

Local Knowledge on the Influence of Land Use/Cover Changes and Conservation Threats on Avian Community in the Kilombero Wetlands, Tanzania

Wilbard A. Ntongani^{1*}, Pantaleo K. T. Munishi¹, Stein R. More², Japhet J. Kashaigili³

¹Department of Forest Biology, Sokoine University of Agriculture, Morogoro, Tanzania

²Department of Ecology and Natural Resource Management, University of Life Sciences, Ås, Norway

³Department of Forest Mensuration and Management, Sokoine University of Agriculture, Morogoro, Tanzania

Email: *ntongani@gmail.com

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Abstract

Local knowledge of the history and ecology of wetland ecosystems is very useful in wetland resources management, especially when other historical ecological information is not available and can be integrated with scientific knowledge to introduce better management of resources. The aims of this paper were to assess existing local knowledge on land use/cover changes in the Kilombero wetlands, thereafter investigate local knowledge on its effect on avian population in the wetland and identify factors influencing local knowledge on such changes in the study area. Random sampling was used to obtain representative sample population for this study. Structured questionnaire and focus group discussions were used to extract information from local people in six villages. Study results from multi-response analysis showed that natural forests had been converted into cropland and bushed grassland, grassland to crop land, grassland to grazed land, forest to settlement and grassland to settlement. Land use change was singled out as primary cause of decrease in avian community in the wetland. Threats to the conservation of avian species were identified as livestock grazing, drought, use of poison, traps and bush meat hunting for food. Age and education level were seen as determinants of household's knowledge on the ecological changes. This pool of existing knowledge is important among wetland users and stakeholders in order to generate conservation strategies of the wetland ecosystem.

Keywords

Local Knowledge, Wetland, Land Use, Avian, Conservation

*Corresponding author.

1. Introduction

Wetlands are converted to other land uses due to agriculture and livestock grazing in many parts of the world [1]-[4] and such human activities affect avian abundance and diversity in the grassland and wetland habitats [5]-[7]. This may be due to services and benefits that are associated with the presence of the wetlands, like fertile soils, water throughout the year which attracts human population to settle and introduce several activities in and around these wetlands.

Local knowledge of the history and ecology of wetland ecosystems is useful in wetland resources management. Historical information can be integrated with scientific knowledge to introduce better management options of natural resources [8]-[10]. Local knowledge has been used to identify conservation threats to the mangrove forests [10]. Apart from being source of ecological information of a given landscape, local knowledge facilitates community to participate in the environmental management. Furthermore, gathering ecological information, oral history also paves the way toward of sustainable resource management by enabling the values and concerns of local community and stakeholders to be articulated, and thus increasing managers' understanding of the social context of the particular locality, which is fundamental to sound environmental decision making and implementation [9] [11] [12]. It is generally accepted that community involvement in understanding local resources increases the possibilities of management actions. For example, local knowledge has been used in monitoring water quality and grazing landscapes to understand how ecological changes happened on such landscapes over time and space [13].

Local ecological knowledge is the knowledge of a particular group of people about local ecosystems, and in contrast to traditional ecological knowledge, does not assume a continuous historical and cultural connection with the ecosystem [14]. Local ecological knowledge can be gathered by using questionnaires [15], by investigating the written documents and maps [9], and through oral history [16]. Oral history is obtained through a prepared dialogue between two persons. Interviewer determines information needed to grasp the ecological knowledge in focus [17].

Several studies have reported the values of oral history as a means to incorporate local ecological knowledge in ecosystem management [9] [10]. For instance, hunters' knowledge has been used to study sustainability of hunting practices on non-game bird species. They were able to suggest specific management actions to reduce the impacts on threatened non-game species in Mexico and United States of America [11]. On the other hand, herders' knowledge has been used to study ecological dynamics of landscapes in northern Tanzania and effects of livestock grazing across seasonal grazing landscapes were evaluated through herder perceptions and field data on plant species composition, richness, biomass and cover [13]. Furthermore, local perceptions on seasonal wetland landscape variability had shown that communities within the Rufiji Delta Tanzania were knowledgeable about the usefulness of such variability [18]. River flooding was viewed as an important factor for soil fertility and crop yield in the Rufiji Delta. Therefore, the specific goals of this study were: firstly, to assess local knowledge on land use/cover changes in the Kilombero wetlands; and secondly, to investigate local knowledge on trend of avian community in the Kilombero wetlands and find out factors determining local knowledge on land use change and avian species in the wetland.

