Management of highland wetlands in central Kenya: the importance of community education, awareness and eco-tourism in biodiversity conservation

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Abstract. The loss of natural habitats through destructive anthropogenic activities has been identified as one of the major drivers of environmental degradation. This is even more prevalent in developing countries where poverty and ignorance of the value of biodiversity is rampant. A pilot study was conducted in two highland wetlands in central Kenya to compile baseline data through the use of field survey, questionnaire and subsequent seminars. The study showed that wetlands offer ecological, social and economic benefits that are not fully appreciated and hence there is a lack of concerted efforts to advocate for their sustainable use. Initial findings showed that both wetlands were rich in biodiversity, especially birds. However, these ecosystems were experiencing environmental problems such as dumping of solid waste, over abstraction of water, encroachment for commercial and residential use, wetland agriculture, overgrazing, improper land use practices on the watershed and wildlife poaching. A follow-up series of public awareness and education campaigns to sensitize the local communities to the importance of the two ecosystems helped change attitudes and perceptions. As a result, the local community organized themselves, revived a dormant community group, and for the last two years have created an eco-tourism venture that has helped address many of the above threats. Future conservation and management efforts for wetlands and their associated watersheds can achieve more with well informed stakeholders. Public education and awareness of the benefits of biodiversity conservation, adoption of wetland user-friendly alternatives, and income generating enterprises offer a unique opportunity to sustainably manage and conserve wetlands amidst increasing populations, poverty and limited resources.

Keywords: Wetlands, landscapes, community conservation, eco-tourism, poverty alleviation

INTRODUCTION

Human activities have been identified as the major drivers of global environmental change on the planet and as a consequence directly influence biodiversity (Vitousek 1994). Changes in land use/cover are projected to have the largest impact on biodiversity, followed by nitrogen influence biodiversity (Vitousek 1994). Changes in land use/cover are environmental change on the planet and as a consequence directly influence biodiversity (Vitousek 1994). Human activities have been identified as the major drivers of global environmental change on the planet and as a consequence directly influence biodiversity (Vitousek 1994). Changes in land use/cover are projected to have the largest impact on biodiversity, followed by nitrogen influence biodiversity (Vitousek 1994).

Wetlands cover less than 9% of the earth’s land surface, but provide habitat to disproportionately high numbers of species (Zedler and Kercher 2005; Dudgeon et al. 2006), such as water birds, amphibians, fish, invertebrates and variety of flora (Mitsch and Gosselink 2000). Wetlands also offer ecosystem services such as water purification, flood control, nutrient cycling and carbon sequestration (Zedler and Kercher 2005, Daniels and Cumming 2008).

In Kenya, wetlands cover approximately 14,000 km² or (2.5%) of the surface area of the country (Crafters 1992). They are rich in living and non-living natural resources, and are important sources of food, water, medicinal plants, fuelwood, materials for building and handicrafts (Kareri 1992; Keter 1992; Gichuki et al. 1998; Thenya 2001, Terer et al. 2004).

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A negative perception of wetlands as ‘wastelands’ coupled with increasing human populations and changing life styles has led to the loss and degradation of wetlands through conversion into other land uses such as agriculture, pastureland, fish farming and residential areas (Owino and Ryan 2007; Macharia and Thenya 2007a, 2007b), that are perceived to be more profitable.

Since the signing of the Ramsar Convention (the Convention on Wetlands of International Importance) in 1971, significant progress has been made to promote conservation and sustainable utilization of wetlands (Ramsar Convention Bureau 2000). While the implementation and adoption of the Convention guidelines has been a success for wetlands of international, regional and national importance, the situation is different for wetlands at subnational and local levels. Generally wetlands at local levels are perceived as less important because of their small size. Though small-sized wetlands are sometimes seasonal, they can cover large areas during rainy seasons as well as be very productive and rich in biodiversity (Ng’weno 1992; Chambers 1999). Small sized and seasonal wetlands are mostly found on private or community owned land, which make conservation interventions by government agencies difficult to implement.

