ASSESSMENT OF EFFECTIVENESS OF COMMUNITY PARTICIPATION IN THE MANAGEMENT OF ONDIRI SWAMP, KIAMBU COUNTY.

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University or institution.

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APPROVAL

This research project has been submitted for examination with an approval of the University supervisors.

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DEDICATION

This work is dedicated to:

My dad (Peter K. Miriti) who sacrificed much of his precious time and money to ensure that I reached this stage of my academic life and encouragement that he rendered to me.

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ABSTRACT

Ondiri wetland has experienced multiple pressures from various anthropogenic activities. This study therefore, sought to examine the effectiveness of community participation in the management and conservation of Ondiri wetland in Kiambu County. This included: assessing whether the community members utilize Ondiri wetland sustainably; whether the community is involved in its conservation, finding out the conservation efforts put in place by the community members to protect Ondiri wetland; and based on the results propose sustainable approaches on utilization and management of Ondiri wetland resources. Primary data was collected by means of structured questionnaire, key informants interviews, community based organization leaders and government institutions. The secondary data included perusal of government documents from Kenya Wildlife Service, National Environment Management Authority, University libraries and other existing databases. The probability sampling technique used in this study was stratified random sampling and simple random sampling. In total, 98 households were selected from the four villages by applying (Nasuirma, 2000) model.

The study established that Ondiri wetland has been affected by anthropogenic activities such as overgrazing, encroachment for settlement and agriculture, siltation, dumping of wastes and overharvesting of papyrus. For instance, 71.4% of the villagers abstract water from the Ondiri swamp for farming, 14.3% grass harvesting, 7% papyrus reeds harvesting and 2% fetching of firewood. At the same time, 55.1% of the community members were directly involved in conservation activities. These activities include: tree planting, building of gabions to reduce soil erosion and cutting down of eucalyptus trees. On the other hand, 44.9% admitted that they were not involved in any conservation efforts reason being that they were not aware of any activity or were not contacted.

Despite the conservation efforts the local community put, there were challenges that hampered with their efforts like inadequate funding and lack of community cooperation hence minimal impact on the ground. Therefore, the study sought to suggest public awareness on the importance of wetlands, introduction of alternative livelihood improvement projects such as fish farming and dairy farming, afforestation exercises and adoption of a clear institutional and legal framework for the management of the wetlands. The study further recommends that NEMA to

work with the local community and other stakeholders and come up with a management plan for Ondiri swamp. The research also recommends sustainable management approaches on utilization and conservation of Ondiri ecosystem.

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ABBREVIATIONS

CBD	Convention on Biological Diversity
CBO	Community Based Organization
EAWS	East Africa Wildlife Society
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
FGDs	Focused Group Discussions
FOWCON	Friends of Ondiri Wetland Conservation
GoK	Government of Kenya
IGAs	Income Generating Activities
IGOs	Intergovernmental Organizations
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
KWS	Kenya Wildlife Service
MDGs	Millennium Development Goals
NEMA	National Environment Management Authority
NGO	Non Governmental Organization
SLA	Sustainable Livelihood Approach
SWM	Sustainable Wetland Management
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on climate change
UNDP	United Nations Development Program
WWD	World Wetlands Day
WWF	World Wildlife Fund

CHAPTER ONE

1.0 INTRODUCTION

1.1. Background of the study

Wetlands are valuable ecosystems occupying about 6% of the world's land surface. They are valuable ecosystems as they play vital roles in the environment. They are very effective in improving the quality of water (Sala *et al*., 2000). According to Kadlec and Knight (1996), wetlands improve water quality through various processes. These processes include: sedimentation, filtration, physical and chemical immobilization, microbial interactions and uptake by vegetation. It has been estimated by scientists that wetlands may remove between 70% - 90% of nitrogen. It is further estimated that riparian forests can reduce nitrogen concentrations in runoff and floodwater by up to 90% and phosphate concentrations by 50%. Wetlands can also help in groundwater recharge and replenishment. Wetlands also help maintain the level of the water table and at the same time exert control on the hydraulic head. This provides force for ground water recharge and discharge to other waters as well. They also help in controlling climate change. According to Richardson and McCarthy (1994) in their study on wetlands, observed that many wetlands return over two-thirds of their annual water inputs to the atmosphere through evapotranspiration. This moderates temperature extremes in adjacent uplands. Wetlands help in controlling soil erosion through wetland plants like reeds, which hold the soil in place with their roots, absorb wave energy, and reduce the velocity of stream or river currents, (Mitsch and Gosselink (1993)

Globally, wetlands have been degraded and most of them have been lost through human actions. Barbier *et al.,* (1997) pointed out that since 1900, more than half of the world's wetlands have disappeared. These losses are generally caused by the public nature of many wetland products and services, user externalities imposed on other stakeholders, and policy intervention failures due to a lack of consistency among government policies in different areas, including economics, environment, poor nature of protection and physical planning, (Turner *et al*, 2000)

Since 1971, when the Ramsar Convention on Wetlands of International Importance was signed, there has been a substantial progress to promote conservation and sustainable utilization of wetlands (Ramsar Convention Bureau, 2000). The adoption and implementation of the convention guidelines has been a success for wetlands of International, Regional and National importance, though the situation is different for wetlands at Sub-National and local

levels. The most popular strategies used to manage designated wetlands of importance is through wise use. As much as we put efforts in contributing to the management of the wetlands countrywide, there is need to sensitize people on the importance of wetlands within our ecosystems. The local community around that wetland ecosystem should be the target group in the management and conservation.

1.2. Problem statement

Sometimes, wetlands are dismissed as wastelands which are viewed as being worthless to the extent of being associated with source of disease like Malaria. In view of this, it follows that wetlands should then be drained and be converted to what is perceived as more rewarding and useful activities (Muhati, 2005). Due to this perception that wetlands are wastelands, there has been an increase in human populations and changing lifestyles that leads to wetlands conversion into other land uses such as residential areas, pasturelands, fish farming and agriculture (Owino and Ryan 2007; Macharia and Thenya 2007a, 2007b), that are perceived to be more profitable. Anthropogenic activities have been pointed out as the major drivers of global environmental change on the planet and has a consequence directly affecting biodiversity (Vitousek, 1994). Land use changes and land cover are projected to have the largest impact on biodiversity, followed by nitrogen deposition, invasive species and increasing carbon-oxide in the atmosphere (Sala *et al*., 2000). In pursuit of National importance of wetlands, Kenya ratified the (Ramsar Convention, 1971) in 1990.

Despite the many services Ondiri wetland offers, it faces serious anthropogenic challenges that threaten its sustainability. The main challenges include: riparian farming, water pumping for irrigation around the wetland, siltation from cleared farms and cleared riparian area that would work as filter. The wetland plants like reeds which help in holding soil particles thereby regulating the water quality is under threat due to harvesting by the community members especially during the dry seasons. The community focuses on maximizing the profit from the sale of mats thereby contributing to unsustainable harvesting of the reeds. In addition, agrochemicals used in the nearby farms are washed into rivers and the wetland. These chemicals and fertilizers pollute the Ondiri wetland hence contribute to the destruction of Ondiri water quality. Proper conservation measures are vital for the society to continue enjoying the wetlands contributions to our cultural, social, national heritage and economy. Sustainable co-existence between wetland ecology system and human activities are possible.

The research will help the government in development of wetland related regulations including incorporation of community participation to ensure proper wetlands utilization and conservation is adhered to, and this will boost ecological performance on the entire ecosystem. It will also help to improve our intellectual understanding by generating information on stakeholder's utilization and conservation of the swamp and associated impacts.

1.3. Research questions

a) What conservation and management interventions are the local community using to conserve Ondiri swamp?
b) To what extent is the local community around Ondiri swamp involved in its conservation?
c) Do the local community understand the importance and management of Ondiri swamp?
d) What are the caretakers' role in facilitating local community in utilizing of the Ondiri swamp?
e) What perceived effects do the Ondiri swamp have on the local community?

1.4. Research objectives

The overall objective of this study was to assess community participation and their effectiveness in the management of Ondiri swamp.

The objectives of the survey are:

a) To assess how the various stakeholders are utilizing the Ondiri wetland.
b) To identify and assess the site conservation efforts put in place by various stakeholders.
c) To assess the strategies put in place to guide the utilization and conservation of Ondiri swamp by various stakeholders.
d) To propose sustainable management approaches on utilization and conservation of Ondiri swamp.

1.5.Justification of the study

Ondiri wetland is an important ecosystem to the livelihoods of most Kikuyu residents. They obtain economic benefits by harvesting macrophytes mainly as forage for livestock and for commercial purposes, water abstraction for irrigation and other domestic uses. These activities directly or indirectly impacts on the wetland ecosystem. The wetland also provides a variety of functions in terms of supporting biodiversity to Kiambu County and Country at large as source of water for domestic use and headwater of Nairobi River, hence important to Utilize Ondiri swamp in a responsible and sustainable way. Increased utilization of Ondiri wetland resources for livelihood may pose a serious threat to its sustainability. Therefore, the local community is a stakeholder in the management and conservation of the wetland. They should be effectively involved at all levels of decision making so that they feel part of the process. This study was necessary since it unveiled the weaknesses of local community involvement in Ondiri wetland management and conservation.

1.6. Scope and limitation of the study

This study focused on effectiveness of local community participation in the conservation and management of wetland resources. The research was confined around Kikuyu sub-location in Kiambu County where it was limited to Ondiri wetland ecosystem. The limitations of this research project were that during the data collection period majority of the household heads had gone to work. The researcher also experienced changing weather conditions especially sporadic rains. The first limitation was overcome by interviewing immediate persons of the family who had attained over 18 years of age. The second limitation was assumed and the researcher made numerous visits to the field.

In addition, it was important to note that the study area is unique in that the Ondiri swamp is Kenya's only quaking bog and second deepest swamp in Africa. It is also affected by various anthropogenic activities taking place around it. I heard of the swamp when the southern bypass was being constructed, since it cut across the swamp and Environmentalists raised concern of interference of the biodiversity. This captured my attention and had interest in finding out how effective are the community in the management of Ondiri swamp.

1.7. Definitions of key concepts

Community

This is a community of people living in a defined geographical area and identified by common history, common culture or common residence in an area, and may comprise representative members of the organized institutions in the private sector or members of the civil society.

Community participation

In the context of environmental management is a stage where the community is involved to identify environmental problems, develop action plans, implements the best plan and monitors the solution.

Conservation

This means the protection, maintenance, rehabilitation, restoration and enhancement of the environment for sustainable use.

Ecosystem

Is a community of living organisms in conjunction with non-living components of their environment (water, air, mineral soils), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flow.

Stakeholder

A person, group or organization that has interest or concern in an organization.

Wetlands

These are areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water and depth at low tide does not exceed six meters.

Wetland conservation

This is a use of measures and strategies to promote wetlands protection to maintain its pristine state and control the wetland resources over-exploitation to ensure sustainability.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This section discusses wetland degradation, government strategies to dealing with wetlands degradation, community participation on conservation and management, sustainable wetland management, wetlands functions and importance and a lengthy discussion on legal frameworks on wetlands management and international treaties.

2.2. Wetland degradation and loss

Many developed and developing countries have allowed inappropriate utilization of wetlands to support the livelihood of their citizens, and some with an urgent need for development cannot abandon the economic benefits provided by wetlands. Chinese wetlands for example contributes greatly to economic development within their country, but improper use of these natural resources have endangered their existence (Wang *et al.,* 2008).

In the world, China's wetlands have significant status not only in ecological functions like removal of pollutants but also there is economic functions like fish and crop production. The total wetland areas of China are more than 65.94 million ha, accounting for about 10% of the world's wetland areas. SFA (2000), points out that; natural wetlands in China cover 25.94 million ha, being approximately 2.6% of China's surface. Wetland areas in China have experienced rapid degradation and loss over the years due to pressures of population growth and economic development especially during the time country struggled to control poverty and achieve food self-sufficiency.

The fact that majority of wetland users lack comprehensive understanding of the wetland values and functions and the insufficient information on the importance of conservation of wetlands, has contributed to rapid wetland loss. Approximately 40% of existing important wetlands have been threatened through wetland degradation and loss (Wang, 1998). Land reclamation, over-exploitation of bio-resources, pollution, exploitation of water resources and hydro-engineering, siltation, coastal erosion, urban development and tourism are the major threats to wetland loss and degradation (SFA, 2000). Wetland losses can also be attributed to urban/industrial or agricultural developments. People tend to reclaim wetland areas for development reasons hence leading to loss of wetland areas over the years. The same case has

also been experienced in the United States where about 87 million ha (54%) of its original wetlands has been lost primarily to agricultural production (Barbier, 1997).

In Kenya, wetlands form part of important ecosystem comprising of varied biodiversity that have enormous economic, social and cultural value. Wetland environment support human populations and economic activities over wide areas and represents a productive resource in a region of rising population and considerable poverty. By the time Kenya ratified Ramsar convention in 1990, most of the country's wetlands had been degraded (Mironga, 2005). Some of the major impacts of agriculture on Kenya's wetlands are land reclamation, drainage, overgrazing, eutrophication of inland waters caused by agricultural pollution through introduction of some chemicals like fertilizers.

2.3. Government's strategies and efforts on wetland degradation

Governments throughout the world have recognized the values of wetlands. The governments of Denmark, Germany and Netherlands for example have set up an international programme to manage coastal wetlands of the Wadden Sea that they share (Russel, 1993). Enactment of the Ramsar convention is a major step towards wetlands conservation. Each country that signs the Ramsar Convention must designate at least one suitable wetland within its territory to be included in the list of wetlands of national importance. Sun (2000), suggests that China too has made great progress in wetland protection. Policies, institutions and laws about wetland protection are among the most important measures China has taken. Government has enacted several laws to ensure protection, accompanied by many policies (Ya-li *et al.*, 2005). This has provided legal support for wetland protection. According to Sun (2000) He noted that from 1980s to the early 1990s, the focus shifted towards integrated utilization of wetlands, which included an increasing emphasis on conservation. In 1992, China officially joined the Ramsar Convention on Wetlands. There are more than 20 laws and statutes related to wetland protection, that China has enacted in which several laws play a major role, such as the Law of Protection of wild animals of China, Statute of Execution of Protection of Aquatic Wild Animals of China and Statute of Management of Natural Reserves of China (Ya-li *et al.*, 2005).

Uganda has made elaborate steps in developing a framework to manage wetland resources. According to NEMA (2000), the Government of Uganda made significant progress in establishing a comprehensive policy, legal and institutional framework for wetlands

management. Uganda is the first African country to adopt a policy on wetlands in 1995. The Uganda wetland policy focuses on wetlands protection from drainage, their use, environmentally sound management, development dependent on environmental impact assessment (EIA) and diversification of uses and users (Howard, 1995).

Although Kenya National Wetland Policy is still in draft form, the country has paid increasing attention to environmental and natural resource management since independence. The importance of wetlands and their conservation in Kenya was first stated by the government in its 1963 manifesto on conservation of natural resources (Masese, 1997). This is evident from many management policies and strategies that have been put in place. They include community participation through the promotion of voluntary community involvement in soil and water conservation so as to ensure sustainable development and management (Nyaoro, 1996).

