Community Perceptions of Environmental Indicators for Management of Wetland Important Bird Areas in Kenya

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DECLARATION

This thesis is my original work and it has not been submitted for examination or any degree award in any other University

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To the loving memory of my late parents, Pine Chikomo and Emily Mlandu Chikomo who laid the foundation by their support, encouragement and extraordinary faith in the capabilities of their children.

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'If I have seen further, it is by standing on the shoulders of giants', Sir Isaac Newton in a letter to Robert Hookes dated the 5th of February 1675

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LIST OF ABBREVIATIONS

APA	American Psychological Association
AEWA	Conservation of African-Eurasian Migratory Waterbirds Action Plan
BINU	Biodiversity Indicators for National Use
BIP	Biodiversity Indicator Partnership
BICS	Biodiversity Indicators Capacity Strengthening Project
BMUs	Beach Management Units
BTO	British Trust for Ornithology
CAPs	Community Action Plans
CPEU	Catch per Unit Effort
CBD	Convention on Biological Diversity
CBNRM	Commnunity Based Natural Resource Management
CIFOR	Center for International Forestry Research
COP	Conference of the Parties to the Convention
CWB	Community Well-Being Index
CEI	Core Environmental Indicators
CPRs	Common Property Resources
CGSDI	Consultative Group on Sustainable Development Indicators
DEI	Decoupling Environmental Indicators
DEAPs	District Environment Management Plans
DPSIR	Driver-Pressure-State-Impact-Response
DMC	Direct Material Consumption
DS	Dashboard of Sustainability
EF	Ecological Footprint
EEA	European Environment Agency
EMCA	Environment Management and Coordination Act
ESF	European Science Foundation
FIRMS	Fire Information for Resource Management System
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GEF	Global Environment Facility

GDI	Gender-related Development Index
GoK	Government of Kenya
GPI	Genuine Progress Indicator
HABs	Harmful Algal Blooms
HDI	Human Development Index
IBAs	Important Bird Areas
IK	Indigenous Knowledge
ICARM	Integrated Coastal Area and River Basin Management
IMP	Intergrated Management Plan
IPCC	Intergovernmental Panel on Climate Change
IPSP	Interim Poverty Strategy Paper
IUCN	International Union for Conservation of Nature
JRC	Joint Research Centre
KWS	Kenya WildLife Service
LBNR	Lake Bogoria National Reserve
LNRA	Lake Naivasha Riparian Association
LPI	Living Planet Index
MEMR	Ministry of Environment and Mineral Resources
OECD	Organization for Economic Co-operation and Development
PSR	Pressure-State-Response
PSIR	Pressure- State-Impact-Response framework,
SOE	State of Environment
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advise
SSGs	Site Support Groups
SU	Stock Unit
UNEP	United Nations Environment Programme
UNCSD	United Nations Convention on Sustainable Development
WCMC	World Conservation Monitoring Centre
WRUAs	Water Resource User Associations
WSSD	World Summit on Sustainable Development
WWF	World Wide Fund for Nature

ABSTRACT

Despite their importance, wetlands are facing a crisis due to anthropogenic factors as well as natural phenomenas. One of the measures to address the challenges being faced by wetlands is to develop indicators. Unforunately to date, indicator development has largely been driven by the scientific community to the exclusion of the local people who are dependent on these wetlands. Biophyisical assessments have thus dominated the indicator development process which has led to these indicators largely being defined as indices, making them difficult to comprehend on the part of the local communities. The overall goal of the research was therefore to assess local perceptions on wetland environments for the purposes of developing environmental indicators for effective management of wetlands especially those that are designated as Important Bird Areas (IBAs) in Kenya. In this regard the following objectives were addressed in this study a) establish the influence of gender, age, type of resource use on community perspective on wetland environmental indicators, 2) determine the state of wetland environments (SoE) and predict their future changes from the local knowledge and community perspective on wetland environmental indicators and 3) determine the Pressure-State-Response indicators across different types of wetlands. The study tested the following hypotheses in order to address the research objectives 1) gender, age and type of resource use are key determinants in the perceptions and/or choices of the wetland environmental indicators held by the respondents, 2) the local community perceptions about the condition of the wetland IBAs are similar based on community perspective on wetland environmental indicators and 3) the community identified indicators are influenced by the type of wetland environment.

To arrive at a study sample size, the study considered the categorical nature of the data to be collected. The study sets an alpha level priori at .05 and 5% margin of error is acceptable. The Cochran's sample size formula for categorical data was used and 475 applied as the appropriate sample size. The three types of wetlands considered in the study were 1) the Tana Delta (for riverine IBAs), 2) Lake Bogoria (for saline lacustrine IBAs) and 3) Lake Naivasha (for freshwater lacustrine IBAs). The justification for the purposive selection of these study sites is that they are high on the priority list for both their conservation value and their human health benefit. Both purposive and non-random sampling was used for selecting the villages within which the community perception analysis was undertaken. The following villages were considered in the study as platforms for analyzing community perceptions: 1) Tana River Delta - Kipini, Ozi, Dida Waride, Moa 2) Lake Bogoria - Loboi, Sandai and Emsos and 3) Lake Naivasha - Kamere, Karagita and Kongoni. A total of 179 respondents were interviewed at Tana Delta, 44 respondents at Lake Bogoria and 252 at Lake Naivasha. A total of 12 different wetland user groups were sampled across three study sites. The respondents were categorised according to the following six age groups; 15-25; 26-36; 37-47; 48-58-59-69 and 70-80 years. Community interviews were mainly conducted through focus group discussions according to the various user groups on site. Each focus group consisted of at least 7 to 12 people and lasted not more than 2hrs. In total, 112 focus group discussions were held. Individual interviews were also held, at least 32 key informant interviews were conducted and this was complimented with direct observation in the field. The discussion was conducted using a standard questionnaire which was structured according to the Pressure, State, Response (PSR) framework. In analyzing the data, the study used non-

parametric tests to determine the level of significance through a Chi-Square Test, assess whether differences exists between group by conducting a Kruskal-Wallis H test and determining association between variables using the Spearman Rank Correlation Coefficient.

The main findings on the objective focusing on socio- demographics showed that the perceptions on the state of the wetland environment were not influenced by the age of the respondents. The study has also shown that the concern for the quality of the wetland IBAs is not a gendered phenomenon. Overall, while gender and age did not influence the choice of indicators, the type of resource use contributed to the kind of desired wetland environmental indicators. The traditional healers, perhaps due to the entrenched historical links, affiliation and in-depth specialization on herbal life, recorded a much deeper perception than the rest of the resource users. Notably, the mean scores for the inland fishermen, agricultural farmers, livestock herders were 1.992754, 1.72619 and 1.612903 respectively and these were slightly higher than the perceptions of the other resource groups. On the second objective, the key findings were that the wetland IBAs were in a deteriorating state; freshwater IBAs seemingly were faced with intense pressures compared to the saline. Different management regimes could also be a factor. The study rejects the null hypotheses that perceptions on the condition were not similar. In total, at least 38 PSR indicators were identified (19 Pressure; 7 State; 12 Responses). A chi-square test of goodness-of-fit determined that the perceptions on PSR indicators from the IBA sites were not equally distributed in the population (with the exception of the state indicator on fish resource at Lake Naivasha). The Statistical Results showed that the community perceptions on the PSR indicators were different across different communities. The selection of community environmental indicators is not by chance hence the study rejects the Null Hypotheses that the community identified indicators were not different.

The study concludes that the socio- demographics of a study population remain a key component of any research work and should be utilised as much as possible in natural resource management. The study has shown that the pressure indicators are relatively much more than compared to the state and response indicators and the implications are that avian diversity and population is hanging in the balance. This shows that the human pressures and development needs are continuing unabated to the extent that internationally protected sites 'do not seem' to safeguard the wetland resources within their borders, giving a widespread sense that this management regime is simply not working. The accuracy of these claims is of critical importance to policy and funding decisions. If internationally protected sites are failing despite best efforts, then better options should be sought. If, on the other hand, internationally protected sites are performing relatively well in a context of serious threats and limited resources, or are simply performing better than the alternatives, their level of support should be increased. The study also concludes that regulations should be complimented with engagement of local communities in decision making. The importance of this work lies in the enhanced understanding of different resource user's expectation of a sustainable wetland IBA and therefore making a strong basis for the bottom up consultation process useful in the collaborative wetland management of the wetland, which Africa in general and Kenya in particular is looking upto for the benefits of both people and birds.

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

1.1.1. Wetlands in Peril

Wetland resources have traditionally been utilized by the people as a source of materials for construction, crafts, furniture, and as hunting and fishing areas. Traditionally seasonal wetlands and margins of permanent wetlands have been used for grazing cattle, growing crops and as a source for domestic water. In addition, they are a major habitat for wildlife resources, especially birds (McCartney and van Koppen 2004; Masiyandima *et al.*, 2004; Turpie 2000; Turpie *et al.*, 1999). Wetlands take an essential part in food security, especially during the dry season or in drought years, and dietary variety (Masiyandima *et al.*, 2004).

Through these activities, and factors emanating from activities occurring outside the sites, wetlands are subject to a range of factors which can lead to loss of wetland area and degradation of wetland quality to the detriment of birds and people that depend on them. Evidence shows that there has been massive conversion of wetlands for commercial development, drainage schemes, extraction of minerals and peat, over fishing, tourism, siltation, pesticide discharges from intensive agriculture, toxic pollutants from industrial waste, and the construction of dams and dikes, often in an attempt at flood protection (Wetlands International, 1998)'. The Ramsar Site Data Base shows that worldwide, 50% of wetlands are estimated to have been lost since 1900. Stuip *et al.*, (2002) also show that since the 1950s, tropical and sub-tropical wetlands, particularly swamp forests and mangroves have also been rapidly disappearing. According to Kotze, Breen and Quinn (1995) and Hollis (1992) the underlying causes of wetland loss and degradation are largely socio-economic political. These include: poverty and economic inequality; population pressures from growth, immigration and mass tourism; social and political conflicts; sectoral demands on water resources; centralized planning processes; and financial policies. The human population is predicted to grow by 2 to 4 billion people by

2050 (United Nations, 2001). The global population reached a 1 billion mark in 1800, a medium projection is that it may take just 13 to 14 years to add another billion to the present total (Cohen, 2003; 1997).

At the national scale, Kenya is no exception as it is facing one of the highest annual population growth rates in the world, estimated in 2000 at 2.3 % per year (World Bank, 2000). As depicted in Figure 1-1, Kenya's population rose from 10.9 million in 1969 to an estimated 38.6 million by 2009. The growing population, combined with limited land availability in the agriculturally productive highlands of Kenya has led to increasing immigration to marginal areas in spite of their ecological limitations. But since those marginal and moisture deficit regions are vulnerable to the increased population, the exerted pressure has often resulted in severe degraded land, soil erosion and sedimentation of surface water bodies (World Bank 2000). A majority of the people in Kenya are poor. Overall rural poverty by region in Kenya is as follows: Coast 62.1%, Central 31.4%, Eastern 58.6%, Nyanza 63.1%, Rift Valley 50.1%, and Western 58.8% (Ministry of Finance and Planning, 2001).

