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Original Research Article

# Public perceptions of papyrus: community appraisal of wetland ecosystem services at Lake Naivasha, Kenya

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ABSTRACT

Papyrus wetlands form ecological buffer zones, protecting lake shallows from sedimentation and open water from eutrophication. Multiple wetland processes and functions also support the livelihoods of adjacent riparian communities. However, ecohydrologists have in the past typically placed insufficient emphasis on social and cultural factors operating within the catchments that they study. Here we outline a process that better integrates social science research methods within ecohydrology, using the 'language' of ecosystem services to prioritise objectives for the rehabilitation of papyrus wetlands at Lake Naivasha in Kenya. Reference is made to Lake Victoria for comparison and to illustrate how and why stakeholders' perceptions of wetland services may vary over even short distances.



## 1. Introduction

Studies of papyrus wetlands are attracting renewed attention from ecologists, economists and social scientists owing to their key role in maintaining the health of aquatic ecosystems and supporting the livelihoods of people living close to them (Harper et al., 2011; Maclean et al., 2011; Morrison et al., 2012; Terer et al., 2012a). The emergent macrophyte *Cyperus papyrus*, L. (hereafter 'papyrus') is a giant member of the sedge family which typically outcompetes coexisting wetland species, forming vast monotypic swathes of swamp in wet parts of central, eastern and southern Africa (van Dam et al., 2011). In Kenya, papyrus wetlands occur along the shores of Lake Victoria (Balirwa, 1995), around the inflowing rivers of Lake Naivasha (Harper, 1992) and, to a lesser extent, within smaller freshwater bodies of the Rift Valley (Terer et al., 2012b).

Papyrus wetlands form ecological buffer zones at the land–water interface, protecting lake shallows from sedimentation (Kansiime et al., 2007) and allowing excess nutrients arriving from the catchment to be efficiently assimilated and recycled into plant biomass (Gaudet, 1977), thereby reducing the risk of eutrophication in open water. Jones and Muthuri (1997) calculated the net primary production of a papyrus swamp at Lake Naivasha to be >6 kg dry weight $m^{-2}$ $yr^{-1}$, making it one of the most productive natural ecosystems on record. Being fast growing and high yielding, papyrus forms a readily renewable source of plant fibre, something upon which humans have long capitalised since ancient Egyptians began to make the first forms of paper c. 5000 years ago (Bell and Skeat, 1935). Today, many communities living near papyrus swamps, particularly in East Africa, continue

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to derive socioeconomic benefits from these highly productive habitats (Gichuki et al., 2001): tall stems are harvested for the production of mats, baskets and furniture (both for subsistence and for sale); rhizomes are uprooted for cooking fuel when alternatives are scarce and the wetland habitat as a whole is prized for hunting opportunities and as a store of traditional medicines (Morrison et al., 2012).

The future ability of these wetlands to continue delivering such a wide array of ecosystem services is uncertain, however. As with other wetland types around the world (Mitsch, 2010), papyrus swamps in East Africa are experiencing severe stress from a combination of: human population pressures (Balirwa, 1995); drainage in favour of agriculture (Schuyt, 2005); over-harvesting (Osumba et al., 2010); ineffective management (Hartter and Ryan, 2010); destruction by large mammals (Morrison and Harper, 2009) and the effects of climate change (Odada et al., 2009). Calls have been made for over a decade in Kenya for the restoration (Zalewski and Harper, 2001), protection (Kiwango and Wolanski, 2008) and future wise use (Terer et al., 2012a) of these important habitats. Morrison et al. (2012) provide an example of community-led rehabilitation and management of papyrus wetlands at Lake Victoria that – in spite of its apparent success – has so far only been achieved on a small scale and is yet to be replicated elsewhere. Larger scale restoration now seems possible at Lake Naivasha, given the support of local and national governance agencies as well as international donor assistance (Harper et al., 2011).

