ASSESSMENT OF TEMPORAL PRIMARY PRODUCTION IN TROPICAL INLAND SWAMP WETLANDS OF UASIN GISHU COUNTY, KENYA

Josephine M. Mulei, Agustino O. Onkware and Donald F. Otieno

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Abstract: Wetlands are highly productive ecosystems offering valuable ecosystem and socio-economic services. Worldwide they are threatened by encroachment due to increasing human population. Limited research has been done on the integrity of the ecosystems and their benefits to the surrounding communities in Uasin Gishu County, Kenya. The study assessed the spatial variations in the physico-chemical quality of water and soil and plant production in four freshwater swamps of Uasin Gishu County. Physico-chemical properties data was collected at an interval of one month for one year while that on nutrients was collected at an interval of three months for one year. Primary production was assessed using 0.25m^2 quadrats laid systematically along transects at peak biomass. All data was subjected to analysis of variance test and multiple relationships existing between biomass and physico-chemical parameters were tested using principal component analysis. Significant ($P < 0.05$) spatial variations in the physico-chemical properties and plant biomass were recorded. Plant biomass was mainly influenced by DO, TN, TP, Fe and the pH of the water and Na concentration in the soil. Physico-chemical attributes vary significantly in the swamps and production is high despite their small size. Their protection and conservation should be considered.

Keywords: Kenya, physico-chemical properties, swamp wetlands, temporal primary production, Uasin Gishu County

Introduction:

The importance of primary production in aquatic systems has been described in many studies (Blomqvist 2001; Ram et al. 2006; Hakrová et al. 2014). It is a critical function that supports many ecosystem services that are provided by wetlands (Sather and Smith 1984; Odum 1989). In natural wetlands, primary productivity is influenced by several factors including species composition (Kirkman et al. 2000), climate, hydrology and environmental variables like availability of nutrients (Olde Venterink et al. 2003; Cronk

Josephine M. Mulei and **Donald F. Otieno:**
University of Eldoret
Department of Biological Sciences
P.O. Box 1125
Eldoret, Kenya

e-mail (Josephine M. Mulei):
josephinemumbe@gmail.com
e-mail (Donald F. Otieno):
dfotieno@yahoo.co.uk

Agustino O. Onkware:
Rongo University
P.O. Box 103-40404
Rongo, Kenya

e-mail: aonkware@yahoo.com

and Fennessy 2009). The most productive wetlands receive nutrients either naturally from flood water or from agricultural runoff. Nutrients such as nitrogen and phosphorus tend to accumulate in many wetlands and these enhance the photosynthetic capability of the plants. A few highly specialized plants pre-dominate primary production in most of these aquatic ecosystems (Moss 1980; Vareschi 1982).

Major physical factors that usually affect wetlands significantly are temperature, light, electrical conductivity and water depth (Boney 1989). Among these factors, variations in temperature usually have the most profound (and sometimes lethal) effects on the living aquatic resources. They have a direct influence on the biological functions of plants and animals (Burgis and Morris 1987; Boney 1989).

Generally, tropical wetlands have the highest primary production of all the world's ecosystems, with a high biodiversity of terrestrial and aquatic communities (Thompson and Hamilton 1983; Richardson 2000; Reddy et al. 2010; Posa et al. 2011; Syeed et al. 2016). The ability of wetlands to self-sustain themselves has been linked to their levels of primary production and biogeochemical cycling of nutrient (Miller et al. 1996).

In Kenya, there are numerous swamp wetlands, some of which have been recognised as important biodiversity hotspots (Kavishe 2001; Abila et al. 2005). Most studies in the country have concentrated on wetlands of commercial interest such as Saiwa and Yala swamps (Abila et al. 2005), but little has been done on small wetlands at local level. Despite their size, small wetlands in Kenya provide many ecological services and functions affecting the people who depend on them. They regulate water quality and control floods and they have been used by indigenous people to provide traditional medicine, fuelwood, thatching materials, income, traditional vegetables among other benefits. These wetlands have largely been neglected in most parts of the country and no policies have been put in place to protect them.