2. Study Site

The study was conducted in the Kilombero Valley Floodplain a Ramsar site since 25th April, 2002 [19]. The wetland is 796,735 ha located 8°40'S and 36°10'E in Morogoro region, Tanzania. The floodplain forms part of Selous Game Reserve, recognized by United Nations Educational, Scientific and Cultural Organization as the World Heritage ecosystem and also the International Union for Conservation of Nature (IUCN) renowned largest wetland valley in Africa. It floods during the rainy season and as days approaches the dry season the larger part of the floodplain dries including few river streams from mountain areas. Kilombero valley floodplain has the advantage of collecting water from its diverse catchment area through small rivers flowing into this valley during wet and dry seasons. This catchment includes Udzungwa and Mahenge mountains and extends from mountain ranges of Iringa and Mbeya regions [20].

The river streams within the extensive floodplain converge near Ifakara to about four kilometres wide near Kivukoni by forming the main stream known as the Kilombero river. From Kivukoni near Ifakara town, the main river flows to north-east about 65 kilometers until it enters into the Selous Game Reserve which is the border of the Kilombero Ramsar site. The area receives rainfall between 1200 to 1400 mm annually and 17°C to

24°C annual temperature.

The vegetation cover categories of the study area is associated with the nature of the floodplain, where the vegetation is distinguished as the distance increases from the main stream of the river flow towards the mountains bordering the wetland, Udzungwa and Mahenge mountain ranges [20]. Its vegetation categories range from tall and short grass, woodlands to forests. Forest habitats are found on large part of Ulanga district for instance Nambinga forest and some forest patches in the Kibasira Swamp in Kilombero district [20] [21]. The wetland is very rich in wildlife; it hosts rare and common species which are ecologically classified as either endemic, vulnerable or endangered. Threatened species include animal species like blue duiker, cheetah, lion and birds like Kilombero Weaver (*Ploceus burnieri*), Stierling's woodpecker (*Dendropicos stierlingi*), Southern-banded snake eagle (*Circaetus fasciolatus*) others as are shown in the IUCN red list.

The study area has experienced human population increase over thirty years as was indicated in population and housing census reports of 1978, 1988 and 2002, with a population of nine persons per square kilometre, which has more implications on the resource use in the wetlands.

3. Methodology

Literature reviews and field techniques were used to collect information for this study. At the beginning, household heads for every village were listed and stratified into two portions based on gender. The names of household heads were used as sampling frame and the household was considered as an important unit of analysis where the right data could be extracted [22] because households are users of local natural resources within the wetland and could notice any changes happening around them over time. Names of households were obtained from sampled village registers. This technique helped to identify and differentiate female and male headed households in the study area in order to get fair gender representation during the questionnaire administration and focus group discussion. Random sampling of 35 households were picked from stratified data of every studied village.

It is recommended that thirty respondents in a sampled population constitute a realistic sample size for field work data collection and analysis [23] [24]. Investigations on socio-economic studies in Sub-Saharan Africa require a sample size between 80 to 120 household respondents [15] [25]. For the purpose of this study a total of 210 respondents were sampled from six villages for interview. Therefore, without considering the total number of household that was found in every village which was sampled, the population sample size was considered as sufficient to generate statistical inferences required for making study conclusions.

Focus group discussions were conducted in order to supplement information that was obtained from questionnaire investigation. The selection of focus group discussion participants was based on two criteria, first, a participant had to be a village resident with a long and sufficient knowledge of the village history aged above fifty years and secondly, he or she had to be considered to understand well the local natural resources available in the village [15] [25]. The village executive officer and Chairman for each village involved were consulted to initiate to obtain members of the group. At least three individuals were selected using village leaders knowledge and thereafter, the proposed individuals were used to include other members whom they thought had enough knowledge to participate in the exercise. The minimum of 4 men and 4 women were allowed to participate in each village. Thus 48 persons were involved in focus group discussions throughout the studied villages. Males and females formed their two independent group discussions. This procedure had an advantage of allowing more freedom especially women to air their opinions and views very openly on the matters of socio-economic activities that had happen in the valley and their impacts on land use and cover change and how they perceive effect of changes of native habitats to bird diversity in the wetland.

