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Research Article

Assessment of the Effect of Antropogenic Activities on Terrestrial Biodiversity Conservation in Matayos Division of Busia County, Kenya

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Abstract: Anthropogenic activities are fundamentally and to a significant extent irreversibly changing the diversity of life on Earth. Virtually all of the Earth's ecosystems have now been dramatically altered through human actions. In Kenya, rapid human population growth and the subsequent land degradation have affected biodiversity causing habitat fragmentation, resulting to modified or degraded landscape and thus disrupting animal and plant diversity. In Matayos division, anthropogenic activities have intensified which affect terrestrial biodiversity. In the past, plants and animals were abundant in the area and currently some species are rare possibly due to destruction of their habitats by human activities. However, there is no known study that has focused on assessing the effects of anthropogenic activities on terrestrial biodiversity conservation in the division. This study aimed at determining the effect of anthropogenic activities on terrestrial biodiversity conservation in Matayos division. Cross-sectional descriptive research design was used. A minimum sample size of 384 household heads was taken out of a study population of 56,186. Purposive sampling was used to get Key Informants such as village elders, chiefs and Sub chiefs. Primary data were collected through questionnaire administration, key informant interview, Focus Group Discussion, Field Observation and Photography. The findings indicated that among the activities undertaken in the division, farming, fuel wood harvesting and charcoal burning had the greatest impact on terrestrial biodiversity. Furthermore, 68% of the respondents regarded farming as a major socioeconomic activity which has led to reduction and loss of animals and birds habitat. The study concluded that some animals and bird species have emigrated and plant species have reduced in the division due to anthropogenic disturbances. There is lack of enforcement that leaves bad practices unchecked like vegetation clearance for agriculture and settlement, over harvesting of fuelwood, charcoal burning, wetland encroachment, bush burning and brick making. Alternative sources of fuel energy like biogas and use of sorghum husks and establishment of woodlots on individual farms could reduce cutting down trees for fuelwood in Matayos division. The entire community should be responsible for the wetland conservation in Matayos division.

Keywords: Terrestrial biodiversity, biodiversity loss, anthropogenic activities, rare species.

INTRODUCTION

According to environmental experts, human activities have driven species to extinction at rates perhaps 1,000 times the expected background rate (WCMC, 1992). In the year 2006, 639 threatened and endangered species were recorded in Australia, and in 2008, an additional 149 endangered species, totaling 788, were recorded (Scully, 2001). Terrestrial diversity in ecosystems provides essential economic benefits and services to human society. However, anthropogenic activities today are placing significantly more species at risk of extinction than at any other time in the past as a result of environmental changes affecting current population sizes, environmental carrying capacity, population density and hence more habitat loss (Global issues, 2009). Anthropogenic activities are socio-economic activities practised by humans on the environment like farming, deforestation and charcoal burning.

Kevin (2007) observed that, disturbance and loss of habitat by human activities has resulted in the loss terrestrial biodiversity. This is combined with agricultural practices which focus on a few crops (RCF, 2010). Wuver and Attuquayefio (2006) pointed out that farming, fuelwood harvesting, hunting and bush fires are human activities that impact on biodiversity. However, this study did not specifically find out how

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these human activities affect terrestrial species. It is therefore clear that the erosion of Africa's biodiversity wealth arising from human activities is a serious problem yet; there are few empirical studies to establish how these human activities affect biodiversity (UNEP, 2006). Scully (2001) observed that habitat fragmentation and habitat loss have the greatest impact on terrestrial biodiversity particularly in regions where vegetation has been replaced by agriculture and settlement. Vitousek et al, (1986) pointed out that hunting of large mammals in the Americas and Australia is thought to have contributed to substantial extinct of large mammals between 50,000 and 15,000 years ago, as humans first moved to these continents for settlement and agriculture. During the end of the last ice age (known as the Pleistocene) about 10,000 to 15,000 years ago, many of the large mammals, birds, and reptiles, collectively known as *megafauna*, went extinction in North and South America (Heywood and Watson, 1995). While we do not have direct evidence of what caused their extinction, most researchers believe that over harvesting of wildlife by humans played a decisive role in much of the extinction.

Biodiversity conservation is fast evolving from the narrow focus on habitat preservation to integrated landscape development and management including the protection of wild lands, the integration of compatible land-uses systems and creation of protected areas to ensure biodiversity conservation (UNDP, 2010). The Convention on Biological Diversity (CBD), (2006) urges parties to put in place measures to conserve threatened species of biodiversity Exsitu (off-site) to support biodiversity conservation. Report by the Republic of Kenya (2003) pointed out that existing rural activities and poor land management practices affects biodiversity by fuelling demand for more agricultural land and therefore altering terrestrial habitats which affect terrestrial animal and plant diversity in the division. High rural population growth has accelerated the demand for new agricultural land, resulting in a high rate of woodland, forest, grassland and wetland conversion into agricultural use (Republic of Kenya, 2005). It is against this background that the study aims at assessing the effect of anthropogenic activities on terrestrial biodiversity conservation in Matayos Division of Busia County, Kenya.

Although biodiversity constitute a great asset to Matayos division and Busia County at large, it is at risk of getting eroded due to increased anthropogenic activities. Related studies have been done in Western Kenya. ASERECA (2006) examined Management of Biodiversity for Rural livelihood around East Africa rainforest in Kakamega focusing on forest biodiversity conservation. Omosa and Maundu (2008) examined the role of Indigenous Knowledge in promoting conservation of biodiversity in rural parts of Western Kenya. There is no known study conducted on assessing the effect of anthropogenic activities on terrestrial biodiversity conservation in Matayos division of Busia County. In the division, anthropogenic activities have intensified to the extent of threatening terrestrial species ant therefore, the need to examine how these activities affect higher plants and animal species in the division.

