

Socio-economic dimensions of conservation of wetlands in African dry lands: A case study of River Ewaso Ngiro basin in southern Kenya

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Abstract

Wetlands that occur in arid and semi-arid areas have unique characteristics and support unique biodiversity. The permanent wetlands are relatively small and isolated by large areas of dry land. There are however, numerous temporary or seasonal wetlands that contain water for only short period in the year. These wetlands contain water, a critical resource for all people, livestock, wildlife and plant life. The availability of fresh water minerals, pasture and other useful products attract humans, thereby making the wetlands to become focal points of economic development and indeed urbanization. The changing lifestyles of resident communities, such as increased focus on subsistence and commercial agriculture and sedentarization as opposed to nomadic pastoralism have profound impacts on wetlands and the biodiversity that they support. This paper provides primary data deriving from the authors' own studies of wetlands and their utilization by the local community in the River Ewaso Ngiro basin, southern Kenya. The study results are supplemented with relevant secondary information from other river basin studies in eastern Africa. The paper exposes the immense natural and socio-economic potential of dry land wetlands in enhancing food security and livelihoods in the arid and semi-arid regions of Africa.

Key words: Wetlands, characteristics, values, millennium goals

Introduction

Inland wetlands cover about one percent of Africa's total surface area. The major wetlands are the Congo River swamps; the Sudd in the upper Nile, Lake Victoria basin swamps, Chad basin swamps and the flood plains and deltas associated with major rivers, such as Niger and Zambezi. In Eastern Africa, wetlands cover over about 4% of the total area. The major wetlands occur in Lake Victoria basin, in the rift valley and in the floodplains and deltas of major rivers, such as Rufiji in Tanzania and Tana in Kenya. Wetlands are important resource base, which yield a number of valuable goods and services Harper and Mavuti (1996). Wetlands support forests and enhance protection of diverse and rich fisheries, including fishes and mollusks. Wetland fishery contributes about 50% of the fishery landings in Africa Vanden and Bernacsek (1990). Artificial fishing activities are an important source of income and livelihood for many African communities, especially the poor. Wetlands are also important source of water for agriculture, livestock and domestic uses. Agriculture accounts for 88% of the total water use.

In spite of their importance in protecting biodiversity and supporting local livelihoods and economy, wetlands are among the most threatened ecosystems in the arid and semiarid areas of southern Kenya. The success of wetland conservation in Africa's arid and semi-arid areas is dependent on people's positive perception of their environment, sustainable use of natural resources, including land, water and biological resources and development of pro-poor policies and initiatives Maltby *et al.*, (1988). The purpose of this study was to determine the values and uses of wetlands by a local community and identify the socio-economic factors that should be considered when developing sustainable conservation programmes in dry lands. The Ewaso Ngiro basin in southern Kenya provided a good case study because the physical environment and patterns of socio-economic development are generally similar to those of other dry lands in Africa.

This study was carried out in the years 2002-2004 in River Ewaso Ngiro basin in Kajiado District, southern Kenya. The river basin lies within the rain shadow of Mount Kilimanjaro and borders Arusha region in northern Tanzania (Figure 1). The lower part of the basin lies in Eastern Rift Valley between latitudes 36° 05'E and 37° 55'E, and between longitudes 01° 10'S and 03° 01'S. The average annual rainfall is 765mm, but its distribution is bimodal with long rains occurring in March-May and short rains in October-December. However, Ewaso Ngiro basin has consistently high ambient temperature (26-33°C) and high potential evapo-transpiration, which ranges from 1700mm to 2500mm per year. Surface water resources are therefore scarce in the area.

The distribution of wetlands in the study area is strongly influenced by local topography and drainage. Major wetland systems were associated with the Rift Valley, Loita Hills and Nguruman escarpment. River Ewaso Ngiro (180 Km long) has a catchment area of 8536 km² and it constitutes the most important wetland system in southern Kenya. The river drains the southern flanks of the east Mau Hills and most of Loita Hills. The river flows into Ewaso Ngiro Swamp before debauching its water into Lake Natron, the most important breeding site of flamingos in East Africa.