Uasin Gishu County lies in the Rift Valley region where only wetlands with international importance have management plans (Kecha et al. 2007). The county has many small swamp wetlands that are habitats for hundreds of species of flora and fauna, some of which are deemed to be endangered (Odongo 1996). They provide important socio-economic and ecological services to the local communities living around them. These wetlands are in danger of disappearing largely because they are not considered as important and as such are converted to other uses such agriculture and settlement. However, the wetlands are very important for nature conservation as well as preservation of their immense benefits to the ecosystem and local communities. If the current rate of destruction is not checked, the ecosystem services associated with the wetlands will be lost. Limited studies have been done on the wetlands especially in their physico-chemical properties and there is virtually no information on their bio-productivity. Primary production is an important environmental process that reflects the amount of matter available to consumers. Limitations on knowledge of these important parameters of the swamps in Uasin Gishu ultimately impair their management.

The current study is a comparative assessment of primary production and water and soil quality parameters of four swamp wetlands in Uasin Gishu County, Kenya. The objectives of the study were:

- to determine the above ground biomass of the selected swamp wetlands;
- to investigate the physico-chemical parameter that influence primary production in the swamps.

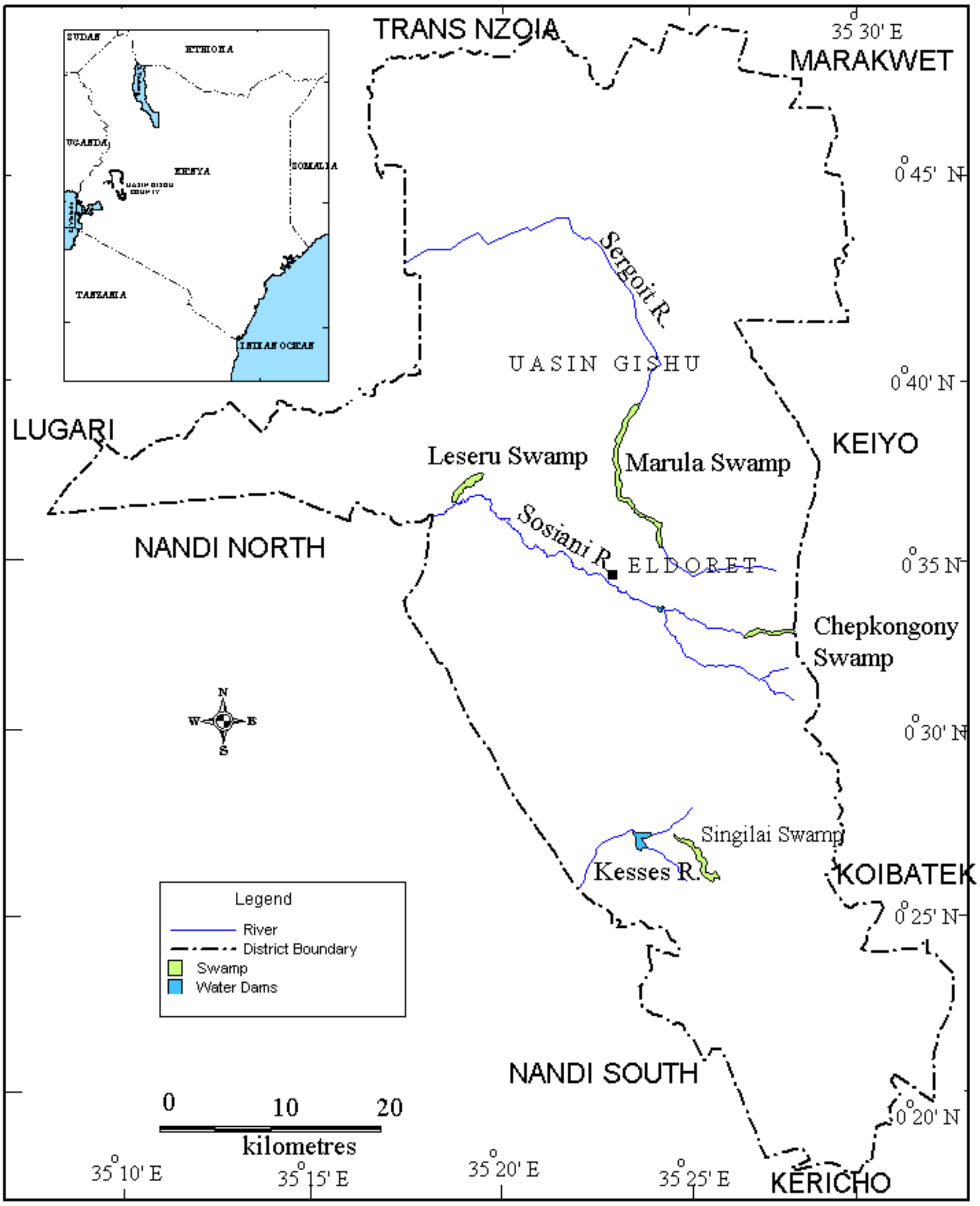
We hypothesised that primary production in the wetlands is not high because of their small size and their physico-chemical parameters do not vary irrespective of their location.

