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Effects of Harvesting Papyrus (*Cyperus papyrus*) Above-Ground Biomass on Productivity, Density, and Recruitment in Saf-Wetland of Siaya County, Kenya

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ABSTRACT

Papyrus is a dominant vegetation in floodplain and littoral wetlands of Lake Victoria. Whereas they are mostly harvested by riparian communities to support livelihoods, the unsustainable removal of papyrus biomass may have detrimental impacts on its growth aspects compromising the structure and functions of the papyrus wetlands. The aim of the study was to assess the effect of papyrus above-ground biomass harvesting on productivity, density, and recruitment of papyrus in such wetlands. Destructive and non-destructive methods were used to measure the biomass in the disturbed and control plots respectively. All statistical analysis was done using SPSS Statistical Software version 20. Data was subjected to normality and homogeneity of variance test after which statistical tests were carried out at $p<0.05$ significance level. Welch ANOVA was used to assess spatial differences among the sites. There was significant spatial variation in density in harvested plots among the experimental sites (Welch Anova: $F_{2, 20} = 26.165$, $P < 0.001$). Also, there was significant spatial variation in biomass of papyrus in harvested and control plots respectively (Welch Anova: $F_{2, 16} = 7.115$, $P = 0.006$; Welch Anova: $F_{2, 17} = 6.041$, $P = 0.010$). Lastly, there was no significant spatial variation in recruitment among the sites.

1. INTRODUCTION

Wetlands are rich ecosystems and home to a wide diversity of plants and animals (Ramsar Convention Secretariat, 2016). Wetland plants (macrophytes) are adadpted to live in aquatic environments either for a short or long period of time. Some of the common wetland plants include: mangrooves (Rhizophora mucronata and Ceriops tagal), giant seed (Arundo donax), Reeds (Phragmitis sp), broadleaf cattail (Typha latifolia L) and papyrus (Cyperus papyrus) (MEMR, 2012; Abdulmalik, 2022). Also, there are an array of invertebrates (Dube et al., 2022), birds, amphibians, reptiles and mammals in different types of wetlands and the species of animal present depends on whether the wetland is freshwater or marine (Dvorak et al., 1998). Both plants and animals are important in maitaining wetland food web and ecological steadiness.

There are several types of wetlands ranging from coastal wetlands, mangrove, lacustrine, and riverine wetlands (Yang et al., 2016; Kelleway et al., 2017; Xu et al., 2020). The wetlands provide different ecosystem services depending on the vegetation type that dominates them. Hughes & Hughes (1992) argue that papyrus wetlands dominated by papyrus form special wetland type in tropical Africa, supporting a variety of diversity. Extensive papyrus wetlands occur in Sudd wetlands in South Sudan, around Lake Victoria, Lake Chad, Lake Naivasha in Kenya, Akagera river floodplain in Rwanda, Malagarasi-Muyovosi wetlands in Tanzania, along major rivers in Zambia, Malawi, Okavango delta in Botswana, and the Zambezi delta in Mozambique. As much as the extent of papyrus wetlands being not extensive as posited by Thompson & Hamilton (1983), their size is still reducing in size due to encroachment and intensified activities around them. Moreover, papyrus wetlands are increasingly becoming recognized as the most productive wetland plant communities in the tropical climate (Perbangkhem & Polprasert, 2010).

Cyperus papyrus occurs naturally between latitudes 17˚ N and 29˚ S of the equator at 2,300 m above the sea level (ASL) of southern, central and eastern Africa (McClanahan & Young, 1996). In Kenya, papyrus swamps are found mainly along with river inflows on the basins and shores of major lakes (Mavuti & Harper, 2006). According to Terer et al. (2015), C. papyrus is a large, emergent, aquatic perennial sedge, producing short rhizomes covered in thick black scales. Ludwig Triest, personal observation, (2015) in his study observed that papyrus roots are tough, extending to depths of 1m or more in suitable substrates. He further observed that rootlets are numerous; culms are erected up to 5 to 9 m tall, and 5 to 15 cm or more across the base on the widest point. The life cycle of culm and umbel ranges between 5 and 12 months depending on the site (Osumba et al., 2010) after which the structure senesces and dies. This results in the recycling of nutrients to the rhizomes and the formation of significant organic detrital deposits on the rhizome surface.