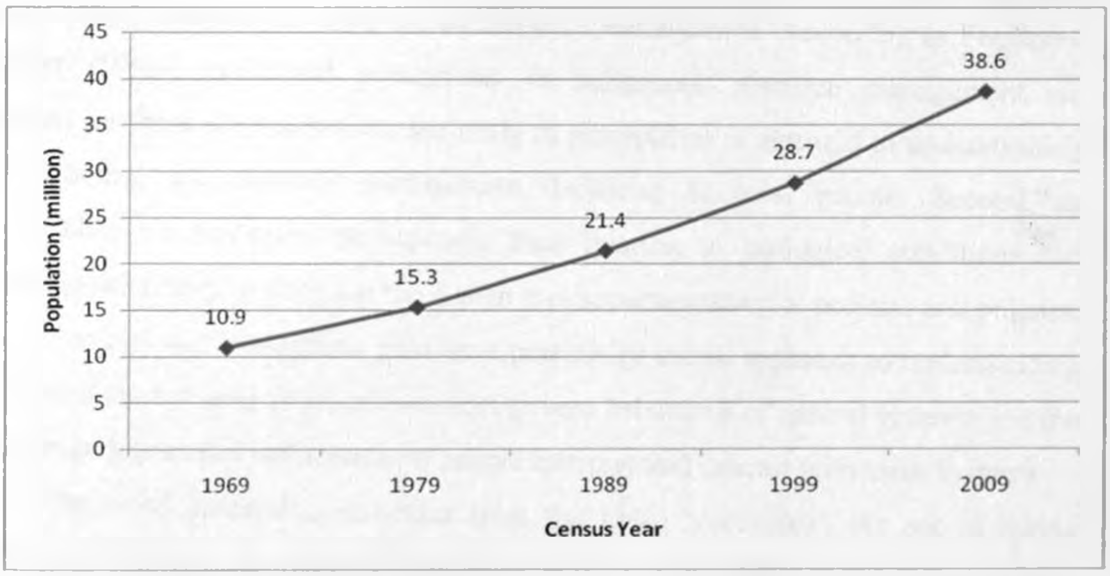


Figure 1-1: Trend in Kenya's population growth

Source: Kenya National Bureau of Statistics (2010); MEMR (2012)

Whilst acknowledging that wetland management is a shared responsibility, the study sought to investigate the perceptions of the local communities that live in proximity to the wetlands for the purposes of identifying indicators for improved management. Dixon and Wood (2003, 2007) affirms that people's long association with wetlands means that indigenous systems of wetland management and utilization are to be found throughout the developing world, thus providing an opportunity for local solutions to threats faced by wetlands for the benefits of both people and birds.

1.1.2. Role of Community Perceptions in Environmental Management of Wetlands

The notion that ecological perceptions are crucial to understanding resources management behaviour is not novel. In 1962, Frake (1962) wrote 'an ethnographer cannot be satisfied with mere cataloguing of the components of a cultural ecosystem according to the categories of Western Science. He must also describe the environment as people themselves construe it according to the categories of their ethno science'. An understanding of ecological change must incorporate lived human experiences of the world and show how this experience translates into behaviour that in turn influences ecological conditions. The nexus of this interrelationship is human perception, which affects ecology through its influence on resource management. According to Fernande-Gimenez (1993), ecological perceptions in indigenous resource management are important for three resources. First the study of perceptions is essential to understanding and predicting the resource management decisions of local people. Second, an understanding of ecological perceptions, their relation to ecological conditions and bearing on behaviour is crucial to the design and implementation of projects and policies. Finally, ecologically perceptions provide a potentially useful approach to understanding the interactions between physical laws that govern behaviour of natural systems and the human experiences that influence how people interpret and interact with these systems.

The word perception emanates from the Latin '*perceptus*', the act of taking possession, obtaining, receiving' (Webster's Third New International Dictionary, 1986). Perception always refers to the ways in which the world acquires meaning to us. For the purposes of this study, three levels of environmental perception can be distinguished. Sensory perception is the direct response to external stimuli and determining literally how we see the world. Cognition is transformation of sensory data into empirical knowledge about the world. Conceptualisation is the process through which landscapes acquire social and cultural meanings, meanings reflected in values and attitudes towards the wetland.

Ecological perceptions in the form knowledge and values constitute sets of decisions criteria and behavioural rules with respects to land, people and their organisms. The role of ecological perceptions in resource management can be evaluated by the 'goodness of fit' between an individual's perception and her resource management behaviour. To what extent and under what circumstances do people follow the 'rules' encompassed by their conceptualisation of the natural world? When and why do they fail to behave according to these rules? One obvious response to the latter is that ecological criteria are not the only criteria that enter into resource management decisions or in setting indicators for effective wetland management. Nevertheless, by examining the relationship between perceptions and decisions we can get a better and more explicit understanding of the diverse factors underlying resource management decisions and tensions between competing decision criteria. Such understanding may in turn help to predict resource management decisions as well as contribute to the design and projects that enable to make riparian communities to make full use of their traditional ecological knowledge and values.

1.1.3. Importance of Environmental Indicators in Management of Wetlands

In addition to international instruments such as the RAMSAR Convention, the international community has identified the need to derive indicators that can be used to assess the state of the environment and ecosystem health of wetlands. Environmental indicators are simple measures that tell us what is happening in the environment. Since the environment is very complex, indicators provide a more practical and economical way to track the state of the environment than if we attempted to record every possible variable in the environment. The OECD (1999) defines Environmental Indicators as indicators which 'deal with the quality of the environment or the area's natural resources'. They help answer the question, "Are our activities helping to improve the environment?" The OECD (1999) defines an indicator as a parameter, or a value derived from parameters, which points to, provides information about, and describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value.

Schreckenberg *et al.*, 2010 discuss both qualitative and quantitative indicators and highlight that they can be defined in terms of 'external' and 'internal' considerations. Internal indicators are created by local stakeholders, according to their own objectives and measurements and vary from place to place. Holland and Campbell (2005) conclude that internal indicators are part of a more 'contextual' and often participatory methodological approach. They argue that this provides an opportunity to explore issues within one locality in depth. On the other hand externally defined indicators are based on pre-defined and external views and agreements, without consulting the local communities (Schreckenberg *et al.*, 2010).

Communication is the main function of indicators: they should enable or promote information exchange regarding the issue they address. Our body temperature is an example of an indicator we use regularly. It provides critical information on our physical condition. Likewise, environmental indicators provide information on phenomena that are regarded typical for and/or critical to environmental quality. The abundance of Black Terns or Lesser Flamingos in a certain area and is an example of an indicator that enable communication on environmental issues.

According to the European Environment Agency (2003), indicators focus on certain aspects of the environment. Thus this study focused on specific components of the wetland across different types of wetlands. The significance of the indicators however goes beyond that obtained directly from the observed properties. To know the population of a specific bird species at one site for example is not enough. It is more relevant to compare these with the numbers in another area which is less disturbed. Then the real significance is in the message of abundance these birds convey regarding environmental quality in that specific area. Environmental indicators communicate those aspects regarded as critical or typical for the complex interrelations between natural species and abiotic components of the environmental system. In relation to policy-making, environmental indicators are used for four major purposes: The first one is to supply information on environmental problems, in order to enable policy-makers to evaluate their seriousness and secondly to support policy development and priority setting, by identifying key factors that cause pressure on the environment. The third use is to monitor the effects and effectiveness of policy responses. Last but not least environmental indicators are also used to raise public awareness on environmental issues.

EEA (2003) states the typology of environmental indicators. The first typology is the 'descriptive indicators which 'are most commonly used as state, pressure or impact indicators'. The indicators identified by the local communities in this study can be said to be descriptive indicators. The second typology is the performance indicators which may use the same variables as descriptive indicators but are connected with target values. 'Performance indicators' are relevant if specific groups or institutions may be held accountable for changes in environmental pressures or states. They are typically state, pressure or impact indicators that clearly link to policy responses. Most countries and international bodies currently develop performance indicators on the basis of (nationally or internationally) accepted policy targets or tentative approximations of sustainability levels (often called Sustainable Reference Values) .The choice between policy targets and sustainability levels has important implications for the presentation and the analysis of the indicators. 'Efficiency indicators' relate drivers to pressures. They provide insight into the efficiency of products and processes in terms of resources, emissions and waste per unit output. The environmental efficiency of a nation may be described in terms of the level of emissions and waste generated per unit of GDP. 'Policy effectiveness indicators' relate the actual change of environmental variables to policy efforts. As such they are a link between response indicators on one hand and state, driving force, pressure or impact indicators on the other. They are crucial in understanding the reasons for observed developments. In any discussion on sustainability and human welfare, the balance between economic, social and environmental development will ultimately be crucial, therefore the need for 'Total Welfare indicators'. Efforts are underway to design balanced sets of individual indicators to support decision-making. However for an integral assessment, some measure of total sustainability would be desirable to answer the question: "are we on the whole better off?. A variant of 'Green GDP', such as the Index of Sustainable Economic Welfare (ISEW) or "genuine savings", may be used for this purpose.

For indicators to be effective, at a general level, they must meet a number of competing scientific and practical criteria. These include qualities such as scientific credibility, sensitivity to environmental change, links to drivers, clarity of message, affordability and ease of update (ten Brink 2003; Gregory *et al.*, 2003; SBSTTA 2003; Bibby, 1999; Caro and O'Doherty 1999 and Landres *et al.*, 1988). The relevance of indicators to policy is captured by the criterion of 'resonance' (O'Malley *et. al.*, 2003) where 'resonance' connotes a situation, where an indicator 'strikes a chord' with its intended audience and this was therefore the intended purpose of this study (Hezri and Dovers, 2006), Peterson, 1997). Resonance involves the twin foci of content and legitimacy. Improving the content of indicators is a subject well covered in the environmental sciences literature. The focus on the legitimacy of indicator systems, on the other hand, is still undertheorised. According to O'Malley *et. al.*, (2003), representation of a broad range of views for a fully informed product is a precondition for indicator resonance across society. Substantive inputs by potential users increase the sense of institutional ownership of the product, which in turn increases the likelihood of its persistence.

1.1.4. The Pressure –State-Response Framework for Wetland Management and Linkages to Perception on Indicators

The PSR framework (or model, or approach) is based on the concept of causality: human activities exert pressures on the environment and change its quality and quantity of natural resources (state). Pressures on wetlands can occur across a range of scales. Their effect can vary depending on a number of factors including intensity, landscape setting, type of wetland (lacustrine and palustrine, riverine and marine and estuarine), sensitivity of the wetland to the pressure, frequency of the pressure and the management in place to mitigate the impacts. Pressures affecting wetlands may be located a long way from the wetland itself, e.g. a dam at the top of a catchment may significantly alter the hydrology of a downstream wetland. Society responds to these changes through environmental, general economic and sectoral responses. Thus, highlighting the relationships between the environment and economic dimensions of sustainable development, the PSR framework takes into consideration socio-economic activities for example fish catches;

their impact on the environment for example depletion of fish stocks); and the response from Governments (for example, off-season). It is important that wetlands are managed from a whole-of-landscape perspective to help ensure pressures are addressed at appropriate scales. Adaptive management is critical, with a focus on wise use of wetland resources, mitigation and strategies to improve wetland management.