Materials and methods:

Study area

Four palustrine wetland sites were selected from Uasin Gishu County which lies between 34°55'33" and 35°38'58"E and between 0°2'44"S and 0°55'56"N (Fig. 1, after Njuguna 1996) and covers an area of approximately 3218 km^2 (GoK 2002). The County is well known for its many swamps due to a permitting climate and the study was undertaken in Marula (5.6 km^2), Leseru (1.5 km^2), Singilai (3.5 km^2) and Chepkongony (1.2 km^2) swamps which are located in the same ecozone and experiencing varying levels of human disturbance.

Figure no. 1 Uasin Gishu County showing the study sites. Inset: Map of Kenya



Methods

Soil samples were taken at four georeferenced random points in each swamp at intervals of three months for one year for determination of pH, phosphorus, nitrogen, sodium, potassium, iron and sulphur following standard methods (Allen et al. 1986; APHA 1998). Triplicate samples were collected from each site at a depth of 15 cm using a hand auger and kept in labelled soil bags. The soil bags were stored in cool boxes kept at 0 °C and transported to the laboratory for analysis.

Water analysis was done at the georeferenced sites in each swamp. Temperature, pH, dissolved oxygen and conductivity were measured *in situ* at monthly intervals for one year using a calibrated JENWAY® 3405 electrochemical analyser (Barloword Scientific Ltd, Essex, UK), with probes for each variable. Water chemical parameters were determined at three months interval for one year at each sampling site. Triplicate water samples were drawn from each site using labelled plastic bottles and transported to the laboratory in cool boxes. They were stored in a refrigerator at 4 °C awaiting analysis. One hundred (100) millilitres of the water samples were filtered through a Whatman No. 42 filter paper for determination of:

- dissolved phosphorus by the Olsen method;
- total nitrogen by the colorimetric method;
- dissolved sulphates by turbidity method (APHA 1998);
- available iron as described by Mulgrave (1989) and Okalebo et al. (2002);
- exchangeable sodium and potassium as described by Okalebo et al. (2002).

Net primary production (Pn) was estimated by harvesting peak standing crop at the end of the growing season (Bouchard and Mitsch 1998; Atkinson et al. 2010; Hakrová et al. 2014). Belt transects were laid randomly across the swamps and in each transect quadrats of 0.25 m^2 (0.5m x 0.5m) were placed systematically at an interval of 10 meters. All the shoot material within each quadrat was removed by clipping to ground level with a pair of secateurs. Samples were segregated by quadrat and all dead material was separated from the living. The living material was sealed into labelled plastic bags.

The dead material was dried in an oven at 80 °C to a constant mass and weighed (Denver Instrument ®XL-3100D, USA). The harvested living material was partially dried in the sun to minimize post-harvest weight loss through respiration and decomposition, dried in an oven at 80 °C to a constant and weighed (Denver Instrument® XL-3100D, USA). The standing stock was calculated as the sum of the dead and live biomass.

All statistical analyses were performed using STATISTICA 6.0 (StaSoftInc 2001) or Statistical Package for Social Sciences (SPSS 13.1) statistical packages. Normality and homoscedasticity of data distribution was checked by means of the skewness and kurtosis (Zar 2001). In cases where data was found not to follow normal distribution (heteroscedastic), log transformation was used to normalize all the biological data (Sokal and Rohlf 1981).

Differences in the physico-chemical parameters (temperature, pH, conductivity, DO and the nutrients) among sites were analysed using a one-way ANOVA. Differences in both spatial and temporal variability were analyzed by Two-way ANOVA. Duncans Multiples Range Test (DMRT) was used for Post-hoc separation of significant differences (Sokal and Rohlf 1981).

Productivity was analysed using One-Way ANOVA with Duncans Multiples Range test to separate significantly different means. Multiple relationships existing between biomass and physico-chemical water and soil parameters were tested using principal component analysis (PCA). All statistical analyses were done at 95% level of confidence.