Papyrus has high harvestable biomass especially in eastern and central Africa. The biomass among various papyrus wetlands ranges from 36.05 tons per hectare in Lake Naivasha, 84.57 tons per hectare in Winam Gulf (Osumba et al., 2010), 86.91 tons per hectare in Rubondo Island in Tanzania (Mnaya et al., 2007) and 136.4 tons per hectare in various papyrus wetlands (Opio et al., 2014). Papyrus biomass is harvested mostly for making mats, thatching, household utensils and decorations, and for fuel (Ojoyi, 2006). Diverse parts and growth stages of the plant are used for different purposes. Osumba et al. (2010) identified from the harvesters' response at Winam gulf that for various commercial purposes most of the papyrus culms are harvested between three to six months of age. Young/tender plants are harvested for twining to make ropes, furniture, baskets, while middle/mature age plants are harvested for making mats, and overgrown plants are harvested for house construction and firewood purposes (Ondiek et al., 2016). These uses, however, have made papyrus wetlands vulnerable from over-exploitation. Papyrus systems also supply food for human consumption indirectly through agriculture and livestock herding in the seasonally flooded zone (Rongoei et al. 2013). According to Gichuki et al. (2001), papyrus wetlands are also important for fishing, both as nurseries and fish production. However, some attempts on integrated aquaculture in papyrus wetlands have remained experimental with little adoption by the farmers (Kipkemboi et al., 2007). In the recent past, papyrus biomass has been exploited on a small scale mainly for mats, baskets, ropes, roofing material and biomass fuel (Gichuki et al., 2001). According to Mafabi (2000) the past aerial surveys on papyrus wetland cover change in the Lake Victoria region showed remarkable decrease and harvesting of papyrus. Riparian communities whose livelihoods have always depended on the water resources, have now found a new source of revenue such as mats and basket cottage industries resulting from papyrus harvesting. This study assessed the impact of papyrus (Cyperus papyrus) above ground biomass harvesting on papyrus productivity, density, and growth stages of Saf-Wetland. The research hypothesized that there is no significant effect of harvesting on productivity, density, and growth stages of papyrus of Saf-Wetland.

2 MATERIALS AND METHODS

2.1 STUDY AREA

Saf wetland is one of the several small wetland areas in Siaya County (Siaya District Environment Action Plan 2009 - 2013) measuring roughly 7 km in length and an average width of 50 m. It has rarely been researched despite being an important system that supports the community and environment. It is part of continuous papyrus system in the Nzoia River basin located in Ugenya Sub County along Kisumu-Busia Road. Saf wetland is located in a high altitude (1303.82 m) areas of Siaya county (GOK, 2013) between latitude 0˚ 14'N to 0˚19'N and longitude 34˚14'E and 34˚15'E (Figure 2.1) with a surface area of about 2.5 km^2. The area receives an annual rainfall ranging between 800 mm- 2000 mm with long rains occurring between March and June and short rains between September and December (GOK, 2013). The riparian communities along this wetland harvest the papyrus for provision of biomass for use as fuel in furniture, mat, and thatch among other uses. Harvesting is common during low rains and drought seasons across one end to the other. Most of those who harvest papyrus are mat and furniture makers. These users exploit papyrus at a higher rate while at age classes II, III and IV. These are the stages when the growth rate is high in a papyrus (Opio *et al.,* 2014) thereby high-water purification process through nutrient uptake. Other activities threatening this wetland are encroachment by conversion into maize farms from the periphery.

2.2 STUDY DESIGN AND SAMLE COLLECTION

The study employed experimental research strategy where plots were established within the wetland and harvested at different periods to simulate the real harvesting by the riparian communities. Main plots measuring 10m by 5m were marked in different parts of the wetland where experimental harvesting was conducted. The plots were divided into two parts measuring (5m × 5m) of which one side was used as control (no harvesting after first clearing till the end of the study and the other part was harvested depending on the frequency outlined. The same measurements were replicated in the three experimental sites of Saf-Wetland (Figure 1). Samples were then taken from randomized triplicate 1m² quadrats made within the plots.