2.4. Community participation in conservation and management of wetlands

Globally, attention has shifted to community participation in wetland management and conservation and therefore different resolutions are made to provide framework for community involvement. Ramsar Convention Secretariat (2011) gives the guiding principles for establishing and strengthening communities' and indigenous peoples' participation in the management of wetlands (Recommendation 63, 1996; Handbook 7), Countries that signed the Ramsar Convention acknowledged that local and indigenous people have a specific interest in ensuring wetlands within their regions are well managed. The convention particularly, ensures that indigenous people have distinct objectives, expertise and aspirations in relation to wetland management.

Major management decisions in Kenya on wetland conservation are usually implemented by various government institutions with very little or no local community participation or involvement (Terer *et al.,* 2004). This has led to conflicts and implementation of these government policies becomes difficult to achieve due to top-down approach in decision making. Lessons learnt during project or programme implementation in rural areas have shown that involving local people in project formulation and implementation create a sense of ownership, which is essential for project success and sustainability. The tactics of involving communities in natural resources management depend on people's value system perceptions, and use of those resources that are within their proximity, (Claridge, 1997)

According to Owiti (2006), different groups of stakeholders influence on how wetlands are managed. The management of these wetlands depends on the user groups and the economic activities that they derive from the wetlands. For instance local fishermen, farmers, private businesses and government agencies have a diverse mandate including fisheries, agriculture, tourism, rural development, and public works, along with a host of domestic and international development organizations. Rarely, do such actors see themselves as linked together, let alone sharing responsibilities for stewardship of vital national resource. Owiti (2006) further noted that any progress towards sustainable management of wetlands demands a systematic and holistic perspective because wetlands tends to defy boundaries. Since wetlands do not lie within the domain of any agency dealing with management; then they are classied as both privately and publicly owned; and their extent fluctuates seasonaly. Furthermore, decisions on resource use within the system directly or indirectly impact on other parts, sometimes in multifaceted ways.

2.5. Wetland functions and importance

The rationale for wetland conservation and sustainable utilization is based on the following unique services and benefits to humans and other life forms associated with them:

Carbon Storage: Wetlands play a distinct role in carbon sequestration and storage. Through the process of photosynthesis, the wetland vegetation uses carbon from the atmosphere and converts it into plant biomass. Davis 1993)

Improvement of water quality: Wetlands can help improve the quality of water by eliminating nutrients, organic matter, and sediments that are carried by runoff and breaking down organic waste. The vegetation on wetlands, absorbs nutrients and toxic substances thereby improving water quality downstream. The biological processes and Plants present in wetlands breakdown and convert these pollutants into less harmful substances. Many chemical, fertilizers, human and household wastes, and toxic compounds are tied to sediment and trapped in wetlands, (Krhoda, 1992).

Prevention of Saline water Intrusion: Wetlands are play a key role in maintaining buffer zone between freshwater and saline water. The destruction of wetlands due to over-extraction or drainage reduces the influx of freshwater and hence increases the intrusion of saline water.

Intrusion of saline water deprives people, agriculture, industry, and ecological communities of valuable freshwater (Goodwin, 1974).

Wetland Soil and Mineral Products: Wetlands are major sources of clay products such as bricks and ceramics. They are also essential sources of minerals such as sand and salt. (Goodwin, 1974). Types of soils within wetlands include:

Hydric soils: formed under conditions of saturation long enough to develop anaerobic conditions.

Mineral soils: less than 20-35% organic matter.
Organic soils have a specific definition dependent upon degree of saturation and soil texture.
Organic soils differ from mineral soils in these categories:

Bulk destiny and porosity (lower bulk density)
Hydraulic conductivity (depends on degree of decomposition)
Nutrient availability (more nutrients are tied up in unavailable organic forms)
Cation exchange capacity (greater cation exchange capacity)

Mineral Wetland Soils- Flooded mineral soils develop *redoximorphic* features. These are caused by the reduction, translocation and/or oxidation of iron and manganese oxides. Redoximorphic features are developed by biological processes. Also required are sustained anoxia, soil temperatures above 5^{o}C, and organic matter to serve as a microbial substrate.

Wildlife products: Wetlands provide a number of wildlife resources and products. These include reptile skins and ornamental (aquarium) fish. Many communities are increasingly harvesting these resources illegally to enhance and improve their livelihoods (Pargal *et al.*, 1999).

Natural Plant Products: Wetland plants are harvested to provide materials for construction and thatching, the cottage industry, canoes, fishing baskets and traps. Wetland plants are also used for medicinal purposes and as a food source.

Flood Control and Erosion Prevention: Wetlands act as a storage (reservoirs) for excess amount of water during heavy rainfall, hence ensures flood control and prevents soil erosion.

They also control flooding downstream by retaining water and releasing it during drier periods through evaporation. Wetlands vegetation too, slows down the flow of floodwater resulting in silt and sediment retention and riverbank protection (Gatiiyo, 2008).

Increased groundwater availability: Wetlands discharge and recharge both surface and ground water resources respectively. Due to impeded drainage, it allows the water to stay in one place long enough to maximize infiltration, enhancing recharge of groundwater and aquifers (Krhoda, 1992). Excess water in wetlands and aquifers discharges into springs, rivers and other water bodies. Aquifers also plays a complementary role by recharging wetlands during dry spell. In Ipswich River basin of Massachusetts, for example the U.S Geological survey found that marshes and swamps functioned not only as water storage and discharge areas but also occasionally as ground water recharge areas (Goodwin, 1974)

Natural habitat: Wetlands are natural habitats for variety of flora and fauna, some of which are of conservation significance, including endemic, migratory and endangered bird species like the waterfowl. Wetlands also acts as in-situ banks for genetic resources (Ramsar, 1996).

2.6. Wetlands products

Wetlands provide people with food, fibre and medicine. They sustain commercial and artisanal fisheries in many areas. Their importance as fish nursery grounds provide a consistent food supply and provides shelter and nursery ground for both marine and freshwater species. Annual fish and seafood production in wetlands and marshes worldwide has been estimated at an average of nine tons per square kilometer, 259 hectares or 640 acres (Ramsar, 1996) Wetlands provides energy in various forms, the most common being hydro-power generation and plant biomass. Several hydroelectric power plants like the Sondu-Miriu and Turkwel dam have been constructed on the upper ridges of Kerio and Sondu-Miriu rivers. Reeds such as papyrus and phragmites are harvested and dried to provide a source of fuel.

Wetlands also provides a number of wildlife resources and products. These include; ornamental fish, reptile's skin. Many local communities living around these wetlands earn a living by harvesting these resources to provide materials for construction: The grass harvested used in cottage industries for thatching, making fish baskets and traps (Gichuki, 2001). Wetlands also provide variety of plant species, some of which are medicinal and

others are source of food. The plant species acts as habitat for variety of animals but rely on regular watering to survive.

2.7.Legal framework on wetland management in Kenya

2.7.1. The Constitution (2010)

The new constitution specifically addresses the issues of the environment going so far as to allow individuals to seek legal redress if their environmental rights are infringed. Moreover, Article 69outlines the obligations of the government in respect to environment, asserting that:

"The State shall ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources and ensure the equitable sharing of the accruing benefits."

As documented by (Lopez, 2002); (Mwakubo *et al.*, 2005) and GoK, (2008) Kenya pursued a sectoral approach to conservation and development in the past, which has not addressed the crosscutting environmental and conservation issues and this has led to intersect oral inconsistencies leading to further loss of the country's natural resources including wetlands.

2.7.2. Environmental Management and Coordination (Wetlands, River Banks, Lake shores and SeaShore Management) Regulations,2009.

On the management of wetlands and wetland resources, the regulation aims at providing framework for public participation in the management of wetlands. It further outlines certain principles to be applied to ensure sustainable utilization and management of wetland resources. One of the principles is about public participation in the management of wetlands. It also mandates the County Environment Committee to assist the communities in the conservation and sustainable utilization of the resources and services for ecological, aesthetic and socio- economic purposes. In addition, the country has laws and policies that seek to address the conservation and wise use of wetlands, which include the Environmental Management and Coordination Act (EMCA) of 1999, (GoK, 2008 and Odote *et al*., 2008), Wildlife (Conservation and management) Act, 2009 and the (Water Act, 2012).

2.7.3. Draft Wetlands Policy, 2008

The draft seeks to encourage communal ownership of wetlands so as to promote conservation and management of wetlands. It plans to incorporate into decision making, the indigenous knowledge as a way of encouraging research, education and awareness. It also aims at encouraging sustainable use of wetland resources by communities in order to improve the livelihoods of all communities who depend on wetlands. In its policy statement number 4, the policy encourages development of stakeholder management plan for wetlands with clearly defined management regimes entered on local community participation.

The Government of Kenya has made significant strides towards the formulation of this policy and supported the developmentof the Kenya Wetlands Atlas (2012, which maps the country's wetland resources. A master plan for the conservation and sustainable management of water catchment areas in kenya has also been developed to guide practical and transformative actions for the sustainable management of these complex ecosystems. According to UNDP (2012) a nationwide inventory of wetlands to take stock of the resources, challenges and opportunities for their sustainable development and management is on-going. This policy also fulfills the aspirations of the Constitution, Kenya's vision 2030, the National Land Policy and the draft Environment Policy, 2013.

Wetlands contribute directly and indirectly to the national economy through: provisioning, cultural, supporting and regulatory services. Despite all these services wetlands offers, they continue to face a myriad of challenges including reclamation and encroachment for agricultural activities, settlements and industrial development, invasive and alien species, pollution and eutrrophication. Other key challenges include; ownership of wetlands, inadequate resources, overlapping institutional mandates, inadequate linkage between research , planning and policy development.

2.7.4. The Water Act 2012

This Water Act provides for the management, conservation, use and control of water resources for acquisition and regulation of rights to use water. It addresses the issues of control, ownership and the use of water resources and it also provide for the protection of water catchment areas. It also creates institutional structure that is useful for the management of all wetland resources in the country. The Act provides mechanism and facilitates for

enabling the public and communities to participate in managing the water resources within each catchment area (GoK, 2012). According to GoK (2012),water resources management reforms are based on consultation. Urban areas provide an ideal institutional structure for community engagement, representing an organized infrastructure to supply water and sanitation services, provide incentives for water use efficiency, as well as consider the environment in water solutions.

2.7.5. Sessional paper No. 6 of 1999

This sessional paper elucidates the connection between environment and development and also highlights the key environmental challenges. This paper also provides priority for action, implementation strategies and capacity building. It states that the overall goal is to integrate environmental concerns into the national planning and management processes and provide guidance for environmentally, economically and socially sustainable development (GoK, 1999).

According to sessional paper No.6 1999, Kenya strives to move along the path of sustainable development tomeet the needs of the present generation without comprimising the ability of the resource base to meet those of the future generations. However, the development process in the country is at the stage at which land use practices such as ranching, tourism, agriculture, wildlife management, forestry, water conservation, mining, manufacturing, human settlements, and infrastructure development are always conflicting. Therefore, the government developed this sessional paper by pointing out comprehensive legal guidelines towards achieving sustainable development.

2.8. International Treaties and Conventions on Wetland

2.8.1. Ramsar Convention on Wetlands of International Importance

The Ramsar Convention places upon its parties three primary obligations, which are sometimes referred to as the pillars of Ramsar: employing the “wise use” approach to wetlands; designating and conserving at least one site as a Wetland of International Importance; and international co-orparation. The wise use provisions mean that wetlands should be managed through ecosystem-based approaches at the landscape/seascape scale, with often the watershed (catchment) forming the basis for implementation (Gardner and Davidson, 2011). Special attention should be paid to integrating wetland management with

coastal zone and river basin plains. The parties should strive to maintain the ecological functions of individual sites, and the Ramsar community recognizes that effective wetland management requires an interdisciplinary effort involving biology, law, economics and policy and social sciences. The involvement of local communities is also critical to the wise use of a site, whether the community uses the site itself or surrounding areas.

The need and potential for an international governmental agreement on wetlands was recognized in the early 1960s by a number of non-governmental organizations, governments and water bird ecologists, in the face of increasing concerns about losses of wetland habitat and associated declines in waterfowl populations. After over eight years of discussions, meetings and negotiations, in 1971 governmental representatives from 18 countries with observers from other countries, Inter-governmental organizations, (IGOs), and Non-Governmental Organizations, (NGOs) met in the Iranian city of Ramsar.

2.8.2. The United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC, 1992) requires parties to take climate change considerations into account, to the extent feasible. It emphasizes on the need of incorporating the consideration in relevant social, economic and environmental policies and actions and encourage the employment of appropriate methods, for example impact assessments to be formulated and determined nationally, with a view of minimizing adverse effects on the economy, public health and the quality of the environment. Wetlands including Ondiri wetland play a significant role in micro-climate for they store carbon that is related to climate change. It also act as strong water storage systems during dry-season.

2.9. Sustainable wetland utilization and management

Sustainable development was defined in "Our Common Future" in the Brundland report of the World Commission on Environment and Development (WCED, 1987) as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". Subsequently, many authors have used the term sustainable development for specific development activities like sustainable agriculture, sustainable forestry, and sustainable energy development among others (Vishnudas *et al*., 2008). A single development may be considered successful if it is weighed against its specific

performance criteria (Vishnudas *et al*., 2008). To attain sustainability, an integrated approach is essential as all different aspects of development should be considered simultaneously.

Sustainable Wetland Management (SWM) is defined as a management of a wetland system with sustainable technology options, which ensures the sustainability of its ecosystem functioning and contribution to livelihoods to conserve natural resources, with adequate institutional and economic options. To achieve this, the four main elements: natural resources, technology, institution and economies should be considered. The study adopted a framework used by Vishnudas *et al*., (2008) to analyze sustainable watershed management projects. Their framework helps in understanding the different aspects and elements of sustainable management and their interactions. They explained that for a watershed project to be sustainable, four groups of criteria should be considered related to natural resources, technology, institutions and economics respectively.