Results and discussion:

All the physico-chemical water quality parameters displayed significant ($P < 0.05$) spatial variations (Tab. 1, Annexes). Singilai swamp displayed the highest water pH. Water temperature, conductivity, dissolved oxygen, sulphur, iron and all nutrients were significantly higher at Leseru, Singilai, Chepkongony and Marula swamps respectively. Significantly low values of conductivity and DO were recorded in Chepkongony and Marula swamps. Soil pH was significantly lower in Chepkongony swamp (Tab. 2, Annexes); sodium, potassium, iron and sulphur were highest in Marula swamp; nitrogen and phosphorus were highest in Leseru and Singilai Swamps respectively.

There was a significant $P < 0.05$ difference in peak standing stock among the swamps (Fig. 2). The highest peak standing crop occurred in Marula swamp. Principal component analysis showed close associations of TP, DO, pH, TN and Fe with biomass of the plant species in the swamps (Fig. 3). Three factors (Eigenvalue > 1) were found to account for much of the observed variability in the original data (79.64%) (Tab. 3, Annexes). On the contrary, Na, conductivity, K and SO_4^{2-} did not have any significant influence on the biomass in the four swamps.

In a PCA to determine the association between biomass and soil physico-chemical parameters, pH, Na and TN (the first three with Eigenvalues >1) appeared to have the greatest influence on plant biomass in the four swamps (Fig. 4). Together, they accounted for 67.38% of the observed variability in the original vegetation data (Tab. 4, Annexes).

Wetlands exhibit different water quality status depending on the geological formation in the catchment and whether the inflow includes wastewater (Bendell-Young et al. 2000). In this study, the physico-chemical environment of swamps in Uasin Gishu was heterogeneous in spatial scale. The temperatures recorded in the present study were higher than those in swamps in the Lake Victoria Basin (Lung'ayia et al. 2000; Raburu 2003) and Saiwa Swamp (Ogutu 1997). The high temperature in these swamps was associated with direct insolation because of the massive destruction of the swamp vegetation.

The dissolved oxygen in the four Uasin Gishu swamps was lower than those recorded for Yala swamp (Owino and Ryan 2007), Nyando Wetlands in Lake Victoria Basin (Obiero 2008) and Saiwa Swamp (Lung'ayia et al. 2000). The remarkably low levels of DO could be attributed to decomposition of the organic materials (Odum 1983). During the sampling period, cases of extreme anoxic conditions were common in areas with decaying vegetation. This therefore could suggest that oxygen was depleted by decomposition of vegetation in the swamps (Wetzel 1983). It could also be possible that the low DO was caused by fertilizer and manure runoff from farms. Philipart et al. (2000) reported that in areas with high anthropogenic activities, there were cases of high BOD that diminished concentration of DO in water.

The highest DO occurred in Chepkongony, which also had the lowest temperature. The open canopy which allows mixing of the water column, coupled with a low temperature resulted in maximum oxygen dissolution in water. In Marula, there was low DO despite the temperature being low, which suggest that other biological factors played an important role in regulating DO.

Thompson et al. (1979) reported that dense canopy of papyrus, as observed in this swamp, limits both mixing of the water column and light, intercepting over 90% of the incoming radiation. In combination with high rates of organic matter decomposition, these conditions result in extremely low oxygen in the water beneath the swamp canopy. In addition, the higher human activities in the area expose the swamp to pollutants such as sewage effluents that deplete the water of oxygen. Low DO levels were recorded in the Rwembaita Swamp of Kibale, Uganda, which is dominated by dense *C. papyrus*. This was associated with decomposition of the dense vegetation which utilizes the oxygen thus depleting it from the water column (Wetzel 1983).

Figure no. 2 Peak standing crop (Mean ± S.E.) of Marula, Leseru, Singilai and Chepkongony Swamps. Vertical bars depict standard error of the mean (SEM)