Figure 1 Experimental plot set for harvesting papyrus in Saf-Wetland

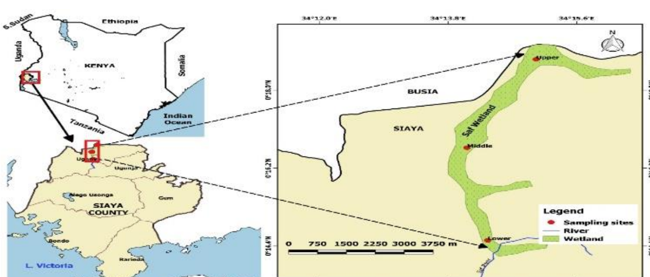

Figure 2 Study Area Map showing location of Saf-Wetland and the selected study sites.

2.3 MEASUREMENT OF ABOVE-GROUND BIOMASS PRODUCTIVITY, DENSITY, AND RECRUITMENT

Triplicate quadrats of 1 m^2 were randomly selected inside the disturbed (harvested) and control (unharvested) plots (Terer et al., 2012, Rongoei and Kariuki, 2019). The plots were located close to each other to reduce the effect of age cycles. For each harvesting regime (cycle), sampling was done to determine *C. papyrus* above ground productivity, culm recruitment and density. According to Kvet et al. (1998) as cited in Terer et al. (2012) mature papyrus stands are in dynamic process to reach particular equilibrium state by creating balance in biomass via interplay of regeneration and mortality. This informed the reason for setting harvested and control plots close to each other. This allowed the determination of effect of harvesting by comparing the changes in the measured parameters within and between the harvested and control plots. For harvested plots in each regime, fresh biomass was determined by cutting papyrus culms at 10cm above the rhizome (Terer et al., 2012). The clearing was done, and plots given time to regrow (Rongoei & Kariuki, 2019) before fast sampling began. The productivity was then monitored for cumulative period of 104 days (approximately 14 weeks for whole study period) (Silvan et al., 2004; Osumba et al., 2010; Terer et al., 2012).

The fresh harvested papyrus was then measured using spring balance to determine the fresh weight. Sub-sample fresh weight was then taken, reweighed, recorded, and taken to the laboratory for biomass determination. The samples were then dried in the sun for 2 days and placed in the oven for further drying at 80°C for 24hrs (Muthuri et al., 1989; Rongoei, 2019) to obtain constant weight (Figure 3). The total dry weight was obtained by using sub-sample dry weight to recalculate the total weight per unit area in m² using the formula below.

$$Biomass = \frac{dry\ weight\ of\ the\ sub - sample \times Total\ weight\ of\ sample\ plot}{weight\ of\ sub - sample}$$

Figure 3 Samples of papyrus ((a) after sun drying for two days and oven dried (b) in the laboratory for biomass determination).

In control plots, non-destructive, *in situ* measurements were taken. Measurements were made for culm diameter and height. Culm units (culm + umbel) from each control quadrat was measured for girth in centimeters at a point just above the tip of the tallest sheathing scale leaf (Figure 4) using a piece of string and a tape measure. Estimates of biomass was then determined from a linear regression fitted to the relationship between culm-unit dry weight of few harvested culms from adjacent plot and girth derived from control samples following Jones and Muthuri (1985) equation shown below:

$$Log\ W = XLogG - Y \qquad \text{(Eq. 3)}$$

Where W = dry weight of culm-unit (culm + umbel)
G = culm girth (diameter) in cm as measured at the top of the scale leaves and
X = Slope,
Y = Intercept of regression

Figure 4 Non-destructive method of biomass determination, measurement of girth (A) and height (B) of papyrus culm units.

