland Ecology: Case of Sitatunga(*Tragelaphus Spekei*) at Kingwal Wetland, Kenya.

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Abstract: The study carried out in Kingwal wetland in the Nandi north district of Kenya to investigate the effects of anthropogenic activities on biodiversity and habitat destruction in the area, as well as the implications of such activities for the future of the Sitatunga animal. The methodology involved questionnaires, interviews with a cross-section of the local people, the organization, and focus group discussions (FGD). Data from Meteorological Department Eldoret was analyzed and used to depict mean monthly rainfall patterns in the study area. Results indicated that Sitatunga is already under threat from the loss and fragmentation of habitat. Encroachment and invasion caused by anthropogenic activities are on the increase, while Climate change poses a new challenge as it often exacerbates the impacts of other pressures. The Kingwal wetland once an extensive wetland and an important breeding site for Sitatunga has been reduced to a narrow stretch of swamp (Ambasa, 2005). It also indicated that, among the various human activities undertaken in the area, cultivation, grazing, and Brick making had the greatest impact on biodiversity conservation through degradation of the wetland over the years. About 95% of the respondents were regarded to engage on major socioeconomic activity in the area. However, majority of the respondents (96%) are aware of the need to conserve the wetland which is the habitat for the rare Sitatunga (*Tragelaphus Spekei*). For the improvement of the current status of the wetland and its sustainable management, it was recommended: (i) enhancement of local participation in biodiversity conservation initiatives, (ii) initiation of public education and awareness campaigns, (iii) integration of traditional and modern knowledge system of biodiversity conservation, (iv) reforestation, (v) provision of alternative sources of income for the local population.

Keywords: Anthropogenic activities, Biodiversity; Climate change, Wetland ecology

1 Introduction

Over the past two decades a large amount of evidence has accumulated, showing that global climate is rapidly changing. Precipitation patterns have probably changed as well, with increased precipitation in some parts of the globe, and decreased rainfall in others (IPCC 2001). And in recent decades the frequency and intensity of droughts has been observed to increase in for instance parts of Africa and Asia (IPCC 2001). The link between climate change and biodiversity has long been established. Although throughout Earth's history the climate has always changed with ecosystems and species coming and going, rapid climate change affects ecosystems and species ability to adapt and so biodiversity loss increases (CBD, 2009).Changes in climate exert additional pressure and have already begun to affect biodiversity. Land and ocean surface temperatures have warmed, the spatial and temporal patterns of precipitation have changed, and sea level has risen. These changes, particularly the warmer regional temperatures, have affected the timing of reproduction in animals and plants and/or migration of animals, the length of the growing season, species distributions and population sizes. It's also noted that the risk of extinction will increase for many species that are already vulnerable, for example Species with limited climatic ranges and/or restricted habitat requirements and/or small populations are typically the most vulnerable to extinction. (IPCC 2001).

In recent times, biodiversity has become easy targets for human over-exploitation due to increasing human populations and the quest for a better life through improvements in science and technology. Studies have shown that Biodiversity is being exploited at much faster rates than ever before with negative implications for sustainable human livelihood (Turner et al., 1990).According to Wilson (1992) biodiversity is facing a decline of crisis proportions which could ultimately lead to mass extinctions in the very near future. In Kenya, increasing evidence indicates that the rate of environmental degradation has increased in recent times (NEMA, 2000), with previously Wetlands being converted to agricultural lands (Hawthorne & Abu-Juam, 1995).

In addition, human activities have affected, and will continue to affect, biodiversity, through land use changes, habitat destruction etc, with changes in climate exerting additional pressure on species, communities and ecosystems (Gitay *et al*. 2002). Current rates of climate change have already resulted in species composition changes. As the climate warms up or cools down, many local species have to shift from their current habitat to areas better suited to their needs. Changing temperatures will also influence their reproductive cycles, their growth patterns and, also as a result of range shifts, the interaction between species (ICLEI 2008). However, it's noted that the risk of extinction is likely to increase for many already vulnerable species; particularly those with restricted range (Gitay *et al*. 2002).Different studies have shown varying approaches to this concern, According to Global biodiversity outlook 3,may 2010 in its report compiled by IUCN the proportion of all species in different threat categories of extinction risk as per IUCN Red list based on data from 47,667 species(CBD,2010). The method use was based on prediction models under climate change requiring paradigm shifts which will not be able predict the future with accuracy, but instead need a strategy for using existing knowledge and bioclimatic modeling to improve understanding of the effects of future climate on biodiversity. A report by Local Government for sustainability (ICLEI,2008), based on Biodiversity Integrated management focused on reducing Co2 through deforestation and land use change as a result of human induced green house emission. This was managed by maintaining local biodiversity and increasing urban green space in particular forest areas which were of significant and effective contribution towards protecting the global climate. In addition providing regulatory framework for encouraging vegetation growth on private properties was done to enhance environmental protection.