Challenges impeding prudent management of wetlands have been identified as: political-tribal mediated insecurity; ineffective governance; different use of resources by different ethnic groups; division of labour along gender and age lines; poverty and inability to diversify resources; traditions and neglect of traditional ecological knowledge (TEK); and
inadequate formal education (e.g. Terer et al. 2004; Mathooko et al. 2009; Hamerlynck et al. 2010).

One of the most popular strategies of managing designated wetlands of importance is to limit human access to these areas in order to minimize destructive activities. Unfortunately this is not applicable for small-sized wetlands that are largely found on private- or community-owned land. This situation is well discussed by Hardin (1968) in his article the tragedy of the commons. Hardin concluded that the only way humans can nurture nature is through education and awareness, which can counteract the natural tendency to do the wrong thing and the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed.

In an effort to contribute to the management and conservation of two small highland wetlands of Manguo and Ondiri swamps in central Kenya, a series of public education and awareness seminars were conducted to help people understand the relationship between the local communities, researchers, resource managers and the two wetland ecosystems. The aim was for all the stakeholders to learn from each other and subsequently appreciate the vital role each can play in the conservation of the environment. In this article we describe some of the lessons learned using these education and awareness methods.

**PHYSICAL AND ECOLOGICAL DESCRIPTION OF ONDIRI AND MANGUO WETLANDS**

**Ondiri** wetland is a swamp with bog-like characteristics. It covers an area of approximately 30 ha, is 2 to 3 metres deep with a perimeter of about 3.3 km. The swamp is located in Kikuyu division, Kiambu district, in the central province about 200 metres from Kikuyu town. Ondiri swamp lies at 2000 metres above sea level, latitude 1°15’S and longitude 36°40’E. The area has a mean annual temperature of 26°C, which ranges between 20.4°C in the upper highlands to 34°C in the midlands of Karai in Kikuyu division. Low temperatures are experienced in July and August while January, February and March are the hottest months. The rainfall is bimodal, with long rains occurring in April and May and short rains during the months of October and November. The average annual rainfall is 1500 mm. Water quality in the swamp is fairly good with conductivity ranging between 230 to 450 μs, temperature 15 to 19°C and pH from 6.1 to 8.2. The swamp is an important source of water for Nairobi river, which passes through the city of Nairobi (Ndiritu et al. 2006). Locally, the swamp provides water for domestic use, irrigation and livestock as well as fodder for livestock particularly during the dry season (Macharia and Thenya 2007a).

Ondiri swamp provides habitat for a significant number of resident and migratory bird species as well as aquatic plants. Common wetland and semi-wetlands plants include individual species of *Typha domingensis*, *Vossia cuspidate*, *Cyperus brevifolius*, and grasses such as *Leersia hexandra*, *Eragrostis exasperate* and *Eriochloa meyerana*. These plants are mainly found growing on the floating mat, an accumulated large amount of semi-decomposed organic matter that forms a thick layer of peat (approximately 0.5 m thick) on top of the water. The disturbed edges of the swamp are primarily vegetated by *Polygonum pilchrum*, *Biden pilosa* and *Oxygonium sinuatum*. Sphaeranthus gomphrenoides and *Melanthera scandens* occur along water canals in the farms. The swamp water catchment and riparian areas are vegetated with exotic tree species of *Grevillea robusta*, *Lantana camara*, *Eucalyptus sp.*, *Jacaranda minosifolia*, as well as a number of indigenous species such as *Croton spp*, *Ficus spp*, *Acacia melanoxylon*, *A. mearnsii* and *Podocarpus*, remnants of the indigenous forest cover of the area.