Both quantitative and qualitative data were analysed during this study. The quantitative data that were obtained through the household questionnaire survey including answers from open ended questions were coded and entered into the statistical software (STATA 9) for analysis. The results were summarised and presented into percentages, tabular form and figures. The analysis was very useful to determine the extent of knowledge of local people for changes which happened in their environment and possible reasons for such changes. On the other hand, the collected qualitative information was analysed depending on its source [26]. For example, the information collected through focus group discussion was sorted and labeled to enable meaningful analysis and interpretation. Therefore, the content functional analysis was performed for the analysis of such data. This analysis helps to know the attitudes of the interviewed person [22] which show the actual feeling of the respondent to-

wards the ideal argument raised within the discussion. The views obtained using this technique helped to know more significant causes of land use/cover change and effects on bird diversity as recognized by local people. It helped to relate the changing habitat in people's environment with actual evidence as understood from local people in the wetland. Thus, a multiple response analysis was used to identify peoples' knowledge on land use change, causes and conservation threats in the study area. The chi-square was used to identify effects of age and education level on the local knowledge of land use change and avian community in the wetland. Furthermore, every household interviewed was given an opportunity to look at photographs of common avian species found in the wetland using the field guide for species identification using the local knowledge.

4. Results

4.1. Local Knowledge on Land Use/Cover Change

The field survey results indicated that local people had witnessed various land use/cover transformation during their lifetime. The majority acknowledged to have noted land use/cover changes in the wetland, For example 85% of interviewed households said natural forests to have been converted into cropland, although could not classify which category of forest (closed or open forest or, wooded grassland or woodland) but they were referring to areas which had thick trees in the past and now have been turned into cultivated areas.

For the period of more than thirty years, the cultivated land has always increasing when compared to other land use categories. However the areas of urban settlements have increased especially Ifakara and Mlimba centres, other areas like Chita, Mngeta, Mbingu and Idete for side of Kilombero district while Kivukoni, Lupiro, Mtimbira and Malinyi on the part of Ulanga district are among of settlement centres which are growing very fast attracting population and are acting as trading centres in the wetlands.

The findings (68%) from local people views showed that human settlements have increased towards natural habitats since 1970s to 2000s. The mode of cultivation would have caused the need of extensive land use since the most of households did not acknowledge to have used modern methods of agricultural farming including use of fertilizers and proper space crop planting in order to have enough crop harvest per hectare. The low harvest per hectare would attract demand of more land for clear cut and burn for farm expansion, the practice which have resulted into land use/cover change in the study area.

4.2. Local Knowledge on Root Causes of Land Use/Cover Change in the Wetland

Local peoples understanding of the main reasons for land use change indicate that livestock keeping rank first (88%), followed by agricultural activities (84%), settlement (77%), bush fires (73%), charcoal making (40%), fuel wood collection (35%) and tree felling for timber and poles (31%). The field observation indicated that areas which are occupied of pastoralists, the closed and open vegetated areas are highly affected during the dry season since these pastoralists graze their livestock in these areas because they contain water and vegetation diet for livestock resulting into completely change of affected habitat within the ecosystem. Studies which have been done in the wetland they mentioned on the conservation threats existing in the wetland but did not show the extent of changes that have happened over a certain period by actual quantification of areas.

4.3. Local Knowledge on the Avian Populations in the Wetland

Local people showed great interest on species identification during field interview and discussions. Thirty three species (**Table 1**) were identified successfully using local knowledge. Every interviewed person mentioned at least one species. Most of these species were those which are very common in the wetland and can visually be found easily.

4.4. Local Knowledge on Conservation Threats to the Avian Community in the Wetland

From the interviews, local people were very much concerned about the future abundance of avian species in the wetland. About 87% of all persons who were interviewed gave their opinions that continuation of extensive agricultural activities into the interior of the wetland is increasing pressure on the existing ecosystem and avian species as among of ecosystem beneficiaries will continue to suffer except those which do not need special habitats.

Table 1. Avian species identified using local knowledge in the wetland.