Kingwal wetland is a massive wetland on the catchments of Yala River. The wetland is popular as a habitat for rare Sitatunga, crane birds and wetland forest of Syzygium spps. The wetland is a very important resource for both the community living in the catchment and those living downstream of Yala River. Cultivation in Kingwal wetland in time of dry season (food stress) is on increase and cause the biggest threat to the system. Extensive maize cultivation and vegetables poses a threat not only to the availability of alternative products from

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wetland but also to the ecological functions of wetlands and socio-economic wellbeing of the community who depends on them. The biggest threat to degradation of Kingwal is linked to dry season which encourages farmers to look to wetland cultivation and leads to burning of wetland vegetation. Another threat is planting of Eucalyptus trees in the wetland which lowers the water table. The once extensive wetland which is an important breeding site for Sitatunga has been reduced to a narrow stretch of swamp. The current situation, if allowed to continue, is likely to result in habitat destruction and loss from the wetland, consequently threatening the survival of the rare Sitatunga (Ambasa, 2005).

The main objectives of this study were (i) to investigate the impact of Anthropogenic activities (cultivation, hunting, grazing, and brick making) and climate change on biodiversity conservation and loss of habitat for Sitatunga and (ii) to obtain useful data/information to enable recommendations on how to Mitigate, reduce the effects of global warming and the impacts of Anthropogenic activities on Sitatunga habitat. This can be achieved through maintaining local biodiversity and increasing green space, in particular forest areas, therefore are significant and effective contributions towards protecting the global climate similar method was used in a report by Local Government for sustainability (ICLEI,2008) .This study focused on creating Awareness on the importance of biodiversity conservation. The methodology used involved questionnaires, interviews with a cross-section of the local people, the organization, and focus group discussions (FGD) together with obtaining data from Meteorological Department Eldoret this ensured original, accurate and reliable data is obtained to solve the problem on biodiversity loss. By doing so, it will help in slowing down extinction rates of ecologically, culturally, economically significant species such as Sitatunga. This study is important because no other study has been conducted,researched and documented on the impacts of anthropogenic activities on biodiversity and climate focusing on the rare sitatunga animal.

2 Materials and methods

Study area

The site chosen for study was Kingwal Wetland in Nandi North District. Kingwal swamp is 25 kilometers from Eldoret towards Kapsabet and almost 400 kilometers from Nairobi and is the habitat for the rare Sitatunga (Tragelaphus Spekei). Kingwal currently measures 2.73 square kilometers. The district is situated in the western part of the Rift Valley Province. It lies within latitudes 0^0 and 0^0 34'' North and longitudes 34^0 44''and 35^0 25''East. (Nandi district development plan 2002-2008).

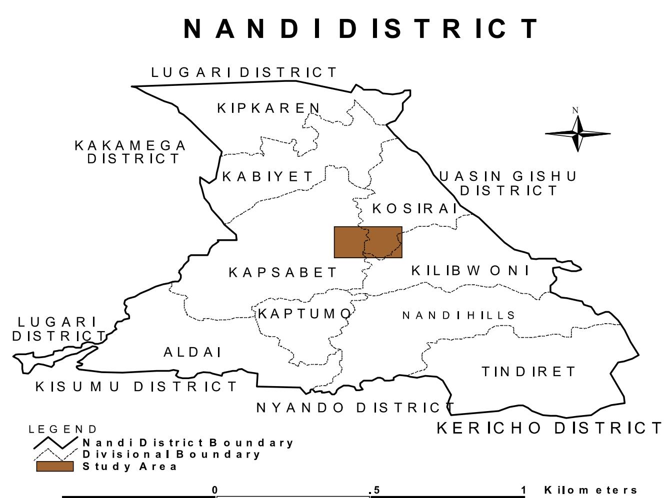

Figure 1 Location of the study area on the maps of Kenya and Nandi District

The vegetation of the wetland is consists of forests, derived grasslands, shrubs and scrubland, Kikuyu grass species is suited for cattle grazing. (Nandi district development plan 1994-1996).

Dominant grass species include *Andropogon gayanus, Hetero-pogon contortus, Panicum maximum,* and *Sporobolus pyramidalis*. About 40% of the area was converted into *Eucalyptus, Azadirachta indica* (neem), and teak plantations when parts of the area were designated as forest reserves (Yenku A and B). The major human activities in the wetland are Extensive maize and vegetable cultivation, grazing and Brick making). Other activities include hunting, Eucalyptus cultivation (Ambasa, 2005).