**Manguo** wetland is a typical tropical swamp, covering an area of approximately 50 ha. It is located in Limuru division, Kiambu district central province, at latitude 1°06’S and longitude 36°38’E and 2200 metres above sea level. The rainfall of the area is bimodal with long
rains occurring in April and May and the short rains occurring in October and November. The area receives an average annual rainfall of 1200 mm. The area has an annual mean temperatures ranging between 15.2°C and 17.6°C during the cold season (mainly between June and Augusts) and 20°C to 24°C during the hot season (January through March). Water quality in Manguo swamp is fairly good with neutral pH values of approximately 7.03, low concentrations of cations, phosphates and nitrates, a situation attributed to presence of fringing macrophytes that limit nutrient flow into the swamp (Macharia and Thenya 2007b). The swamp is an important source of water for Limuru town and the surrounding rural area mostly through two boreholes located in the northern low flooded area of the swamp. Manguo swamp has three unique ecological units (i.e. open water, swamp and floodplain) that support substantial populations of bird species and wetlands plants (Macharia and Thenya 2007b). Over 30 species of resident bird and palaearctic bird species have been recorded in the swamp, a feature that make it an important site for bird watchers and researchers. Common plants in the swamp consist of the sedges Cyperus dives, C. darcilema, C. rigidifolius, C. exactatus, Typha domingensis and Potamogeton spp. and the grass Eragrostis esperata. The riparian and catchment areas are mainly covered by exotic eucalyptus trees, a phenomenon characteristic of much of the central Kenya highlands after the clearing of the original indigenous trees in the early part of the 20th century.

STUDY METHODS AND INFORMATION GATHERING
This study was carried out in the Ondiri and Manguo swamps in Kiambu district in 2006 and 2007, respectively. The study entailed gathering data in the field and from published sources on local population, wetland ownership, values, uses and threats, current wetland conservation and management practices. First, all secondary data were solicited from libraries, individuals and government offices. This was later followed by fieldwork which involved collection of data on water quality, vegetation, birds and the socio-economic status of both swamps (Macharia and Thenya 2007a,b). Water quality parameters (pH, temperatures and conductivity) were manually determined in the field using water measuring meters. Birds were identified using Zimmerman et al. (1999), grasses (Ibrahim and Kabuye 1987), sedges (Hanes and Lye 1983) and herbaceous flowering plants (Agnew and Agnew 1994). Socio-economic information was obtained using both structured questionnaires and oral discussions. Focus Discussion Groups (FDGs) were organized in the field and later during the education and public awareness seminars. The aim was to obtain consensus on the wetlands' values, uses, threats, extent of involvement of community members and local environmental NGOs and government agencies. Lastly, education and public awareness were delivered through seminars in three phases: sensitization of the local communities, identification of the environmental problems and realization of opportunities. Phase One consisted of dissemination of the physical, ecological and socio economic information gathered on wetlands to the local community. Phase Two was identification and ownership of the environmental problems and; Phase Three involved deliberation of alternative wise use and restoration of wetlands.

SOCIO-ECONOMIC VALUES AND USES OF ONDIRI AND MANGUO SWAMPS
Eight one percent of the people interviewed in Manguo indicated that the swamp had high value for them and that they used it throughout the year (Fig. 2). The two most important uses were recreation and livestock grazing. The swamp offers a good place where locals relax and watch birds. It is also a famous stopover for international birdwatchers who visit on transit to other tourist destinations in the Rift Valley. Nature Kenya, an international environmental non governmental organisation (NGO), regularly organizes outings for birdwatchers. The National Museums of Kenya has included the swamp on the list of wetlands for annual water bird counts and has noted the presence of unique species such as the Grey Crown Crane (Balearica regulorum) and other palaearctic migrants. The presence of palatable and nutritious fodder plants on Manguo floodplain and swamp, make it important for livestock grazing, particularly during the dry seasons. Other uses of the swamp include sources of water for irrigation of the neighbouring farms, washing of cars and skin hides.

Similarly, Ondiri swamp is an important resource and provides numerous benefits to the local people. The swamp is a source of water for farming activities, horticulture and livestock rearing. Local communities and schools that obtain water from the Ondiri swamp include Alliance high school, Kikuyu hospital, University of Nairobi (Kikuyu campus), residents of Kikuyu Town Council, locations of Karai, Nderi, Maai Hii and Kenya Railways. In addition, the swamp is the source of the Nairobi River, which courses through the middle of the city of Nairobi. During the dry seasons, the swamp provides fodder for livestock and macrophytes are used as mulching material in horticulture farms and tree nurseries.

It is apparent that both Manguo and Ondiri peri-urban wetlands are rich in natural resources, features that make them support various socio-economic activities. However, some of the activities in the swamps are unsustainable and destructive.