Scientific name	English name	Local name
<i>Haliaeetus vocifer</i>	African Fish Eagle	Ngwasi
<i>Treron calva</i>	African Green-Pigeon	Ninga
<i>Anastomus lamelligerus</i>	African Open-Billed Stork	Kopo la ngongo
<i>Tchagra senegala</i>	Black-Crowned Tchagra	Kalitwika
<i>Lonchura cuculata</i>	Bronze Mannikin	Mtundu
<i>Dendropicus fuscescens</i>	Cardinal Woodpeker	Ng'ong'ondo
<i>Bubulcus ibis</i>	Cattle Egret	Ndandala
<i>Pycnonotus barbatus</i>	Common Bulbul	Likongojole
<i>Francolinus sephaena</i>	Crested Francolin	Ngwale
<i>Alopochen aegyptiacus</i>	Nightjar	Chaluwatula
<i>Anthus cinnamomeus</i>	Grassland Pipit	Kipulima
<i>Pelecanus onocrotalus</i>	Great White Pelican	Mbinji
<i>Scopus umbretta</i>	Hamerkop	Mgetu
<i>Numida meleagris</i>	Helmeted Guineafowl	Ng'ang'a
<i>Ploceus burnieri</i>	Kilombero Weaver	Mbalamatete
<i>Phalacrocorax africanus</i>	Long-Tailed Cormorant	Ndukunduku
<i>Lophaetus occipitalis</i>	Long-Crested Eagle	Kipanga
<i>Leptoptilos crumeniferus</i>	Marabou Stork	Twangu
<i>Gypohierax angolensis</i>	Palm-Nut Vulture	Ngwasi
<i>Ceryle rudis</i>	Pied Kingfisher	Chamlopo
<i>Ardea purpurea</i>	Purple Heron	Limdede
<i>Quelea erythrops</i>	Red-Headed Quelea	Kwelekwele
<i>Lagonosticta senegala</i>	Red-Billed Firefinch	Kamtundu
<i>Francolinus afer</i>	Red-Necked Spurfowl	Ng'wale
<i>Streptopelia capicola</i>	Ring-Necked Dove	Kiiba
<i>Colius striatus</i>	Speckled Mousebird	Simbilisi
<i>Bucorvus cafer</i>	Southern Ground Hornbill	Nditi
<i>Plectropterus gambensis</i>	Spur-Winged Goose	Miyogi
<i>Centropus superciliosus</i>	White-Browed Coucal	Dudumizi
<i>Vanellus albiceps</i>	White-Crowned Lapwing	Kolekole
<i>Ciconia ciconia</i>	White Stork	Nyombi
<i>Euplectes nigroventris</i>	Zanzibar Red Bishop	Ndagala
<i>Amandava subflava</i>	Zebra Waxbill	Kalusambi

The livestock grazing (60%) (Figure 1) and the unpredictable rainfall which have resulted into longer periods of drought season (18%) in recent years provide another threat to the conservation of the species. Furthermore, the use of poison (16.19%) and bush meat hunting (1.43%) were seen as causing risks of species' survival in the wetland.

4.5. Local Knowledge on Species Disappearing in the Wetland

Local people used their local knowledge experience to single out kind of species which they see, they have a decreasing trend in the wetland when the occurrence of species at the time of fieldwork is compared to the past

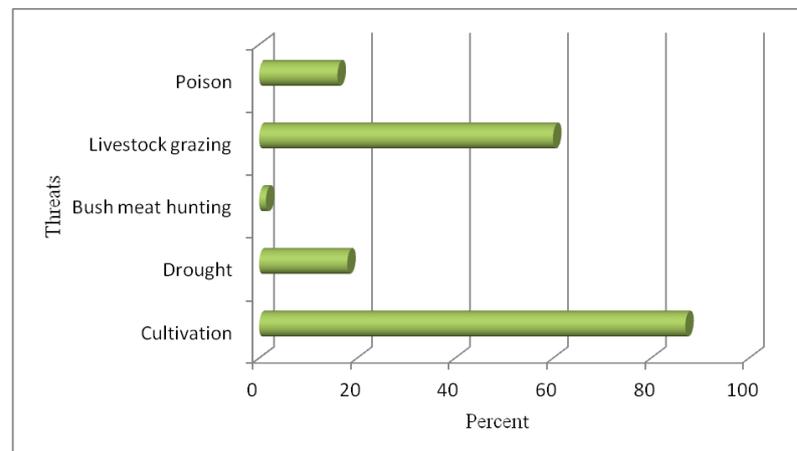


Figure 1. Conservation threats in Kilombero Wetland.

15 years, in the wetland.

The understanding of the decreasing species in the wetland as indicated in **Table 2** was influenced by age of household head interviewed. The higher age and education level led to an increased awareness of changes of avian populations in the wetland. Both age and education level were statistically significant ($n = 210$, $P < 0.05$). Species that were highly identified with decreasing trend included the *Francolinus sephaena* (Crested Francolin), *Numida meleagris* (Helmeted Guineafowl), *Francolinus afer* (Red-necked Spurrow) and *Treron calvus* (African Green-Pigeon).