II LITERATURE REVIEW

Ecosystems Approach (EA) (2007) stated that anthropogenic activities have decreased and degraded the global terrestrial biodiversity**.** Humans have taken over, disturbed, or degraded 40-50% of the earth's terrestrial land surface, especially by filling in wetlands and converting grasslands and forests to crop fields and urban areas (Turner *et al.,* 2000). Heywood and Watson (1995) asserted that no part of the world can be considered truly undisturbed and the world's habitats have been so significantly modified by human action that terms such as "undisturbed" are nowadays considered of little value. Anthropogenic activities have been a cause of species extinction for thousands of years especially when humans migrated to new habitats (Perry, 1994). As explained in the 3rd UN's Global Biodiversity outlook, the rate of biodiversity loss is being experienced because of the five principle pressures on biodiversity. These are: habitat loss and degradation, over-exploitation of biological resources, climate change, nutrient load and other forms of pollution and invasive alien species (WCMC, 1992). However, these five principal pressures have not been critically examined on how they affect terrestrial species diversity.

Habitat fragmentation and habitat loss have the greatest impact particularly in human dominated regions where natural vegetation has been replaced by crops and concrete (Heywood and Watson, 1995). Allister *et al.,* (2009) have further argued that habitat change has been the single most important driver of biodiversity loss across biomes over the last century, followed by overexploitation and introduction of alien species through improved technology. Further, Allister *et al.,* (2009) stated that driven by global population growth, pressures for increased food as well as fuel production have been the primary drivers to convert nature into land for agriculture. However, this study (Allister *et al.,* 2009) did not find out the effects of these land use changes on terrestrial plants and species diversity. Introduction of exotic species into new habitats affect species diversity. These exotic organisms interrupt the ecosystem and, since they have few or no terrestrial enemies in their new environment, they are difficult to eradicate (CBD, 2007). These invasions drive the loss of indigenous species. Pollution from industrial and agricultural wastes can have catastrophic effects on many species (RCF, 2010).

In West Africa, Luc and Emmanuel (2003) stated that overharvesting by illegal hunting, cutting of wood for different types of fuel such as charcoal

production are other causes for biodiversity loss. In the semi arid rural areas of southern Cochabamba (Bolivia) it was shown that out of 132 inventory plants, that the local people use for traditional medicinal purposes, 10 were threatened due to their intensive collection (Sinclair, 2000). For example, Moabi (*Baillonelia exisprma*) used to be a common tree in West Africa. The fruits are eaten, cooking oil is extracted from the seeds (karite) and the bark is used for medicinal purposes. For its reproduction, the plant depends on the elephants. Only these animals swallow and disperse the Moabi seeds. Further, Sinclair (2000) observed that the remarkable reduction of elephants in countries such as Ivory Coast, Ghana and Benin has had an impact on the distribution of the Moabi tree. Africa is well endowed with both variety and abundance of biodiversity (Botkia and Talbolt, 1992). Commercial logging practice both illegal and legal has reduced the diversity present in many timber species (Perry, 1994). National Red List assessments of the status of South Africa's species indicated that overall, 2577 (13%) of South Africa's plants are threatened with extinction while 20% of its mammals are also threatened (Raimondo, 2011). A large yet unknown number of species of medicinal plants are over harvested and their populations are declining rapidly in Africa (WHO, 1993). Many areas of terrestrial habitat are permanently destroyed by activities as diverse as urban housing developments, clearing for cultivation of crops or forestry plantations world (WRI, 2008).

In Africa, the Atlas Mountains shelter rich pine and oak forests and also a number of endemic rare species such as the wild olive and the Saharan myrtle. These Mountains also provide prime habitat for migratory birds and a key refuge for threatened wildlife (Conservation International, 2007). Kevin (2007) observed that, uncontrolled medicinal and aromatic plant harvesting constitutes a major threat to survival of many endemic species. In addition, the intensive cutting of oak for charcoal and the need for livestock fodder during winter gives rise to extensive overgrazing and soil degradation which affect biodiversity. In Sahara desert, wildlife habitats have been heavily altered by human activities (UNEP, 2008). In addition, some localities have been overstocked with domestic animals especially around water holes or wells. The desert of Namibia has rich flora and 69% of its plants are found nowhere else on Earth together with unique reptile species (UNEP, 2006). Further, UNEP (2006) observed that human activities like grazing, agriculture, roads construction and mining have resulted to habitat fragmentation. Logging, mining, hunting and human population growth is placing extreme stress on the African forests causing habitat loss at an unprecedented pace (Waring and Schlesingen, 1985). Situma and Wamukuya, (1999) concluded that as the forests are logged for wood and exploited for other natural resources, hundreds of unknown species are put in danger of extinction.

The regions with high biodiversity levels tend to have relatively fertile soils and therefore attract human settlement and other human activities leading to biodiversity loss (Botkia and Talbolt, 1992). According to WRI, (2008) as habitat is destroyed, the areas available for inhabitation by various species and ecosystem types is reduced and some species or ecosystems may fall below a threshold where they are viable and hence become extinct. Habitat conversion to agriculture leads to reductions in local native biodiversity (Peter and Andrew, 1996). Many species are widely disturbed and thus initially, habitat destruction may reduce local population numbers. Species which are local, endemic or specialized habitats are much more vulnerable to extinction. Bland and Reddish (1996), stated that habitat loss and fragmentation causes species extinctions in Africa. In the future, the only species that survive are likely to be those whose habitats are highly protected as whole habitats correspond to the degraded state associated with human activity.