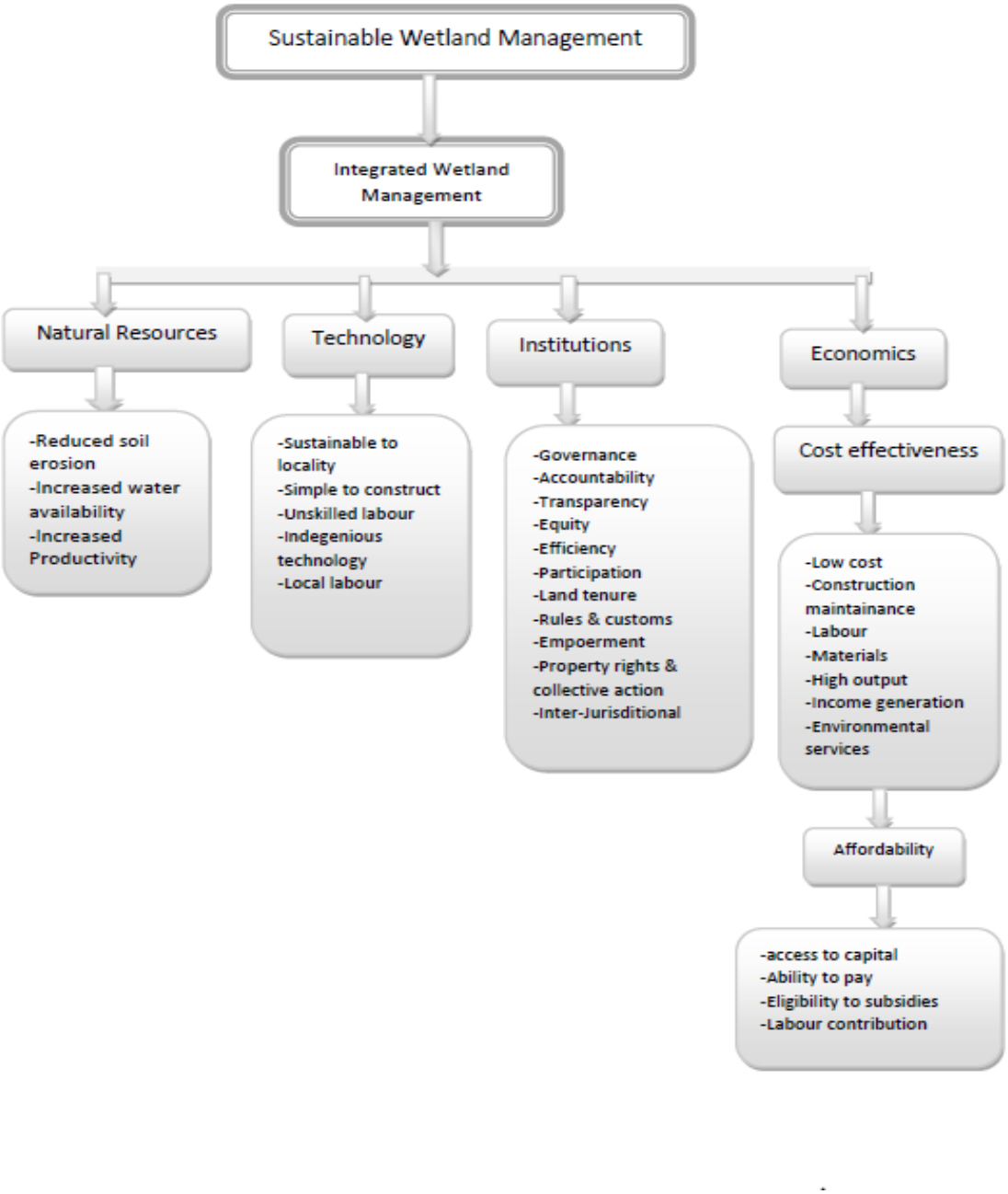
2.9.1. Some principles of sustainable wetland utilization include:

Collaborative and participatory approach: An integrated approach to wetland conservation and management should involve stakeholders at all levels including; local community, government, civil society and the private sector.

Wise use: Wetlands contribute significantly to the health and well-being of people and are an important element of Kenya's natural biodiversity; as such they should be integrated into national economic planning for sustainable development, wealth creation and environmental management.Vishnudas *et al*., (2008) through this you ensure they are utilized sustainably for the present and future generation.

Precautionary principle: Where information is adequate for decision-making, the pre-cautionary principle will apply. Lack of full scientific certainty should not prevent implementation of measures to minimize/ manage wetland degradation

The global dimension: The global dimension of environmental impacts of actions and policies should be recognized and considered. It is through this, that the World recognizes 2nd February of each year as World Wetlands Day, (WWD).



Source: Adopted from (Vishnudas *et al*., 2008)

Figure 2- 1: sustainable wetland management approach framework

2.9.1.1 Natural resources

The available natural resources in Ondiri swamp are; water, biodiversity and soil. According to figure (2.1), these natural resources should be protected from degradation and maintained for good production by reducing soil erosion, increasing water availability and increasing biomass production.

2.9.1.2. Technologies

Within one area, there may exist different resource types and people usually make use of them alongside each other, for example in a wetland there can be cultivation of crops, irrigation, grazing livestock, fishing, aquaculture, papyrus harvesting at different levels with varying benefits for the local community (Kinaro, 2008). Utilization and conservation of these resources should be a simultaneous process for sustainability to be attained. Technology used for conservations measures should be cost-effective.

2.9.1.3. Institutions

Integrated wetland management is not merely limited to water, soil and biomass, but also concerned with integration for self-reliance and holistic development of the rural poor. In operational context, this would mean integrating different uses and management of resources, different departments with sectoral interests through inter disciplinary approaches and towards alleviation of poverty (Mollinga, 2000). The main stakeholders involved are; internal agencies (Self-help groups, user groups or watershed communities) and external agencies (Government, NGOs, researchers, local administration and politicians). All these actors should be actively involved in the management of the wetland.

2.9.1.4. Economics

Conservation of the wetland resources requires ideal measures. Any new technique or measures proposed for soil, water and biodiversity conservation must be economically viable, otherwise the people will not accept it and it will be doomed to fail. As illustrated in the SWM framework, components of this element are: maintenance and construction costs, labour costs, price of materials, the value of output, income generation, and access to capital, ability to pay, and the cost of labour contribution. In relation to this, sustainability can only be achieved if all these components are considered. This will determine the conservation measures put in place are cost-effective and affordable to the people.

2.10. Theoretical framework

The theoretical framework is based on the Ecosystem Approach Theory regarding wetland management. It is anchored in the (Convention on Biological Diversity, 2010) which explains that the ecosystem approach is a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. It was first applied in a policy context at the Earth Summit in Rio de Janeiro in 1992, where it was

adopted as an underpinning concept of the Convention on Biological Diversity. It has evolved to become a fundamental element of environmental policy.

In his view, Shepherd (2004) highlights that ecosystem approach is not a set of guidelines for the management of various ecosystems, but a framework for thinking ecologically that results in actions that are based on holistic decision-making. It incorporates all the stakeholders involved in the wetland management. Ecosystem approach exhibits a holistic interdisciplinary perspective and this places wetlands centrally in the implementation of the ecosystem approach. Linkages between society and the natural environment on the one hand, and environmental management on the other, should be made explicit in order to achieve sustainable use and management of wetlands that is valuable for, and valued by, society as a whole (Hahn *et al.,* 2006). The connection should be realized by way of the roles wetlands have in the water cycle, ecosystem functioning, spatial relationships and government policies and fit into management of water resources, use and conservation of wetland resources, connectivity and vulnerability in the landscape, social significance and the economic values of wetlands in providing ecosystem services. Environment and society interrelate and priority concerns of society, linking natural and social science thereby achieving good management of the ecosystems as illustrated in (figure, 2.2).

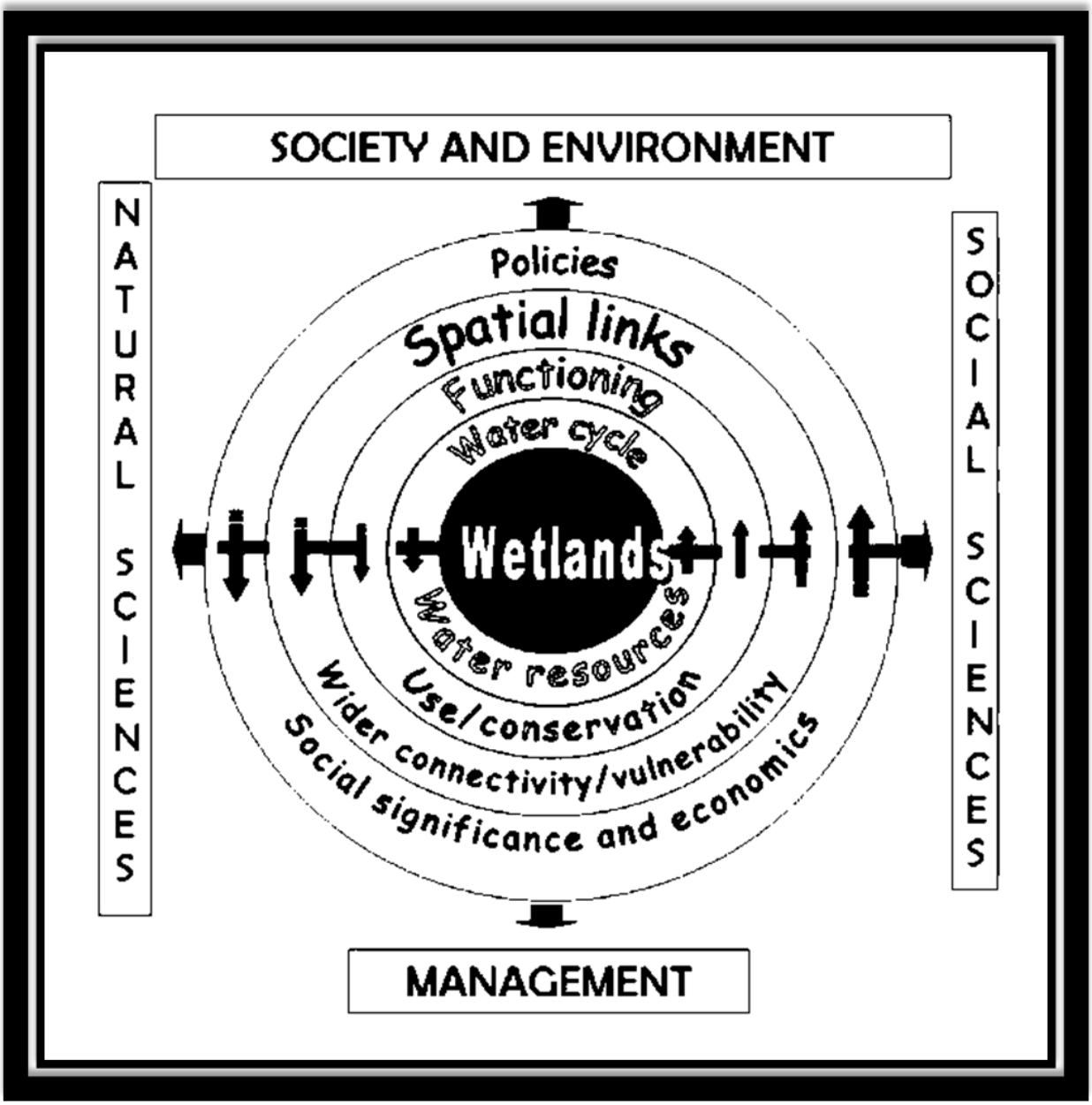


Figure 2- 2Theoretical model- Multidisciplinary perspective of the priority concerns of society, linking natural and social sciences. Adopted from: (Maltby, 2009

2.11. Conceptual framework

The conceptual framework tries to weave together relationships that the study believes are crucial for the improvement of community participation in the co-management of wetlands. The status of today's wetlands, including those considered to be most pristine and are as a result of complex interactions among them: physical, biological, and human sources over time. Virtually all of the earth's wetlands have been influenced and altered by patterns of more or less intense human use (Gawler, 2000). There is growing awareness that, in areas where indigenous and traditional people live, and have done so for hundreds of years, the

authority for resource and ecosystem management must be devolved as much as possible to the local level (Claridge *et al.*, 1997).

It is hinged on the fact thatt for any community based wetland management program to be successful; it has to put into consideration the following variables: the community, community livelihood benefits, attitudes and practices. This will ultimately result in improved wetland conservation. However, this will depend on the social, economic, political and institutional factors that are in place. It presupposes that effective community participation in wetland management will bring about; community's livelihoods that are likely to change in terms of improvement in income, increase in the quantity and quality of wetland resources, enhancement of social capital, and improvement in human capacity. With improvement in the community's livelihoods, the attitudes and practices of the community members is likely to shift from negative environment attitudes to positive environment attitudes hence resulting to an improved wetland status, which is indicated by increased water level, improved biodiversity (plants/flora and fauna/ animals) leading to wetland conservation. The social, economic, political and institutional factors may also influence wetland conservation.

Community participation on wetland management and conservation

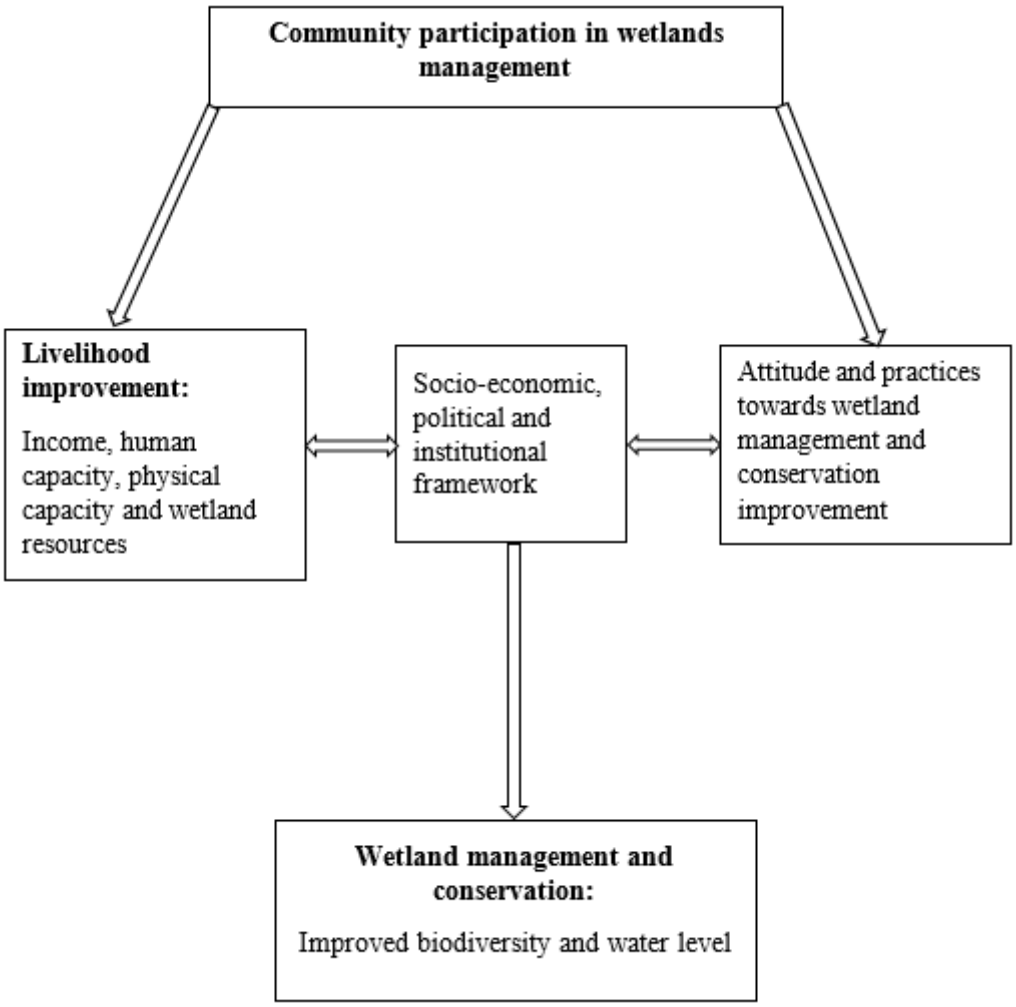


Figure 2- 3: Conceptual model Source: **Adopted from Berkes *et al.*, 1991**

Community involvement is therefore, essential for those attempting to ensure sustainable management of wetland resources to understand that the involved 'community' is not generally restricted to a particular user group. Management of wetland resources seldom takes the form of rational control by one or even more groups. In practice, it is generally better understood as a process in which a variety of groups is struggling for access to, or control of, different wetland resources. Different groups are often interested in quite different aspects of wetlands (Mermet, 1990)