2.4 MEASUREMENT OF DENSITY AND RECRUITMENT

Recruitment was measured by counting and classifying live culms into age groups (Terer et al., 2012; Jones et al., 2018, Rongoei & Kariuki, 2019). Young/Juvenile has green stems and unopened or newly opened umbel; mature has open green to pale green umbels; senescent culm has pale yellow stem and more than half of the stem is brown (Muthuri, 1985). The research also borrowed from Jones et al. (2018) to classify them into classes as shown in table 2.4. The young and juvenile culms were considered as recruits since they were not counted in the previous sampling. The counted culm units in the 1m^2 triplicate quadrats were averaged and expressed as density per square meter (Opio et al., 2013, Opio et al., 2014, Rongoei & Kariuki, 2019).

Table 2 Showing Culm category description from class 0-VI (Muthuri 1985)

Class size	Description
0	Between newly recruited to I
I	Young elongated culm with a closed umbel
II	Elongated culm with umbel just opening
III	Fully elongated culm and fully expanded umbel
IV	Mature culm
V	Senescing culm (≥40% achlorophyllous)
VI	Dead culm (≥60% achlorophyllous).

3 DATA ANALYSIS

Data collected were first organized in Microsoft excel for

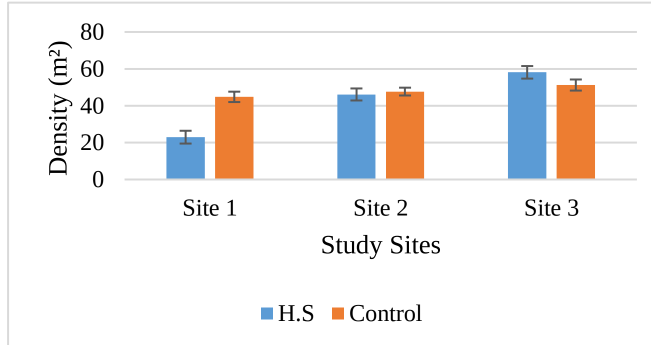

Figure 5Spatial variation of density among experimental sites of Saf-Wetland

analysis. All statistical analysis were then done using IBM SPSS Statistical Software version 20 (USA). All statistical tests were carried out at $p < 0.05$ significance level and data subjected to normality test (Shapiro-Wilk) and homogeneity of variance (Levene's) tests. Data for biomass, density, and recruitment were normally distributed therefore student t-test was used to test the mean difference between harvested and control plots. Lastly to measure spatial variation among the three sites as a result of harvesting over time, Welch ANOVA was used to test the effect of harvesting regimes which was designed to follow this pattern: Site one was frequently harvested (monthly), site two was moderately harvested (after every two months and two weeks) and site three was less frequently (after every three months and two weeks) to assess the effect on above ground papyrus biomass, density, and recruitment.

4 RESULTS

4.1 DENSITY AND RECRUITMENT

The study assessed the impact of wetland disturbance (harvesting) on density of Saf-wetland. There was significant difference among the sites (Welch Anova: $F_{2, 20} = 26.165$; P = <0.001) in harvested plots. Further analysis through Games Howel post-hoc analysis showed that site one (Mean = 22.95, SD = 15.892) was significantly different from site two (Mean = 46.11, SD = 9.778), P <0.001 and site three (Mean = 58.11, SD = 10.203), P < 0.001). However, sites two and three were not significantly different (P = 0.053). In unharvested (control) plots, there was no significant difference among the sites Welch Anova: $F_{2, 20} = 1.178$, P = 0.328 (Figure 5).

4.2 PAPYRUS RECRUITMENT

The effect of harvesting on papyrus recruitment was assessed in Saf-Wetland. There was no significant variation among the three sites in harvested plots (Welch Anova: F2, 20 = 0.229, P = 0.797). Similarly, there was no significant difference in control plots in the three sites (Welch Anova: F2, 18 =0.935, P = 0.411) (Figure 6).

4.3 ABOVE GROUND BIOMASS OF PAPYRUS IN SAF-WETLAND

The effect of disturbance (harvesting) was measured in the three sites. The harvested plots showed significant variation (Welch Anova: $F_{2, 16} = 7.115$, P = 0.006). Further analysis through Games Howell post-hoc test showed no significant difference between site 1&2 (P = 0.758), site 1 & 3 (P = 0.074), and site 2&3 (P = 0.397) (Figure 4.3.1). Similarly, the spatial comparison in control plots showed significant difference among the sites (Welch Anova: $F_{2, 17} = 0.010$). Further analysis through Games Howell post-hoc analysis showed significant difference between site 1&3 (P = 0.030), however, there was no significant difference between site 1&2 (P = 0.666) and site 2&3 (0.292).