Introduction of alien **(**non-native) species can disrupt entire ecosystems and impact populations of native's plants and animals. These exotic species can adversely affect native species by eating them, infecting them, competing with them and mating with them (Wagner *et al.,* 2008). More land is being diverted from local food production to "cash crops" for export and exchange; fewer types of crops are raised, and each crop is raised in much greater quantities than before (UNEP, 2008). UNEP (2008) further observed that the introduction of mono cropping and the use of relatively few plants for food and other uses is responsible for a loss of crop diversity and genetic variability. The native plants and animals that have adapted to the local conditions are now being replaced with "foreign" (or "exotic") species. Such species frequently drive out native species (Bland and Reddish, 1996). Species extinctions occur more rapidly in fragments, because species depend upon each other. The absence of large predator species leads to imbalances in prey populations, and, since many of the prey species are seed-eaters, their absence may lead to decline in the population levels of many plant species (RCF, 2010). Perry (1994) stated that converting former wild lands to human settlements and agriculture, grazing or other land use affects biodiversity directly by displacing species in the landscape. Besides, converted lands are disturbed repeatedly by human activities.

In Kenya, deforestation is one of the major forms of habitat destruction causing species loss (Situma and Wamukuya, 1999). This has been as a result of increase in population leading to encroachment for settlement, agriculture, fuelwood collection, harvesting of wetland resources like reeds and papyrus, charcoal burning, overgrazing and thatching grass (Tsingalia, 1990). Reduced land productivity is forcing

many people to start utilizing the marginal land such as wetlands, river banks and lake shores for agricultural activities (KIFCON, 1994). Overdependence of the population on fuel wood as the main source of energy has accelerated the deforestation leading to loss of tree cover (Baan, 2003). Forests have dwindled because large tracts of terrestrial and wetland ecosystems have been converted to farmland (UNEP, 2006). Furthermore, over the past decade more than 46000 hectares of the Mau forest have been cut off and converted to other land uses, such as human settlement and private agriculture. Large scale encroachment of human populations, charcoal production and logging of indigenous trees are causing massive deforestation with severe impacts on biodiversity.

In Kenya, wetlands are habitats to many species. However, the ever growing need of cultivation and grazing land has led to many communities living in the neighboring of wetlands depend on them for grazing and agriculture. This has led to lose of many plants and animal species though habitat loss, fragmentation and reduced size (Maltby, 1986). Some animals relocate to other places, others die due to lack of food since the food chain is disrupted (Tsingalia, 1990). Overgrazing leads to loss of species diversity. If an area of grassland is overstocked with herbivores and the minimum amount of leaf and stem tissue is removed, the soil becomes unstable and the crumb structure of soil disintegrates as the micro flora and fauna becomes reduced (Scully, 2001). Loss of biodiversity can never be fully recovered, but through our conservation efforts we can help to ensure that species are able to persist and to restore the capacity of ecosystems to adapt to change and disturbances in other words, to build ecological resilience (Western, 2001).

Kenya is putting in place interventions to tackle biodiversity loss ranging from environmental policies and legislation, community involvement, national biodiversity assessment and documentation, sustainable management and conservation of biodiversity including fair and equitable benefit-sharing (Lusweti, 2011). Lusweti, (2011) has argued further that facilities to cater for endangered species and manage small numbers of species for posterity have been put in place, for example; the Zoos, Arboreta, Parks and Parklands, Botanic Gardens, and the Seed Centre at the Kenya Forestry Research Institute (KEFRI) and private lands. However, the efforts and strategies employed to preserve the threatened areas, human livelihoods and the threatened species and to reverse the loss of biodiversity, indirectly address the effects of human activities on terrestrial biodiversity. There was need to identify these activities and establish their effects on terrestrial biodiversity conservation in Matayos division.

In Busia County, biodiversity loss is caused by deforestation, wetland degradation due to population growth and encroaching human settlement, selective tree harvesting for firewood and charcoal burning, hunting and inappropriate farming techniques such as use of poisonous chemicals (BWSR,1999). In Matayos division, the vegetation has undergone considerable changes, the result being remnants of the original vegetation types due to human activities such as charcoal burning, clearance for cultivation, encroachment on wetlands, over harvesting and introduction of alien species (Republic of Kenya, 2005). Human activities are placing significantly more species at risk of extinction today than any other time in the past as a result of environmental changes affecting current population sizes, environmental carrying capacity and high population growth rates (Wass, 1995). However, the effects of these environmental changes on terrestrial plants and animal species diversity have not been critically examined. There is an urgent need to address the anthropogenic activities and their effects on terrestrial species in Matayos division and Busia County at large so as to enhance terrestrial species conservation.

III: METHOD

Study area

Location and Size

Matayos division is found in Busia County, which is located in the west of the republic of Kenya and borders with the republic of Uganda on the South-East. It lies on the north of L. Victoria. It borders Nambale division to the East, Butula division to the South East, Teso County to the North and Funyula division to the South West. Matayos division is divided into five locations namely; Bukhayo West, Mayenje, Matayos South, Busibwabo and Burumba and twelve sub-locations namely; Mjini, Mayenje, Mundika, Esikulu, Bugeng'i, Nasira, Nang'oma, Nakhakina, Murende, Busende, Alung'oli and Lung'a sub-locations (Republic of Kenya, 2005). The division lies approximately between longitudes $33^0$54'32" East and $34^0$25'24" East and Latitude $0^0$1'36" south and $0^0$35 North. The division covers an area of 173.7 Km.