Data collection

A total of 80 questionnaires were administered according to human activities carried out by individuals within Kingwal wetland. This targeted cultivation, grazing, brick making who were grouped into stratus. We visited Individuals for interviews from each stratum (activity) whom were selected at random to ensure randomization of the selection of respondents for the interview (Kirubi *et al.*, 2000). A total of 20 individuals from each strata (activity) working at the wetland was selected for sampling. It was expected that this will form between 10-20% of the total individuals in each stratum as recommended (Kangwana, 1996).

Key informants as Chiefs, Assistant chiefs, Village Elders, area councilors, and KWS officials Nandi District were interviewed. Focused group discussions (Community conservation forums, women and youth groups focused on conservation).Field visits and observation were conducted on the study area to ascertain biodiversity loss. This method enabled us to obtain first hand data that was highly reliable.

Collection of meteorological data

Meteorological data for the study site used in this paper was obtained from hydrological year book at the Eldoret Meteorological Services Department.

3 Results and Discussions

Cultivation in the study area was observed to be the leading activity recording (38%) with most respondents owning 1/4acre of cultivated area (60%) and most of them using it for the least 6 to10years(40%). Extensive maize and vegetables cultivation is predominant among cultivators at the wetland with 15% and 70% respectively. It should be noted, however, that unreliability of rainfall (91%) was an important factor associated with the choice for wetland cultivate especially during dry period Table 1(a-f)}. Draining of water for easy cultivation was done with majority of the respondents digging trenches to drain excess water (85%). However, those who cultivated either used chemicals or fertilizers on their fields (80% and 60%) respectively Table 1(g-i)

Table 1 statement of Anthropogenic activities in Kingwal Wetland

a)

Activity Engaged at wetland	*Percentage*
Cultivation	38.3
Grazing	25.0
Cultivation and grazing	21.7
Brick Making	15.0

b)

Use of wetland for cultivation	*Percentage*
Yes	90.0
No	10.0

c)

Reliability of rainfall	*Percentage*
Reliable	05.0
Unreliable	91.7

Not sure	3.3

d)

Methods used in clearing land	*Percentage*
Burning	60.0
Slashing	10.0
Chemicals	00.0
Burning and Slashing	30.0

e)

Cultivated area(Acres)	*Percentage*
1	05.0
0.75	00.0
0.5	35.0
0.25	60.0

f)

Time stayed in wetland(years)	*Percentage*
1-5	03.1
6-10	12.9
11-15	78.0
Over 15	06.0

g)

Duration of cultivation on the wetland	*Percentage*
Permanently	15.0
Only in dry periods	85.0

h)

Methods of draining Excess water	*Percentage*
Digging trenches	85.0
pumping	03.0

i)

Crops grown in the wetland	*Percentage*
Maize	10.0
Tomatoes/Vegetables	75.0
Potatoes	0.5
Legumes	10.0

j)

Use of chemicals /fertilizers	*Percentage*
Yes	80.0
No	20.0

Grazers

Majority of the respondents who grazed on the wetland (75%)had large number of herds(70%)with most of them owning cattle and sheep(55%) Table 2(a-c)}.

Brick Making

Most of the Brick makers conducted their activities on the wetland representing 78%.Out of the respondents interviewed majority(70%) indicated their fear of the future status of Sitatunga animal declining at a fast rate, and that there is need to conserve the wetland(96%) if the reverse has to be observedTable3(a-c).

Generally, From the meteorological data obtained results showed that there was low mean monthly rainfall with majority months 8 out of the 12 months getting less than 100mm(Jan,Feb,Mar,Jun,sep,Oct,Nov and Dec) for the study period of 30 years(1981-2010).

Table 2 Analysis of Brick makers

a)

How often do you graze at the wetland	*Percentage*
Regularly	75.0
Not regularly	25.0

b)

Type of animal grazed	*Percentage*
Cattle	25.0
Cattle and Sheep	55.0

Sheep and Goats	05.0
All of the above	15.0

c)

Quantity of livestock owned	*Percentage*
Large	70.0
Small	30.0

Table 3 Human Activities

a)

Where do you carryout Brick making Activity	*Percentage*
Wetland	93.0
Outside wetland	07.0

Future of Sitatunga	*Percentage*
Fast declining	70.0
Slowly declining	20.0
No idea	10.0

b)

What should be done to the wetland	*Percentage*
Conserve our wetland	96.7
Continue with our daily activities	03.3

Human activities have affected, and will continue to affect, biodiversity, through land use changes and habitat destruction. This has given rise to widespread concern that changes in climate will exert additional pressure on species, communities and ecosystems (Gitay *et al*. 2002). Habitat destruction is currently ranked as the most important cause of species extinction worldwide (pimm et .al, 2000). Climate change may modify and enhance local anthropogenic disturbances. According to Jenkins (1992), rates of habitat modification are currently so high that virtually all natural terrestrial habitats and protected areas are destined to become ecological 'islands'in surrounding 'oceans' of habitat much altered.