THREATS AND CONSERVATION CHALLENGES OF ONDIRI AND MANGUO WETLANDS
It was obvious during our study that both Ondiri and Manguo swamps were experiencing serious environmental problems relating to the dumping of solid waste, over abstraction of water, encroachment of wetland for commercial and residential use, wetland agriculture, overgrazing, improper land use practices on the watershed and wildlife poaching. Most of the recorded uses were incompatible with wise use of wetlands such as washing of cars, irrigation, harvesting of macrophytes for fodder and mulching and waste disposal (Fig. 2). Bird poaching and collection of their eggs was also common around Manguo swamp. Just like in the Manguo area, Ondiri swamp was threatened by unsustainable anthropogenic activities in the swamp.

Normally, small-sized wetlands such as Manguo and Ondiri are reserved as government property under either the local county council or central government. However, due to an inadequate government supervisory role there is free access to every member of the community and over time this has lead to their over-exploitation and degradation. For example around Manguo swamp, 70% of the degradation was attributed to private land owners, 10% to the municipal council and 5% to the entire community. Moreover challenges to conservation of the swamps are due to private land ownership (53%), corruption and illegal land excision within the municipal council (16%), theft of tree seedlings (13%) and lack of funds to initiate conservation activities (3%).

The management and conservation of Ondiri and Manguo swamps presents enormous challenges primarily due to the nature of ownership which allow free access by every member of the community. It was apparent both wetlands were experiencing ownership crisis, with
Different stakeholders (i.e., private, local government, and central government) claiming ownership and use, but no conservation and restoration responsibilities. This scenario resembled Hardin’s “free rider” assertion, where degradation and over-use is linked to a common property regime (CPR). For example, approximately 70% of the lands surrounding both swamps are privately owned, with most of the land owners having less than 2 ha. Due to high human population growth in the area and the need for more land, a significant portion of the population is turning to government lands to supplement their economic needs. Usually communities are unlikely to invest resources and time conserving land that has no security of tenure or where ownership is not clear. During FDG sessions, most local people reported being unaware of the impacts of their activities on the swamps, though during their lifetime they have observed the size of the two wetlands decrease and a deterioration in the natural resources.

**PUBLIC EDUCATION AND AWARENESS**

The Public Education and Awareness (PEA) campaign provided a unique platform for all major stakeholders to interact, and exchange ideas and experiences on the best way to restore and conserve the Manguo swamp. The PEA process involved seminars, carried out in three phases. During Phase One and Two, the local communities appreciated the importance of the swamps and identified environmental problems. In Phase Three alternative sustainable use practices were deliberated upon. Guided by relevant government ministries and departments, the local community freely discussed the following themes: (1) opportunities and challenges of developing income generating activities; (2) who should be responsible for conservation and management of the swamp and; (3) institutional and community participation in wetland management.

The community members in the Manguo area identified land ownership as the major impediment to implementation of any conservation activity in the swamp. Though members discussed the issue of compensation, it was found to be unrealistic and non-viable as the government might not be willing to compensate them with cash or offer them alternative land. Members identified ecotourism as the most viable and environmentally friendly programme to undertake for the swamp. The people acknowledged that the swamp is strategically situated along the rich tourist circuit of the Rift Valley lakes and Kikuyu escarpment, famous for their scenic beauty, splendour and richness in biodiversity. To resolve the issue of land ownership and use, members agreed that resource utilization in the swamp will fall under wise use guidelines and those activities detrimental to the wellbeing of the swamp will be disallowed. These activities were identified as car washing, dumping of waste and wetland agriculture. The local authority agreed to discourage these activities. The hunting of birds and collection of their eggs will no longer be allowed in the swamp in an effort to enhance bird populations and diversity, with enforcement entrusted to the Kenya Wildlife Service and the local authorities. A grazing fee was introduced to control overgrazing, with the money collected used to demarcate and fence the critical area as well as improve supervision by employing a caretaker.

The local people agreed they were unaware of the rich biodiversity and unexploited potential of the swamp and the National Museums of Kenya (NMK), Kenya Wildlife Service (KWS), the local authority and the University of Nairobi (UoN) were given the task of enlightening the community. Relevant government institutions to assist in the management of the swamp were identified as the ministries of environment, land and water, while key stakeholders were recognized as land owners, the business community, conservationists and research institutions.