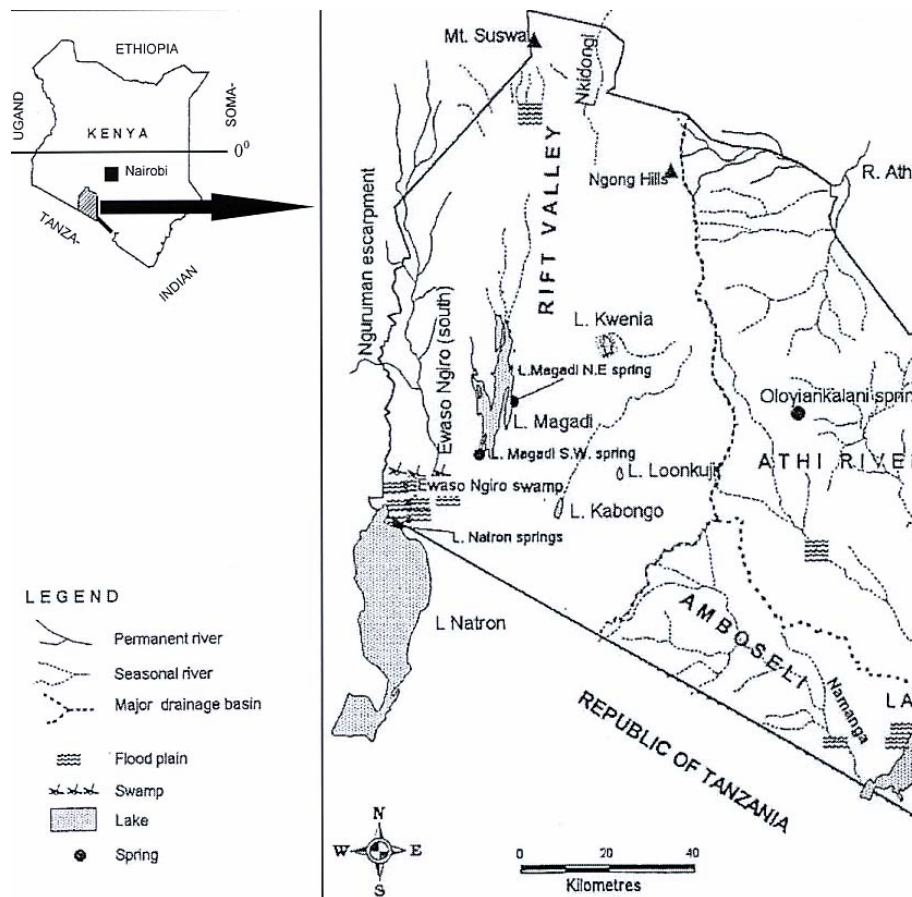


Figure 1: Study area.

About 30,000 people inhabited the basin with an average population density of 3.75 persons per km². The biological and physical resources in the basin, including fertile agricultural land, supported about 80,000 heads of livestock from Kajiado, Narok and the neighbouring districts in northern Tanzania. The basin also supports large numbers of wild animals, including monkeys, gazelles, buffalos, elephants, elands, and Coke's Heartbeest. Most of the study was carried out in villages located in Nguruman, Olkirimatian and Shomploe locations in Magadi Division of Kajiado District.

Materials and methods

A physical inventory of wetlands and an assessment of their characteristics was conducted in Ewaso Ngiro basin. The wetlands were located and their size estimated using topographic maps of scale 1:50,000 and Geographic Information System (G.P.S). The local community was also involved in locating and documentation of wetland values and uses. The wetlands were classified into four broad hierarchical systems and subsystems as described by Cowardin *et al.*, (1979).

Eight villages in six sites were selected for study by systematic sampling procedure. These were settlements located approximately within 3km of the

nearest wetland. It was assumed that people who depended on wetlands lived close to it. About 5% of the estimated total population of six thousand people in the eight villages was sampled. The villages were selected at regular intervals but the individual respondents were sampled at random. Information on wetland values, attributes, uses and threats was gathered through direct observation and interviews with local landowners with a view to increasing the range, relevance and reliability of data Theis *et al.*, (1991). In total 300 individuals responded to oral or written questions in a questionnaire administered by the project executants or field assistants. It was also found necessary to target certain respondents in order to get information on specific themes, such as cultural values and utilization of medicinal plants.