The Pressure-State-Response Framework can be linked to perception of indicators. Over the years, conventional development indicators have been developed mostly within the PSR framework which is explicitly recognized by the CBD (CBD, 2003; CBD, 1997a; CBD, 1997b)) and used by several OECD member countries including the Netherlands (Jackson *et al.*, 2000; Adriaanse, 1993). The PSR Framework can reveal data gaps, thus guiding data collection efforts. Indeed, PSR indicator system provides a useful and simple tool to formalize environmental problems due to its intuitive structure – human pressure on environmental state and political responses to adopt solutions. Environmental scientific programs have also adopted the PSR framework for developing interaction indicators. The PSR Framework is also used by organizations such as BirdLife International, The Nature Conservancy, WWF-U.S., the Biodiversity Support, Programme, and Foundations of Success.

A number of authors have noted some theoretical limits of this framework (Wolfslehner and Vacik 2007; Hukkinen 2003a; OECD, 1993) leading to subsequent modifications and adaptations of the PSR framework (Hukkinen 2003b; Briassoulis, 2001; CSD, 2001). The PSR model has been further expanded in three different directions: the first variation replaces the pressure indicator category with a category of driving force indicators (creating a Driver-State-Response framework), the second variation adds a category of impact indicators, transforming it into a Pressure- State-Impact-Response (PSIR) framework, and, finally, the last version includes all five indicator categories creating a DPSIR framework. Driving force indicators are able to encompass social, economic, and institutional aspects. The impact indicators are able to capture changes in physically measurable characteristics of the environment, and are able to focus on existing policies and management practices used (Segnestam 2002). It is important to note that this research recognises the limitations with the PSR model; however in assessing community perceptions at the local scale, the elements as propounded in the Driver-State-Response Framework, for example, the behavioural factors were covered. PSR model was used because it is more systematic, simplified and was practically easier to apply at the local scale.

1.2. Statement of Research Problem

The study investigated local community perceptions at three different wetland environments for the purposes of developing environmental indicators for effective management of wetlands especially those that are designated as Important Bird Areas. Systematic assessments of local perceptions can enable us to capture the values and concerns of the local people and take them into account in any wetland management decision making. Considering that wetlands are critical ecosystems in terms of biodiversity richness as well as the widespread threats facing them all over the world due to their huge attractions to society, there is need to avail the most appropriate tools for managing them in a sustainable manner. Unfortunately, biophysical and economical assessments have hitherto dominated decision making which has resulted in little consideration for the local people's knowledge, opinions or perspectives. The magnitude of the problem is so serious that some authors have stated that the environmental indicators developed so far for sustainable management 'are the best kept secret of the world' as they are hardly known by users. The scientific community defines indicators as indices- 'a set of aggregated or weighted parameters'. These indicators developed by the scientific fraternity are therefore unfamiliar, difficult to understand, unsuitable to local needs and at times irrelevant to policy instruments. To address this challenge, this study sought to identify indicators that describe the phenomena at the wetland for various stakeholders, especially the local community to comprehend,

1.3. Research Questions

The research questions included the following:-

- Do socio- demographic factors such as gender, age and type of resource use influence the perceptions held by local communities on wetland indicators?
- What are the perceptions of the local people about contemporary and future conditions (pressure-state-responses) at the study sites?

- Does the typology of community identified indicators vary from one wetland site to another?

1.4. Objectives of the Study

The overall goal of the research was to assess local perceptions on wetland environments for the purposes of developing environmental indicators for effective management of wetlands especially those that are designated as Important Bird Areas (IBAs) in Kenya. In this regard the following objectives were addressed in this study.

Objective 1: Establish the influence of gender, age, type of resource use on community perspective on wetland environmental indicators.

Objective 2: Determine the state of wetland environments (SoE) and predict their future changes from the local knowledge and community perspective on wetland environmental indicators

Objective 3: Determine the Pressure-State-Response indicators across different types of wetlands.

1.5. Study Justification

1.5.1. Theoretical Contributions to Perceptions of Environmental Indicators and Wetland Management

The study has a potential of enriching the intellectual discourse on environmental indicators in Africa. The study contributes to literature substantively, by providing empirical evidence of perception and behavioral patterns regarding environmental problems in wetland Important Bird Area settings. Last but not least, the empirical analysis adds to the growing literature on indicators in developing countries. The topic is also worth being investigating because concepts of biodiversity in general and biodiversity indicators in particular are new (Bubb *et al.*, 2005). The subject under study is topical and likely to continue in the future and there is evidence and authoritative opinion to support the need for the development of biodiversity indicators for sustainable environmental management. Given the magnitude of the environmental problems, the CBD has repeatedly emphasized the importance of developing national biodiversity indicators and building capacity for their further development and use. The study is therefore geared and committed towards an existing global agenda for environmental sustainability.

In 2002, world leaders committed, through the Convention on Biological Diversity, to achieve a significant reduction in the rate of biodiversity loss by 2010. To that end, a team of experts compiled 31 indicators to report on progress toward this global target. Despite some local successes and increasing responses (including extent and biodiversity coverage of protected areas, sustainable forest management, policy responses to invasive alien species, and biodiversity-related aid), the rate of biodiversity loss does not appear to be slowing (Butchart *et al.*, (2010). Kenya has also been facing a plethora of environmental challenges which continue unabated, negatively impacting on the millions of people dependent on natural resources and the livelihoods of the future generation. The study fits in well with the Ramsar's theme for 2010 on 'Caring for Wetlands – An Answer to Climate Change' in response to the expected impacts of climate change on wetlands, birdlife and society. Additionally, the United Nations has declared the year 2013 as a year of Water cooperation. As water is a global resource, this implies that cooperation at different scales i.e. technocrats and local communities, developed and developing world, private sector and public sector and also between institutions is a pre-requisite.

The study also fits in well with the mandate of UNEP, especially in the Division of Environment, Information and Assessment whose mandate is to 'keep under review the state of environment; enhance understanding of critical linkages between environment and human activities; identify priorities for international action; flag emerging issues and strengthen national, regional and global information handling'. Moreover, the subject is researchable, feasible, and ethical. It is also worth investigating issues in areas internationally recognized as Important Bird Areas (IBAs) because birds have a real connection with people and their lives. Birds can reflect trends in other animals and plants and can be sensitive to environmental change.The floodplain environments such as the Tana Delta/Floodplain and especially the ox-bow lakes in the area are among the least investigated areas in Kenya and yet so important, vulnerable and with a lot of community and development issues. Thus, despite the long standing and important role of wetlands as providers of resources, these systems have in the past been neglected by research, policy and legislation. This can partly be attributed to the perception of wetlands as wastelands that should be drained (Matiza and Crafter, 1992). The lack of understanding and appreciation of wetland values, functions and products by planners has led to the irreversible damage of wetlands (Matiza and Chabwela, 1992).

1.5.2. Methodological Contributions to Perceptions of Environmental Indicators

Methodologically, the study contributes by using the pressure-state-response models to define weighted multidimensional profiles of environmental perception and behavior

1.5.3. Policy Contributions to Wetland IBA Management

Indicators have the potential of influencing policy decisions (USEPA, 1996) as well as informing biodiversity planning and management at the local levels particularly in the case of District Environment Management Plans (DEAPs), District Strategic Plans, site specific management plans and Community Action Plans (CAPs). The study recognises that it may not be possible for the policy makers to take into account all the indicators identified by the local community. Furthermore, there is no unique set of indicators to be applied in all geographical areas and scales. In each case there are unique aspects which should be considered for each wetland IBA.

1.6. Operational Definitions

Traditional knowledge (TK), indigenous knowledge (IK), traditional environmental knowledge (TEK) and local knowledge generally refer to the long-standing traditions and practices of certain regional, indigenous, or local communities. Traditional knowledge also encompasses the wisdom, knowledge, and teachings of these communities. In many cases, traditional knowledge has been orally passed for generations from person to person.

CHAPTER TWO

THE STUDY AREA

2.1. Size and Location of the Study Areas

This chapter provides an introduction to the study areas, which are all Important Bird Areas, hereafter referred to as IBAs. These IBAs were purposively selected from three wetland types in Kenya. The IBAs are 1) Tana River Delta and Floodplain (for riverine/deltaic IBAs); 2) Lake Bogoria Nature Reserve (for saline lacustrine IBAs) and Lake Naivasha IBA (for freshwater lacustrine IBAs). They are recognised as sites of international biological importance, with specific reference numbers KE022, KE045 and KE 048 respectively. Figure 2-1 shows the geographical location of the study sites.

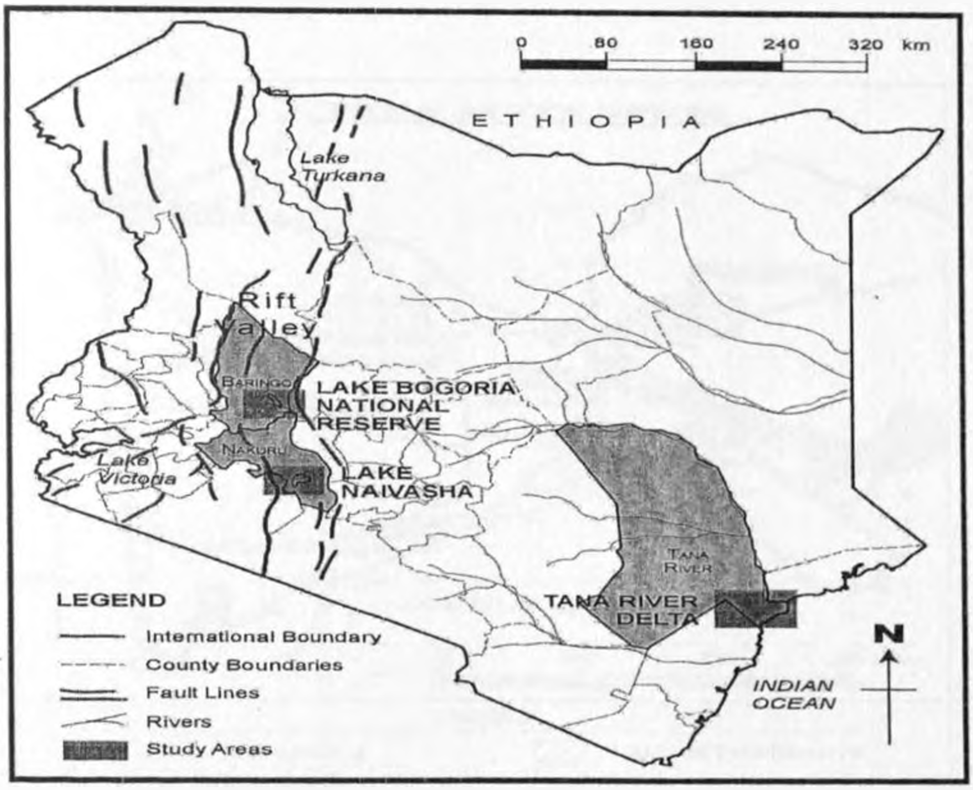


Figure 2-1: Location of the three study areas in Kenya

Source: Researcher, 2013

The Tana River Delta and FloodPlain IBA which measures 130,000 ha is located in the Tana River County. The IBA can be found at 40°20.00' East 2° 30.00' South within this county. The county is one of the seven that constitute the Coast region and it shares boundaries with Kitui to the West, Mwingi to the Northwest, Garissa to the north east, Ijara to the east, Meru North and Isiolo to the north, Lamu to the south east and Malindi to the southwest. It also borders the Indian Ocean to the south with a coastal strip of 35km. The total land size of the county is 38,782 km^2, divided into seven administrative divisions, three constituencies namely Bura, Galole and Garsen and forty three wards. The expanse area of the delta implies that there are a plethora of socio cultural activities which may have a bearing on the health of the ecosystem. Furthermore, multi- national companies have been showing more interest in tapping the vast resources that this wetland holds. Figure 2-2 shows the location of the study sites in the Tana Delta, namely Kipini, Ozi, Dida Waride and Moa.