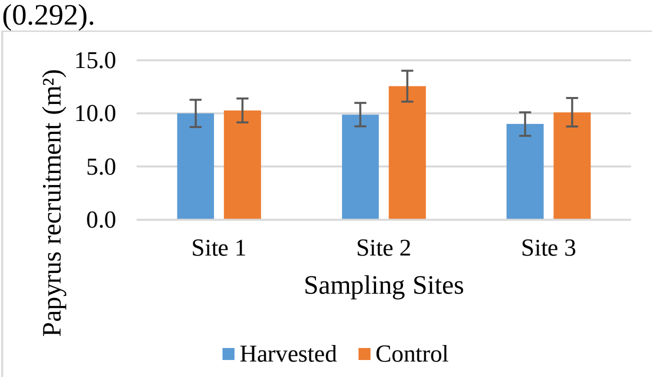

Figure 6 Spatial variation of Papyrus recruitment among the sampling sites of Saf-Wetland

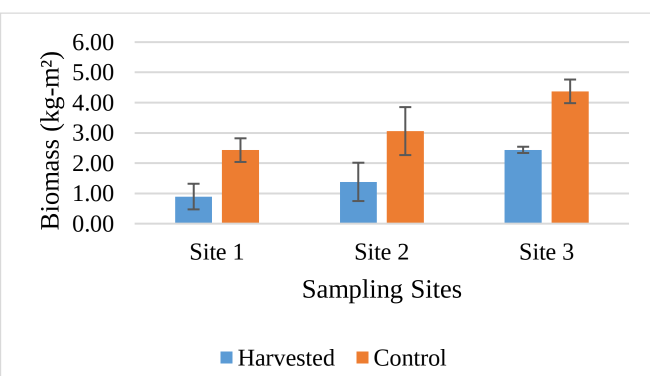

Figure 7Spatial variation of Papyrus biomass among the sampling sites of Saf-Wetland

5 DISCUSSIONS

5.1 EFFECT OF PAPYRUS HARVESTING ON CULM DENSITY AND RECRUITMENT

Studies have found that plant density can be used to describe the characteristics of plant communities. Density is basically the number of individual plants in a given unit area. It is regarded as an important component since it is used to monitor threatened or endangered plant species and other important statuses because it gives the actual number of individual plants per unit area. This component is also important to understand the trend of one species, for example, whether they are increasing or decreasing. In the wilderness, the density of plants is affected by animals browsing, natural disturbances such as fires, natural deaths, or utilization by human beings (Chen et al., 2014). It is imperative to study plant population in the ecosystem since it is the most basic critical level of plant ecology connecting individual species with communities and ecosystems. Harvesting, which is a human factor, was the focus of this study. According to Zhang et al. (2008), human factors include disturbances such as land use change, roads construction, among others. Studies have indicated that Papyrus (*Cyperus papyrus*) is harvested by communities living adjacent to the papyrus wetlands for handicraft and building and for fuel (Nyunja, 2003; Mbaria, 2006). In this study, density decreased steadily in harvested plots for two periods (period 1 and period 2) and increased for period 3. However, in control plots, density increased steadily for the three sites (tables 6, 7, and 8). In site one, density in the harvested quadrats decreased from the initial 58 culms/m^2 to 2 culms/m^2 over a period of six months (July-January). A similar trend was observed in site 2 where harvesting was moderate. We note therefore that there was distinction in papyrus densities between harvested and control plots in sites one and two. The observation for site three was contrary to what was observed in sites one and two. In this case, density increased in both harvested and control plots. Since this harvesting regime did not affect the papyrus density, it can be a good conservation measure in Saf wetland management.