In the valuation of wetland resources and attributes, two approaches were used. The first approach was indirect opportunity cost whereby time spent in wetlands to acquire essential resources was valued against forgone opportunities of working elsewhere, earning the money and then using it to buy the items needed from other people or local shops. In the second approach, costs of using a substitute item that was available elsewhere other than in wetlands was use a measure of the value of the wetland product. The results were presented in the form of

scores or indices of the relative importance, based on the number of respondents who considered wetlands to be essential (5 scores), very important (4 scores), important (3 scores), not important (2 scores) and no opinion (1 score). Thereafter, the mean scores for each wetland value were computed and compared.

Results

Ewaso Ngiro basin covers a total area of 8,536 km² of which wetlands cover 4.5%. The major wetlands

were classified into four hierarchical systems each with several subsystems (Table 1). The riverine system comprised all wetlands contained within the channels of River Ewaso Ngiro and its tributaries: Oloibortoto, Entasopia, Sampu and Parkase. These streams drain the Nguruman escarpment and Loita Hills. A forest of fig trees (*Ficus natalensis*) and acacia trees (*Acacia xanthopholea*) occurred all along the river valley.

Table 1: Hierarchical classification of wetlands in Ewaso Ngiro basin.

Wetland system	Wetland subsystem	Typical wetlands
Riverine	Riverbed	River Ewaso Ngiro bed
	Riverine woodland	River Ewaso Ngiro Shrub/woodland
Lacustrine	Floodplain	Ewaso Ngiro Swamp
	Limnetic habitats	Lake Natron open water
		Marginal cold/hot springs
Littoral habitats		Unconsolidated Rocky/gravel shore
	Palustrine	Seasonal grasslands
Unconsolidated bottom		Water pans/dams
Shrub/woodland		Spring fed forest floodplain in Nguruman
Artificial	River-based impoundments	Fish ponds and irrigated farmlands
	Palustrine	Waste water lagoons, water storage dams

The Ewaso Ngiro swamp and the flood plain covered 8,000 hectares and the main vegetation types were *Echinochloa* sp. *Cyperus papyrus* and *Typha domingensis*. The river channels contained water throughout the year but the swamp received most of its water during the periods of heavy rain in the catchment area. Apart from surface water flow into the basin, there was additional and more permanent subterranean water supply to the Ewaso Ngiro Swamp from numerous springs that occur at the fringes of the swamp (Table 2).

The lacustrine system comprised all wetlands and deep-water habitats in natural depressions or dammed river channels that lacked trees, shrubs and herbaceous emergent plants. Permanently flooded basins, such as Lake Natron and water reservoirs were typical lacustrine systems with notable wave action at the shores.

The palustrine system comprised all non-tidal wetlands, such as marshes and wet grasslands. They also include fishponds and dams as well as small seasonal pools. Other typical palustrine wetlands were wastewater treatment lagoons for tourist lodges, dispensaries, boarding schools and private farms.

The distribution of all wetlands, however, was strongly influenced by the drainage pattern, local topography, and soils. The two main features of wetlands in this semi-arid region were their fluctuation in size and changes in water quality. Permanent wetlands changed in surface area by 15-30 % between the wet season and the dry season.

The fluctuations in wetland size were attributed to the seasonality of rainfall, high ambient temperature and the associated high rates of evaporation. Seasonal wetlands were widespread during the long rains in April and May. For that reason, fresh water was widely available to livestock and wildlife, thereby reducing concentration of animals in the Ewaso Ngiro flood plain. However, most of the seasonal wetlands dried up before the short rains in November and December.

The lacustrine system comprised of alkaline or saline water bodies. These water bodies were permanent, but the water was not suitable either for domestic, livestock or irrigation of farmland. Even the seasonal wetlands contained moderately alkaline water, which was not suitable for human consumption. River Ewaso Ngiro is a crucial source of fresh water for people, livestock and wildlife.