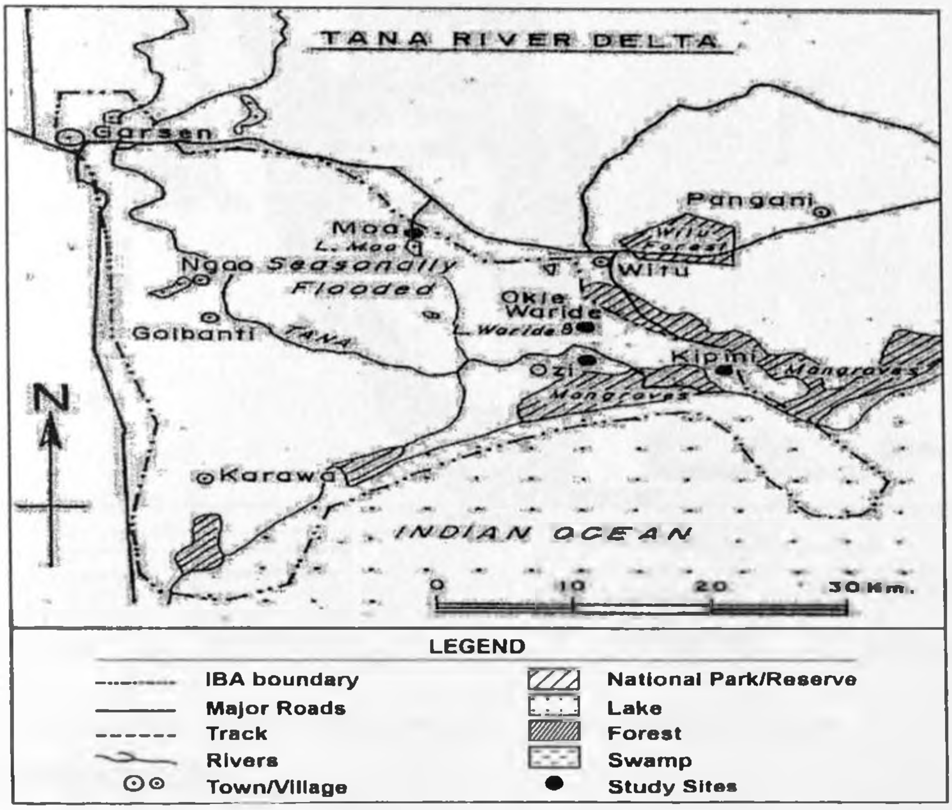


Figure 2-2: Location of the study sites Tana Delta and Flood Plain IBA

Source: Researcher, 2013

The Lake Bogoria National Reserve IBA lies between 36° 4' and 36° 7' East and 0° 20' North and about 10km North of the equator in Baringo County of Rift Valley region in Kenya. The Reserve, measuring 10,700 ha lies close to the eastern wall of the Great Rift Valley and has its headquarters at Loboi Gate (Bennun and Njoroge, 1999). Most of the reserve is occupied by the lake. Compared to the other two study sites, the reserve is fairly small in size as will be seen further in the study. Lake Bogoria Traditional Leaders Council is in a position to tour the length and breadth of the site as part of their inspection/monitoring of water points and grasslands for livestock. Figure 2-3 shows the study sites at Lake Bogoria, namely Loboi, Emsos and Sandai.

Figure 2-3: Location of study sites at the Lake Bogoria National Reserve

Source: Reseacher, 2013

Lake Naivasha watershed covers an area of approximately 3,400 km^2 (Morgan, 1998). Lake Naivasha is the only freshwater lake situated in the floor of the Eastern Rift Valley in Kenya at a mean altitude of 1885m above sea level is located at latitude 36° 22'E in Nakuru District, about 100 km north-west of Nairobi. The lake is located in the Nakuru County. It is a shallow freshwater lake (15,600 ha) with a fringing *Acacia* woodland (c.7, 000 ha). The Lake consists of the main lake, a small separated Lake Oloidien and a smaller Crater Lake Sonachi. The basin is bounded to the west by the Mau Escarpment, to the south and south-east by the Olkaria and Longonot volcanic mountains, to the east by the Kinangop Plateau and to the north and north-east from the Aberdare Mountain Range and finally to the north-west by the Eburu volcanic pile. Figure 2-4 shows the location of the study sites at Lake Naivasha, namely Karagita, Kamere and Kongoni.

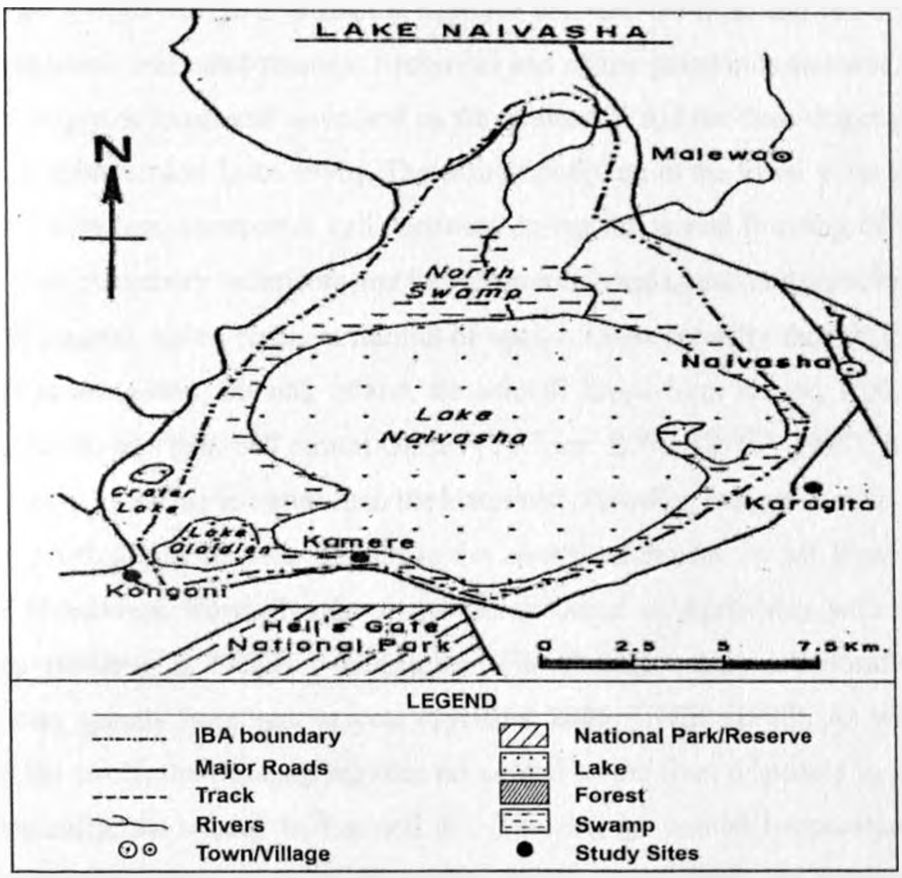


Figure 2-4: Location of study sites at Lake Naivasha

Source: Reseacher, 2013

2.2. Topography and Climate of the Study Sites

The major physical feature in Tana River District is an undulating plain which is interrupted in a few places by low hills. The main hills are Minjila in Garsen Division, Bilbil in Bura and Madogo making these areas the highest points in the county. The land in Tana River County generally slopes south-east wards with an altitude that ranges between 00 m along the coastline to 200 meters above the sea level on the hills (Ministry of State for Development of Northern Kenya, 2009).

The delta is roughly triangular in shape, with its apex at Lake Bilisa (north of Garsen) and its base a 50 km stretch of beach along Ungwana (or Formosa) Bay, stretching from Kipini in the north-east to Mto Kilifi in the south-west. This low-lying area is bounded by higher land to the east and west and to the south by a dune system bordering the Indian Ocean. It forms the interface between the river and the ocean, with fresh and brackish lakes and streams, freshwater and saline grasslands and wetlands, and succession stages of forest and woodland on the riverbanks and the dune ridges parallel to the shore (Robertson and Luke 1993). The entire floodplain in the lower parts is covered by alluvial sediments, transported and deposited during the annual flooding of the River. These lie over quaternary sediments that include marine sands, mud and coral breccia.

The coastal region receives rainfall of upto 1,250m annually though the rainfall varies and is unreliable. Moving inland, the rainfall drops from around 1,000 mm per year at Kipini to less than 600 mm at Garsen (Tychsen, 2006; UNEP, 1998). It therefore follows that the coastline is wetter than the hinterland. Flooding happens not as a result of local precipitation, but because of rain in the river's catchment on Mt Kenya and the Aberdare Mountains. Normally, the major floods occur in April-May with a smaller, short-rains flooding in October -November. The timing, extent and duration of the flooding vary greatly from year to year (Tychsen, 2006; UNEP, 1998). As will be seen further in the study, the flooding regimes are central to the lives of people in the area of focus. Generally, the county is, hot and dry. The average annual temperature is about 30°C. Temperatures are highest in the months of February, March and April, i.e. before the long rains (Kitheka *et al.*, 2004; UNEP, 1998). They are also significantly high in the months of September and October. The very high temperatures (which top 37°C and 38°C in some instances) lead to very high rates of evaporation and evapo-transpiration

(Ministry of State for Development of Northern Kenya, 2009). The climate in the Lake Bogoria National Reserve is arid to semi-arid regimes except in the moist highlands around Subukia (WWF, 2007). The climatic conditions are strongly influenced by the ITCZ (Inter Tropical Convergence Zone) and there are two distinct wet and dry seasons. Within the reserve and adjacent areas, the climatic conditions are harsh with temperatures at the lake ranging from 18°C-39°C with a daily mean of 25 °C. Mean annual precipitation varies from 500-1000mm and falls in two seasons April- May and October-November (WWF, 2007). The combination of weather variables and physiographic location give the lake basin a hot, semi-arid climate (WWF, 2007). Mean annual precipitation within the reserve varies from 500-1000mm and falls in two seasons April-May and October- November (WWF, 2003). The combination of weather variables and physiographic location give the lake basin a hot, semi-arid climate which is characteristic of the ecological zones 5 and 6 of Kenya.

The study area comprises mainly of rangelands with the rearing of goats, sheep, cattle, donkeys and camels and bee keeping forming the major livestock activities (WWF, 2007). However, several swamps occur in the study area and differ in size, water chemistry, biota, and hydrology. The Loboi swamp is the largest and constitutes a key ecosystem component as a water reservoir for livestock, domestic, and agricultural supply (WWF, 2007). Swamps along Sandai River play an important role in nutrient removal, agro-chemical retention, and sediment filtration. The seasonal streams and flash floods following heavy rains also make a contribution to the lake's volume.