"Special attention needs to be given to the local population who will be the first to benefit from improved management. Devolution of control over resources from central government to local structures may be in critical element in the success of approaches to wise use, and ways of achieving this need to be examined in all field projects." (Davis, 1993)

CHAPTER THREE

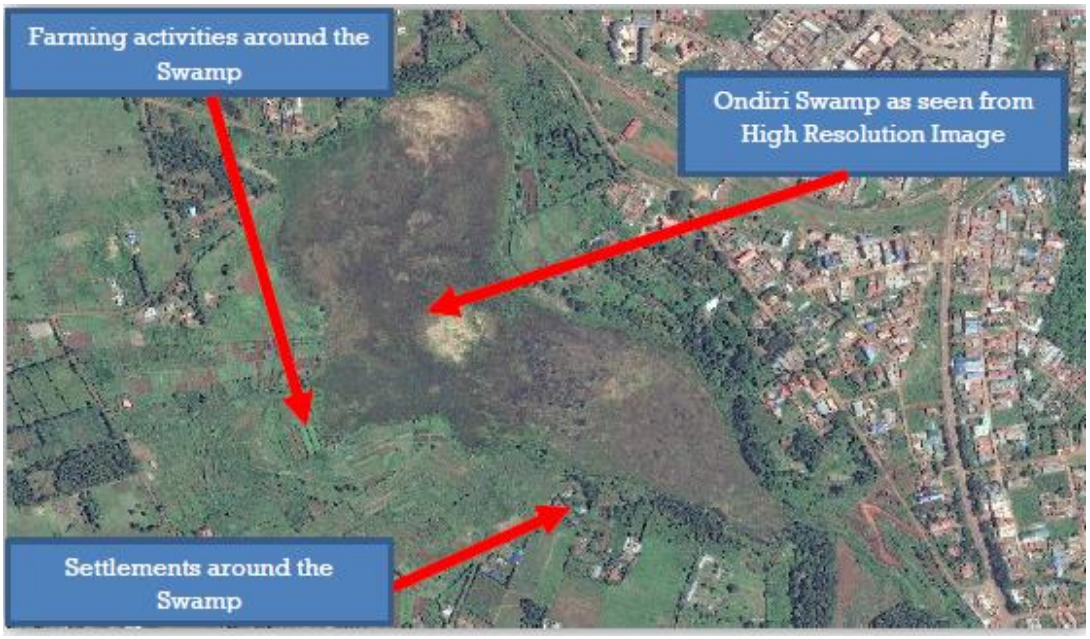
THE STUDY AREA

3.1. Introduction

The study was carried out in Ondiri swamp in Kiambu County. This chapter provides a brief description of the study area to enhance deeper understanding of the geographical area, attributed by geographic location, physiological features, climate, biodiversity, population, soils and drainage.

3.2. Geographical location

Ondiri swamp is found in Kikuyu division of Kiambu County. The division is bordered by Limuru to the North, Kajiado to the west and southern region. The wetland lies $1^0$15'S and Longitude 36^0 38'E and is one kilometer down the slope from Kikuyu township. Ondiri swamp covers an area of approximately 30ha with a perimeter of about 3.3km and it is the second deepest wetland in Africa and the largest quaking bog in East Africa (FOWCON, 2009). Plate 1 indicates the activities taking place around the swamp and its environs.

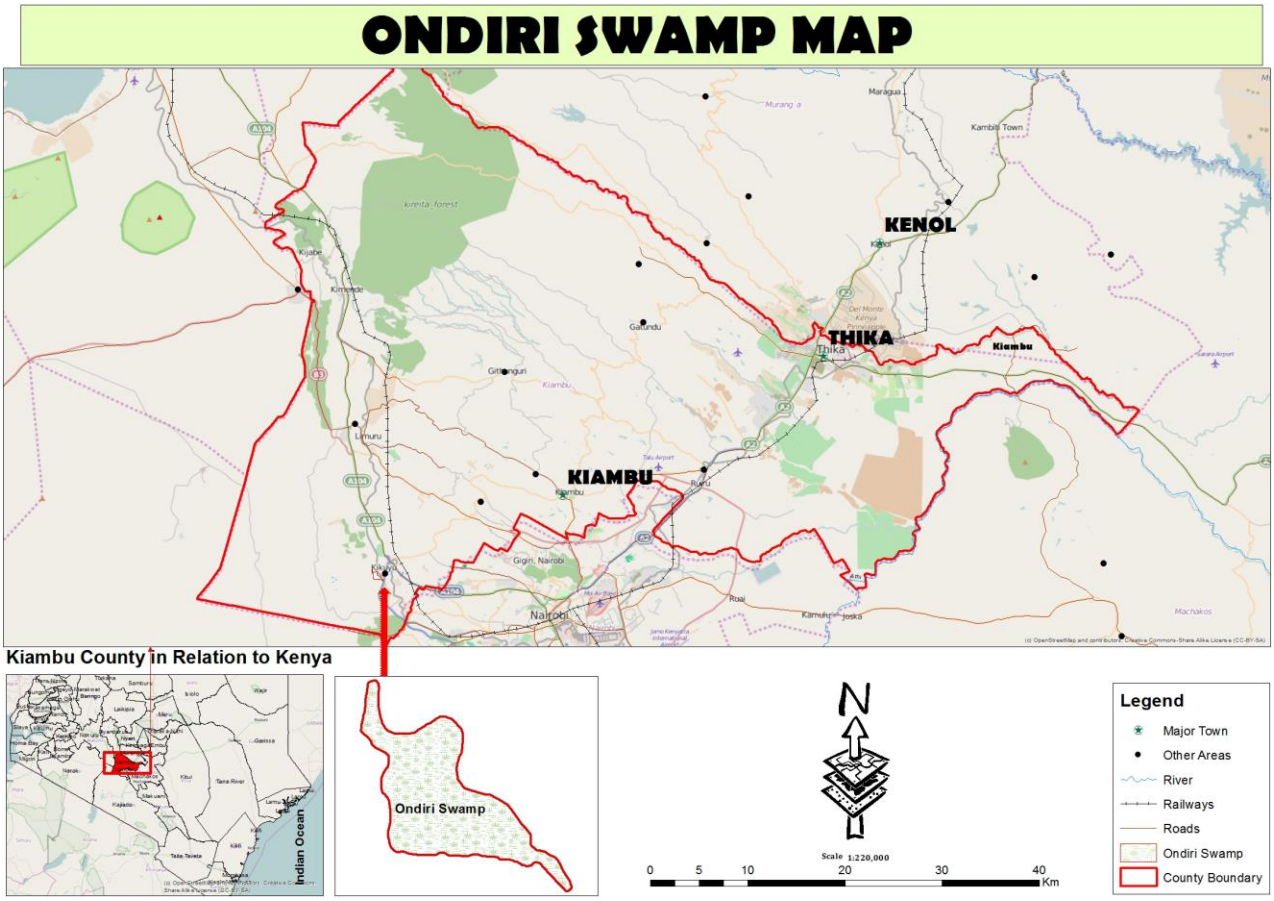


Source: Ramani Geosystems: aerial imagery, 2015

Plate 3- 1: Ondiri Swamp

It is one of the few remaining quacking bogs that is located at the foot of Aberdare ranges in the central part of Kenya. Ondiri wetland is a shared resource drawing interest from various stakeholders, which include government agencies, private developers, farmers, schools and local authorities.

Ondiri swamp being one kilometer away from Kikuyu Township, it faces human encroachment. The swamp is surrounded by both urban and rural settlements. Figure (3.1) indicates the location of the Ondiri swamp on the topographical map.



Source: Researcher 2015. Generated using ArcGIS 10.3

Figure 3- 1: Location of Ondiri swamp

3.3. Physiological features

Kikuyu ward, where Ondiri wetland is located, is characterised by hills, plateau and high-level structural plains. Ondiri wetland is 1800m above sea level at the foot of Kikuyu escarpments which is 2kms west of the Ondiri wetland. Ondiri wetland forms the headwaters of Nairobi river, which is a tributary of the Athi River. The swamp formed as a result of tectonic depression as is common on the lower slopes of Nyandarua-Aberdare ranges (Gichuki, 1998).The depression where the swamp occupies was formed due to reversed faulting during or after the formation of the Rift Valley (Nyamweru, 1992)

3.4. Climate

Altitude is the major factor influencing climate around Ondiri. The temperature in the County is on average 26^0C and ranges between 20.4^0C in the upper highlands to 34^0C in the lower

midland of Karai. The months of July and August have the lowest temperatures, whereas January to March is the hottest period. The rainfall regime of the area is bimodal and relaible. The long rains occur between April to May, approximately 1500mm per annum and short rains in october through to November. The driest months are January, February,July and August (Ogondo, 2008).

3.5. Soils and land use

In most places, thick mantles of soils consist of well drained podsals and andesols. The soils are developed of undifferentiated tertiary volcanic and basic igneous rocks. They are well drained, shallow and dark reddish brown although in some places they are imperfectly drained and are characterized by dark to black soils especially in valley bottoms. Soil nutrients in the area support a wide range of crops such as cabbages, tomatoes, spinach, kales and carrots and besides all this dairy farming is prominent. There is continous supply of water for irrigation from the wetland that ensure farming goes on throughout the year. The wetland is also known to have peat soils. These soils are both static influence on holding water and dynamics of transmission and sedimentation of water. Soil substrate is harvested and used by Kenya Research Institute (KARI) for research purposes in their plant nursaries (Muhati, 2005).

The current land use around the wetland is a mix between residential plots, small gardens, some small scale farms and exotic vegetation. As such, land is very important. The land is divided into small portions on which permanent or semi-permanent residential structures are erected. This is attributed to the fact that residential houses have a higher return compared to small-scale agriculture. The management of Ondiri wetland and its watershed appears to be closely linked to the daily activities and welfare of the local people. This is because of gradual shift from animal keeping to horticulture. Residential and commercial buildings, with the associated infrastructure of roads, sanitation and pavements have steadily increased since 1990s, with growing human population, increases in water use, generation of waste material and intensification of land use is expected (Hardin, 1968)

3.6. Biodiversity

The wetland supports the existence of a diverse and rich assemblage of biodiversity. It has a diverse community of herbaceous aquatic plants and various animal species. Sixty eight plant species and seventy-four bird species have been recorded in the wetland. Some bird species

include: (cattle egret) *Bubulcus ibis*, (Africa sacred ibis) *Threskiornis aethiopicus*, (hadada ibis) *Bostrychia hagedash* and (Africa marsh harrier) *Circus ranivorus*. Small mammals, reptiles and amphibians have also been recorded. Small mammals include otters, frogs and several invertebrates such as water bettles, water skaters and cray fish. There are also few fish within the wetland ecosystem though in small population (Gichuki, 1998). It shelters diverse species of plants, insects, amphibians, reptiles, birds, fish, and mammals. Frogs, fish, snakes and other insects depends on this wetland as their home and breeding ground. On vegetation the wetland of Ondiri is dominated by Echinochloa, Phyragmites, Typha and Microphytes (Macharia and Thenya, 2007b). These plant species have evolved physiological and morphological attributes to allow them either grow as emergent within the littoral zone, submerged below the water surface or as free floating vegetation mainly sedges and grass. The grass and reeds in the wetland have high trapping effects for sediments and water pollutants and therefore act as accumulation site for incoming sediments. During the rainy season, the wetland receives both natural and anthropogenic waste from the surrounding areas. These not only include plain silt but also a wide range of agro-industrial chemicals. During the dry season, residents indiscriminately harvest this vegetation mainly for sale as fodder (Gatiiyo, 2008).

3.7. Population

Ondiri wetland is located in an area where there is high population density with current figures putting it at about 500persons per km^2. The population of Kikuyu some years back was 130,370 persons and 135,459 male and female respectively giving a total of 265,829 in the year 2009 National population census (GoK, 2010). The area around the wetland has one of the fast growing populations in Kiambu as a result of urban influence of Kikuyu town, presence of steel rolling, milk procesing and garment making factories which attracts immigrant workers. The rapid growth in human population and unchecked human activities in the area has raised pressure on Ondiri wetland to the extent of threatening the long term management of the wetland as a source of goods and a powerhouse for ecosystem services (Crafter, 1992).

3.8. Drainage system

The Ondiri swamp is part of the Lari-Ondiri fault drainage system. River Nyongara is one of the four rivers whose source is Ondiri wetland. It is also believed that the wetland is the source of four underground streams: Mbagathi, Kabuthi, Kikuyu springs and Rungiri. The

main direction of outflow of the wetland is to the south and east where several small streams join downstream to form larger streams that make the headwaters of Nairobi River. The water body is linked to Kikuyu springs, which lies to its east through a sub-terranean passage. The spring is a major source of Nairobi's water throughout the year and it is under a 24-hour guard from the Administartion Police. Together with other streams that emanates from Ondiri wetland and elsewhere, it forms a significant catchment for Nairobi River.

The south of Ondiri wetland forms the headwaters of Athi River. After passing underground through Thogoto forest, it resurfaces at Karinde near Karen Estate, where locals refer to it as Gitwe Kia Mbagathi (headwater of Mbagathi). To the southeast, the water from Ondiri forms the Nyongara River, which passes through highly populated areas such as Thogoto, Dagoretti market, Withaka, Uthiru and Kawangware, finally joining the Nairobi River at Waithaka. These areas are mainly inhabited by low-income people and if the wetland is to be well managed, the residents of these areas would greately benefit from the water.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1. Introduction

This chapter describes the methods which were employed in the study. These methods and procedures were relevant and reliable towards attaining the set research objectives and goals.

4.2. Research design

The research design adopted both qualitative and quantitative research methods. The quantitative approach relied on questionnaire and relevant documents while qualitative approach relied on interview schedule.

4.3. Sources of data collection

4.3.1. Primary data

Primary data was collected through questionnaires and semi structured interview schedules. Self-administered questionnaires were administered to households with the target being household heads. In the case where the head of the family was not available, the immediate person in the family was considered provided that he/she has attained over 18yrs of age. Data collected from the households was on household general characteristics, stakeholder's wetland utilization, site conservation efforts, stakeholder's role and responsibility. The key informants were asked questions that required attention and clarity on some issues that were not fully addressed that related to wetland utilization and community involvement. This was achieved by key informant interview guide that targeted six key informants around the swamp. Key informants in my study were very helpful in getting some first-hand information on the utilization and management of the Ondiri swamp.