Kingwal wetland is a massive wetland on the catchments of Yala River. The wetland is popular, as a habitat for rare Sitatunga. Cultivation in Kingwal wetland in time of dry season (food stress) is on increase and cause the biggest threat to the system (85%) Table 2. Extensive maize cultivation and vegetables poses a threat not only to the availability of alternative products from wetland but also to the ecological functions of wetlands and socio-economic wellbeing of the community who depends on them. The biggest threat to degradation of Kingwal is linked to dry season which encourages farmers to move to the wetland for cultivation as a result burning the wetland vegetation(60%){Appendix 1,Table1d}.Most of those who cultivate at the wetland Burn their lands. They also engage in draining excess water by digging trenches (85%) thus destroying the habitat and leading to loss of biodiversity. The use of fertilizer and chemicals (80%) cause water pollution and endanger the species within the wetland and especially the Sitatunga Animal. Another threat is planting of Eucalyptus trees in the wetland which lowers the water table. The growing urban market opportunities do also encourage wetland drainage for vegetation growing.

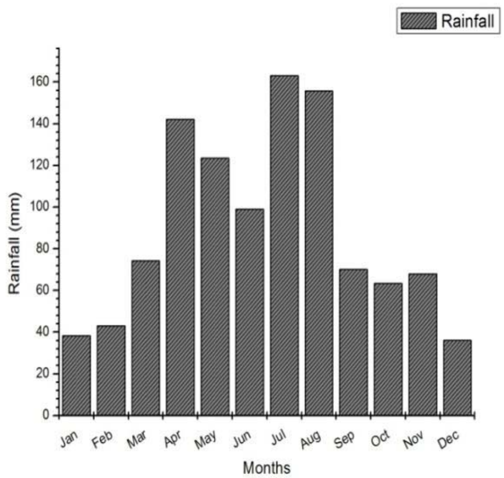

Figure 2 Mean monthly rainfall in Kingwal Area for the last 30 years (1981-2010)

Significantly Kingwal wetland is upheld highly in the community as an important pasture during dry season (85%). Traditionally this wetland has been used in the region to provide communal grazing for animals and customary initiation site for Nandi community. The local community has relied on this resource for a long time as a food security safety valve. The study noted that regular (75%) and increased grazing with large herds (70%) causes' threat to the already shy sitatunga as competition for the scarce pasture material and continuous disturbance affects the breeding site for the sitatunga animal (,Table2c). Encroachment of the wetland by brick makers threaten wetland area, plants and wildlife which are of social-economic importance to the riparian communities. It exploits and destroys wetland resources leading to the loss of original characteristics, modifying this important ecosystem and threatening the life style and livelihood of local communities (Iyango *et al.*, 2005). Brick making activity is largely practiced within the wetland (78%) and these poses threat to sitatunga as the abandoned pits may harm or cause death to the animal. From the study it was confirmed that the future of sitatunga is fast declining(70%) due to this factors contributed by anthropogenic activities and climate change, and that the only way to reverse this state is to find ways of conserving the wetland and avoiding destruction and habitat loss, hence sustainability of ecosystem and sitatunga environment. From the results the area receives low rainfall with majority months getting less than 100mm (Fig2), which relates to unreliability (91.7%) Table1c, to maintain growth in plants to maturity levels and low pasture for livestock this has always left people with little or no hopes at all for survival forcing them to seek alternative source at the wetland.

4 Conclusion

From the results of the study, the major anthropogenic activities which caused positive impact on the biodiversity in Kingwal wetland were Cultivation, Grazing and Brick making in order of importance. Cultivation during dry seasons was observed to have increased over the years, and continuous use causing the biggest threat to the system (85%). The impacts of climate change depicted by erratic changes in rainfall patterns have always resulted to continued spell of long dry months forcing farmers to look for alternative adaptative mechanism thus resorting to wetland cultivation. This has contributed to massive burning of wetland vegetations (60%).While, Grazers seek pastures for their livestock and brick makers sort livelihood from brick making to enhance socio-economic benefits. In order to sustain the ecological-importance Kingwal wetland as well as biodiversity conservation initiatives in the study area, the following are recommended:(i)Initiation of education and awareness programmes targeted at children and the youth, stressing the direct and indirect values of wildlife.

(ii) Initiation of forestation programme to attract wildlife to maintain catchment areas and discourage planting of Eucalyptus trees in wetland ecosystem.
(iii)Provision of adequate financial resources for agencies involved in conservation efforts in the wetland to enhance their efficiency and performance
(iv) Provision of alternative sources of income for the local people to reduce pressure on the already depleted biodiversity of the wetland

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