The Naivasha basin is administratively located in eight areas within the Nakuru and Nyandarua counties (Naivasha, Narok North, Gilgil, Mirangini, Kipipiri and Kinangop, Nyandarua central and Nyandarua South in the Rift Valley and Central regions) (GoK, 2012). The Lake Naivasha basin area is approximately 3400 square kilometres, lying in the Eastern Rift or the Gregory Rift and extending into the Mau Escarpment rising to 3048 metres to the west and Nyandarua Mountains or Aberdare Ranges, rising to 4000 metres to the east (GoK, 2012). The ridges are among the highest ranges in the central part of the Rift Valley and are likely to have sufficient elevation to cause climatic conditions that result in greater rainfall relative to other major lake catchments. The mean annual rainfall in the Aberdare Range is 1350mm. Lake Naivasha basin is mainly dominated by a semi-arid environment in the lower catchment and has only a narrow semi- humid zone in the upper catchment. The rainfall is bimodal and is distributed between two rainy seasons in April- June (long rains) and October- November (short rains). The rainfall is of considerable variation, with between 1000-1500 mm per annum in the upper catchment especially in the Aberdares Ranges and less than 800 mm per annum in the Rift Valley Floor (GoK, 2012). The mean temperature around Lake Naivasha is approximately 25°C with a maximum temperature of 30°C, with December – March as the hottest period. July is the coldest month with a mean temperature of 23°C. The Lake Naivasha watershed is drained by only two perennial rivers, namely Malewa River and Gilgil River with catchment areas of 1700 km^2 and 400 km^2 respectively (GoK, 2012). The rivers and ground water sources are a key to the provision of water to the Naivasha and Nakuru municipalities as well as other adjoining human activities. The lake basin has immense socio economic and environmental benefits, which support over five hundred thousand people.

2.3. Population and Socio –Cultural Aspects of the Study Sites

The Tana River Delta and Floodplain is located in a district which is one of the least populated in the country with its population mostly concentrated along the river Tana and small urban centres scattered in the area. The total population is expected to grow by 13% every 5years. In 2009, the County had 217219 persons where 111,456 are female and 105,763 are male (2009 Population Census). The extensive delta created by River Tana presents great potential for the industrial development of the district. It also provides a grazing area during the dry seasons and its waters are used for agriculture, the main crops grown being rice, mangoes, maize, bananas and soya beans. Fishing, forestry and agro-forestry are also supported by the Tana Delta. Due to the vast potential of this area, different communities including farmers, fishermen, pastoralists and semi-pastoralists utilize the river floodplain for their livelihoods. The ethnic groups comprise of the Orma and Pokomo (pasturalists and agriculturists) and the Luo and Luhya (fishing). The indigenous communities of the river basin have practiced traditional land use activities for thousands of years without major impacts on the environment. An estimated 40,000 people live in the surrounding area of the Lake Bogoria National Reserve, according to the 2009 census figures. The population continues to increase due to immigration. Cattle grazing and human settlements have recently become evident within the reserve's boundaries and are steadily increasing. The problems are further exacerbated by uncontrolled and illegal over- abstraction (Mogaka *et al*, 2006). The local economy is primarily dependent on the lake's natural resource base. People rely on the Waseges River for water for domestic use, agriculture and for watering their livestock. The Loboi swamp plays a key role in storing water, which is used for irrigation purposes by the community.

It's important to note that Lake Bogoria is in a dry area, which cannot support rain-fed agriculture and therefore relies heavily on irrigation. River Waseges, which drains into Kesubo swamp before draining to Lake Bogoria, supports Sandai Irrigation Scheme, which is contracted by Kenya Seed Company to plant maize seeds. River Loboi on the other hand supports Kamoskoi irrigation scheme before draining to Kiborgoch Swamp (Mogaka *et al*, 2006). Kiborgoch (Loboi) swamp is dominated by papyrus reeds. This is an important resource that is harvested and utilized by both men and women in the study area. The papyrus is utilized by the Women Groups to generate income (Average of Ksh.20, 000) by making mats and other products. The communities at Emsos village in the southern part of the lake are now actively engaging in fish farming using freshwater from Emsos and Mgun streams (WWF, 2007).

Lake Naivasha supports an outstanding horticulture/floriculture sector that provides employment and generates significant amounts of foreign exchange for Kenya to the tune of over 100 million USD per year. It also supports a thriving fishery, livestock farming and a growing tourism sector. The water contributes to geothermal power generation in Olkaria Wells and supports significant biodiversity (both terrestrial and aquatic) (Becht and Harper 2002). Most importantly, a population of about 250,000 people in the vicinity of the lake gets its domestic water from the lake. The population of the Naivasha sub-county, within which the lake falls, has registered a rapid increase in population from 43, 867, 95 339, and 105, 458 to 158, 679 in 1969, 1979, 1989 and 1999 respectively (Kenya Bureau of Statistics). According to the 2009 census, the total population of the basin was estimated to be 650, 000 people of which approximately 160, 000 lived around the Lake itself.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Study Design

This is both a qualitative and quantitative study in the sense that an effort was made not only to describe, explore, and explain the phenomena being studied, but to conduct a detailed statistical analysis of the data. The purpose of conducting the descriptive study was also to demonstrate associations or relationships between the study variables (Bickman and Rog, 1998).

3.2. Data Types and Sources

The study considered a number of variables that can take on different values. In this regard, the study considered quantitative / numerical and non-numerical values as well as independent and dependent variables. The variables that were considered by the study include type of IBA, size of the IBA, protection status of the IBA, age of respondents, gender of respondents, resource users, distance from the wetland IBA and duration of residence in the village. The following section describes the operationalization of the variables selected for the study. The purpose of this was to attempt to answer two questions; 1) how is each variable for the study defined and 2) how is each variable for the study measured.

In terms of the type of the IBAs, the selected study sites were categorised according to Riverine, Saline and Freshwater Lake, while the size of these sites was measured according to hacters, for example, the riverine wetland measured 130,000 ha, the saline wetland measured 10,600 ha and the freshwater wetland was 15,600 ha. The protection status of these wetland IBAs was also crucial and they were identified as non-protected, reserve and protected. Protected areas are gazetted landscapes/seascapes that have been surveyed, demarcated and gazetted either as National Parks and/or National Reserves. The distinction between the two categories is: in parks there is complete protection of natural resources and the only activities allowed are tourism and research. On the other hand in reserves, human activities are allowed under specific conditions.

Age of respondents can be considered a variable because age can take different values for different people or for the same person at different times, for instance adult and adolescents. The different age ranges were 15-25; 26-36; 48-58; 59-69; 70-80 age groups. Similarly, location of respondents can be considered a variable because a person's location can be assigned a value- for example the distance from the wetland. The study considered respondents that were located within a 5km radius of the wetland.

The variable 'gender' consisted of two text values: 'male' and 'female'. The study was cognisant of the fact that gender is a remarkable discriminating tool in the distribution of labour, care, possession, income, education, organisational qualities or diseases. Social and cultural gender patterns were internalised to an extent where our self-worth was partially determined by the fact that we are male or female.

For wetland resource users, a total of 12 attributes were applied; agricultural farmers, livestock owners/livestock herders/pastoralists, coastal and inland fishermen, traditional healers, mangrove harvesters, reed harvesters, papyrus harvesters, carpenters, bee-keepers and charcoal burners. With regards to condition of the resource, the following attributes were used; state and pressure of the wetland resources mainly water, wetland vegetation, wetland birds, fish and grazing resources. Response interventions for wetland management was another variable with various attributes such as; education and awareness raising, institutional capacity building, security of land or resource tenure, devolution of responsibility to lower levels, enforcement of traditional rules, control or eradication of invasive species and habitat restoration. The other variables that were considered but not analysed were religion, which is a nominal value categorised in the study according to Christian, Muslim and other. Another variable was education which was measured by highest qualification attained beginning 1) no formal education, 2) primary education, 3) secondary education, 4) advanced level and 5) university.

3.2.1. Primary Data

The study collected the following primary data (Box 1) from the local respondents using a standard questionnaire:

Box 1: Primary data collected by the study

a) Water resources; quantity and quality of water, pressures on water quantity and water quality.
b) Wetland vegetation; abundance of wetland vegetation, pressures on wetland vegetation.
c) Wetland birds; abundance of wetland birds, pressures on wetland birds.
d) Fish; abundance of fish, pressures on fish resources.
e) Wetland pasture resources; quality and quantity of wetland pasture, pressures on wetland pasture.
f) Predictions of the condition of biodiversity in the future namely water, wetland vegetation and wetland birds.
g) Preferred Pressure-State-Response indicators.
h) Response interventions namely education and awareness raising, institutional capacity building, security of tenure, devolution of responsibility to lower levels, enforcement of traditional rules, control or eradication of invasive species and habitat restoration.

3.2.2. Secondary Data

The study collected the following data from secondary sources:

a) The data on population and number of households are from the 2009 Kenya Population and Housing Census Report published in August 2010, by the Kenya National Bureau of Statistics (KNBS) and also from the Ministry of Environmental and Mineral Resources.
b) Demographic data for 2009 was obtained from the Kenya Central Bureau of Statistics.
c) Annual water fowl census for Lake Bogoria and Lake Naivasha was collected from the databases and water fowl census reports generated by National Museums of Kenya and Nature Kenya.

d) Socio - economic characteristics of the study areas was obtained from the management plans and previous studies on the selected sites.
e) Spatial data was in the form of spatial data maps.
f) Topography and climate data from the Ministry of State for Development of Northern Kenya.

The study ascertained the work that had already been done by technocrats in the same study sites. Published and unpublished documents were used to capture information on the condition of the wetland resources. Project assessment reports, workshop presentations and correspondence were reviewed in order to establish the institutional/organizational pathways, follow up strategies, and challenges faced by relevant implementing agencies such as the Lake Bogoria National Reserve and the Fisheries Department in the Tana Delta.

3.3. Data Collection

3.3.1. Pilot Study (Reconnaissance) at One of the Sites

All 'known' attributes of the wetland, condition of the wetland and the associated benefits derived from the same were listed and then grouped into sub-sets following an extensive literature review. A pilot study was then conducted to each of the three wetland sites during the month of February 2010 in order to assess the completeness of the questionnaire, as well as to provide an introduction to the field research assistant prior to actual data collection. Pre-testing allowed the researcher to gain familiarity with the questionnaire and provide an opportunity to apply and review the method. The focus was on assessing how respondents understood the research questions and identifying any problems encountered in providing answers. Changes were proposed, reviewed and incorporated into the final questionnaire. Through informal interviews, the pilot study revealed the existence of several benefits attributed to the wetlands not recorded from the literature that were therefore added to the list. Furthermore, the pilot study was useful in that it enabled the researcher to compute the appropriate sample for the selected study sites.

3.3.2. Target Population and Sample Size

3.3.2.1. Target Population

The main target population for the study was both the direct and indirect users of the wetland. The target users were located with a 5 km range of the wetland.

3.3.2.2. Sample Size

To arrive at study sample size, the study considered the categorical nature of the data to be collected. The study set an alpha level priori at 0.05 and 5% margin of error which is generally acceptable in most studies, (Krejcie and Morgan, 1970). Table 3-1 shows the demographic statistics used in the determination of the sample size using the Cochran method.