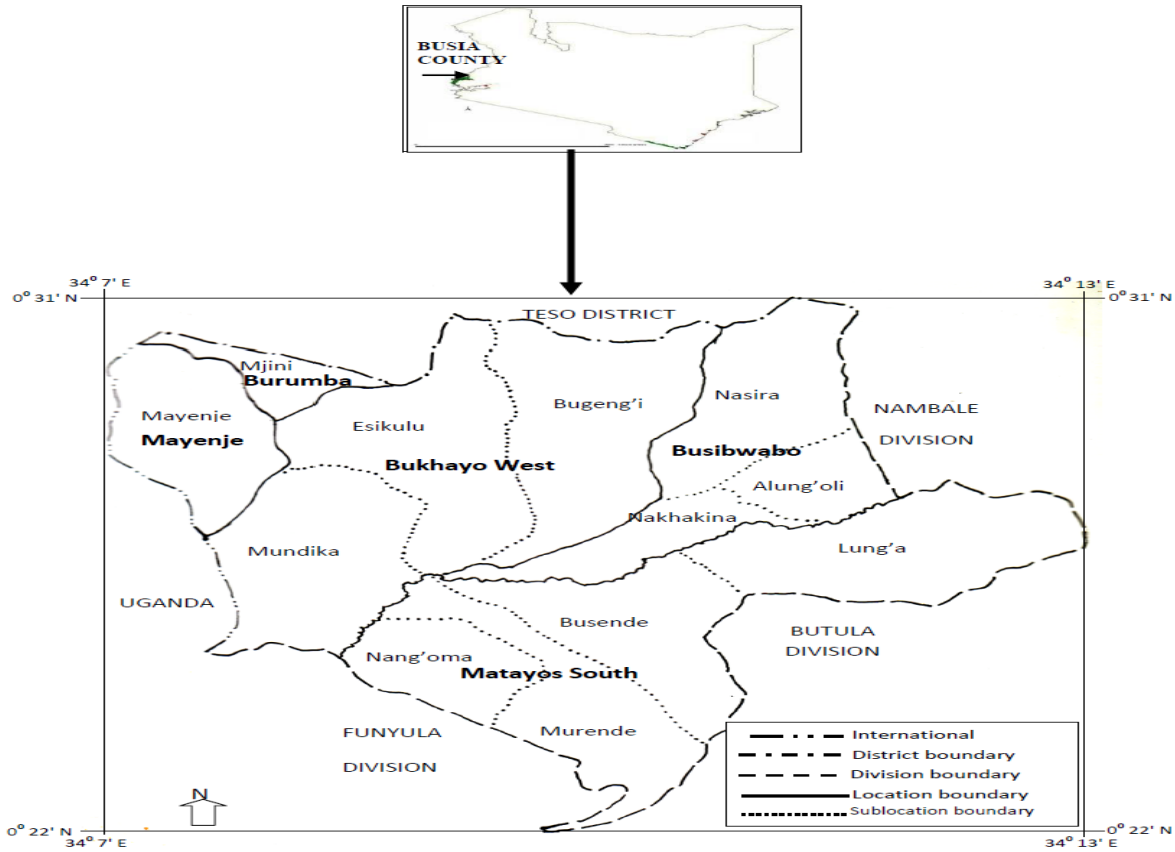

Figure 2: Map of Matayos division
Source: Republic of Kenya, 2005

Study Population, Sampling and Data collection

Simple random sampling was used to select 384 respondents from a study population of 56,186 as recommended by Mugenda and Mugenda (2003) since the study population was greater than 10,000 individuals. This was generated from a list of 987 households provided by the ward administrators from the five sub locations Namely; Mundika, Mayenje, Esikulu, Bugeng'i and Nang'oma. Purposive sampling was used to select three locations namely Bukhayo West, Mayenje and Matayos South that were studied and five sub- locations from these locations namely; Mundika, Mayenje, Esikulu, Bugeng'i and Nang'oma. Data was collected through questionnaires, Key informant interviews, Focus Group Discussions, photography and observation checklist.

Data Analyses and Results Presentation

Quantitative data was analyzed using descriptive statistics which included percentages, mean and frequency distribution. These were processed using Statistical Package for the Social Sciences (SPSS) version 12 as a tool. The qualitative data were first edited and cleaned up then the data were organised. The categories, themes and patterns were created and evaluated to determine the adequacy of the information, the credibility, consistency and evaluating the usefulness in answering the research questions. Data was synthesized and written in narratives in the form of statistical tables, charts, photographs and percentages

IV: RESULTS AND DISCUSSION

The findings of this study revealed that human activities practised in the study area affected terrestrial biodiversity. These activities were; farming, fuelwood collection, harvesting of medicinal herbs, charcoal burning, bush burning, hunting and gathering, brick making and grazing.

Farming

The study sought to find out how farming has affected plants and animal species in the study area. Figure 2 shows the percentage of respondents undertaking farming in the division.