The ultimate beneficiaries of papyrus wetlands are riparian communities ('*wetlanders*': Coles and Coles, 1989), whose livelihoods depend, to varying degrees, on the direct and indirect benefits arising from wetland processes and functions, including access to clean drinking water and the provision of fish and fibre (MA, 2005). We can therefore expect that the attitudes and behaviours of these groups in relation to the wetlands will, to a considerable extent, determine the state and structure of the ecosystem over time, while taking due account of wider processes such as climate change. Ecohydrologists designing and implementing proposed wetland restoration measures thus require a nuanced understanding of the ecosystem from the perspectives of these key stakeholders, in order that they may strike a balance between enhancing the biophysical and ecological state of the wetlands and addressing the needs of the people who use them.

Hiwasaki and Arico (2007, p. 4) contend, however, that:

> "...the trend of past activities conducted under UNESCO's ecohydrology theme shows that emphasis placed on social and cultural factors has been insufficient. An important aspect that has yet to be fully addressed by ecohydrologists is the one related to people's relationship to water and the surrounding environments."

The authors discuss the need to integrate concepts and methodologies from the social sciences into ecohydrological research in order to "overcome the gap" separating its practitioners from the multiple social, cultural, political and economic interactions critical to effective water resources management (Hiwasaki and Arico, 2007). We agree that concerted efforts to integrate the social sciences into ecohydrological projects are crucial in the search for sustainable solutions to issues connecting water, the environment and people. At Lake Naivasha, an 'Ecohydrology Demonstration Site' since 2005 (Harper et al., 2011), a detailed analysis of people's values and beliefs regarding papyrus is currently missing. Closer integration of social and cultural considerations with ecohydrological research is particularly warranted in the case of Lake Naivasha since management plans for the ecosystem are presently under review, partly in response to claims of exclusion of certain stakeholder groups (Harper et al., 2011).

The aim of the present study, then, is to begin to overcome this knowledge gap, using the 'language' of ecosystem services to establish informed social and ecohydrological objectives towards the successful rehabilitation and future wise use of Naivasha's wetlands. A comparative analysis with riparian communities at Lake Victoria is made in an attempt to reveal how and why different stakeholders' perspectives may differ between sites and to consider the implications of this variation for wetland management.

### 1.1. Study areas

Lake Naivasha (0° 45′ S, 36° 20′ E) is Kenya's second largest freshwater body (surface area c. 140 km$^2$, max. depth c. 6 m) lying at an elevation of 1890 m.a.s.l. in the Rift Valley province, with a surrounding catchment area of around 2150 km$^2$ (Harper et al., 2011). Much of Naivasha's ecological history has been summarised in Harper et al. (2002). The lake is unusual in being one of only two freshwater bodies in a system of otherwise alkaline-soda lakes (Harper and Mavuti, 2004). This freshwater system is used for drinking, washing and livestock-watering by some 800,000 people (KNBS, 2012) living throughout the catchment whilst, at the same time, supporting geothermal power industries (generating c. 15% of Kenya's total power production, projected to rise to c. 39% by 2014: Afara Global, 2012) and irrigated vegetable and flower-growing – the latter being Kenya's top foreign-exchange earner and thereby making the Lake Naivasha ecosystem a critical component of the national economy (Harper et al., 2011).

Lake Victoria (1° 0′ S, 33°, 0′ E) is the world's second largest freshwater body (surface area c. 68,500 km$^2$, max. depth c. 84 m) lying at an altitude of 1133 m.a.s.l., with a surrounding catchment area of some 185,000 km$^2$ (Balirwa, 1995). Aspects of its ecological history have been summarised in Witte et al. (1999). The Kenyan part of Lake Victoria, roughly 6% of its total surface area, fringes Nyanza province (with a population of around 5 million people: KNBS, 2012) in the southwest of the country. In addition to fishing (the region's principal source of protein), subsistence agriculture and local craft industries, Nyanza's natural resources provide raw materials for textile and paper mills, rice plantations, sugar refineries, leather tanneries, cement plants and agrochemical factories (Kairu, 2001).