The measurements at the start of the study revealed that Saf-Wetland had culm-density ranging between 47-65 culms/m^2. This observed population trend is way above the observation made by Jones and Muthuri (1985) of 12.7-17.9 culms/m^2. However, it is supported by observation made by Mnaya et al. (2007) in their study in Rubondo Island, Tanzania where they recorded a highest figure of 117 ± 18 culms/m^2. These high figures were attributed to high rainfall received in Rubondo Island. The area was reported to receive rainfall amount of 1300 mm per annum (p.a) unlike other studies such as Osumba et al. (2013) who recorded rainfall amount in their study area at 910 mm p.a. In their study of Winam Gulf wetlands, Osumba and others observed papyrus population range at 6-28 culms/m^2. High papyrus population density in Saf-Wetland could also be attributed to the high rainfall amounts received in the area (GOK, 2013) and the high-water levels in the wetland as observed during the study. High rainfall is important because it helps in diluting any pollutants that might hinder papyrus growth and increase water level in the wetland therefore supporting papyrus growth (Terer *et al.*, 2012a). Another study that agreed with my observation is Rongoei et al. (2016) who recorded the highest density of 37 ± 13culms/m^2 and 15 ± 4.5 culms/m^2 among different sites in Nyando wetland. Among these wetlands reported in literature, culm-density of Nyando wetland is close to the observations made in this study.

5.2 HARVESTING FREQUENCY AND PAPYRUS CULM DENSITY

Harvesting frequency seems to have affected the density of papyrus in Saf-Wetland. In site one where experimental harvesting was done on monthly basis (frequently), density decreased by 91.67%. These observations are supported by Terer et al. (2011) who found 69% (15-5 culms) reduction in culm density in 6 monthly harvesting regimes in harvested quadrats. Similarly, they observed an increase in culm density in unharvested quadrats. The findings of this study agree with those observations since in the unharvested controls there was 96% increase in culm density per unit area (25-49). In the 2.5 months harvesting regime (moderate), the papyrus density in the harvested plot reduced by about 34.71% in comparison to the baseline density while the unharvested plot showed an increased density. From the observation we can argue that harvesting affects the density of papyrus and high frequency of harvesting reduces density at a faster rate compared to moderate harvesting frequencies. The 3.5 month harvesting regime did not significantly affect the papyrus density. This could be because this time space was not enough to allow for the regrowth of papyrus.

5.3 THE RELATIONSHIP BETWEEN HARVESTING FREQUENCY AND PAPYRUS GROWTH STAGES

Growth is an important parameter since it helps in understanding population dynamics of papyrus and any other wetland plants. Papyrus plant growth stages are divided into different class sizes starting from I to VI (Muthuri, 1985). In this study, harvesting did not have a significant effect on different growth classes for all the three sites except for size class 5 and 6 in site one only where there was a significant difference between harvested and control plots. The significant difference observed in class 5 and 6 in site one where harvesting was done monthly could be attributed to the fact that these stages take long to develop. Frequent harvesting affects transition into higher size classess. This was observed by the differences between harvested and control sites. The lack of substatial differences in the early stages could be because the papyrus plant had regrown before the subsequent sampling was done, which would not be the case for classes 5 and 6.

An estimate biomass recovery time varied markedly from 3.5 to 24 months in wetlands as noted by (Osumba *et al.*, 2010). The longest harvesting regime in the current study was 3.5 months and this was not enough time for the papyrus plant to rejuvenate to full maturity cycle hence notable difference in stages 5-6 between control and harvested sites. According to Muthuri *et al.*, (1989) papyrus stems take about 6 months to reach maturity and 9 to 12 months to senescence. Terer *et al.* (2012b) recommended a 12-month harvesting regime especially in a papyrus swamp to provide sustainable time for regeneration of papyrus plants. However, from what we witnessed in the field, riparian communities harvest papyrus almost on a daily basis since this is their source of livelihood. Therefore, the proposed 12 month harvesting regime might be a challenge since these communities rely on papyrus for various socio-economic services like food, shelter, enoergy, health among others (Gichuki *et al.*, 2001; Terer, 2011). This is a threat to Saf wetland and other papyrus wetlands; therefore, the concept of wise use and sustainable management should be employed urgently.