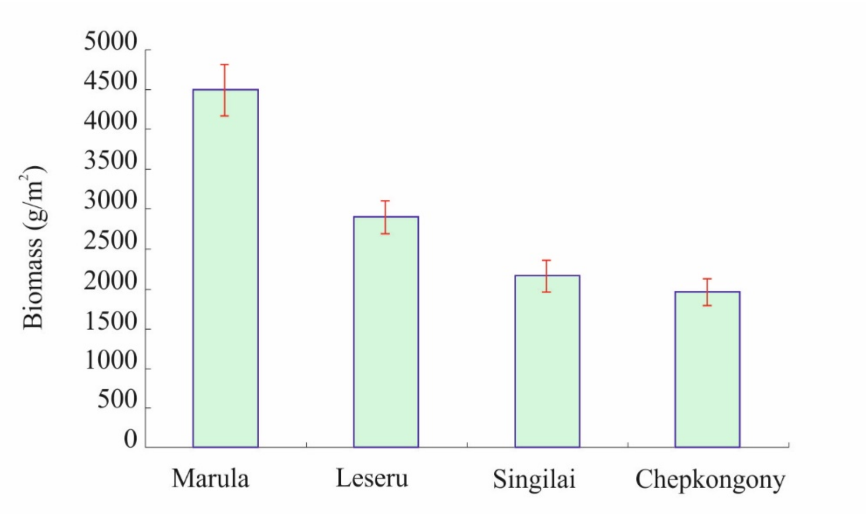


Figure no. 3 PCA results showing the relationships between biomass and physico-chemical water quality parameters at Marula, Leseru, Singilai and Chepkongony Swamps

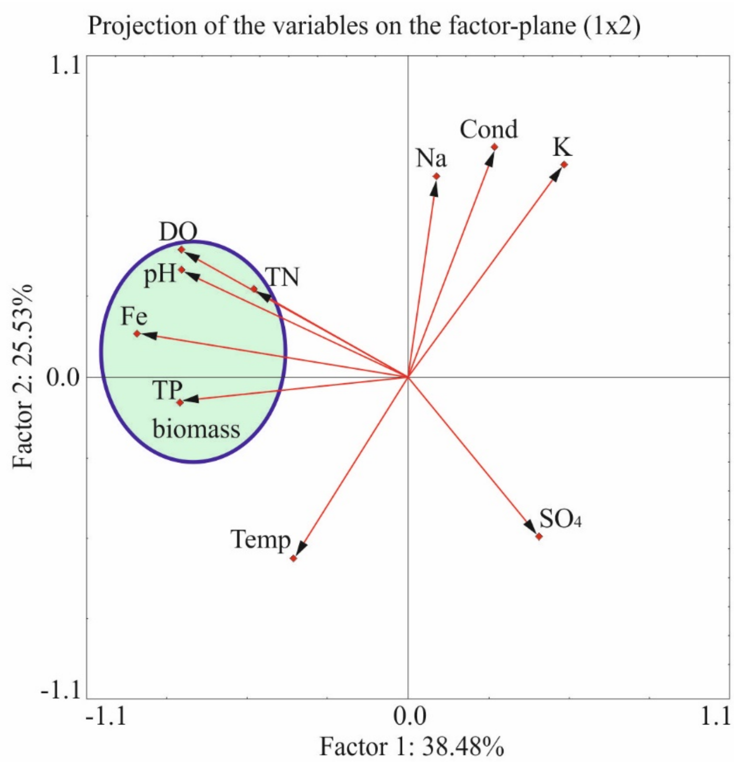
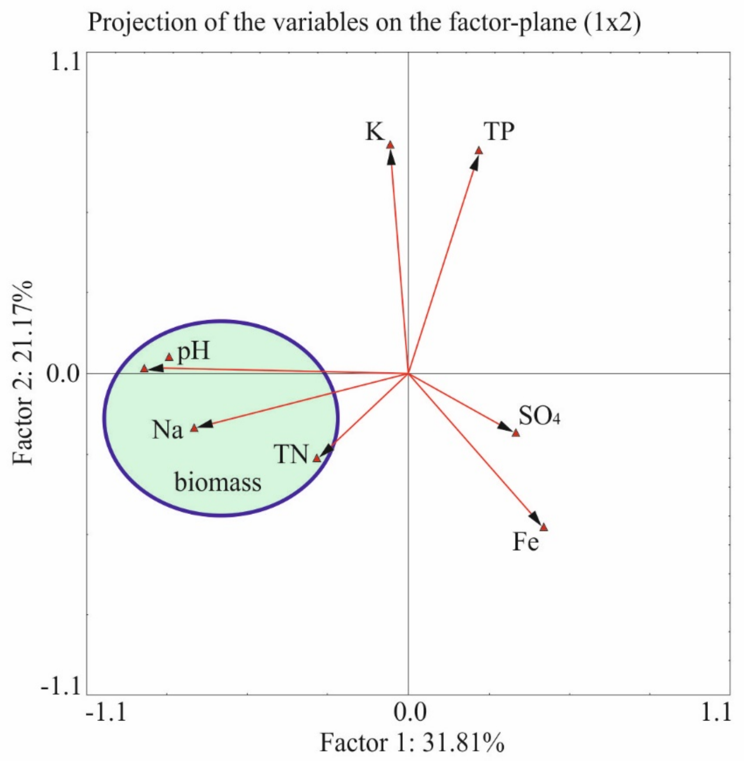