About 80 % of the residents, especially the Maasai community, reared large numbers of livestock. Over many centuries these traditional pastoralists have established knowledge systems, which enable them to optimize utilization of specific products and services from wetlands. Permanent fresh water wetlands were rated as essential for agriculture, water supply and livestock grazing by both farmers and livestock keepers (Table 3). However, farmers considered wetlands to be very important for fisheries while the pastoralists did not consider wetland fisheries to be an important livelihood or income generating resource. Collection of wild food plants and medicinal plants were considered to be important use values by pastoralists but not by

farmers. The livestock keepers valued salt licks for salt for domestic use or for batter trade. livestock and the salt pans, where women collected

Table 2: The relative water stability and quality in the wetlands.

Wetland type	Water stability	Relative water quality
Riverine system		
Major rivers	Permanent	Fresh
Secondary streams	Permanent	Fresh
Fresh water springs	"	Fresh
Floodplains swamp	Seasonal	Fresh
Lacustrine system		
Major lakes	Permanent	Alkaline
Hot springs	"	Alkaline
Palustrine		
Seasonal grasslands	Seasonal	Moderately alkaline
Water storage dams	"	Fresh water
Water pans	Seasonal	Moderately alkaline
Rock ponds	"	Fresh water
Irrigated fields	"	Fresh water*

Note: water flowing from irrigated fields is contaminated with pesticides, which are harmful to wildlife and livestock.

Table 3: Socio-economic valuation of wetlands by adult men and women from the pastoralist and farming communities in Ewaso Ngiro basin.

Wetland value/attribute	Pastoralists		Farmers	
	Men (81)	Women (53)	Men (96)	Women (70)
Agriculture	4.1	3.2	4.8	4.9
Fisheries and aquaculture	2.6	2.1	4.1	4.4
Food and medicine	3.2	4.3	1.2	1.2
Livestock grazing	4.9	4.5	4.3	4.2
Biomass harvesting	3.3	2.4	3.2	3.6
Water supply	4.9	4.7	4.3	4.8
Waste water treatment	1.3	1.1	1.4	3.2
Wildlife conservation	1.2	3.5	3.1	2.2
Mineral mining	3.4	4.7	2.1	2.4

While the farmers considered wetlands to be valuable for biomass harvesting, the pastoralists valued them for grazing and watering their animals. Both farmers and pastoralists did not consider wildlife conservation and waste water treatment to be important use of wetlands. The importance of wetlands for wastewater treatment was, however, recognized by operators of tourist lodges, slaughterhouse managers and service institutions, such as dispensaries and boarding schools in Nguruman area. The community, however, recognized the importance of wildlife in the development of tourism.

Gender differences in wetland valuation

Adult men and women from the farming and pastoralist communities valued wetlands differently. Use values allocated to wetlands were not independent of sex of the respondent ($X^2 = 8.99$, d.f = 3, $p < 0.05$). in four indirect use values (Table 4). Gender differences were apparent in the way men and women valued wetlands for livestock grazing, agriculture, water supply and all other values put together.

Table 4: Gender differences in wetland valuation.

Gender	Livestock	Agriculture	Water supply	Other values
Male	32	43	16	9
Female	55	65	64	16
Total	87	108	80	25

Data in the table are numbers of adult men and women respondents who ranked wetlands either as essential or very important for a given user value or attribute.

Women activities, such as fetching water, preparing food for the family, looking after the young and sick animals and selling salt or exchanging it with food crops, showed stronger links with wetlands than those of men in the same community. Hence, gender considerations are important when planning for management of wetlands in the Ewaso Ngiro basin and other semi-arid areas of southern Kenya.

Discussion

The wetlands in the Ewaso Ngiro basin vary in size considerably, expanding during the wet season and shrinking in size during the dry season Gichuki and Oyieke (1997). The wetland ecosystems support valuable biodiversity, including diverse populations of mammals, reptiles, fishes, birds and rich plant communities Gichuki et al (1998). Seasonal and temporary wetlands constitute an important component of the dry lands and their primary function is to increase access to water and maintain the life cycles of opportunistic plant and animal species. Wetlands in dry lands also perform important ecosystem services and functions Shumway (1999). The Ewaso Ngiro wetlands play an important role in disturbance regulation, water supply and flood control. They also support unique species of wild plants and animals. The riparian woodland on the riverbanks and flood plain regulate river floods by slowing down the speed of water and encouraging silt deposition. The silt deposits permit regeneration of pasture and subsistence agriculture.