Table 3-1: Demographic information at village level **Source:** Population Census (2009) - Kenya Bureau of Statistics

District	Division	Location	Sub Location	Male	Female	Total	Households	Area sq km	Density
Baringo	Marigat	Sandai	Sandai	590	616	1206	179	32.09	30.87
Baringo	Marigat	Chelaba	Emsos/ Maji Ndenge	541	518	1059	237	47.8	443.12
Baringo	Marigat	Chelaba	Loboi	546	540	1086	356	74.26	29
Sub Total				1677	1674	3351	772	154.16	502.99
Naivasha	Kongoni	MoiNab (Kamere)	Kipkonyo (Kamere)	1289	1235	2524	612	122.39	20.62
Naivasha	Kongoni	Maiela	Kongoni	2054	2050	4104	1209	86.3	48
Naivasha	Kongoni	Hells – Gate	Karagita	500	4209	4709	1562	119	56
Sub Total				3843	7494	11337	3383	[illegible]	124.62
Tana Delta	Kipini	Kipini	Ozi	2113	2060	4173	801	28.1	148
Tana Delta	Witu	Dide-Waride	Moa	1814	1754	3568	667	334.9	11
Tana Delta	Witu	Dide-Waride	Dide-waride	3043	2770	5813	1095	362.4	16
Tana Delta	Kipini	Kipini	Kipini	9913	9664	19577	3743	374.5	52
Sub Total				[illegible]	16248	33131	6306	[illegible]	227
Total				22403	25416	47819	10461	1581.74	854.61

The dichotomous nature of the gender variable was considered at a 5% margin of error and this meant that the proportion of respondents of either sex was within ±5% of the proportion calculated from the research sample. Since the study captures the gender of respondents who are users within the IBA sites, therefore the estimated standard deviation of the scale is 0.5. The Cochran's sample size formula for categorical data was used (Cochran, 1977).

$$n = \frac{(z)^2 x(p)(q)}{(d)^2}$$

Where Z = value for selected alpha under a standard normal curve table, Z is $\pm$ 1.96 for a 95% confidence level. *(The alpha level of 0.05 indicates the level of risk the researcher is willing to take that true margin of error may exceed the set margin of error)*

*d=e=margin error= (pq) = (0.5) (0.5)=0.25/ (Maximum possible proportion (0.5) * 1- maximum possible proportion (0.5) produces maximum possible sample size).* d = acceptable margin of error for proportion being estimated = 0.05 (error researcher is willing to except). Therefore, for a population of 47819, the required sample size is 384. However, since this sample size does not exceed 5% of the population (47819*.05=2391), Cochran's (1977) correction formula was to calculate the final sample size as follows:

$$n_1 = \frac{n_o}{\left(1 - \frac{n_o}{Population}\right)}$$

$$n_1 = \frac{384}{\left(1 - \frac{384}{47819}\right)} = 387$$

Where population size = 47819

n_0 = required return sample size according to Cochran's formula= 384

n_1 = required return sample size because sample < 5% of population.

These calculations result in a minimum returned sample size of 387. However, there was oversampling in the targeted population with a response rate of 81%, a minimum drawn sample size of 475 was used. These calculations were based on the following:

Where anticipated return rate = 81%.

Where n_2 = sample size adjusted for response rate.

Where minimum sample size (corrected) = 387.

Therefore, $n_2 = \left(387/_{0.81}\right) = 475$. Hence for this study $n_2 = 475$ was adopted as the study sample size.

3.3.3. Data Collection Instruments

The data was collected between the months of February 2010 and April 2011.Out of the diverse data collection instruments, the researcher focused on those instruments that would be able to measure the variables in the research questions. The data collection instruments used by the study included the following;

a) Structured questionnaires
b) Interview schedules with the different wetland user groups
c) Interviews with individuals accessing wetland resources and selected randomly
d) Attendance at the Lake Bogoria Council of Elders Meeting
e) Existing records, Workshop presentations, Project assessment reports and Management Plans for Lake Bogoria, Lake Naivasha and Tan Delta.

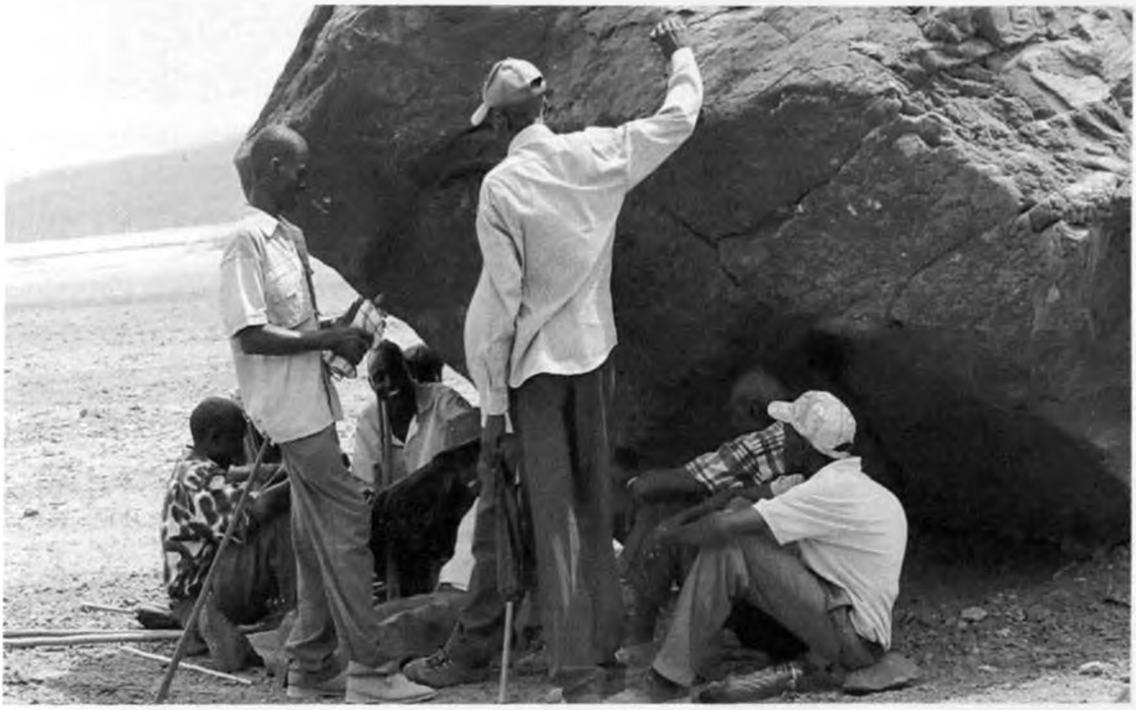
3.3.4. Sampling Procedure (Data Collection Procedure) or Techniques

3.3.4.1. Focus Group Discussions (FGDs)

The focus group discussion was the main approach used for soliciting responses from the respondents. Purposive sampling was applied, with the researcher selecting participants based on the resource use type. At least 112 FGDs were held with respondents across the three study sites. The selection of focus group discussion participants was based on two criteria; first, a participant had to be a village resident with a long and sufficient knowledge of the community and that he or she had to be considered to understand well the local natural resources available in the village. The individuals were selected using village leader's knowledge and thereafter, the proposed individuals were used to include other members whom they thought had enough knowledge to participate in the exercise. Each focus group consisted of at least 7 to 12 people and lasted not more than 2hrs.

Males and females formed their two independent group discussions. This procedure had an advantage of allowing more freedom especially women to air their opinions and views very openly on the matters of socio-economic activities that happened in the wetland area and their impacts on land use and cover change and how they perceive effect of changes of native habitats to bird diversity in the wetland. In some of the groups, there was a mixture of both males and females; for example male dominant and female dominant groups. Plates 3-1, 3-2 and 3-3 shows some of the respondents that participated in the focus group discussions with a focus of interphase between livestock farmers, fishermen and papyrus harvesters with their wetland environments respectively.

Plate 3-1: Focus Group Discussion with livestock herders at Lake Bogoria



Source: Reseacher, April 2011

Plate 3-2: Focus Group Discussion with fishermen at Ozi Village

Source: Reseacher, April 2011

Plate 3-3: Focus Group Discussion with the Chelaba Handicraft Project members at Lake Bogoria

Source: Reseacher, February 2011

This section also discusses the epistemology and theoretical perspective of focus group discussions and what these different epistemological stances imply for the design and implementation of focus group investigations. According to Guba and Lincoln, (1994), focus group discussion's epistemological stance is anchored in the belief that it has the ability to elicit broader as well as more indepth understanding of an issue or topic, because the interaction process stimulates memories, discussion, debate and disclosure. The emphasis here is on content. This view is widely considered as the 'essentialist stance'. On the other hand the 'social constructionist stance' assumes that the focus groups are more appropriate to the analysis of processes of social interaction. Flexible tools like focus group discussion had to be used in order to offset the bias that is inevitable with more pre–structured tools (Bernard, 2002). It also enabled rapid generation of information and timely correction to any wrongly given information by the other participants. The focus group discussion also has in built checks and balances by allowing the participant to debate the responses (Bickman and Rog, 1998).

3.3.4.2. Individual Interviews

Individuals encountered close to the water source within the riparian zone (defined for the purposes of this study as land lying between the wetland edge and up to 500 m inland) were approached in a random, systematic manner at each site. Each individual in the population of interest had an equal likelihood of selection. If a participant was to be interviewed, open-ended questions were asked and responses written down verbatim. The unstructured informal interviews were conducted as a preliminary step in the research process to generate ideas/hypotheses about the subject being investigated so that these might be tested later in the field research. These interviews were entirely informal and guided by a pre-defined list of issues, such as resource use patterns and frequency of resource use. This was done in a random, systematic manner as all individuals within the vicinity of the wetland had a probability of accessing, using and managing the resources.

3.3.4.3. Key Informant Interviews

In order to select key informants for the study, purposive sampling was done. The researcher adopted a systematic and pragmatic approach to selecting the key informants were knowledgeable, reflective members of the community of interest who knew much about the culture and were both able and willing to share their knowledge. Specifically, these informants were chosen based on traditional ecological knowledge, residency, professional activity, age and elders with empirical knowledge and people involved in providing technical guidance, such as personnel/practitioners from the relevant institutions. The study also ensured that the informant was near as possible to the theoretical norm of the sampled population (for example. as close as possible to the typical livestock herder), and able to communicate often with other people of his or her craft (Allen, 1971; Lewis and Sheppard 2006).

To arrive at this, the researcher familiarized herself with the study sites and also sought guidance from the Chiefs and the Chairpersons on the WRUAs. At least 32 key informant interviews were held across the three study sites. Some of the key informants included the District Commissioners, Fisheries Officers, past and present Chiefs, Chairpersons of the Beach Management Units (BMUs), Chairpersons of the WRUAs, Leaders of the Pastoralists Outreach Services (POS), Council of Elders, project coordinators and extension officers. Plate 3-4 shows some members of the Council of Elders at Lake Bogoria demonstrating their traditional ecological knowledge in creating artificial man- made water pans known in the local knowledge as "Tabari" meaning pan dams.