5. Discussion

This study has revealed that local knowledge about ecological changes is highly enhanced by age and the level of education. This observation concurs with previous studies on local knowledge and biodiversity changes [1] [15] [27]-[29]. A person who has lived in the same environment with at least an age of 40 years and above was considered to have better knowledge of ecological changes that occurred in the past. This age corresponds to about two generations of population. Human increase from one generation to another with coupled human activities could lead to habitat changes as well as biodiversity in an environmental setting. This study got more useful information from aged household heads during group discussions. There were areas which had intact forests for instance from Namwai Forest to Mofu village and in the western part of Mofu Village. These areas, in 1970s, an individual person could not walk alone in these areas without accompanied by another person. In those days every one could fear to see the wildlife, but know is different. The forests have “changed completely to open woodland” one of interviewed household at Mofu village commented (*pers.com.*).

Through this study, regardless of education level of interviewed person, most of local people interviewed were able to distinguish land use/cover changes which happened for the past thirty years’ time. They used their daily life experience to tell changes which they had observed in the past and showed possible threats to bird species. Some species’ abundance showed a decline trend according to the local knowledge. Basing on their view, some human practices are strange to the species. The most activities which were unhappily said were the frequent occurrence of fire in wetland and use of traps and poison to kill bird species. The reasons for trapping and poisoning were mainly two; to obtain bush meat for food, most of target species are Guinea fowls and Francolins although other species are also trapped and eaten by humans. Hunting of avian species has been observed in other countries [11].

Poison was said to be used purposely to kill birds which are the pests to the food crop. It is a seasonal practice used by few farmers of paddy before harvest. The use of poison in wetlands is also reported in Kenya and Botswana as threat to bird species where Wood sandpiper (*Tringa glareola*) in Kenya around Bunyala paddy scheme were poisoned and sold for meat [30]. Furthermore, influx of large numbers of livestock since 1990s is another threat which was viewed by local people as one of challenge to the conservation of wetland habitats. Livestock keepers were associated with encroachment of green vegetated areas during the dry season. The fieldwork confirmed local observations on the existence of livestock in parts of Kibasira Swamp during the dry season

Table 2. Decreasing bird species in the wetland.

Scientific name	Species common name	Response (N ¹ = 210) n ²	Percent
<i>Serinus citrinelloides</i>	African Citril	5	2.38
<i>Microcarbo africanus</i>	Long-Tailed Cormorant	30	14.29
<i>Ardea purpurea</i>	Purple Heron	15	7.14
<i>Francolinus afer</i>	Red-Necked Spurfowl	54	25.71
<i>Ploceus burnieri</i>	Kilombero Weaver	7	3.33
<i>Treron calvus</i>	African Green Pigeon	40	19.05
<i>Alopochen aegyptiacus</i>	Egyptian Goose	13	6.19
<i>Numida meleagris</i>	Helmeted Guineafowl	74	35.24
<i>Quelea erythrops</i>	Red Headed Quelea	3	1.43
<i>Francolinus sephaena</i>	Crested Francolin	103	49.05
<i>Strix woodfordii</i>	African Wood Owl	26	12.38

¹Entire sample count/respondents; ²Affirmative count/respondents to a particular question.

October, 2010. Such livestock disturbance in the wetland could have altered avian species composition, abundance and diversity in the wetland. This observation using local knowledge and field work is supported by other scholars who found that the intensive livestock grazing decreased avian abundance and diversity in the grassland and wetland habitats [5]-[7]. The abundance and diversity of species would depend on the habitat management and condition which determine the foraging status, breeding and nesting success of species.

6. Conclusion

This study has indicated that local knowledge is important in understanding the ecological changes that could have happened in the past and can be linked with the actual ecological information obtained through physical inventory or imagery acquired data for better understanding of changes in the wetland. The findings of this study can be used by decision makers in the process of wetland conservation. Local communities, stakeholders or wetland users should be well informed on changes happening in the wetland. These are the people who can be involved when conservation plans and strategies are to be addressed before their implementation. They can be informed about the effects of their daily human activities to the natural resources and be involved in setting out the conservation programs and laws at their local level to facilitate people understand and participate fully in the whole process of bylaw making for governing the biodiversity within the wetland. For that matter apart from bylaws, people residing in the wetland should be informed appropriate technologies on how they would change the mode of resource utilization within the wetland in order to reduce human pressure of resource use on the natural habitats.

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