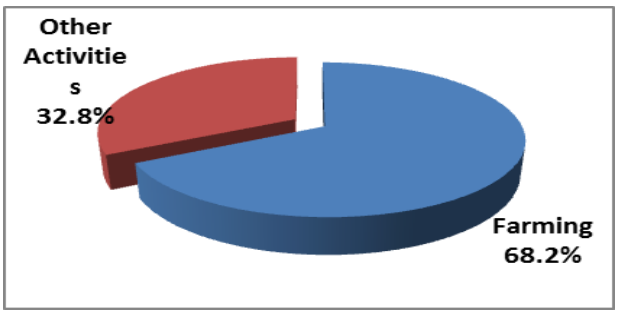

Figure 2: Percentage of farming in relation to other activities by the respondents
Source: Field data

Through household questionnaires, key informant interviews and further confirmed through FGDs, the study revealed that farming is undertaken by a larger proportion (68.2%) of the respondents. Moreover, majority of the respondents did not consider farming activities as threats to terrestrial plants and animals in the study area. The study found out that clearing of vegetation for cultivation of maize, cassava, sorghum, sugarcane, sweet potatoes farms, among others resulted to reduction of plants like trees. FGDs and observation further confirmed converting wetlands in to crop farmlands could result to destruction of animal habitats like monkeys, squirrels, and antelopes. It appeared that farming was carried out without considering sustainable land use practices, with many areas being cleared for growing crops at the expense of valuable species habitat.

The study further revealed that areas of Nang'oma, Bugeng'i and Budokomi which were forested in early 1980s are now under crop cultivation (Republic of Kenya, 2003). Through in-depth interview and observation, the study revealed that there was use of many modern practices like monocropping and land intensification approaches aimed at achieving high crop yields. These have led to simplification of plant diversity and to ecologically unstable production systems. Over the past 50 years, patterns of agricultural expansion especially in tropical and sub-tropical forests, grasslands and savannas have substantially reduced levels of biodiversity and ecosystem services over significant areas undermining the long-term sustainability of agricultural production itself (CBD, 2006). Farming has a negative effect on the population growth rate of terrestrial species. Farming leads to habitat loss and habitat loss alters species interactions by affecting breeding, dispersal success, predation rate and aspects of animal behaviour that affect foraging success rate (UNEP, 2008). Species showing declining trends are more likely to occur in areas with high habitat loss (Scully, 2001). When the bushes are cleared, the species are affected in that; all species have special food and habitat needs. Some species relocate to other places, others die due to lack of food since the food chain is disrupted (Tsingalia, 1990). The more specific these needs and the more localized the habitat, the greater the vulnerability of species' habitat loss to agricultural land.

Bland and Reddish (1996) counter that in the future, the only species that will survive are likely to be those whose habitats are highly protected from habitat fragmentation caused by farming. When land is cleared and replaced with arable crop, this reduces both the complexity and stability of the system. This reduces the species diversity of the system often in care of the plants to a single species. Mugabe and Clark (1998) also concurs that this also affects the food web in the system. It is therefore important to appreciate the indirect values of terrestrial species by adopting proper farming methods as well as minimizing vegetation clearance so as to prevent destruction of species' habitat through conversion of these habitats into farm lands, and other related activities.

Fuelwood Collection

The study also established that firewood is the main source of energy supply and constitutes nearly 90% of the domestic energy requirement as shown in Table 1.

Table 1: Type of fuelwood, respondents' gender, firewood sources and areas number of respondents involved

Type of fuel wood	Number of the respondents	Percentage (%)
Firewood	345	89.7
Others (Kerosene, charcoal, electricity)	39	10.3
Total	**384**	**100**
Gender		
Females	252	65.6
Males	132	34.4
Total	**384**	**100**
Source of firewood		
From wetlands	250	65.0
Nearby bushes	77	20.0
Own farm	38	10.0
Local market	19	5.0
Total	**384**	**100**

Source, Field Data.

According to FGDs revealed that in Matayos division, fuelwood plays an important role in activities like cooking, production of charcoal and preparation of bricks. Other supplementary sources include charcoal, kerosene and gas used (mainly in urban centres like Mundika and Busia). Thus, majority (70%) of the respondents collected firewood more than twice in a week as shown in Table 2.

Table 2: Frequency of fuelwood collection and Number of Respondents involved

Frequency of firewood collection	Number of respondents involved	Percentage %
Once or twice a week (2 bundles)	115	30
More than twice a week (4 bundles	269	70
Total	384	100

Source: Field data

This study established that frequent firewood collection resulted to over harvesting leading to reduced common plant species like gum tree, reeds and papyrus. This implied that pressure was high on the tree species used for fire wood like *Lusiola (Markhamia Lutea), and Omudodo* (*Ficus thionningnii)*. This in turn resulted in use of plants like *Obengele (Lantana camara)* and cassava sticks. FGDs further revealed that fuelwood shortages are becoming more common in the study

area. For instance, the shortage of wood fuel has meant that communities in Munongo and Mayenje villages use sorghum husks for cooking and domestic heating. These shortages are also being felt in the alternative economy where young people in the study area are denied the opportunity of an income from trees through timber for the construction industry or wood for brick making which is a booming business in the county. Papyrus harvesting in the wetlands for wood fuel was not sustainable. It was revealed that papyrus cannot burn for a longer time and hence one may need to harvest a lot for just simple cooking.