4.3.2. Secondary data

Secondary data was acquired from the central government agencies and from the relevant literature. Data on soils, hydrology and climate was obtained from the State of Environment report for the County in NEMA office. Data on the demographic characteristics of the area was obtained from the Kenya National Bureau of Statistics whereas relevant reports on community involvement in the conservation of Ondiri wetland was obtained from Friends of Ondiri offices.

4.4. Target population

The population from which the sample was drawn consisted of household residents in four recognized villages of Kikuyu ward that were bordering the swamp and were less than 200 metres namely: Kidfarmaco, Ondiri, Kikuyu Township and Jadi.

Selected villages in Kikuyu Ward bordering Ondiri swamp		
Villages	**No. of Households**	**Sampled Households**
Kikuyu township	1230	28
Jadi	53	2
Ondiri	428	10
Kidfarmaco	2525	58
TOTAL	**4236**	**98**

Table 4- 1: Sample distribution of each village *Source (KNBS, 2010)*

All the interviewees of this study were drawn from the Ondiri area and were beneficiaries of the swamp direcly or indirectly. The locals from the villages surrounding the swamp were targeted to give information on community participation on the wetland conservation.

4.5. Sampling designs

For the purpose of this study, the researcher used probability sampling to carry out the study. Simple random sampling was used because it was highly representative of the population and would eliminate bias that arose during data collection. Stratified sampling was also used in the study, where the area was stratified into four thematic areas within which data collection was randomized. These areas were: Kikuyu Township, Kidfarmaco, Ondiri and Jadi. Ondiri village had 428 households with population of 1,511 Jadi had 53 households with population of 197 and Kidfarmaco had 2,525 households with a population of 8,229 and Kikuyu Township had 1,230 households with a population of 3,559 (Kenya Census, 2010)

Sample size Computation

The study used a sample size of 98. This sample was divided among the four areas proportionally based on population and used in administering household questionnaire. The ninety eight (98) households were determined using (Nasuirma 2000) model. It is used to determine the sample size when you know the total population size.

Nasuirma model determined by:

$n= \{NC_v^2\}/ \{C_v^2+ (N-1) e^2\}$

Where: N = is the target population

n=Sample size

Cv = is coefficient of variation

e = is tolerance at desired level of confidence

(N) - in this case was 4236 for the four areas

For this study:

Cv = 0.5

e = 0.05.

Therefore: $n= \{NC_v^2\}/ \{C_v^2+ (N-1) e^2\}$

$n= 4{,}236 (0.5^2)/ 0.5^2+ (4{,}236-1) 0.05^2$

$n =1059 /10.84$

$n= 97.69$

The sample size therefore was (n) 98

To select the 98 respondents to be interviewed from the four villages, I obtained households list from the local chiefs of these villages, upon which I selected the respondents randomly.\

4.6. Methods of data collection

4.6.1. Questionnaire surveys

Questionnaires were prepared and administered as one of the tool to collect data so as to give an in-depth information. The information collected was divided into five (5) categories: This being, general information of the respondents, various stakeholders and wetland utilization, site conservation efforts by stakeholders, strategies put in place to guide utilization of the wetland and stakeholder's role and responsibility in sustainable utilization of the wetland.

4.6.2. Key informant interviews

The institutions that were interviewed include: Alliance school, National Environment Management Authority (NEMA), University of Nairobi Kikuyu Campus, Water Resources Management Authority (WRMA), Friends of Ondiri official and Kenya Forest Service (KFS)

4.7. Data analysis

To analyze qualitative data obtained from the field, a process of content analysis was adopted to analyze the content of interviews and questionnaires in order to identify the main themes that emerge from the respondents. The process involved: identification of the main themes from the responses while aligning them to the research objectives and questions; classifying the responses under each theme through analyzing all questionnaires; and integrating the themes and compiling the result into final write-up. Photographic materials from the field were analyzed by deducing information from them. The quantitative data collected was edited first for accuracy, consistency and completeness. The data was then coded and cross-tabulated to enable the responses to be statistically analyzed. Descriptive statistics was used to analyze data through frequencies, and percentages. The report findings were presented in form of graphs, pie charts and tables.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1. Introduction

This chapter discusses the data analysis, presentation and interpretation. The chapter is divided into four sections. The first section discusses the demographic characteristics of respondents according to age, level of education, and land ownership. The second section analyses the site conservation efforts, and third section discusses the strategies put into place to guide utilization and conservation of Ondiri swamp. The fourth section analyses the threats Ondiri swamp faces. The fifth section analyses sustainable approach framework for Ondiri.

5.2. Bio data of the interviewees

5.2.1 Age distribution on households sampled around Ondiri swamp

The research targeted household's head to be interviewed. From the research that was carried out, respondents with over 25 years old made 70.4%, with those below 25 years being small proportion of only 29.6%. In the age bracket majority were aged between 19-25 years 29.59% and 25.5% aged between 26-30years, 19.4% aged between 31-40yrs, 13.3% aged between 41-45% and 12.2% aged above 45 years (figure 5.1)

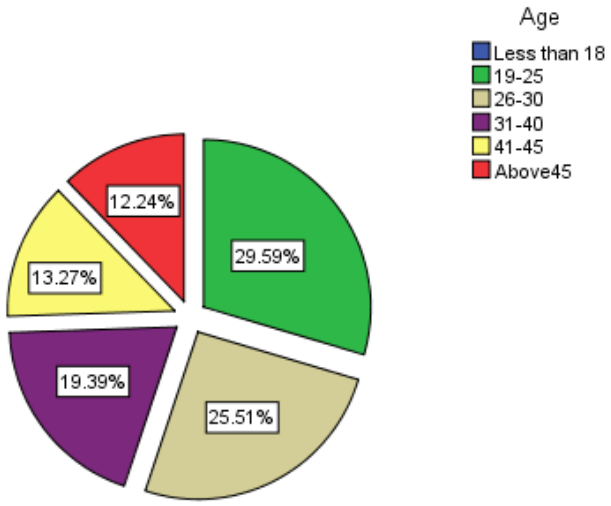


Figure 5- 1: Age distribution of Ondiri swamp respondents Source: Field survey, 2015

5.2.2 Literacy status

Literacy level is crucial as it affects diverse aspects of life, including knowledge, skills, practices and attitude. The distribution of the level of literacy of the area of study was analyzed (figure 5.2). From the pie chart, majority of community members again had achieved secondary level of education 43% indicating that the region had a satisfactory literacy level, followed by college 37%, primary and university level respectively.

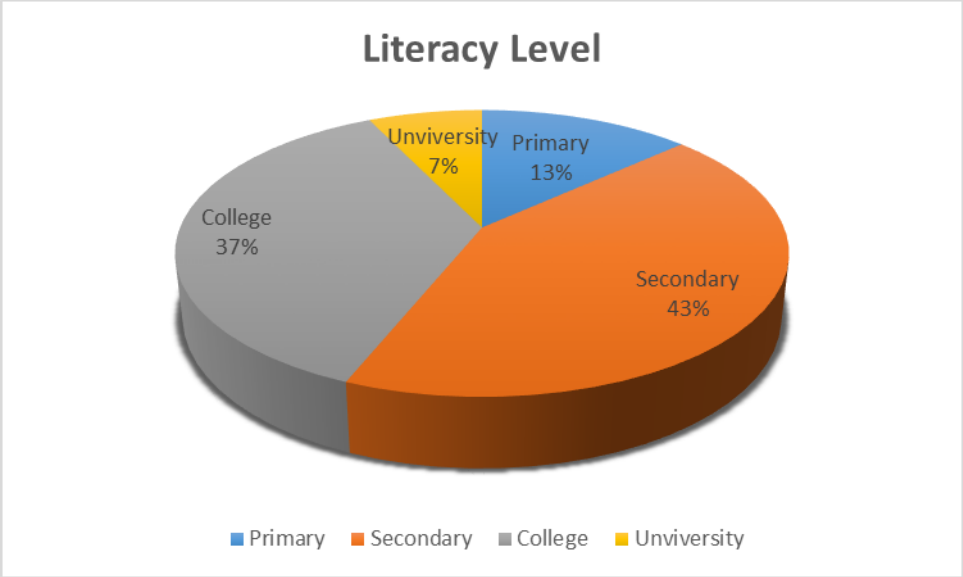


Figure 5- 2: Literacy status of the residents

Their high literacy level enabled them to participate and provide useful information through data collection instructions. They were also able to understand the importance of wetland conservation.

5.2.3 Land tenure

From the analysis of the questionnaires administered in the study, it was established that most respondents owned land under freehold (figure 5.3). According to this study, land tenure system was a factor hence, under freehold, the absolute ownership of the land is vested in an individual. From the interviewees' responses, 33% of the land around Ondiri swamp was freehold. Therefore, the land tenure system allowed for long term investments like tree planting. For instance, alliance school has a good scenic forest adjacent to the swamp although it is eucalyptus. Other landowners have put up commercial housing facilities while others have erected gabions to reduce soil erosion.

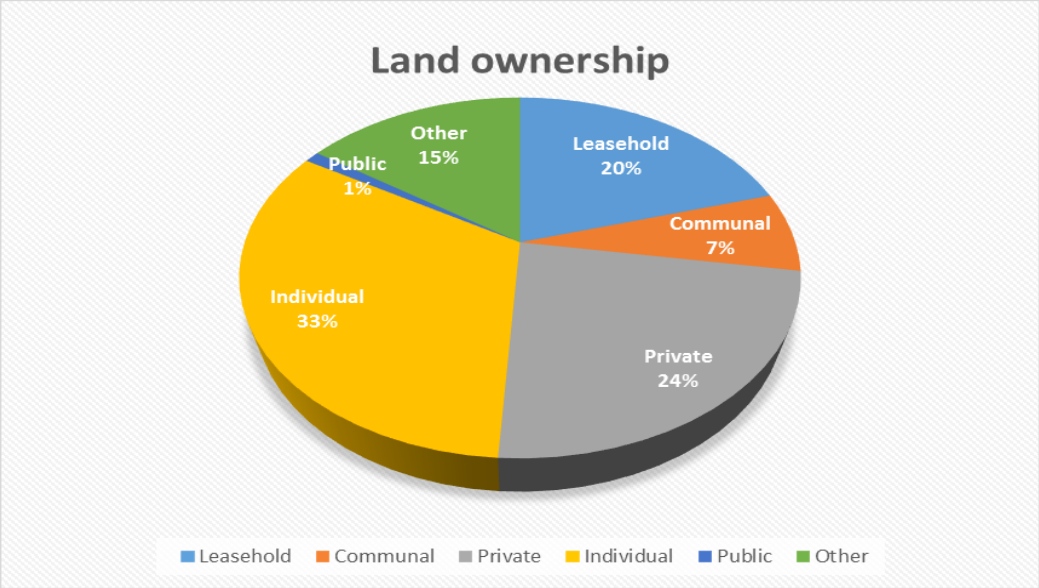


Figure 5- 3: Land ownership Source: **Field survey, 2015**

According to the survey carried out in Ondiri swamp, there were various stakeholders involved in resource utilization (table 5.1) Majority of the stakeholders involved in resource utilization at Ondiri swamp were local residents who utilized 40.8% of resources from Ondiri while 38.8% were the farmers who benefit from the swamp by abstraction of water for irrigation. These resources include: vegetables, grass, firewood and reeds.

Those involved in resource utilization		
	Frequency	Percent
NGOs	8	8.2
Local Residents	40	40.8
Local authority	3	3.1
Large/Small farmers	38	38.8
Other Stakeholders	9	9.2
Total	98	100

Table 5- 1: Stakeholders involved in resource utilization Source: Field survey, 2015

Local authority utilized 3.1% (table 5.1) by abstracting water that is piped to nearby schools, institutions and town residents. The local residents of Ondiri blamed the local authority for excessive water abstraction by farmers 71.4% (table 5.2). This was because the water

abstraction by farmers was not metered nor licensed, therefore, excessive abstraction endangering the wetland which is reducing its original size as time elapses. About thirty (30) pumps were recorded around the swamp that were owned by the farmers at the time of study, some of them being active and others have been abandoned due to malfunction and others were half submerged by the water due to siltation.

Resources extracted		
	Frequency	**Percent**
Animal feed	2	2
Firewood	2	2
Grass	14	14.3
Reeds	7	7.1
Vegetables	1	1
Water	70	71.4
Total	98	100

Table 5- 2: Resources extracted from Ondiri swamp Source: Field survey 2015

Ondiri wetland provides other numerous goods and services to the people and the environment at large. Table (5.2). Local residents are the direct beneficiaries of the resources extracted from the swamp. Water is the most valuable resource abstracted from the swamp which stands at 71.4%, grass is the second most extracted resource 14.3%, some use it to thatch their houses, mulch the nurseries and feed their livestock (table 5.2) All the villages interviewed use water from the swamp since they carry out farming and boarder the wetland which is the nearest source of water for them. Water is drawn from the swamp on a daily basis to irrigate their farms and greenhouses. Some farmers do large scale farming, especially vegetables for commercial purposes. Crops grown include: broccoli, kales, Chinese cabbage, tomatoes, spinach, bananas and arrow roots.


Plate 5- 1: Crops grown using water from Ondiri to irrigate the farms and greenhouses

5.3 Site conservation efforts

	Conservation efforts around Ondiri	Frequency	Percent
	Avoid harvesting	1	1
	Checking waste management	1	1
	Control resource use	2	2
	Cutting down eucalyptus	2	2
	Fencing the swamp	3	3.1
	Gabion building	12	12.2
	Making of roads	1	1
	Introducing metered pipes	2	2
	None	11	11.2
	Proper dumping of waste	1	1
	Protection of the swamp from intruders	2	2
	Restricting grass harvesting	1	1
	Site conservation	2	2
	Terracing	2	2
	Tree planting	54	55.1
	Waste collection	1	1
	Total	**98**	**100**

Table 5- 3: Conservation efforts practiced by stakeholders Source: Field survey, 2015

The people around Ondiri swamp have teamed up and formed groups that joined a CBO known as Friends of Ondiri to foresee that the swamp is well utilized. Some of the conservation efforts practiced around the swamp are analyzed in (table 5.3) According to the respondents, tree planting is the most practiced activity around the swamp (55.1). The farmers are also encouraged to plant indigenous trees and cut down the eucalyptus. The other common practice commonly practiced is gabion building (12.2%) due to extensive farming activities along the wetland banks. 11.2% of the respondents admitted that they were not aware of any conservation efforts taking place.