African wetlands sustain rural livelihoods and provide basic resources that are harnessed for socio-economic development Thieme *et al.*, (2005). In Ewaso Ngiro basin, wetlands support subsistence agriculture, livestock, wildlife conservation, tourism, fisheries, mining of soda ash and other socio-economic activities. In fact wetlands contribute 40% of the total income deriving from local natural resources Gichuki et al., (1998). Wetlands recharge shallow wells with water thereby making it available to people. Overall, water supply is an essential function of wetlands in all Kenya's arid and semi-arid areas.

Availability of freshwater influences the distribution and activities of people, livestock and wild animals Mungai (1992). The occurrence of wildlife and livestock in the wetlands, enhances competition for pasture and soil compaction. In the study area, the foraging activities of large animals and those of people, such as burning of wetlands vegetation, appeared to initiate an ecological succession with the nutritious herbaceous vegetation being replaced by woody vegetation. This has been observed in semi-arid lands of northern Nigeria and in Mali in West Africa Child *et al.*, (1984).

In Ewaso Ngiro basin, livestock keeping is the most important economic activity. Both farmers and pastoralists considered wetlands to be essential for livestock grazing, water supply and agriculture. Other values of wetlands, such as salt licks, food

and medicinal plants were of secondary importance, more so to the farmers rather than to the pastoralists. The low user values accorded to natural wetlands as sources of salt, food, medicine and fish can be attributed to the fact that those products were available in shopping centers or in other areas away from the wetlands. In Uganda, Lwanga (1996) found that lower user values were accorded to wetland products, whose suitable alternatives were available in the local markets.

In the study area, women attached higher values to wetland products than men. These gender differences can be attributed to the different roles of men and women in the community. For instance, women were responsible for fetching drinking water and were therefore interested in the quantity and quality of water available within their home range. They were also responsible for collecting fuel wood, nurturing children and caring for young or sick animals at home. The activities of the women brought them closer to wetlands. Despite those gender differences, the community had a strong cultural attachment to wetlands and had established mechanisms that ensured wetland conservation.

Millennium Development Goals (MDGs) address issues of poverty eradication and sustainable development through a set of targets and dates World Bank (2002). In order to ensure achievement of those goals the New Partnership for Africa's Development (NEPAD) adopted a strategic action plan for conservation and management of wetlands in Africa NEPAD (2003). The recognition of the role wetlands in water and biodiversity conservation as well as sustainable development in Africa is relevant to Kenya's current development policies and strategies.

Wetlands can play a significant role in the implementation of millennium development goals. Extreme poverty, hunger and malnutrition are closely related to people's livelihood and vulnerability of households. The communities resident in Ewaso Ngiro basin derive a large part of their food and income from livestock, cultivated crops and wild plants. Availability of water and pasture in wetlands is therefore of direct relevance to poverty reduction (MDG One).

Well-preserved wetlands can continue to provide domestic drinking water as well as water for livestock and farm use. The wetlands would also continue to yield plant biomass and fisheries as well as food and medicinal plants (MDG 7). Hence, maintenance of ecological integrity of wetlands in dry lands of Africa is necessary for ensuring food and nutritional securities as well as a socio-economic development in general Dugan *et al.*, (2002).

Wetland resources can also help to promote gender equality and empowerment of women (MDG3). The dual role of women as micromanagers of family property and providers of food and health care to the

family makes them vulnerable to factors that generate poverty and restrict access to education by the girl child Henninger and Hammond (2000). In the Ewaso Ngiro basin, women and children are responsible for collecting drinking water, food and fuel wood. They are therefore vulnerable to the negative effects of poverty and ignorance. The wetlands in the area provide clean or filtered water, fish for protein, fibre and food plants on continuous basis. Availability of those resources allows women to engage in other productive activities and children to go school.

In conclusion, water security is a major issue affecting many aspects of socio-economic development in the African dry lands. In order to ensure water availability wetlands should be conserved by all means possible. The livelihoods of many rural communities in Africa, particularly fishing are tied to wetlands. The whole issue of poverty

alleviation and socio-economic development in semi-arid lands is closely linked to wetlands conservation. Indeed, wetlands have immense potential for helping African countries to conserve biological diversity and address the millennium development goals.

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