Figure no. 4 PCA results showing the relationships between plant biomass and soil parameters at Marula, Leseru, Singilai and Chepkongony Swamps



The pH of wetland waters is largely determined by the geology and soils of the catchment, as well as the human activities in the wetlands and catchment. The high water pH in Leseru Swamp could be associated with alkaline condition in the water related to burning of vegetation. Production of ash has been shown to cause increased alkaline condition of water bodies (Nasirwa and Njoroge 1997). The high values of soil pH in Singilai and Leseru supports the occurrence of high pH in the water in the two swamps, although the soils may also have been alkaline. A previous study by Njuguna (1996) however indicated much higher pH values in the swamps of Uasin Gishu suggesting a decrease in pH in the swamps. The relatively low water pH in Marula swamp, which is a papyrus swamp, could be attributed to the high levels of dissolved carbon dioxide and humic acids formed from organic matter decomposition (Balirwa 1998).

Swamps

Papyrus swamps have been categorized as detritus-based ecosystems (Howard-Williams and Gaudet 1985), and decomposition is low because of the mainly anaerobic conditions in the swamp (Chapman et al. 1995). In swamps dominating the wetlands of Lake Victoria, pH often ranges between 7.0 and 8.5 (Lung'ayia et al. 2000). Similarly in Saiwa Swamp, which is one of the protected swamps in Kenya, the pH ranges between 7.3 and 8.3 (Ogutu 1997). The pH ranges recorded in the four swamps of Uasin Gishu County differ from findings in other swamps around Kenya and Uganda (Milbrink 1999).

Conductivity in the selected swamps was very high for freshwater bodies, which are not proximate to any industry (Burgis and Morris 1987). The high conductivity in the swamps could be due to various factors including discharge of fresh water with loads of anthropogenic allochthonous inputs into the swamps (Bendell-Young et al. 2000). The high EC recorded in Singilai and Leseru Swamps was attributed to internal loading of the nutrients, agricultural run-off from the surrounding farms or to ions originating from soils and rocks in the watershed. In Marula, there were high economic activities including discharges of wastewater, agriculture and urban centres which tend to increase EC. However, the relatively lower levels of EC in the swamp was attributed to dense vegetation of papyrus, which has been reported to sequester nutrient and dissolved substances from the water (Kansiime et al. 2007).

Electrical conductivity was lowest in Chepkongony swamp, an indication that it receives very low amounts of dissolved ionic substances from its catchment area. However, the immense destruction of the swamp could also suggest absence of autochthonous inputs of nutrients and other dissolved substances from the vegetation. Absence of fertilizer use by farmers in the region could also imply low inputs of nutrients and dissolved substances in the swamp. However, water quality in wetlands is known to be influenced by geological formation in the catchment (Kansiime et al. 2007). The low levels of EC in Chepkongony could also be an indication of poor or infertile soils in the catchment.

The concentration of Na and K was low but that of total nitrogen and phosphorus were higher than in most swamps in Kenya. Other nutrients such as Fe and S were higher than often observed in freshwater bodies (Lung'ayia et al. 2000). The low concentration of Na and K in Uasin Gishu swamps could be linked to geochemical availability (Luoma and Rainbow 2008) and the high N, P, Fe and S in the swamps could be the result of their availability from anthropogenic sources. Kansiime et al. (2007) reported that fertilised cropping increases nutrient inputs into surrounding waters. The concentration of Na and K in water was related to their concentration in the soil suggesting the presence of metal adsorption and desorption from the inflowing water (Rainbow 2007).

Various human factors may have contributed to the high concentration of nutrients in Marula Swamp. The swamp receives waste water from a sewage treatment plant and a flower farm which are sources of dissolved ions. Agriculture using inorganic fertilizers is the main activity in the swamp catchment. The dense papyrus is capable of accumulating large amounts of nutrients and they are released into the swamp upon the death and decomposition of the plants (Kansiime et al. 2003).

