

Abundance and Conservation of *Cyperus papyrus* in the Nakivubo wetland, Uganda

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Abstract

Due to high population growth, there is increasing pressure on wetlands to the extent that wetland natural vegetation is continuously being replaced with food crops to meet the increasing food demands. The natural vegetation of Nakivubo wetland is dominated by *Cyperus papyrus*. *Cyperus papyrus* has recently been intensively harvested, there by creating a gap between its conservation and utilization. This study was conducted to compare the abundance of papyrus in the disturbed and non disturbed sites and document the strategies used to conserve *Cyperus papyrus* in Nakivubo wetland. The abundance of papyrus was assessed in 1m x 1m plots established along 2 transects in the disturbed and undisturbed parts of the wetland. The strategies used by the wetland users to conserve papyrus were determined by administering a questionnaire regarding wetland utilization to thirty respondents. The results showed that generally individuals of papyrus per hectare were higher in the undisturbed sites than disturbed sites. The non disturbed sites had more culms than the disturbed site though there were more juveniles in the disturbed site than in the non disturbed sites. All the respondents did not domesticate papyrus. Majority of the respondents did not allow the papyrus to regenerate after harvesting. They were not aware of the recommended harvesting intervals for papyrus. It is recommended that responsible authorities sensitize the public about appropriate use of the wetland and inform them about the suitable harvesting intervals for papyrus.

Key words: Conservation; *Cyperus papyrus*; Disturbance, Wetlands.

1. Introduction

Wetlands are characterized according to the dominant vegetation; papyrus wetlands being dominated by *Cyperus papyrus*. The papyrus wetlands occupy the transitional zone between permanently wet and generally dry environment.

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Uganda's wetlands consist of permanently flooded papyrus and grass swamps, swamp forests and upland bogs [1]. However, *Cyperus papyrus*, *Miscanthus violaceus* and *Phragmites mauritaanus* typically dominate the permanently inundated wetland areas along most of the shores of Lake Victoria [2], of which Nakivubo wetland is part. Papyrus (*Cyperus papyrus* L.) is one of the largest herbaceous species with its culm growing up to a height of 5m above the ground. It is commonly called papyrus and belongs to the family Cyperaceae. The culm is topped by characteristically large, spherically shaped, reproductive umbels that serve also as the main photosynthetic surface. Papyrus is a rhizomatous, perennial plant which forms extensive floating mats around the perimeter of lakes such as Lake Victoria [3]. Papyrus has both economic and ecological importance. Papyrus is used to make sandals, boxes, ropes, mats, cloth, and building materials. In Uganda, papyrus generates income in three major ways—mostly through the sale of raw materials to artisans such as thatchers and mat makers, through the production of rough low cost mats and through the production of fine high cost mats [4]. Papyrus is also currently being used as a raw material for making sanitary pads at the Faculty of Technology, Makerere University (makapads). Ecologically, papyrus is important because of its potential to carry of waste water treatment, nutrient retention and its high standing biomass [5]. However, due to the increasing population growth, the pressure on wetlands has increased and more than half of Nakivubo wetland has been drained for agriculture and the natural papyrus vegetation (*Cyperus papyrus*) has been progressively utilized for coco yams production (*Colocasia esculenta*) [5] to meet the increasing food demands and the papyrus that is left is also extensively harvested. This has therefore created a gap between the utilization and conservation of the papyrus. Therefore, there is a need to know the abundance and conservation if papyrus is to be sustainably utilized. Many studies for example [5, 6, 7] about papyrus have focused on its growth characteristics and its ability to contribute to the ecological functioning of the wetland. The diversity and distribution of sedges has been studied [8, 9]. The abundance of papyrus is not known. The aim of this study was to determine the abundance and conservation of papyrus around Nakivubo wetland. Papyrus harvesting is a source of income for some of the people living around the wetland, however, there is little evidence available on its sustainability as an income generating activity and impact on the ecological functioning of the wetland, so the information obtained from the study will enable responsible authorities such as National Environment Management Authority and the local people to make informed decisions necessary to regulate harvesting of papyrus and ensure the conservation of the wetland as a whole.

2. Study area and methods

2.1 Description of the study area

Nakivubo wetland is about 2.8 square kilometers in size. It is found in Kampala District and forms a boundary between Nakawa and Makindye divisions in the valley between Bugolobi, Mpanga and Muyenga hills [10]. It has been receiving wastewater from the city of Kampala for more than 30 years. The wetland is located at 00°18'N; 32°38'E with an altitude of 1135 m above sea level. The wetland is fed by Nakivubo River and its tributaries that include; Katunga, Kitante, Lugogo and Nakulabye rivers. It runs from the central industrial district of Kampala and enters Lake Victoria at Murchison Bay. The wetland is dominated by *Cyperus papyrus* and *Miscanthus violaceus* although the less water logged areas have been modified by construction and the cultivation of yams, sugar, especially around Namuwongo and Bugolobi. The upper slopes of the adjacent zones are occupied by high cost residential settlements with low or medium densities while the low-lying residential areas of the wetland are mainly comprised of low cost high density settlements and slums. Agriculture is one of the economic activities carried out around the wetland in areas that are not water logged and the crops mainly grown are sugarcane and cocoyam. Fishing is also carried out parting some parts of the wetland next to Lake Victoria [4]. The soils of Nakivubo wetland are alluvial and lucustine sands, silt and clays overlying granite gneisses. Resistivity studies indicate that the underlying soils consist of up to 30 m thick of impervious clays, implying that a thick barrier to free mixing between ground water and swamp water. In Nakivubo wetland, peat formation is very poor, possibly because of the effects of the flood regimes where by the materials are exported from the swamp in to the lake [11]. The Nakivubo swamp is falls within the equatorial belt and is moist sub-humid. It receives a bi-seasonal rainfall in the periods of March to May and September to November. The rainfall is linked to the Intertropical Convergence Zone (ITCZ), the altitude, local topography and the lake climate. There is very little annual variation in air temperature and limited variation in irradiation [11].