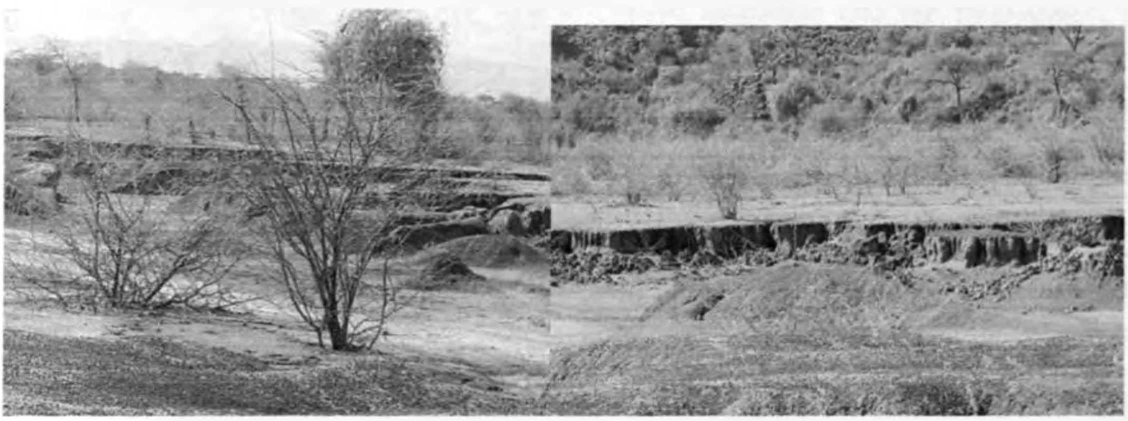
Plate 3-4: Lake Bogoria Council of Elders demonstrating water point identification

Source: Reseacher, February 2011

3.3.4.4. Direct Observations in the Field

While in the field, the researcher in addition to the FGDs and individual interviews also directly observed the local communities and their engagement in the various wetland related activities. The purpose of observational data was to describe the setting that was being observed in terms of both the activities that are taking place, the actors who participate in the activities, and the meanings of what is observed (Hammersley and Atkinson 1995). Through nonparticipant observation, the researcher obtained valuable information that could not have been obtained otherwise. During the first visits to the sites, social settings were observed. Observations the researcher found interesting and relevant to the study were transcribed in order to make them part of the data material for example, observed resource use patterns and gully formation which showed the extent of land degradation, for example in Plate 3-5.

Plate 3-5: Gully formation at Sandai Village



Source: Reseacher, February 2011

By making use of unobtrusive methods, the researcher was able to make an observation of people in their natural setting and the avoidance of being obvious about observing them as this can affect the situation and thereby the data being collected. The aim was to see the world from the point of view of the subject(s) being studied rather than imposing the researcher's own views. The researcher wanted to understand what social processes and actions mean to the people involved in them and develop theoretical statements about them.

3.3.4.5. Selection of Wetlands

The following considerations were made in the selection of geographic study sites and site specific focus groups for data and information gathering:

a) The study purposively sampled wetlands that are classified by BirdLife International as Important Bird Areas using scientifically agreed criteria
b) The sites are regarded as of international importance according to Ramsar even though at the commencement of the research, the Tana Delta was not yet classified as a Ramsar Site. At the time of commencement of the study, evidence point to the fact that Tana Delta was home to vulnerable, endangered, or critically endangered species or threatened ecological communities (Ramsar Criterion 2). The wetlands are internationally important because they support populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region (Criterion 3).
c) The sites were to be representative important bird area across the three types of wetlands in Kenya, namely the riverine, saline lacustrine and the freshwater lacustrine IBAs.
d) Each wetland type has its own unique attributes hence the different classification standards. The following section provides a description of the distinct attributes in each site;
    a. Tana Delta – floodplain ecosystem are among the earth's distinctive features.
    b. Lake Bogoria - alkaline/saline lake with unique ecology; vital for flamingo conservation – lesser flamingos feed and reproduce only in alkaline-saline lakes; hot springs are synonymous with the lake.
    c. Lake Naivasha - unique among the East Africa Rift Valley lakes in that the water is fresh. It has long been thought that the low salinity of this lake is due, in part, to rapid water loss from the lake into the local ground water system. Lakes in the Rift Valley are normally saline unless water can escape through an outlet; however there is now no visible outlet to the Naivasha Lake. The supposition is that there is underground seepage

maintaining the movement of fresh water brought into the lake by the Gilgil and Malewa rivers in the north.

e) The sites have different institutional/management systems where Lake Bogoria is a National Reserve; Lake Naivasha is an internationally protected site under private management that allows human activities and the Tana Delta was unprotected at the time of commencing this study. The assumption was that there were differences in the interface between human beings and biodiversity between protected and unprotected sites thus the interest in ascertaining the factors affecting traditional ecological knowledge/local perceptions of the community.

3.3.4.6. Choice of the Sample Villages

a) Having made a choice of regions/wetlands to conduct research, the next stage was village selection. Purposive and non - random sampling informed by both scientific and operational issues approximated a set of criteria, some of which were similar to those for selecting regions, while others were slightly different. The purposive sampling method employed in this survey was based on the understanding that communities are not homogenous particularly in terms of levels of wetland utilization, conservation challenges, socio-economic values attached and development concerns and threats;

Some of the key considerations in the selection are highlighted below;

b) The study was cognizant of focusing on people of interest that suit the purpose of the study;
c) The study focused on local communities located within the 5 km range of the wetland. This was done on the assumption that these communities would have a better appreciation of the condition of the biodiversity resources;
d) Distance from main roads (accessibility);
e) The study considered the sites that had diverse ethnic groups;
f) Villages which had some differences in terms of size, ethnicity, livelihoods but which would still allow some comparisons, as well as contrasts, to be made. Operationally, the villages had to be logistically accessible to the

research team, yet far enough away from each other to ensure that 'spillover' was unlikely;

g) The following villages were selected 1) Tana River Delta (riverine); Kipini, Ozi, Dida Waride, Moa; 2) Lake Bogoria (saltwater lacustrine): Loboi, Sandai and Emsos and 3) Lake Naivasha (freshwater lacustrine): Kamere, Karagita and Kongoni. An additional village was selected in the Tana River Delta study area, bringing the total number of villages to four. The fourth village has an oxbow lake and the justification for selecting this site was that these unique wetlands have not been studied extensively. Furthermore, the Tana Delta is an expansive area- hence the study had to cover an additional village so that the results were representative;

h) The study made an effort to cover villages in the upper, middle and lower sections of the catchment.

3.3.4.7. Selection of Resource User Groups

a) From the onset, the wetland resource users were the groups in mind for the accomplishment of the study. Thus, a total of 12 different wetland user groups were purposively sampled across three study sites.

b) The participants comprised of agricultural farmers, livestock owners/livestock herders/pastoralists, coastal and inland fishermen, traditional healers, mangrove harvesters, reed harvesters, papyrus harvesters, carpenters, bee-keepers and charcoal producers.

c) These wetland resource users can be categorised into direct and indirect users or consumptive and non- consumptive users.

d) The age of the respondents was taken into account. The resource users included in the sample ranged from the 15-80 as it was indicative that they had some level of responsibilities that required either direct or indirect use of the wetland and to a certain degree, a level of accountability with regards management of the wetland.

e) A deliberate effort was made to give consideration to gender in the sampling process to choose respondents in the research. This was based on the background that women and men interface with wetlands differently and the associated challenges that come with this interaction are different for women from men. Although it was not possible to balance the numbers in the distribution, views of women were captured out of the total 475 respondents to the research questions, represented by 19.6%.

3.4. Ethical Considerations

Social scientists have an obligation to their colleagues, their study population and the larger society to conduct their research in an ethical manner. As well as being integral to our everyday lives, ethics is a major branch of philosophy that has occupied great minds for many centuries. Researchers must ensure the rights, privacy and welfare of the people and communities that are the focus of their studies' warns Berg (2001). Fontana and Frey (2000) condenses the ethical considerations as 'informed consent', 'right to privacy' and the protection from harm. The latter was a lesser concern in this research. In order to ensure that the study was conducted in the most ethical manner- meetings were held with the local community to explain the objectives of the study before starting the field work, and requests for their participation as well as seek their mandate to conduct the study.

Furthermore, ethical consideration for the conduct of the study pertained to 1) clarification regarding the resource user groups that would be approached and how these would be accessed, 2) provision of an information sheet and consent form, clarification how confidential/anonymity would be protected and provision of the copy of the interview questions. The study endeavoured to respect indigenous intellectual property rights as well observing the culture of the local community. An effort was made to ensure that community's decisions were respected and that the study did not challenge existing systems but rather be seen as adding value to conservation and development in the selected areas. The respondents were made aware that no material would be placed in the public domain without their prior consent to do so. All respondents were offered the right of veto and censure for any material they are associated with for example knowledge about medicinal plants.

An additional safeguard was that no material in any way could be attributed to the individual participant. From the outset, the respondents were identified in generic categories such as 'resource users'. However, some demographic and organizational status information relevant to the study and known to the researcher, which may have identified the individual, was now made public knowledge. While conducting the field and conducting interviews photographs were taken- in cases where individual were photographed their permission was sought, detailed written notes were taken as well as audio recording to enable re- visiting for clarification if necessary. The Ministry of Education, Science and Technology of Kenya which granted permission for this research to be undertaken after all the necessary paper work had been submitted also has a set of ethical standards for all research conducted in Kenya and these were complied with accordingly.

3.5: Data Processing and Analyses

3.5.1. Data Processing

The first step was to ensure that the data was clean and free from inconsistencies and incompleteness. The research instruments used were scrutinized for errors and omissions and as far as possible, gaps in the information obtained from respondents. This was done immediately in the field and in some cases at a central place after the field work. In some cases, phone calls were made to the research assistants in the field to verify the data. Once the data was clean it was coded by assigning a numerical code and value so that it could easily be fitted into the appropriate categories. Each answer was assigned a separate number. The valid returns were then converted into tables as these offered useful means of presenting large amounts of detailed information in a small space.

The Statistical Package for the Social Sciences (SPSS) was used to examine any cross tabulation or associations/groupings which emerge from the variables in this study. In order to assess the reliability and validity of data, the researcher had initially planned to administer the questionnaire or portions of the questionnaire to the same respondents at different times or under different circumstances in order to assess how stable the answers were. Due to logistical challenges this was however not conducted. Nevertheless, the approaches to establishing validity included comparing survey results with behavioral observations, comparing the sample surveyed with groups that are expected to be similar or dissimilar in critical ways, comparison of results to the results of other data collection instruments expected to measure the same thing, obtaining expert opinion, and internal analyses of the instrument. A triangulation of methods as stated above were thus useful in ensuring that unbiased and reliable data was collected. In reporting the results of the statistical analysis, the research complied with the American Psychological Association–APA (2010) style which dictates reporting the exact *p* value within the text (unless the *p* value is less than 0.001). With the exception of some *p* values, most statistics in the study were rounded to two decimal places. Generally, the study also ensured that the name of the test, the value of the test statistic and the degrees of freedom and/or sample size was reported on. Specifically, the study focused on three pieces of information (1) the effect significant (p-value), (2) the size of the effect (effect size), and (3) the direction of the effect (the count within each cell as part of the evaluation of the statistical data.