The primary production in the swamps ranged from 1000 to 6000 g dry matter (dm) m^{-2}, which showed a remarkable similarity with what has been recorded in other swamps in East Africa (Okurut 2000; Kipkemboi et al. 2002). Marula swamp, which had the highest net primary production, was dominated by a small number of macrophytes, including papyrus (*Cyperus papyrus*), *Pycreus nitidus*, and *Typha latifolia*. Large portions of this swamp were dominated by pure stands of *C. papyrus*. Studies have shown that stands of *C. papyrus* are capable of accumulating large amounts of nutrients and have a high standing biomass (Muthuri and Jones 1997; Kansiime et al. 2003). *Cyperus papyrus* has a very high photosynthetic and productive potential (Chapman et al. 2001). In Lake Naivasha in Kenya, the harvestable standing biomass has been estimated at 32 tons per hectare, and the plant can regain its original biomass in less than twelve months. Muthuri and Jones (1997) associated the high productivity of *C. papyrus* in the wetlands of East Africa to the presence of C_4 photosynthesis, a characteristic of many highly productive tropical grasses. C_4 photosynthesis facilitates more efficient use of nitrogen.

The low biomass in Chepkongony swamp could indicate that human impacts are partly responsible for productivity of the swamps.

Factors that had a high positive correlation with plant biomass in the four swamps were TP, DO, pH, TN, Na and Fe. Nitrogen, phosphorus and iron are essential to life processes (Reynolds 1984). These nutrients provide enrichment to the water body and therefore enhance primary production by encouraging high floral standing crop. Due to the shallow depth of these swamps coupled with high temperature, there is a maximum photosynthetic activity resulting from water mixing that circulates nutrients and oxygen needed for plant production.

Conclusions:

The primary production of small local swamp wetlands of Uasin Gishu County is high and comparable to that observed in wetlands considered to be of national importance. Plant biomass in the swamps is significantly different with areas having less human disturbances having a higher biomass than those more impacted. However, the type of vegetation also has an impact on biomass. Peak standing stock of plants in the swamps is mainly influenced by the concentration of dissolved oxygen, total nitrogen, total phosphorus, iron and pH in water and pH, and sodium in inflowing water and the soil. Steps should to be taken to avert the continued destruction of the wetlands so as to safeguard the vital role they play.

Rezumat:

EVALUAREA PRODUCȚIEI PRIMARE RELATIVE ÎN ZONELE UMEDE DE MLAȘTINĂ TROPICALĂ DIN PROVINCIA UASIN GISHU, KENYA

Zonele umede sunt ecosisteme extrem de productive, care oferă servicii ecosistemice și socio-economice valoroase. În întreaga lume acestea sunt amenințate ca urmare a creșterii populației umane. Au fost realizate cercetări limitate privind integritatea ecosistemelor și beneficiile lor pentru comunitățile din provincia Uasin Gishu, Kenya. Studiul a evaluat variațiile spațiale ale calității fizico-chimice a apei și a solului și a producției vegetale în patru mlaștini cu apă dulce din provincia Uasin Gishu. Datele privind proprietățile fizico-chimice au fost colectate la un interval de o lună timp de un an, în timp ce datele privind nutrienții au fost colectate la un interval de trei luni timp de un an. Producția primară a fost evaluată folosind rame de 0.25 m^2 așezate sistematic de-a lungul transectelor în momentul maxim al biomasei. Toate datele au fost supuse analizei testelor de varianță, iar multiplele relații existente între biomasă și parametrii fizico-chimici au fost testate folosind analiza componentelor principale. Au fost înregistrate variații spațiale semnificative ($P < 0.05$) atât în ceea ce privește proprietățile fizico-chimice, cât și biomasa vegetală. Biomasa vegetală a fost influențată în principal de DO, TN, TP, Fe și pH-ul apei și a concentrației de Na în sol. Caracteristicile fizico-chimice variază semnificativ în mlaștini, iar producția este ridicată în ciuda dimensiunilor mici. Protecția și conservarea acestor zone umede ar trebui avute în vedere.