2.2 Methods

2.2.1 Sampling procedure

Abundance of papyrus was assessed in 40 plots established along two transects each of 100m. One of the transects was established in the disturbed area of the wetland (between Luzira prison and Namuwongo) and the other in the undisturbed parts of the wetland (in Luzira adjacent to Lake Victoria). The sampling along the transects was done at 10 sampling points 10m apart. At each sampling point, 2 rectangular plots of 1m x 1m were established equidistant from the sampling point at a distance of 1m from the transect. In each plot, all the papyrus culms were counted and divided into 3 age classes; (i) juvenile, with unopened umbels; (ii) mature, with opened green umbels; and (iii) senescent, with more than half of the umbel brown (achlorophyllous) and clear evidence of senescence of the culm following [12]. A total of 40 plots were established, 20 in the disturbed and 20 in the undisturbed parts of the wetland. Conservation strategies of papyrus were assessed by administering 30 questionnaires to 30 people who use papyrus from the villages surrounding the wetland. The questions sought to understand the socio-economic characteristics of the respondents, what they use the wetland for and how they sustain its productivity.

2.2.2 Data analysis

The numbers of papyrus culms of the different size classes in each plot were obtained by counting and their abundance was calculated as

$$\text{The abundance of papyrus} = \frac{\text{Total number of individual in the 20 plots}}{\text{Area of the 20 plots (m}^2\text{)}} \times 10,000(\text{m}^2)$$

Using SPSS version 12, One way ANOVA was used to determine the effect of disturbance in the abundance of the different size classes of papyrus in the disturbed and undisturbed sites of the wetland. Also questionnaire responses were summarized as frequencies and presented in charts and tables.

3. Results

3.1 The abundance of papyrus in the disturbed and non disturbed sites of the wetland

The abundance of papyrus in the disturbed and undisturbed sites of the wetland ranged between 19,500 individuals/ha to 265,500 individuals/ha. Generally the non disturbed site had more culms than the disturbed site though there were more juveniles in the disturbed site than in the non disturbed site. The population of mature culms and senescent culms was higher in the non disturbed sites than the disturbed sites (Figure 3.1). The mean number of juveniles in the disturbed site was not significantly higher than in the undisturbed sites of the wetland ($p = 0.147$). The mean number of mature papyrus culms in the undisturbed site was significantly higher than in the disturbed sites of the wetland ($p = 0.000$). The mean number of senescent papyrus culms in the undisturbed was significantly higher than in the disturbed site of the wetland ($p = 0.000$).



Figure 3.1: The abundance of papyrus culms in both the disturbed and non disturbed sites of the wetland.

3.2 Characteristics of the respondents in the study area

The majority (60%) of the respondents were female. The highest percentage (53%) of the respondents had attained education up to Ordinary level, 27% attended primary school and 7% did not go to school. Majority of the respondents were between the ages of 26 – 35. Most (63%) of the respondents were business people, 27% of the respondents use the papyrus for making mats (Table 3.1).

Table 3.1 Characteristics of the respondents

Characteristic	Percentage
Gender	
Male	40
Female	60
Age (years)	
18-25	33.3
26-35	43.3
36-45	16.7
46-55	3.3
56 and above	3.3
Occupation	
Business	63.3

Papyrus mat making	26.3
Cattle rearing	6.7
Any other	3.3
Education level	
Primary	26.7
O' level	53.3
A' level	6.7
Tertiary	6.7
No school	6.7

3.3 Strategies in place to conserve *Cyperus papyrus*

After harvesting, majority of the respondents (77%) leave the wetland to regenerate. Some of the respondents do not harvest papyrus and therefore do not know what happens after harvesting as others use the land for other activities such as agricultural crops farming. Most of the respondents do not know the period it takes for papyrus to re-grow to a harvestable size after harvesting. About 16.7% leave the papyrus for one year before they could harvest them again. All the respondents encountered do not domesticate papyrus (Table 3.2).

Table 2 Wetland conservation by regeneration

Variable	Percentage
Regeneration	
Yes	76.7
No	6.7
Do not harvest	16.7
Time taken to re-harvest	
One year	16.7
6 months	6.7
3-4 months	3.3
Do not know	73.3

3.4 Other strategies used to conserve papyrus

Some of the respondents (30%) see no reason as to why they should conserve the papyrus, 23% conserve papyrus by conserving the wetland, and 23% of them suggested that selective harvesting of papyrus (harvesting only those that a mature) can conserve the wetland. Other respondents suggested that papyrus can be conserved by them to regenerate whereas the rest did not know how to conserve the papyrus.