During the plenary session, all participants acknowledged that the workshops had enlightened them about the value, environmental problems and unexploited potential of the Manguo swamp. To move forward, the participating community members agreed unanimously to revive the dormant Manguo Land Owners Association which had been formed earlier to conserve the wetland under a new name, Manguo Eco-tourism and Conservation group (MECONG). A committee of ten people was selected to oversee registration and formulation of bylaws that will guide its operations. The NMK, KWS, UoN and the local authority agreed to continue working with the group and assist with technical support whenever required.

In 2008, the NMK, and UoN together with the MECONG management committee secured a small grant from the Ecosystems Grants Programme (EGP) of the Netherlands embassy. This has helped to boost the group meet some of its set targets. For instance, the group has managed to put up a fence around the swamp, build a bird viewing platform, train some members as local bird guides as well as buy ecotourism accessories such as some binoculars and birding guide books. The funding has also helped the group develop and produce publicity and education materials, which have assisted in earning some income from donations and in-kind support from visitors and well wishers. Also, the group recently received some funds from the government under the Economic Stimulus Programme. The funds were used for a fish farming initiative, Two fish ponds were built with the aim of selling fingerlings to farmers and recreational facilities. In the near future there are plans for the members of the group to start tree nurseries, to help restore the watershed with its indigenous tree population. Overall, all the above activities have made the members of the group united in purpose and most members are willing to assist in the conservation of Manguo swamp and its catchment.

Meanwhile public education and awareness initiatives in Ondiri swamp yielded positive and similar results to those in Manguo swamp. To minimize unsustainable wetland use, the local community in collaboration with Athi River Water Resources Management Authority and Kikuyu Town Council decided to form a Water Resource Users Association (WRUA) to control water abstraction for domestic and irrigation purposes. This community association has succeeded in regulating water abstraction from the swamp, by registering active boreholes and putting a limit to the area of land that each member can irrigate. The WRUA is in the process of formulating an integrated management plan for the whole ecosystem that is intended to demarcate and zone the swamp for conservation purposes, increase scientific knowledge, control unsustainable practices and organize regular environmental awareness education sessions for the local community. Recently the Friends of Ondiri Swamp a community based conservation group secured a second grant from Rufford Foundation, an international funding organisation to strength and support their conservation and eco-tourism initiatives in the swamp (Mungai 2010). These were good news and shows that environmental education is one way of empowering a society to conserve biodiversity while at the same time alleviating poverty among them.

**CONCLUSIONS**

It is evident from these two case studies that future conservation and management efforts of the environment lies with well informed stakeholders including local communities, natural resource managers,
policymakers, law enforcers and researchers. This reinforces Hardin’s assertion that “the only way humans can nurture nature is through education and awareness, which can counteract the natural tendency to do the wrong thing and the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed”. Apparently during this study most members of the community were unaware of whether their activities had an impact on the environment. This was attributed to serious communication breakdown between all stakeholders, particularly the educators and researchers on one side and local communities, natural resource managers, policy makers and law enforcers on the other. Although environmental education is offered in schools, colleges and universities in Kenya, its application has not yet been transferred to the general public, a major reason why environmental problems are widespread (Ndaruga, 2003; 2009).

Photo 1. Grazing cattle near the wetlands.

Figure 2. Ranks of major uses of Manguo swamp (n=30). Ranks represent (1) very important, (2) important, (3) less important and (4) not important.
These studies showed that it is possible to integrate economic activities and environmental conservation in privately owned lands. This is promising for the future of a significant part of biodiversity that is found on populated biomes (Ellis and Ramankutty 2008). Adoption of environmental user friendly alternatives and income generating enterprises in the wetlands such as ecotourism, fish farming and tree nurseries, have offered a unique opportunity to sustainably manage and conserve wetlands amidst increasing populations, poverty and limited resources. All these promising environmental conservation strategies are consistent with Millennium Development Goals (MDGs) and Kenya’s Vision 2030, which all seek to reduce poverty and ensure biodiversity conservation.

Finally, there is an urgent need for the Kenyan Government to take a more active role in conservation of the environment. There should be incentives and rewards for land owners who adopt environmental friendly activities, and penalties for those who degrade the environment.

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Photo 2. Refuse dumping at Manguo wetland.