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Annexes:

Table no. 1 Selected physico-chemical attributes (Mean ± SE) of the water in the four swamp

Parameter	Marula	Leseru	Singilai	Chepkongony	P-value
pH	6.7 ± 0.04^{c}	6.9 ± 0.1^{b}	7.3 ± 0.1^{a}	6.7 ± 0.1^{c}	0.000
Temperature (^{o}C)	18.6 ± 0.4^{b}	20.5 ± 0.3^{a}	18.5± 0.4^{b}	18.1 ± 0.4^{b}	0.000
Conductivity (µS cm^{-1})	182.3 ± 8.9^{c}	290. ± 15.9^{b}	344.1 ± 13^{a}	98.2 ± 3.8^{d}	0.002
Dissolved oxygen (mg L^{-1})	3.1 ± 0.2^{c}	3.4 ± 0.3^{bc}	4.0 ± 0.3^{b}	4.9 ± 0.3^{a}	0.001
Nitrogen (µL^{-1})	37.0 ± 2.1^{a}	29.0 ± 2.4^{b}	24.0 ± 2.5^{c}	25.0 ± 3.1^{c}	0.016
Phosphorus (µg L^{-1})	4.6 ± 0.6^{a}	3.5 ± 0.4^{b}	2.8 ± 0.8^{c}	3.4 ± 0.8^{b}	0.015
Sodium (mg L^{-1})	11.9 ± 1.4^{a}	7.6 ± 1.4^{b}	8.4 ± 3.5^{b}	4.4 ± 0.2^{c}	0.000
Potassium (mg L^{-1})	7.2 ± 1.2^{a}	6.1 ± 0.8^{b}	4.5 ± 1.6^{c}	4.9 ± 0.7^{c}	0.005
Sulphur (mg L^{-1})	7.1 ± 1.3^{a}	6.9 ± 0.6^{a}	6.7 ± 0.8^{a}	4.9 ± 3.7^{b}	0.001
Iron (mgL^{-1})	3.6 ± 0.4^{a}	2.8 ± 0.2^{b}	3.2 ± 0.5^{ab}	2.6 ± 0.7^{b}	0.000

Note: Mean values with same letter as superscripts in each row are not significantly different ($P > 0.05$).
SE, standard error, calculated from mean-square for error of the ANOVA.

Table no. 2 Selected physico-chemical attributes (Mean ± SE) of the soils at the four swamps

Parameter	Marula	Leseru	Singilai	Chepkongony	P-value
pH	5.3 ± 0.2^{a}	5.2 ± 0.1^{a}	5.4 ± 0.1^{a}	4.8 ±0.1^{b}	0.000
Total nitrogen (%)	0.5 ± 0.04^{b}	1.0 ± 0.08^{a}	0.9 ± 0.05^{a}	0.6 ± 0.04^{b}	0.000
Olsen phosphorus (ppm)	13.4 ± 0.56^{b}	17.6± 0.75^{a}	18.1 ± 1.05^{a}	13.6 ± 1.03^{b}	0.000
Exchangeable sodium (mg kg-1)	52.8 ± 16.32^{a}	37.4 ± 3.52^{b}	34.6 ± 4.60^{b}	22.8 ± 2.84^{c}	0.000
Exchangeable potassium (mg kg-1)	85.8 ± 16.63^{a}	45.2 ± 11.32^{b}	56.6 ± 12.22^{b}	45.8 ± 10.16^{b}	0.001
Sulphur (mg kg-1)	69.5 ± 8.23^{a}	63.9 ± 8.71^{a}	42.6 ± 6.94^{b}	44.9 ± 11.31^{b}	0.047
Iron (mg kg-1)	5.6 ± 1.70^{a}	3.5 ± 0.81^{b}	4.0 ± 1.01^{b}	5.2 ±1.29^{a}	0.005

Note: Mean values with same letter as superscripts in each row are not significantly different ($P > 0.05$).
SE, standard error, calculated from mean-square for error of the ANOVA

Table no. 3 Eigenvalues of correlation matrix, and related statistics between biomass and water quality parameters

Value number	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	4.23	38.48	4.23	38.48
2	2.80	25.53	7.04	64.01
3	1.72	15.62	8.76	79.64
4	0.85	7.75	9.61	87.40
5	0.57	5.22	10.18	92.62
6	0.36	3.31	10.55	95.96
7	0.25	2.29	10.80	98.22
8	0.08	0.73	10.88	98.95
9	0.06	0.55	10.94	99.52
10	0.04	0.43	10.99	99.94
11	0.01	0.05	11.00	100.00

Table no. 4 Eigenvalues of correlation matrix and related statistics between biomass and soil chemical parameters

Value number	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	2.54	31.81	2.54	31.81
2	1.69	21.17	4.24	52.99
3	1.15	14.39	5.39	67.38
4	0.92	11.48	6.31	78.86
5	0.72	8.95	7.02	87.81
6	0.50	6.27	7.53	94.08
7	0.26	3.27	7.79	97.35
8	0.21	2.65	8.00	100.00