This implied that the continued papyrus harvest to meet the fuel demand has led to depletion of the papyrus from the Neranda and Sango wetlands. As a result, some respondents buy their firewood from the shopping centres like Munongo, Store, Matayos and Mundika at a cost of Kshs.200 or more depending on the size and the supply of the bundle. Other wetland plant species used as cooking fuel include Nyabende *(Lantana spp.)* gum tree, Osawa (*Sesbania spp.*), Asao (*Sesbania sasban).* These species have reduced in quantities and others like gum tree have become rare in the study area. These results are consistent with Khan *et al.* (1994) who concluded that firewood is the main source as cooking fuel in the developing world and has resulted to reduction of trees and reeds due to demand. Korem (1985) also observed that fuelwood provides the main source of energy for both rural and urban households in African countries with estimates of about 65% of the total energy consumption and forests have been over exploited leading to reduced tree species.

The study also revealed that 36.3% of the respondents collected dead branches from the wetland and nearby bushes as shown in Table 3.

Table 3: Part of the tree used as fire wood and number of respondents involved

Part of tree used as firewood	Number of respondents involved	Percentage (%)
Dead branches	139	36.3
Whole tree	59	15.2
Twigs	71	18.6
Twigs and branches	94	24.5
Branches and Trunks	21	5.4
Total	**384**	**100**

Source: Field data

There were 15.2% who used to cut trees and 18.6% of the respondents used twigs, 24.5% used both twigs and branches while 5.4% used both branches and trunks. FGDs revealed that the common trees used for firewood are *Lusiola (Markhamia Lutea), Obengele (Lantana camara), Nyabende (Lantana spp.), Milulusia (Vernonia amygdalina) and Omudodo (Ficus thionningnii).* The findings are corroborated by Baan (2003), who observed that dead branches were the tree section which majority of people use.

Harvesting Of Medicinal Herbs

Through FGDs, and Interviews, the study established that the people of Matayos division have passion for medicinal plants and use them for a wide range of heath related applications like curing common cold, memory improvement, treating poisonous snake bite and enhancement of body's general immunity. Table 3 shows the medicinal herbs used by the respondents, their local names and the diseases treated.

Table 4: Medicinal plants, botanical names and local names, part(s) used and disease(s) treated with it

Scientific Name	Local name (Lukhayo and Saamia)	Part(s) used	Disease(s) treated
Azodiradita indica	*Mwarubaini*	leaves	Stomach ache, skin infections
Tithonia spp.	*Khalulu*	Leaves	Stomach ache
Aloe spp.	*Likakha*	Leaves	Snake bites
Ocimun spp.	*Mnyinyi*	Roots	Stomach ache, rashes
Ocimum kilimandscharicum	*Okite*	Roots, leaves	Amoeba
Mondia whytei	*Mukombero*	Roots	Apetite
Ficus thionnignii	*Omudodo*	Root, leaves	Anaemia
Kigelia africana	*Murabi*	Leaves ,stem	'boils'
Vernonia amygdalina	*Mululusia*	Roots	Sexually Transmitted Infections, stomach ache
Indigofera spp.	*Rayue*	Roots, Stem	Stomach ache, skin infections, snakebites
Sesbania sesban	*Asao*	Roots	Livestock medicine
Tithonia diversifolia	*Akech*	Leaves, stem	Stomach problems
Kedrostis foetidissima	*Ang'we*	Leaves, stem	Measles
Solanum incanum	*Achoki*	Fruits (seeds)	Fresh cuts and bruises
Cassia floribunda	*Nyayado*	Leaves, stem	Stomach problems
Vernonia spp.	*Ekaha*	Roots	Malaria
Melia spp.	*Musengese*	Leaves	Allergy
Markhamia lutea	*Lusiola*	Leaves	Throat diseases, conjunctivitis
Olea welwitshii	*Mukhuyu*	Roots, stem	Skin infections
Cassia accidentalis	*Imindi*	Stem, roots	Stomach problems

Source: Field data

This meant that Matayos area has a wide variety of medicinal plants used to cure variety of ailments. However, FGDs established that current practices of harvesting such plants are unsustainable in the wetlands of River Sio, Munongo, Neranda and Sango, and have led to depletion of plant species like reeds, and papyrus. Confusion also exists in identification of plant materials where the origin of a particular drug is assigned to more than one plant like *Okite (Ocimum kilimandscharicum*) sometimes leading to overharvesting of the same. The study found out that several medicinal plants like *Khalulu, (Tithonia spp.), Likakha (Aloe spp.)* have been assessed as being endangered, vulnerable and threatened, due to over harvesting and or unskillful harvesting. Removal of roots and barks of trees like *Mukhuyu (Olea welwitshii), Mnyinyi (Ocimum kilimandscharicum),* makes the tree dry up.

Overharvesting of other herbal plants for example, *mukombero (Mondia whytei)* has resulted to their scarcity in the study area. The study also established that most (90%) of the respondents went to the wetlands and bushes for herbs and ended up interfering with the animals habitats. According to WHO (2002), the surge in global demand for herbal medicines has been followed by a belated growth in international awareness about the dwindling supply of the world's medicinal plants. Over-harvesting for commercial purposes and destructive harvesting practices have all been recognized as contributing factors. WHO (2002) further estimated that 80% of the populations of developing countries rely on traditional medicines for their primary health care needs. Medicinal plants occupy an important position in the social-cultural, spiritual and medicinal arena of rural people of Africa (Wilson, 2002). Tewari, (2000) concurs that medicinal plants continue to be an important therapeutic aid for alleviating ailments of humankind but overharvesting has a serious implication on the survival of several plant species, with many under serious threat to become extinct. Plate 1 shows *Mukhuyu (Olea welwitshii),* which is a rare herbal plant species in the division.