5.4 Strategies put to conserve and manage Ondiri wetland sustainably

5.4.1 Environmental education and awareness programs

The Ondiri community is involved in creation of awareness on the value of Ondiri wetland to the community members and the need for its protection. According to key stakeholders, community members are engaged in the awareness creation activities. This is done through workshops organized by Kenya Forest Service to train the community members on the need to conserve the wetland through tree planting exercise; periodic radio-talk shows by Nema through local stations/electronic media; during annual events like the World Wetlands Day (WWD) celebrations, schools are involved through essay writing on wetland topics. Sensitization is also undertaken through chief barazas. Environmental education and awareness is also done through value addition on wetland materials, marketing and sharing/lesson learning exchanges.

5.4.2 Participation in wetland conservation programs

It was established that most respondents participated in conservation activities of the wetland with 55.1% participating in wetland conservation activities whereas 44.9% did not participate in conservation activities (figure 5.4)

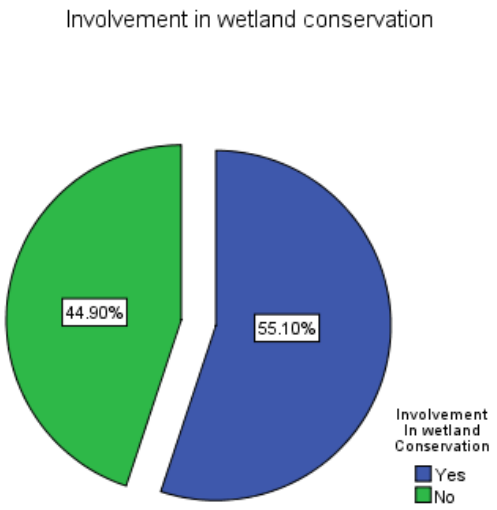


Plate 5- 2: Community participation in wetland management Source: Field survey, 2015.

Those who participated in the Ondiri wetland conservation efforts outlined public awareness, alternative livelihood improvement activities and wetland conservation strategies like preventing soil erosion, discouraging planting of eucalyptus and avoiding overgrazing as some forms of participation in the conservation of the wetland. The respondents who did not participate in the conservation efforts however attributed it to lack of information on the ongoing conservation activities.

Other respondents perceived it as a waste of time to be involved in wetland conservation because they have other businesses to attend to like work in their farms and private retail shops. In the process of undertaking wetland conservation activities, the respondents identified the following as the major challenges facing them in the course of carrying out wetland conservation activities. The majority, reported lack of cooperation 52 % among the members of the community, time constraints 2%, inadequate funds 1% and lack of awareness 2% as the major stumbling blocks to their efforts (table 5.4).

Reasons for not being involved in wetland conservation	**Frequency**	**Percent**
Lack of cooperation	51	52
Believe it is self-protected	3	3.1
Duration of stay is short	3	3.1
Engaged in other activities	1	1
Far from the area	1	1
Lack of awareness	2	2
Lack of proper guidelines	1	1
Lack of finances	1	1
Lack of income/incentives	1	1
No apparent reason	6	6.1
No benefit derived	2	2
There are organization allocated	1	1
No apparent reason	2	2
No time	2	2
Not approached	2	2
Not aware	2	2
Not contacted	10	10.2
Not my duty	4	4.1
Not owner of the swamp	2	2
Restriction by some people to access it	1	1
Total	**98**	**100**

Table 5- 4: Reasons why some people are not involved in conservation effort Source: Field survey, 2015

There are various strategies that were put in place by the stakeholders to ensure proper utilization of the wetland. Figure (5.5) highlights the responses from the interviewees. 80.61% of the respondents said that there are no strategies put in place, while 18.37% said there were strategies and 1.02% were not sure of any strategy. The researcher therefore, found that majority had no idea of whether there were strategies to govern utilization of the swamp.

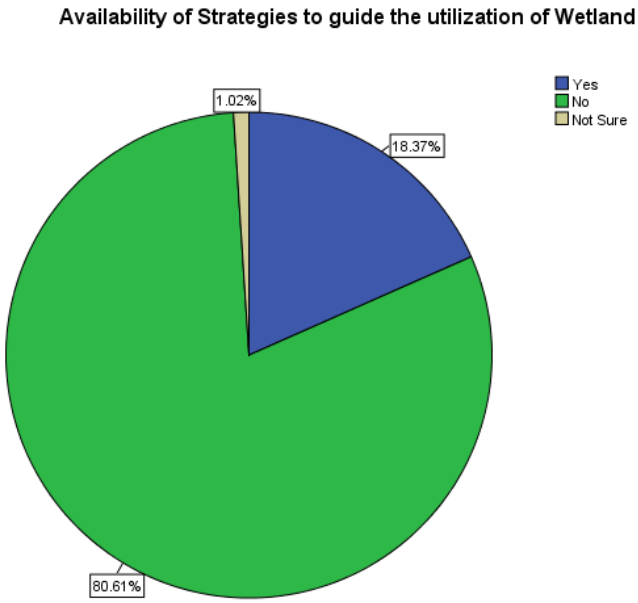


Figure 5- 4: Strategies put into place **Source: Field survey, 2015**

18.37% of the respondents who admitted that there were strategies put in place, emphasized that not all strategies were fully implemented due to problems of land ownership around the Ondiri wetland. Table (5.5) gives some of the major strategies applied in Ondiri wetland.

Name strategies put in place		
	Frequency	Percent
Building gabions	8	8.1
Clean up exercise	6	6.3
Conservation of papyrus reeds	6	6.1
Discourage eucalyptus planting	13	13.1
Educate on best way to use swamp	4	4.1
Ensure licensing of activities	3	3.0
Friends of Ondiri monitoring	9	9.2

Introducing management plan	3	3.1
Minimize over utilization	6	6.1
NEMA regulations	3	3.1
Public awareness on utilization	12	12.2
Regulating water abstraction	12	12.3
Restricting developers from encroachment	9	9.2
WRMA regulations	4	4.1
Total	**98**	**100.0**

Table 5- 5: Strategies put in place to conserve Ondiri swamp Source: Field survey, 2015

According to the research carried out, the most common strategy used to conserve the wetland was discouraging planting of eucalyptus trees 13.1% (table 5.5). Farmers who had planted eucalyptus trees were advised to uproot them by friends of Ondiri and were provided with other tree seedlings to plant by the Water Resource Users Associations in collaboration with the Kenya Forest Research Institute. Regulating water abstraction was another strategy encouraged by the local authority 12.3%. Over utilization of the resources from the swamp was evident thus also discouraged grass and reeds harvesting. Gabion building was also practiced to reduce soil erosion where 8.1% of the respondents acknowledged the use of this method. Other strategies practiced are enlisted in (table 5.5).

5.5 Threats to Ondiri wetland's sustainability

Major threats to the wetland identified during the study included; encroachment for agriculture and settlement; Over-harvesting of wetland resources e.g. papyrus, grass harvesting and cutting down of trees); Majority of the respondents cited dumping of waste into the wetland as the major threat to the wetland ecosystem, followed by increased harvesting of the wetland plants like papyrus reeds for making mats.

5.5.1 Encroachment for agricultural development and settlement

Plates 3, 4, 5 & 6 shows the area of study. It is evident that human encroachment into Ondiri wetland is a threat to its sustainability. Community members have grown crops like maize, banana, kales, spinach, Chinese cabbage, tomatoes, cabbages and arrow roots right beside the wetland site (plate 3). This has reduced the actual acreage of the wetland size over the years. In addition to that, some have settled near the wetland.

Plate 5- 3: Encroachment into Ondiri wetland (kales, cabbages, spinach banana crops besides the wetland; settlement built along the wetland area and a path across the swamp to access the other end of the Swamp). Source: Field survey, 2015.

5.5.2 Siltation

Siltation in the wetland results from soil and other particles carried away by running water especially during the rainy seasons. Due to the unsustainable agricultural practices in the area, loose soil particles are swept away and deposited into the wetland (plate 4).

Plate 5- 4: Silt deposits at the bank of the wetland. Source: Field survey, 2015.

5.5.3 Over-harvesting of wetland resources

It was established that there is unsustainable usage of the Ondiri wetland resources by the community members. The wetland resources used unsustainably by the community members include; water, papyrus and plants (plate 5). According to friends of Ondiri, some community members burn the wetland during the dry season so as to provide avenue for greener grass regeneration. In some areas, papyrus have been overexploited in the name of making mats, baskets, chairs, roofing and other materials for commercial purposes.

Plate 5- 5: Harvesting of grass for livestock feed Source: **Field survey, 2015**

5.5.4 Dumping of wastes into Ondiri swamp

Ondiri swamp is under threat from various activities taking place around the swamp especially chemicals from the farms that find their way into the swamp. The wetland being within the Kikuyu Township, faces other threats like raw sewage from the town being drained into the swamp and there is possibility of seepage from septic tanks, since Kikuyu town has no sewer connections. This has highly contributed to pollution of the swamp. Residential houses have mushroomed around the swamp and some residents dump household waste along the swamp (plate 6).

Plate 5- 6: Waste dumped into Ondiri swamp Source. **Field survey, 2015**

Water has been polluted by wastes from towns, farm chemicals, and raw sewer from the town, storm water that is directed into the swamp and there is likelihood of sewer seepage from the septic tanks from Kikuyu town and its environs since they lack drainage system. Littering is also evident by the passersby who come to visit the swamp and have an experience of the quaking bog of the swamp. The water has turned brackish due to heavy pollution. Fig (5.5) indicates the key stakeholders and their immediate role in ensuring wetland sustainability.

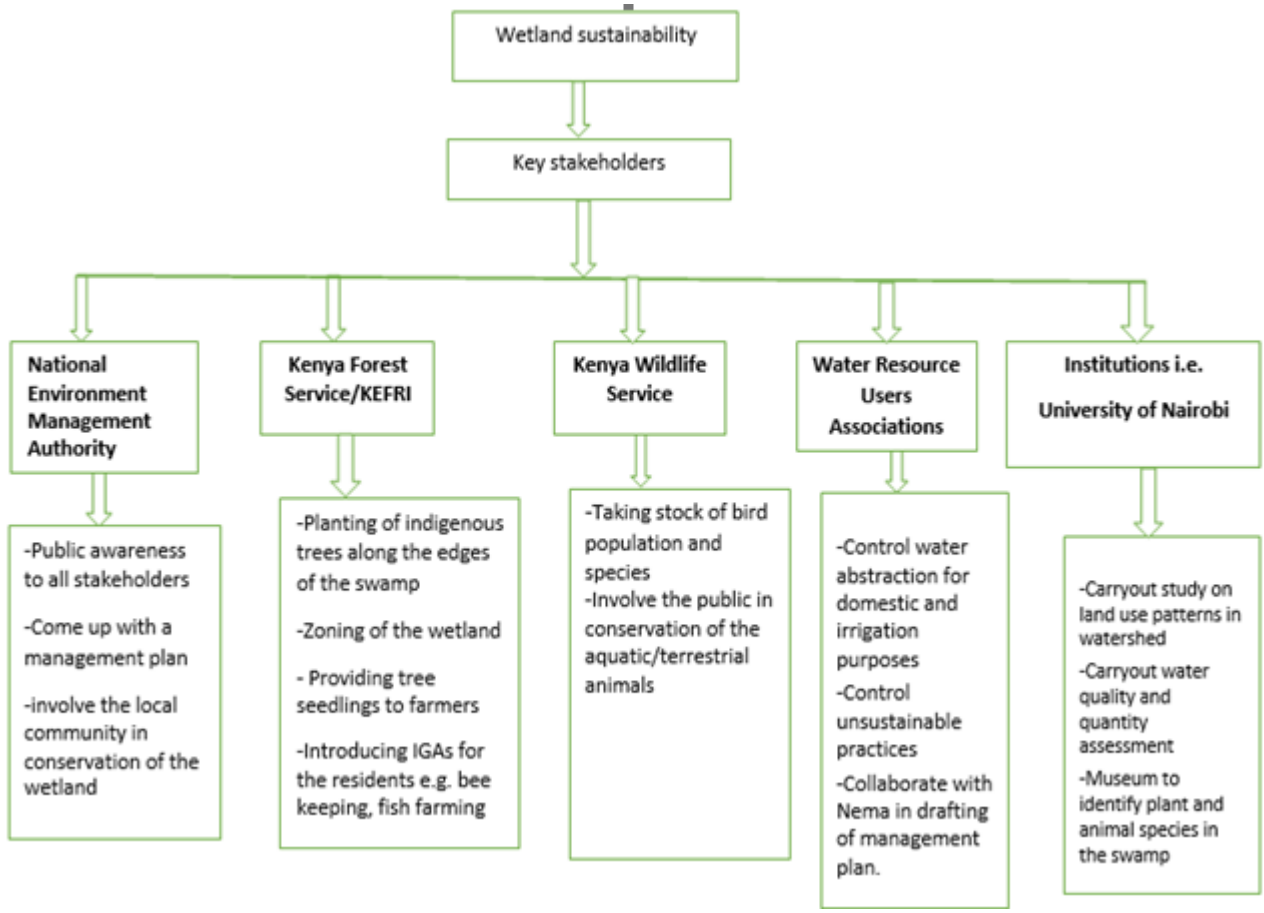


Figure 5- 5: Roles played by key stakeholders Source; **Researcher, 2015**

There is need for a common approach in wetland resources management by all stakeholders. To achieve this, it is important to take the drivers of wetland change into considerations. For instance, irrigation, forage harvesting, abstraction of water for domestic use and income generation are some of the activities that are important in supporting the livelihood of the local community. These could also be used to bring community together for a common purpose with the aim of sustainable use of the resources for future and present generation.

Increased harvesting of papyrus reeds should be controlled by Friends of Ondiri Wetland Conservation members, Water Resource Users Association members and Nema should regulate harvesting periods probably by charging for its harvest or banning harvesting during the dry seasons. At the same time, there is need to educate the stakeholders on their rights and obligations in the management of the swamp.

Encroachment of the wetland ecosystem, can be managed by fencing off (zoning) the area by the Kenya Wildlife Service, Kenya Forestry Research Institute and NEMA should ensure any development project is subjected to Environmental Impact Assessment to find out the

magnitude of the project and likely impacts on the wetland. It should also come up with a management plan for the swamp and seek support of its implementation from all stakeholders and users of the natural resources. The Kenya Forest Service, should educate the local farmers and neighbors bordering the swamp, the importance of forest cover and encourage them to practice agroforestry. With this mind set, deforestation will be controlled. KFS should partner with farmers and start up tree nurseries and engage them in tree planting exercise.

Siltation can be controlled through de-siltation to ensure more water retention. This is an expensive method of controlling siltation, therefore other methods like adopting better cultivation method to prevent soil erosion in the neighboring farms. KFS, Ministry of Agriculture, Kiambu County government and other stakeholders should take an initiative to plant indigenous trees along the edges of the swamp. Based on these roles and Ondiri wetland resources a management matrix was proposed.

5.6. Proposed planning matrix for the sustainable management of Ondiri wetland

Rural communities have become important drivers of environmental conservation in many parts of Kenya. Communities living in wetland areas must receive continued support from the government. For instance, community initiatives to sustain and conserve the wetland through afforestation, zoning of the wetland and sustainable farming practices. Ondiri wetland has faced numerous anthropogenic threats due to various activities taking place around it. Table (5.6) highlights some of the problems Ondiri wetland faces, causes, action taken, expectations to ensure sustainable utilization and responsible stakeholders.