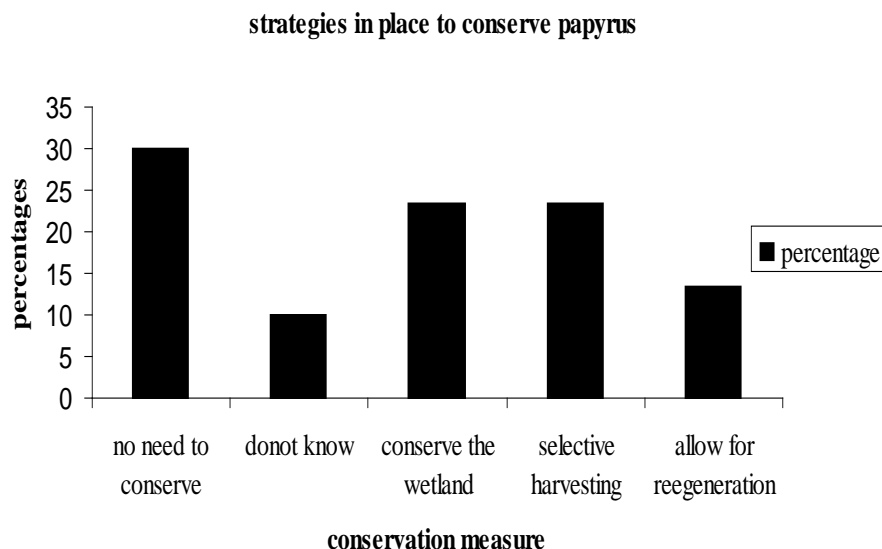


Figure 2: The strategies in place to conserve papyrus.

4. Discussions

4.1 The abundance of papyrus in the disturbed and undisturbed sites of the wetland

The study indicated that the abundance of papyrus in the disturbed site of the wetland was lower than that of the undisturbed sites. This could be attributed to the short harvesting intervals that lead to a reduction in the papyrus yield as revealed by [13]. The human activities such as grazing and crop cultivation that were carried out in the disturbed sites for a long time, coupled with continuous harvesting could have altered the wetland's flow conditions and thus making the conditions unfavorable for the growth of papyrus and allowing the growth of other aquatic plant species that compete with papyrus for resources as a few culms survive the competition [14]. The abundance of juveniles was higher in the disturbed sites than in the undisturbed sites because clearing of the wetland opens up the canopy and allows the papyrus rhizomes to receive light so as to regenerate.

4.2 Papyrus conservation strategies

After harvesting, most of the respondents left the wetland so as to allow for the regeneration of papyrus. This is because the National Environment Management Authority (NEMA) prohibits the cultivation of agricultural crops in wetlands. More so only a few crops can do well in those water logged areas. Though sugarcanes and coco yams are known to be grown in wetlands, they grow in less water logged areas than those where papyrus grows. Access to such water logged areas is also a problem since wetlands are also habitats of other wildlife for instance snakes. Majority of the papyrus users do not know the recommended harvesting intervals. The recommended harvesting interval for papyrus is 12 months [15]. This means that the respondents have limited information on papyrus conservation. This is dangerous since sustainability of papyrus yield depends on harvesting regimes, the regime should ensure less alteration of the wetland flow conditions while stimulating culm production [13]. Inadequate awareness of wetland users on the harvesting intervals can be attributed to the low levels of education of most of the respondents and the fact that the relevant responsible authorities have not come up to raise the public's awareness on wetland conservation. All the respondents do not domesticate papyrus probably because papyrus harvesting from the wetlands is not an illegal activity so those who need it can freely harvest it from the wetland. In addition, the demand for papyrus has not yet exceeded the amount currently supplied by the wetlands. The majority of the people interviewed had no reason as to why they should conserve papyrus arguing that papyrus regenerates naturally hence

no need to take care of it. This is in agreement with [16] who revealed that insufficient awareness of the functioning of the wetlands is one of the major factors leading to inappropriate use of wetland resources.

5. Conclusions and recommendations

The abundance of papyrus was generally higher in the non disturbed sites than in the disturbed sites, though the juveniles were more abundant in the disturbed site. Most of the people leave papyrus to regenerate but lack information on its conservation strategies and proper harvesting intervals. Around Nakivubo, all the people depend on the wetland for their papyrus needs since none of them domesticates it on their farms. To conserve papyrus, there a need for the relevant authorities to sensitize the public especially people involved in papyrus harvesting about the proper harvesting intervals for papyrus and other conservation strategies. The national environment management authority and all the relevant authorities should strictly implement the laws against carrying out illegal activities in the wetlands since these have been found to affect the functioning of the wetland. There is a need for more studies into more efficient and profitable use of papyrus so as to act as an incentive for people to plant it on farm and thus reduce the pressure on the papyrus in the wetlands.

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