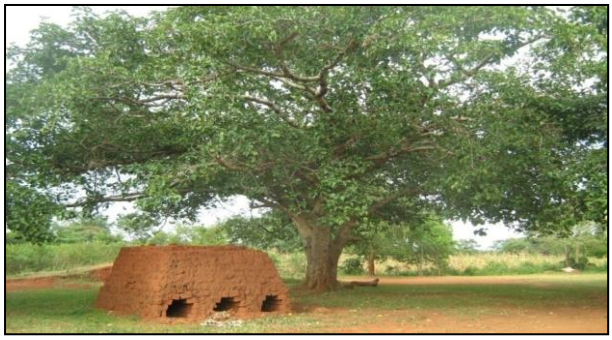

Plate 1: *Mukhuyu (Olea welwitshii)* a rare plant species at Munongo Catholic Church compound in Mundika sub-location
Source: Field data

Lack of proper harvesting of medicinal herbs and poor wetland policy led to over harvesting of these wetland resources. The importance of traditional medicine in meeting the health needs of indigenous people, rural communities and the poor throughout the developing world has led to unsustainable harvesting practices by the herb gatherers (Akerele *et al.,*1991). This has resulted in depletion of many medicinal species in otherwise healthy ecosystems (WHO, 2002). Therefore, medicinal plants are a living resource, exhaustible if overused and sustainable if used with care and wisdom. Therefore, conservation efforts should be put in place to ensure sustainable medicinal plants use.

Charcoal Burning

Charcoal provided an important supplementary income for the families in the study area since the capital realized was used for family support and social welfare including the education of children and health provisions. Charcoal burning has resulted to a rapid decline in tree population in the area. Bushes and grass are also harvested to burn the charcoal. The study established that species like Mvule (*Milicia excelsa*) *Lusiola (Markhamia Lutea)* and *Musegese (Melia spp.)* which are highly used for quality charcoal production have been depleted. Mvule (*Milicia excelsa*) has a slow growth rate yet, the rate of its exploitation is high due to high demand of its quality products. The tree is at the verge of getting endagered. The charcoal producers are of the view that other highly valued species like *Lusiola (Markhamia Lutea)* are no more available in the study area. Current tree species in the study area are the exotic species manely; *Eucalyptus* spp., *Pinus patula*, *Grevillea* and *cypress (Cupressus)* spp. that have taken over the indigenous species because of their faster growth rate.

However, through interviews, the study established that charcoal burners lack skills in sustainable tree harvesting and good forest management practices which is the solution to the current unsustainable forest use in the country. Rensselear (1998) concurs that charcoal plays an important role in most African countries and its increased demand has resulted into reduction of tree species. Charcoal burning tends to selectively damage the environment selectively (ASARECA, 2006). Certain species are preferred and, by natural selection, growth of disfavoured species especially *Lantana Camara Spp.,* locally known as *Obengele is* the only available alternative. A study by Baan (2003) concur that the inefficiencies inherent in the production and use of charcoal, rapid urbanization and the preference of urban dwellers for charcoal place a heavy strain on local wood resources.

Bush Burning

Most of the farmer – respondents (65.7%) practised bush burning (Figure 3). The setting of bush fires in the study area could be explained by the fact

that most of the human activities on the wetlands and farms required the use of fire as a shortcut to achieving the desired results during farming and hunting. Bush fire setting was also considered to be beneficial in driving away dangerous animals like snakes which hide in dense vegetation. Bush burning was also done to destroy unpalatable grass so that new and more palatable grass sprouts for grazing animals at the beginning of the rainy season. Figure 4 illustrates the percentages of causes of bush burning as revealed by the respondents.

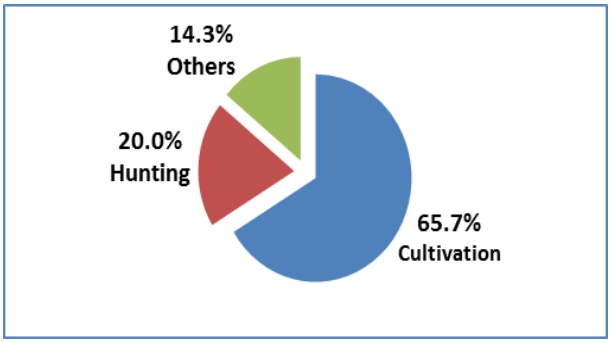

Figure 3: Causes of bush burning

However, through FGDs the study revealed that bush burning destroyed shrubs, grass, seeds, seedlings and animals like antelopes, hare and birds could relocate to bushy areas of the neighbor country since their habitats were destroyed. According to Turner *et. al.,* (1990), vegetation burning is beneficial to both the biotic and abiotic components of ecosystems. However, indiscriminate and repeated bush burning impacts negatively on such ecosystems and therefore need to be checked. Unfortunately, the fire setters do not take into consideration that fire destroys vegetation through burning. Waring and Schlesingen (1985) observed that each plant community has an associated animal community and the destruction of the former by fire has severe repercussions for the latter. In addition, the competitive balance achieved in the micro fauna (expressed in terms of food attachment area, breeding territories may be destroyed). Wuver and Attuquayefio (2006), add that it also exposes the vulnerable animals to predation besides their habitats being destroyed. Although larger animals may move away from the field area, it will not be easy for them to re-establish in adjacent communities. There will have been an overall reduction in carrying capacity of the region. Scully (2001) pointed out that ecological niches and food sources in these undisturbed areas will already have been "claimed" by the species in possession. While these animals are not burnt, may subsequently starve to death. Animals seeking new territories will also be very susceptible to predation.