Problems	**Causes**	**Present Actions**	**Desired Actions**	**Expectations**	**Responsible stakeholders**
Overharvesting of wetland resources such as papyrus, water and grass.	-High poverty rates -Population increase over time -Demand of	-Awareness creation on wetland resources. -Livelihood improvement	-Training on use of biogas energy to minimize overharvesting of reeds for energy.	-Sustainable harvesting of wetland resources. -Wetland	WRUAs & CBOs KWS & NEMA

	products -Limited alternatives	projects introduced to the Community.	-Undertake agroforestry practices. -Diversify sources of income. -Promote roof catchment water harvesting. - Participatory zoning the wetland into suitable land uses.	zoned into different land uses and user rights.	
Wetland encroachment for grazing, farming and settlement.	-Inadequate grazing land -Inadequate enforcement of the laws due to inadequate personnel	-Educating the community members on wetland conservation. -Mandatory EIA for upcoming developments around the wetland ecosystem	- Development of Ondiri wetland Management Plan -Enforce existing laws and regulation to prosecute culprits. -Embrace dairy farming &	-Reduced encroachment into the wetland.	Kikuyu County government NEMA

			IGAs to reduce encroachment by livestock.		
Catchment degradation and deforestation.	-Land for cultivation. -Firewood demand.	-Tree nurseries established. -Enlighten the community on the importance of wetland vegetation.	-Planting of wetland trees in the catchment area. -Embrace sustainable energy sources like solar, biogas	-Improved wetland catchment and landscape management	KEFRI, KFS & WRMA
Pollution of the wetland.	Agrochemicals from farmland. -Human wastes.	-Creation of awareness on the dangers of wetland pollution.	-Embrace sustainable land practices and sustainable agriculture. -Improve sewerage connections -Buffer zone creation i.e. grass strips and terraces	-Improved water quality.	WRUAs, CBOs, County government &NEMA
Siltation	-Soil erosion due	-Tree	-Tree		KFS,

	to poor landscape management -Clearing of vegetation from the wetland banks	nursery establishment	planting along river banks and in the catchment area. -Practice sustainable agricultural practices. -Building of gabions	-Reduced wetland siltation.	KEFRI, KWS & CBOs

Table 5- 6: Planning matrix for Ondiri wetland management Source: Field survey, 2015

5.7. Ondiri wetland management initiative

As earlier discussed, various stakeholders have interest in Ondiri swamp in terms of conservation and benefits it offers. Some of the benefits derived from the wetland is irrigation water abstraction, harvesting of macrophytes and domestic water abstraction. Despite the benefits derived from the wetland, it also under increasing threats from the agricultural activities within the riparian, increasing settlement around the swamp and uncontrolled water abstraction, planting of exotic trees especially eucalyptus close to the swamp which accelerates water loss through evapotranspiration, increased water pumps without clear record on their water abstraction quantity. All these were verified during the field study.

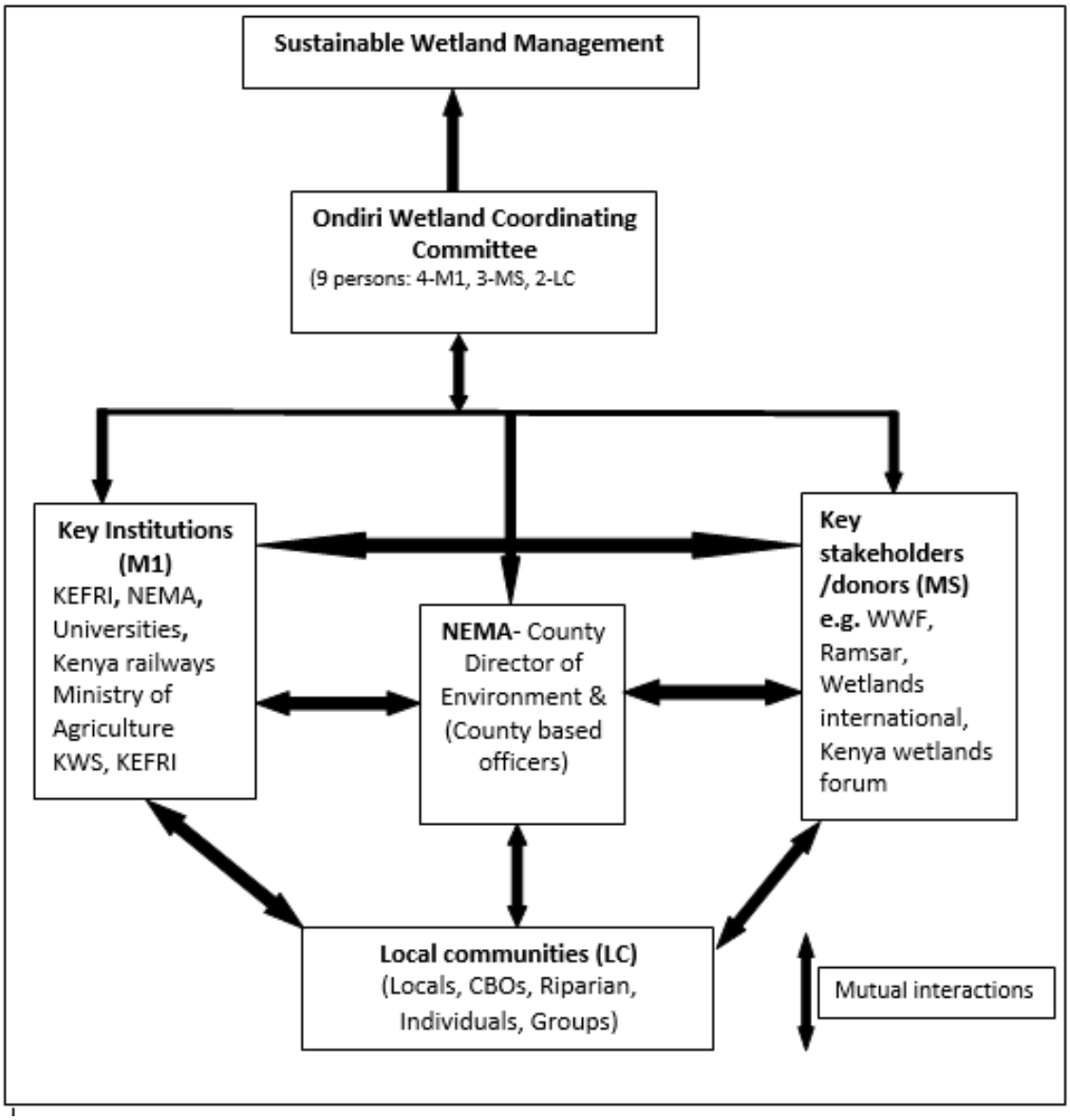


Figure 5- 6: Stakeholders interaction on wetland sustainable management initiative

Source: Adopted from NEMA, wetland monitoring & assessment report, 2015.

The Ondiri wetland coordinating committee comprises of key research and management institutions (e.g. KEFRI, NEMA, KWS, Universities, Kenya railways, Ministry of lands, Ministry of Environment, Water & Natural Resources and Ministry of Lands), international and national organizations (e.g. UNEP, Wetland International, WWF, EAWS) and local community organizations. All organizations and stakeholders of the wetlands must be brought together and encouraged to collaborate on wetland matters; with their mandates, roles and responsibilities recognized and appreciated. One institution at National level should be selected and mandated to compile data and information on wetlands from other institutions. The committee would be comprised of the institutions and organizations that have a stake in wetlands (Fig. 5.7). Since the Country has no wetland policy, the committee is expected to act as a coordination unit of wetland research issues, particularly information gathering and ensure that all stakeholders fully participate in wetland management process from the user groups to the committee members who are in-charge of wetland implementation plans to ensure fully participation at all levels.

These stakeholders have individual roles that they play in ensuring wise use of Ondiri swamp. All these stakeholders have direct or indirect benefits they derive from the swamp, hence the need to conserve it. To achieve this, the local community should be fully involved as they plays a key role in conservation efforts for they are believed to be the custodians of the Natural resources around them. They should be involved in various activities through public awareness, seminars and field visits. For instance, during the World Wetlands Day celebrations, NEMA should involve the local community fully in celebrating the day.

There should be regular training workshops for the County Director of Environment, Environmental Officers and other government officers and volunteers on wetlands data collections including updates and new findings on wetland status in Kenya. On the other hand, the government should be compelled to fund research in country. To avoid wastage and effort duplications, funding should be competitive and pragmatic targeting innovative research to generate new data or ideas, support management plans, public education, awareness and participation. The already existing efforts to monitor some of the aspects of wetland such as annual birds count coordinated by National Museum of Kenya should be supported and information availed in a format ready to be used by policy makers, researchers and general wetland stakeholders. The Kenya wetland Policy, which is long overdue should be passed without further delays. Once passed and implemented will put wetland ecosystem

at par with other government sectors such as land, water, forest and agriculture. Through this, sustainable wetland management would be achieved.

Fig (5.6) highlights the Ondiri swamp stakeholders, who have an initiative to ensure the swamp is well utilized by the consumers/users, researchers and interested individuals like the tourists who visit the area occasionally. Through the Ondiri wetland coordinating committee formed, they should come up with some conservation measures to ensure sustainable utilization. These include:

- Planting of indigenous trees
- Control pollution
- Avoid burning of vegetation
- Awareness creation
- Law enforcement
- Construction of terraces
- Zoning the swamp

Existing laws on Natural resource conservation should be enforced by the key institutions, so as to safeguard the resources provided by these ecosystems. For this to be effective, public awareness on the importance of the swamp like Ondiri should be disseminated to the people and be involved in decision making from initial stages, so that they can fully participate in the conservation process. For instance, groups like WRUA provides a suitable vehicle around which to mobilize and coordinate the participation of water users in water resource management. WRUAs, if properly encouraged, can provide a significant contribution where other institutions might struggle to achieve the same impacts. The participation of WRUAs is not just about consultation, but is about stakeholder participation in Water Resource Management (WRM), hence need for all stakeholders to work together to achieve the intended goal of sustainable wetland utilization.

Fig (5.6) highlights the roles played by various stakeholders to ensure wetland is sustainably utilized. The major activity taking place around Ondiri swamp is farming 41.8%, (table 1.2). Ministry of Agriculture therefore, should encourage farmers and sensitize the farmers on sustainable farming practices. To achieve this, the Ministry should work closely with the farmers by giving them incentives like seedlings, fertilizers and through this, it is easy to interact with the farmers and educate them on best farming practices to minimize over

utilization of the wetland, flood control and soil erosion control methods. Local community engagement in all levels of conservation efforts is crucial for they are the most affected parties, therefore, involving them from National level to grassroots level is important so as to achieve the intended purpose, for they are termed as the custodians of the Natural Resources.

5.8. Discussions

Based on the findings of the study, it was revealed that education plays an important role in community participation. This is in agreement with Jacobson *et al*., (2006) who suggested that conservation and environmental education aims to provide learners with the opportunity to gain an awareness or sensitivity to the environment, knowledge and experience of the problems surrounding the environment to acquire a set of values and positive attitudes, to obtain the skills required to identify and solve environmental problems and the motivation and ability to participate. These findings also correspond to Aworti (2012) who argues that participation increases with education. He indicated that households that are educated tend to participate more when called upon to do something.

The study also revealed that the level of community participation is essential in attempting to ensure sustainable wetland management through individual income, attitude, incentives, consultations, interaction and self-mobilization where people participate by taking initiates. This agrees with Lee (1998), Aworti (2012) argue that the level of household income influences the level of community participation in projects. Similar findings were obtained by Claridge and O'Callaghan (1997) found in the Danau Sentarum Wildlife Reserve Conservation project that the uppermost concern in the minds of local user community members were making a living. This finding concurs with Walker (2008) who states that communities that have adequate source of funding are more likely to sustain their projects as compared to those without adequate income generating activities.

Results from the analysis also established that most respondents owned land under freehold 33% and the absolute ownership of the land is vested in an individual. Therefore, the land tenure system allowed for long term investments like tree planting. For instance, alliance school has a good scenic eucalyptus forest adjacent to the swamp. Other landowner have put up commercial housing facilities while others have erected gabions to reduce soil erosion. These findings are similar to Aworti (2012) affirming that local community is more likely to participate in community projects as they are more likely to see the intended long term

benefits of a project as opposed to tenants. Similar findings have also been reported by Pargal, Huq & Gilligan (1999) when evaluating the determinants for garbage collection services in Dhaka, Bangladesh, they realized that homeowners have stronger community ties than those who are temporary residents; hence homeowners were more likely to appreciate in garbage collection. Lockie and Rockloff (2005) found that participants expressed strong environmental values and argued that rural land holders are on the whole responsible and competent natural resource managers. They believed that efforts to conserve and manage important and vulnerable natural resources have traditionally focused largely on legal prohibitions and regulation or on economic rewards or penalties.

The study findings also revealed that strategies put in place for wetland conservation and utilization vary with the individuals understanding. According to the study carried out, there were certain strategies used to conserve the wetland, but its application depended on one's perception of the strategy to be applied. These findings corresponds to Claridge, (1997) that indicates, strategies of involving communities in natural resources management depends on people's perceptions and value systems which dictates whether to adopt the strategy.

The study reveals that Ondiri wetland provides numerous resources like reeds, grass, water and firewood to many residents. These findings concurs with Macharia and Thenya (2007b) that locally, the swamp provides water for domestic use, irrigation and livestock as well as fodder for livestock, particularly during the dry season.

The study further revealed that 57% of the people around the study carried out agricultural activities and used the water from the swamp to irrigate their farms. Similar findings were obtained by Shadrack (2013) where 70% of the local people living around the Yala swamp practiced farming in large scale due to water availability within their farm proximity.

The study findings also revealed that people around Ondiri swamp have teamed up and formed groups like Water Resource Users Associations, Friends of Ondiri Wetland Conservation and Ondiri Riparian Users to ensure that the wetland is well utilized and ensure conservation efforts like tree planting are being implemented. From two case studies of Manguo and Ondiri swamps, Macharia *et al* (2010) found that future conservation and management efforts of the environment lies with well-informed stakeholders including local communities, natural resource managers, policymakers, law enforcers and researchers. This

reinforces Hardin's assertion that "the only way humans can nurture nature is through education and awareness, which can counteract the natural tendency to do the wrong thing and the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed" (Hardin, 1968)

From the analysis of past studies, it is clear that community participation is very important in wetland conservation efforts, hence the key stakeholders should involve the community. There is a growing interest in wetlands, a conservation trend in many countries that have adopted laws and policies to prevent any new loss or degradation of these environments, to ensure application of the wise use principle and to promote wetland value oriented research. From the review it is evident that the success of wetland conservation efforts is dependent on the mutual involvement of all stakeholders, it is also clear that while most community projects have been planned and implemented by involving local communities, most of these projects are not the original ideas of the people, they were suggested to them (Claridge, 1997).