Even though the study period was short, the information obtained will be very important to adopt conservation measures, management policy making and safeguarding sustainable use of Saf-wetland and other papyrus dominated wetlands. From the findings of the study, we can conclude harvesting frequency affected the occurrence of desired papyrus stage for sustaining ecosystem services, for example culms at different growth stages required for specific uses such as making ropes for house construction, mats, senenscing mat for thatching, among others. Frequent harvesting therefore does not provide ample time for sustainable exploitation.

5.3 THE IMPACTS OF PAPYRUS HARVESTING ON THE ABOVE GROUND BIOMASS

The baseline papyrus mean biomass reported in harvested plots was 1.79 kg/m2 and the mean in control plots was 2.05 kg/m2. These means were within the range of 1.384-8.456 kg/m2 for African papyrus swamps reported in previous studies. Several studies (Kipkemboi et al., 2002; Owino & Ryan, 2007; Osumba et al., 2010; Terer et al., 2012a;) have attributed the high papyrus biomass variation to several factors like; different water levels in the wetlands, anthropogenic disturbances, nutrient variability, and attitudinal differences of the wetlands. This study noted that a monthly harvesting regime reduced above ground-biomass to near zero which shows that this is a very dangerous practice and therefore threat to wetlands. Further, there was a noteworthy difference between harvested plots biomass and control plots biomass in this regime. This is in agreement with the study by Osumba et al. (2010) who reported that monthly harvesting suppresses papyrus growth to nil just after three months. In a 2.5 month harvesting regime, the biomass did not reduce to zero, however the mean for the harvested plot (6.32 kg/m2) was still within the range of 1.384-8.456 kg/m2 reported for African papyrus swamps. The biomass did not reduce significantly because the time range between one sampling time to the next was enough to allow regeneration. However, we can’t conclude with certainty whether moderate harvesting frequency after every 75 days (2 months 14 days) cannot reduce papyrus biomass significantly.

On the contrary, we would expect the mean papyrus biomass for harvested and control plots not to vary in a 3.5-month regime just like it did not in 2.5-month regime; however, this was not the case. We noticed that there was a substantial variation between harvested and control plots. The mean biomass for both harvested and control plots surpassed the range conveyed for the African papyrus swamps. It is important to note that Terer et al., (2012b) reported six months harvesting regime significantly affected aerial biomass production, culm density, culm diameter, culm height and clonal young shoot regeneration compared to the twelve-month harvesting regime. At the same time, Osumba et al., (2010) reported that a six-month study period is not enough time to study the effect of harvesting on papyrus biomass since it is not the plant complete life cycle. This could explain the lack of consistency in 2.5 (site two) and 3.5 (site three) month harvesting regimes in the present study.

The high biomass observed in this study in the 3.5-month harvesting could be associated with the little disturbance (harvesting) of growth stages in this site. Terer 2011 and Terer et al., 2012 reported that papyrus users in Loboi swamp estimated a 4–7-month regrowth period, which is close to 3.5 months of our study. Another possible reason for the observed high biomass in sites two and three could be because of high rainfall received by Saf-wetland which encouraged high growth rate of papyrus within the short time. Further, low nutrients were observed during the study, and this could be because papyrus are efficiently taking up the nutrient from water and use it for growth.

6 CONCLUSION

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6.1 LIMITATIONS OF THE STUDY

This study was conceptualized with the aim of fulfilling knowledge gap in utilization of papyrus from papyrus wetlands and other dominant vegetation from natural wetlands by adjacent communities that depend on them. Even though the study was successful, raft of challenges occurred before and during the study. First of all, malicious papyrus harvesters posed a threat to the experimental plots by cutting them down. Another challenge was this study was carried out across the low and high rainy season. During high rainy seasons, some plots were damaged by heavy runoff that carried away the floating papyrus from the plot. This forced the researcher to set a new plot for site two (moderately harvested) and begin fresh observation.

AUTHORS CONTRIBUTION

Robert Ogolla designed the study, set up experimental plots, collected samples, analyzed data and wrote the manuscript. Julius Kipkemboi and Nzula. Kitaka gave guidance on the study design and manuscript writing. All authors contributed to the article and approved the submitted version.

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