Hunting and Gathering

Respondents in Matayos division were involved in hunting and gathering activities where wild animals and birds are hunted for food, skins and hides, and feathers as shown in Table 4.

Table 5. Respondents engaged in hunting and gathering activities.

Respondents engaged in hunting and gathering	Number of the respondents	Percentage (%)
Involved	172	45
Not involved	212	55
Total	**384**	**100**

Source, Field Data

The study revealed that the low percentage (45%) involved in hunting could be due to the fact that hunting activity is never a routine practice for the people of Matayos division. Further, about two thirds of the respondents (69%) reported a reduction in catches of antelopes, bushbucks and hares in recent times, which were attributed largely to habitat change as a result of farming, fuelwood collection and bushfires. The study established that there are varieties of animals hunted in the area as shown in Table 6.

Table 6: Animals hunted by the respondents in the study area

English name	Zoological name
Hare	*Lepus capensis*
Antelopes	*Tragelapus spp.*
Weaverbirds	*Ploceus spp.*
Harlequin quail	*Coturnix delegorguei*
Ducks	*Syluicapra grimmia*
Egyptian geese	*Alopochen spp.*
Sitatunga	*Tragelaphus spekii*
Reedbuck	*Redunca redunca*
Monkeys	*Vervet spp.*

Source: Field data

FDGs revealed that hunting led to death of animal species like hares, reedbucks and monkeys thus reducing their numbers. In-depth interviews further confirmed that hunting and gathering led to reduced species of Haleaquilea birds, antelopes and guinea folks. Baboons and wild pigs had become rare in the region. Antelopes had relocated to bushy areas away from the area for security since they are much preferred for their delicious meat. Monitor lizards and pythons had become rare because they are hunted occasionally for their skin which is used by the local musicians to make their special drums called *sririi*. Illegal hunting of wildlife is against wildlife conservation regulation and leads to death of and to an extent extinction of species (Wuver and Attuquayefio 2006). The World Bank (1999) reported that widespread rural poverty, illiteracy and hunger have compelled rural populations to exploit natural resources unsustainably for their survival. This

appears to be the case with the inhabitants of Matayos division who could only be expected to appreciate terrestrial biodiversity through education and awareness programmes which stress the importance of biodiversity conservation and its role in ultimately increasing species diversity.

Brick Making

It emerged from household questionnaires, Key Informant Interviews and further confirmed through observation that 65% of youth were involved in brick making activity as shown in Plate 2.

Plate 2: Brick making site in Budokomi village. Source: Field data

During brick making activity, the rich and fertile top soil containing essential nutrients for growth of vegetation is used for making bricks. In the process not only is the top soil destroyed but the land cover on which the kiln is built is also rendered infertile, due to the high heat generated during making bricks. Brick making has thus led to destruction of habitats for animals like antelopes, hare, squirrels among others and death of grass, drying of bushes around the kiln and finally bare land which cannot support life. In addition, the process requires firewood for firing the bricks and this has contributed to growing scarcity of trees in the study area, which are habitats to plants and animals, and resulted to use of fruit trees like mangoes. It was observed that in areas like Burigala in Mundika sub-location, brick makers use arable land thinking that brick making is more lucrative than farming on depleted soils. Botkia and Talbolt (1992) concur that large quantities of firewood are needed for firing bricks which contributes to cutting of trees and hence loss of biodiversity.

Grazing

Through household questionnaires the study established that wetlands provided grazing grounds for the adjacent rural communities. Also, an observation made during this study was the free range grazing of animals on Neranda and Sango wetlands. Large herds of cattle were always allowed to range freely in these wetland areas. FGDs revealed that frequent grazing along the roads and wetlands contributed to drying of grass. Grazing also interfered with living and breeding habitats for birds, snakes and reedbucks. During grazing, the animals stepped on species like tortoise and snails killing them. These grazing areas are feeding and breeding habitats for variety of species, especially birds and they end up relocating to other areas. Free ranging and overgrazing of livestock on such areas rich in species diversity can have a negative impact on biodiversity. Perry (1994) agrees that grasses can withstand moderate grazing by virtue of the fact that leaves grow from the base rather than the tip, so removal of this does not stop growth, but even promote it by encouraging light penetration. However, a minimum amount of leaf and stem tissue must be left after grazing to allow regeneration and prevent soil being blown away. Scully (2001), notes that overgrazing lead to compaction of soils and this negatively affect the soil structure and its biological activity.

CONCLUSION

There is lack of enforcement of biodiversity conservation that leaves bad practices unchecked like vegetation clearance for agriculture, over harvesting of fuelwood, uncontrolled charcoal burning, wetland encroachment, over harvesting of reeds and other wetland resources, bush burning and brick making which all affect terrestrial species. Farming is a known cause of habitat loss which leads to reduction of vegetation cover, destruction of breeding, nesting, feeding places of terrestrial species and also leads to relocation of animals to other places. Charcoal burners are lacking skills in tree harvesting and good forest management practices which are the solution to the current unsustainable tree use in the division. Practices like wetland encroachment for crop cultivation, over harvesting of fuel wood and handcraft materials, brick making and hunting of wild animals among others, resulted in decrease of plants and animal species in the division. Terrestrial biodiversity conservation can provide important services to the communities around them and therefore the "wise use concept" is paramount to ensuring that these resources are managed well for the benefit of all. The wise use concept identifies the best use to which the resource can be put without affecting the other values of that resource.

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