Many scholars have drawn attention to the importance of community participation in the natural resource management decision-making process to improve the outcome of management results. They have emphasized the mobilization of local communities, utilization of local institutions and local knowledge, establishment of a common property regime and effective partnership for community-based management with formal institutions (Berkes 1997; Berkes and Folke 1998; Berkes 2007 Pomeroy *et al*; 2008). These findings concurs with Pargal, Huq & Gilligan (1999) where in their studies they found that involvement of community participation in decision-making and implementation of the laid out laws and regulations work best.

The study findings revealed that local communities are particularly interested in getting involved in the decision-making process of wetland resource management under the opportunities created by the development projects. According to Ahmed *et al.* (2008). Through their involvement, local communities can assure enhanced livelihood opportunities, access to and control over resources, and the legitimacy of exercising collective actions. The present management system of wetland resources is focused on property rights transfer from state to individuals/groups for revenue earning, which inevitably excludes local communities from access and traditional use rights to resources.

The study carried out established that 44.9% of local people around the swamp were not involved in its management. According to McNeely (1994) emphasized that there is need for partnership between people and protected areas in this sense, participation is a key strategy to engage local people and to link scientific and local knowledge about the management of the protected areas and fragile ecosystems.

The study suggested a participatory process fig (5.6) to develop links between the user groups and institutions, and laid out the democratic and deliberative forms of engagement, the nature of partnerships and linkages whether vertical or horizontal. Critics have argued that participation could turn into tyranny' if the participatory process fails to account for complex social power structure and implement participation as tools rather than empowerment (Holmes and Scoones 2000; Cooke and Kothari 2002; Mosse 2002). From this consideration, it is therefore, required to use appropriate participatory methods that confer suitable fitting to community level planning for contested Natural Resources.

According to Hannan, (2011) Top-down, command-and-control, and bureaucratic system of Natural Resource Management has limited space for multi-stakeholder governance approach. Attributes of governance, such as accountability, transparency, equity and fairness, participation and deliberations, and an information-sharing system, are virtually absent in the state-governed management approach (SMA). Vertical and horizontal linkages of institutions are not in place for sharing experiences, knowledge and feedback to improve management decisions. My study concurred with Hannan (2011) sentiments that local communities (user groups) are not fully involved in conservation and management of the wetlands. The findings also highlighted that the community was not fully aware of any strategy put into place to safeguard the Ondiri swamp. This showed that there was communication breakdown and likelihood of a Top-down management approach.

CHAPTER SIX
SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1. Introduction

The overall objective of this study was to assess the effectiveness of community participation in the management of Ondiri wetland. This chapter contains a summary of findings, recommendations and the conclusion arising from the findings.

6.2. Summary of findings

In answering the first objective on whether the community members utilize Ondiri wetland sustainably, it was established that Ondiri wetland still faces serious pressure and threats from some members of the community despite calls for conserving Ondiri wetland. The following were cases identified during the field survey and were evidential facts that showed some cases of unsustainable manner in which the wetland is put into use by the community. This was evident by encroachment by the local residents for settlement and agricultural activities; Over-harvesting of wetland resources e.g. grass and plants); Majority of the respondents cited encroachment into the wetland for agriculture and settlement as the major threat to the wetland ecosystem. This is followed by overharvesting of the wetland plants like papyrus reeds for making mats. The unsustainable usage of Ondiri wetland by a section of the community members can be attributed to lack of proper awareness on the importance of conserving the wetland, and also lack of alternative sources of livelihoods.

The second objective examined site conservation efforts put in place around Ondiri wetland ecosystem and the livelihood of the community members. It was established from the field survey that the community's livelihood activities are dependent on the wetland resources. Community members derive such benefits as harvesting of papyrus reed for mat making, roofing materials, water for domestic uses, and pasture for livestock among others. Degradation of Ondiri wetland has led to increased siltation thereby reducing the quantity of water in the wetland. This may in future directly affects the community since water will becomes scarce in the area. According to one of the key informants during field survey, the area under papyrus reeds has significantly reduced over the years due to human encroachment occasioned by agricultural and settlement development.

On finding out the conservation efforts put by the community members to protect Ondiri wetland, the study establishes that the community together with other organizations like NEMA, NGOs, and other government agencies are putting some measures to conserve and protect Ondiri wetland. Some of these efforts include; creation of awareness and educating the public on the need to conserve Ondiri wetland; introduction of alternative livelihood improvement projects to reduce pressure on the wetland; afforestation and reforestation programs; and sustainable utilization of wetland resources. However, the respondents cited some of the shortcomings that hinder their efforts in conserving the wetland. Some of the factors that have thwarted their efforts include: inadequate financial assistance in starting and implementing alternative livelihood improvement projects; obstinate community members who are unwilling to change their attitude towards conservation measures of the wetland.

The fourth objective was to propose sustainable system framework for utilization and conservation of Ondiri wetland resources. The study ascertained that there was no Ondiri wetland management plan to ensure proper utilization. According to NEMA, there is a sessional paper in parliament on Ondiri wetland awaiting debate.

6.3. Conclusion

Wetlands have played irreplaceable roles to the humanity and yet they have suffered from anthropogenic actions in the past. In spite of the comprehensive framework for wetland management at the global level, the challenges on wetlands management and conservation at the local level have persisted. The global framework has established standards and developed mechanisms for collaborative wetland management especially with regards to involving the participation of the local community. It is imperative to note that no successful gains can be achieved in any wetland management and conservation effort that alienates the participation of local community. The community members are thus crucial in the management and protection of the wetland because their actions either directly or indirectly impact on the wetland. It is clear that wetlands and people are inseparable and therefore, any efforts geared towards conserving and managing the wetland should incorporate the community's input. The program should respect and integrate into decision making the community's livelihood, culture and spiritual attachment to wetlands. By involving the community in the management of the wetland reserve and the catchment area, it will be possible to ensure a sustainable future for the wetland resources that we have. To address this, there is need to have a paradigm shift in the management of wetlands to focus on the role played by the community.

This will call for participatory planning, decision making and implementation of the wetland management plans to achieve a sense of ownership among the community. This is referred to as co management of wetland.

6.4. Recommendation

It was established that; to promote the involvement of the local community in the conservation and management of the Ondiri wetland ecosystem, the following measures and strategies would be of great importance towards achieving this goal:

(i) Establish a management committee for the wetland with subcommittees to plan for the land management, water and biological resources in Ondiri swamp like water and land. This can be achieved by strengthening water resource users (WRUAs).

(ii) There is need for KWS to work with the local leaders to raise public awareness and sensitivity towards the Ondiri swamp. In this effort, the local academician should be incorporated so has to raise a sense of ownership and pride in their wetland resource.

(iii) Develop a management plan and seek to support its implementation from all stakeholders and users of the resources from the swamp. NEMA should ensure this is put in place and involve development partners/locals community and other stakeholders.

(iv) Delineate the swamp for better management, for instance set clear boundaries through zonation of wetland use and the establishment of buffer zones or even physical obstructions to prevent human and animal encroachment on wetland resources. The demarcation should take into consideration the user rights of the community members so as to develop greater responsibility and a feeling of ownership among the local communities.

(v) There is need to enforce mandatory Environmental Impact Assessment (EIA) for projects likely to have a negative impact on the swamp.

(vi) Farmers in the catchment should be given incentives to practice sustainable agricultural practices and agroforestry so as to lessen degradation of Ondiri wetland through increased forest cover. To achieve this, the government and other NGOs can give the local community incentives to start up tree nurseries.

(vii) Community awareness and education programs that are aimed towards enlightening the community members on their roles in the conservation of Ondiri wetland should be intensified. These programs should also be frequently

conducted on a day to day basis. These programs should not only create an awareness of the importance of wetlands conservation, but also to train all wetlands users on the best practicable and sustainable wetland user options.

(viii) NGOs and government agencies should follow up by monitoring the projects on the ground to ensure their objective have been achieved. Sustainability of these efforts should also be ensured so that the community does not go back to unchecked exploitation of wetland resources.

(ix) Educating farmers on sustainable farming methods through workshops and seminars.

6.5. Recommendations for further research

From the study findings, it recommends the following topics for future study:

- Sustainability of wetland restoration projects
- Provision for Multi-stakeholder governance in Natural Resource Management.

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APPENDICES

Appendix I: Questionnaire

I am a student at the University of Nairobi, Department of Geography & Environmental Studies. This research helps me to write my final year Project paper that is examinable and passed through the University Examination Board.

I hereby call upon your kind assistance in answering the following questions. The information provided is/will be treated private and confidential, as the research is strictly educational.

SECTION A: GENERAL INFORMATION OF THE RESPONDENT

1. Age Below18 years[ ] 19 – 25 years [ ] 26– 30 years [ ]
   31 – 40 years [ ] 41-45 years [ ] above 45 Years [ ]
2. Marital status Married [ ] Single [ ]
   Divorced [ ]
3. Level of education: Primary education [ ] Secondary education [ ]
   College [ ] University [ ]
4. For how long have you lived within Ondiri swamp?

   _____

5. What is your source of income?

   _____

6. Why did you decide to live around Ondiri Swamp?

   _____

7. What type of ownership is your land?

   ( ) Leasehold ( ) Communal ( ) Private
   ( ) Individual ( ) Public Other Specify----------

8. What is the size of your farm?

   ( ) Less than 5 acres ( ) 5-10 acres ( ) More than 10 acres

SECTION B: HOW VARIOUS STAKEHOLDERS UTILIZE THE ONDIRI SWAMP

a) Who are involved in the utilization of Ondiri swamp resources?

   ☐ NGOs ☐ Local residents ☐ Local Authority
   ☐ Large/ small farmers ☐ other specify----------

b) What are some of the resources extracted from the Ondiri wetland?

   _____

_____

_____

_____

c) How often are these resources named above harvested?

( ) Daily ( ) Weekly ( ) Monthly ( ) Annually

d) Which of these resources in (b) above do you use in your household?

_____

_____

_____

e) How do you benefit from these resources?

_____

_____

f) For what purpose do you use wetland for?

[ ] Grazing [ ] Fishing

[ ] Farming [ ] Reed harvesting

[ ] Water extraction [ ] Waste disposal

[ ] Tourist Attraction [ ] other specify_____

g) Which of the above activities in (f) are common around the swamp?

_____

_____

_____

h) Do people seek permission to extract Natural resources from the swamp?

( ) Yes ( ) No

i) If yes, who gives the permission?

_____

j) Are you involved in farming activities around the swamp?

( ) Yes ( ) No

SECTION C: SITE CONSERVATION EFFORTS PUT IN PLACE BY STAKEHOLDERS

a) Who are the Managers of the Ondiri wetland?

_____

_____

b) What are some of site conservation efforts being practiced around the Ondiri wetland?

_____

_____

_____

c) Are you involved in the conservation of the wetland?

( ) Yes ( ) No

d) If yes in (c) above, how are you involved?

_____

_____

e) If no, why?

_____

f) Who do you consult to use the wetland?

[ ] Appointed committee

[ ] Elders

[ ] Local Authority

[ ] Government

[ ] Appointed local people

[ ] Other Specify_____

g) Are there measures that are being used to promote conservation of Ondiri?

[ ] Yes [ ] No

h) If yes in (g) above which are these measures?

_____

_____

_____

i) Other than community members, who else should be involved in the management of the swamp?

_____

_____

j) What role would they play?

_____

_____

_____

k) Are there community groups involved in management of this swamp?

( ) Yes ( ) No

l) If yes in (k) above, name them.

_____

SECTION D: STRATEGIES PUT IN PLACE TO GUIDE UTILIZATION AND CONSERVATION OF ONDIRI SWAMP BY VARIOUS STAKEHOLDERS.

a) Are there strategies put into place to guide the wetland utilization?

( ) Yes ( ) No

b) If yes in (a) above, what are some of the strategies used in this wetland conservation?

_____

_____

_____

c) Would you support conservation measures that allows maintenance of this wetland?

( ) Yes ( ) No

d) Do you think the current conservation measures have been successful?

( ) Yes ( ) No

e) If No for (c) above, which of the following possible reasons for the failure? Rank them

Where 1, represent prime reason 2, represent Average reason 3, least reason

( ) Inadequate funding

( ) Lack of good will and support

( ) Lack of harmonized approach

( ) Inadequate sensitization and conservation education

f) Are there some laws or regulations governing the utilization of the Ondiri swamp?

( ) Yes ( ) No

g) If yes in (f) above, which are they?

_____

_____

h) When one defied procedures for the use of the swamp, what would the community do? (Describe in detail)

_____

_____

_____

i) When there was misunderstanding over the use of the swamp amongst members, how do the community handle? (Describe in detail)

_____

_____

j) Are there people who are assigned to monitor the use of Ondiri wetland?

( ) Yes ( ) No

k) If yes to (j) above, who are these people?

_____

l) Do you think the swamp is well used?

( ) Yes ( ) No

m) If no, how is it misused?

_____

SECTION F: STAKEHOLDER'S ROLE, RESPONSIBILITY AND CONTRIBUTION IN SUSTAINABLE ONDIRI CONSERVATION.

a) What role do you play in conservation efforts of the Ondiri swamp?

_____

b) Are there guidelines on the roles one play in the conservation efforts?

( ) Yes ( ) No

c) If yes in (b) above, which guidelines are these?

_____

_____

_____

d) Who do you think should be responsible for wetland conservation management?

( ) Local community

( ) Government

( ) Non-Governmental Organizations

( ) Local Authority

( ) Friends of Ondiri

Other Specify_____

e) In which way would you wish to assist in Ondiri wetland conservation?

_____

_____

f) What challenges do you face towards conservation of this wetland?

_____

_____

g) What can be done to ensure sustainable use of wetland?

_____

h) Do you think people need training to use wetlands?

( ) Yes ( ) No

i) In your Opinion, is Ondiri wetland used sustainably?
( ) Yes ( ) No

j) If No above, what can be done to ensure sustainable use of wetland?

_____

_____

k) What are some of the interventions taken into account to ensure sustainable utilization?

_____

_____

l) Give recommendation on how to improve community participation in wetland management.

_____

---------Thank you------

Appendix II: Interview Guide for Key Informants

INTRODUCTION

Dear Sir/Madam, I am Eric Mwenda, a Master's student at University of Nairobi. I would appreciate your contribution to this study dealing with assessment of the community participation and conservation of Ondiri wetland.

Please be free to give answers to the best of your knowledge. I am assuring you that the response you give will be kept confidential according to the research regulations of University of Nairobi.

Thank you for your willingness to participate in this research.

NAME OF INSTITUTION

_____

Location

_____

Name of officer

_____

Designation of the Officer

_____

1. What are the uses of papyrus reeds in Ondiri area? Name them.
2. Are there strategies put in place to ensure Ondiri wetland is sustainably utilized?
3. What are the effects of increased harvesting of papyrus reeds in Ondiri swamp?
4. What is your opinion about the conservation of Ondiri Swamp?
5. Which conservation measures are put in place to protect the Ondiri?
6. Are local community involved fully in conservation of the wetland?

--------Thank you---------