To have respondents communicate their perceptions, feelings, attitudes, opinions, and evaluations in some measurable form, the study used the Likert interval scale in both numeric on each of the criteria listed and semantic forms (making extensive use of words rather than numbers). The following variables that were measured as follows; state of the wetland resources on water quantity, wetland vegetation, wetland birds, fish and wetland pasture. These variables were measured on a five (5) point scale for example; very low, low, moderate, high and very high. The variable on water quality was measured on a (6) point scale, for example; poor, marginal, fair, good, very good and excellent. This was done in order to provide respondents with more options considering the importance of water quality for livelihoods. The most common standards used to assess water quality at the local level related to livestock watering; drinking water; safety of human contact and the health of ecosystems- particularly aquatic resources-fish.

In terms of predicted future changes to the wetland environment, the resource user's perceptions were measured on a (5) point scale as follows: do not know, remain constant, decreases, disappear and increase. The variables on response interventions namely education and awareness raising, institutional capacity building, security of tenure, devolution of responsibility to lower levels, enforcement of traditional rules, control or eradication of invasive species and habitat restoration measured on a five (5) point scale for example; very low, low, moderate, high and very high, with a few exceptional cases where respondents indicated 'none'. In order to measure the resource user's perceptions on pressures exerted on the wetland environment and the response interventions, a (5) point scale was also used and this is as follows; very low, low, moderate, high and very high. In terms of which Pressure-State-Response indicators would be more suitable at the local scale, a rating of (3) was used for example; 1- Least; 2- Medium and 3-High.

3.5.2. Data Analysis Techniques

In the analysis of perceptions held by the local people about the wetland environment, the study used both descriptive (frequency tables, cross tabs) and inferential statistics (chi-square). Descriptive statistics is the term given to the analysis of data that helps describe, show or summarize data in a meaningful way such that, for example, patterns might emerge from the data. Descriptive statistics do not, however, allow the researcher to make conclusions beyond the data has been analysed or reach conclusions regarding any hypotheses the researcher might have made. They are simply a way to describe the data. On the other hand, inferential statistics seeks to reach conclusions that extend beyond the immediate data alone. The study used inferential statistics to make inferences from the data to more general conditions and descriptive statistics simply to describe what's going on in the data.

3.5.2.1. Measuring Variations in Resource Users Perceptions

The Kruskal Wallis H test was used to understand different perceptions of resource user groups between IBA sites. The independent variable was the resource user groups. This test was considered appropriate for use because the study had three or more conditions that had to be compared and each condition is observed by a different group of participants. The study takes recognition of different assumptions of the Kruskal Wallis as noted by (Hinkle *et al* 2003). If the Null Hypothesis of equality of distribution is false, *H* will unusually be larger, resulting in a one tailed test. For sample sizes of five or greater, the rejection region for *H* is based on the chi –square distribution with (k-1) degrees of freedom. The appropriate p value is 0.05 as a 5% significance level is required.

The test statistic is given by:

$$K = (N-1)\frac{\sum_{i=1}^{g} n_i(\bar{r}_{i\cdot} - \bar{r})^2}{\sum_{i=1}^{g}\sum_{j=1}^{n_i}(r_{ij} - \bar{r})^2},$$ where:

- n_i is the number of observations in group i
- r_{ij} is the rank (among all observations) of observation j from group i
- N is the total number of observations across all groups
- $\bar{r}_{i\cdot} = \frac{\sum_{j=1}^{n_i} r_{ij}}{n_i}$,
- $\bar{r} = \frac{1}{2}(N+1)$ is the average of all the r_{ij}.

3.5.2.2. Measuring of difference in perceptions among user groups in IBA Types (Contingency Chi-Square Test)

The researcher applied this statistical procedure to assess whether there was any difference in resource user group's response to state of environment in the three IBA sites. The study selected respondents from the population of interest, and the data are categorized on the basis of the two variables of interest, that is the IBA resource user group and the IBA type (freshwater for Lake Naivasha, riverine for Tana delta and alkaline for Lake Bogoria). This test was important in assessing the respondent's observations on various IBA indicators. Such measures can be used in statistical hypothesis testing, for example whether outcome frequencies follow a specified distribution. The statistical symbol for Chi-square is (χ^2) and the formula for calculating is stated here- below.

$$(X^2) = \sum (Observed - Expected)^2 / Expected$$

The study found it imperative to determine at what level the test will be significant, usually using the significant level of P=0.05. The test statistic was based on the principle that the Chi-Square Test is only valid if '0 cells have an expected count of less than 5'. If there is any value above 0, the chi-square is not valid. At the end of the test, the researcher compared the significant value (from the output table) against the level of significance which is already predetermined.

3.5.2.3. Determination of association between variables (Spearman Rank Correlation Coefficient)

The study used the Spearman Rank Correlation coefficient, r_{est} as a non-parametric measure of the strength and direction of association that existed between two variables measured on an ordinal scale. The co-efficient is denoted by the symbol r_s (or the Greek letter, pronounced rho). The formular used to calculate Spearman's Rank is shown below;

$$r_s = 1 - \frac{6\sum D^2}{N(N^2-1)}$$

The test is used for either ordinal variables or for interval data that has failed the assumptions necessary for conducting the Pearson's product-moment correlation test. The correlation coefficient, which ranges from 1 to 1, was used to determine whether the variables are related linearly in a negative or positive manner as outlined by Rowntree (1981). Correlation coefficients whose magnitudes are between 0.9 and 1.0 indicate variables which can be considered very highly correlated. Correlation coefficients whose magnitudes are between 0.7 and 0.9 indicate variables which can be considered highly correlated. Correlation coefficients whose magnitudes are between 0.5 and 0.7 indicate variables which can be considered moderately correlated. Correlation coefficients whose magnitudes are between 0.3 and 0.5 indicate variables which have a low correlation. Correlation coefficients whose magnitudes are less than 0.3 have little if any (linear) correlation. In reporting the results of the Spearman's Correlation, the researcher included *r* - the strength of the relationship and *p value* - the significance level. "Significance" indicates that there is the probability that the line is due to chance. More specifically, the "Significance" represents a test of whether the line is different from a flat line (e.g. a flat line would be represented by a Pearson correlation = 0). Any p-values less than 0.05 indicate that the result is not due to chance.

3.5.2.4. Pressure-State – Response Approach in Analysis of Indicators

In this study, the Pressure-State-Response approach – which is widely recognized as a tried-and-true method for sustainable management of wetland ecosystems –is adopted to identify problems faced by specific wetlands and to develop appropriate indicators for policy-making. This is discipline specific analysis technique which was used for identifying a set of proxies at each wetland IBA which indicate environmental, economic and social problems. Then, identified proxies were arranged in separate PSR frameworks to structure a set of problem packages. Finally, a set of indicators were selected from existing literature review or synthesized based on available data on the wetland in three groups: pressure, state and response indicators. To establish the common and unique environmental indicators, the number of stakeholders for which each particular indicator was scored was considered. This gave a frequency of score for each of the indicators in the consolidated list indicator frequency matrix table. The following classes are distinguished, high (common), medium (semi- common) and least (unique).

3.6. Scope and Limitations of the Study

In addition to the other sites within the Tana Delta, the study had intended to cover Lake Shakababo. However, Lake Shakababo, located approximately 98kms from Kipini and Ozi was not easily accessible during the rainy season. Moreover, there were implications in terms of time as well as resources. The study was therefore limited to one part of the Delta, the eastern side where Kipini, Ozi and Didewaride as well as Lake Moa are located. The study did not investigate whether demographic factors of education level, employment status, and state of residence influenced the perceptions about wetland environments and whether these variables showed any disparity across the wetland types. The study limited itself to the gender, age, resource user groups, proximity to the wetlands. The study also did not compare the environmental attitudes between children and adult, nor did it address environmental perceptions longitudinally within the individuals.

CHAPTER FOUR

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

4.1. Introduction

The previous chapter introduced the reader to the reason why the research was undertaken. The purpose of this chapter is to review literature pertinent to the study. Opening the chapter is a contextualization of the factors that influence community perceptions in biodiversity conservation. Section 4.2 provides an insight into the construction, logic and consistency of community indicators. Section 4.3 provides and insight into the status of wetlands and management regimes in Kenya and last but not least in the significance of the Important Bird Areas as critical sites for conservation.

4.2. Factors Influencing Environmental Perceptions

Perception is the process by which organisms interpret and organize sensation to produce a meaningful experience of the world. Sensation usually refers to the immediate, relatively unprocessed result of stimulation of sensory receptors in the eyes, ears, nose, tongue, or skin. Perception, on the other hand, better describes one's ultimate experience of the world and typically involves further processing of sensory input (Interaction Design Foundation, 2006).

Perception is influenced by a variety of factors, including the intensity and physical dimensions of the stimulus; such activities of the sense organs, as effects of preceding stimulation; the subject's experience; attention factors, such as readiness to respond to stimuli; and motivation and the emotional state of the subject (The Columbia Electronic Encyclopedia, 2007). The theoretical accounts of perception can, by and large, be divided into two groups; bottom-up theories (or data-driven) and top-down theories (Sternberg, 1996). Top-down theorists start their explanation of perception from the top, focusing on expectancies, prior knowledge, and other higher-level cognitive processes and then work their way down to considering the sensory data such as perceptual stimulus. Bottom-up theorists start from the bottom and consider the perceived physical stimulus, the observable form or pattern, and work their way up to higher-level cognitive processes such as the organising principles (Sternberg, 1996). Generally, public perception refers to the conscious understanding that people have of public and official issues (Interaction Design Foundation, 2006). There may be a basic disparity between the factual truth and their virtual truth influenced by the public opinion, level of education and the mass media. All political and public figures and corporations are subject to public scrutiny which makes them pursue the right path to avoid the perils of negative public perception. According to the French scientist, Alexis de Tocqueville, perception is an opinion that establishes itself in the majority of the people or a community; it persists for a long time as it is not attacked by anyone (Davison, http://www.britannica.com)

Public opinion or perception is largely influenced by media and public relations. The mass media uses various advertising techniques to convey their message and influence the thoughts of the people on important issues. People's opinions depend on various factors such as their immediate situations, their social factors, and their already existing knowledge and system of beliefs and values (The Columbia Electronic Encyclopedia, 2007). Opinion leaders who voice their opinions on popular issues have a major role in influencing public perception about them. In many cases public perception is swayed by rumors and emotions which may not always be accurate. By and large the public may possess factual information about the public figures and corporations which leads to their forming a general perception about public issues (Interaction Design Foundation, 2006). At times public perception is swayed by cultural prejudices and may distort the truth of a prevailing situation. Public perception can change easily and is largely dependent on the powers that control the press and media.

It is common to regard public perception as passive as it is greatly influenced by what is being conveyed to the public by various external agencies such as the media. For instance regarding the issue of corruption ailing the government and private sector, it is the media which exposes such issues in the absence of which the public would have a favorable view towards these organizations (Interaction Design Foundation, 2006). Similarly if the people are exposed to negative news about a certain industry they would see it in bad light despite any truth in the allegations. In short public perception is shaped by what is told to the public and as such the social environment has a pervasive influence on public perception. People's attitude is influenced by the opinions prevailing in the social group to which they belong. In short the person's family friends, community, place of work, school, church and other social networks can influence public perception. For example it was found that the soldiers in the U.S. military during World War II who had to move from one unit to another often changed their opinions to adjust to the general opinion of the unit in which they were stationed (Interaction Design Foundation, 2006). Interest groups, religious groups, Non-government Organizations (NGOs) and labor unions help in developing and spreading public perception on various economic, political and ideological issues affecting their community and state. They work mainly through public relations, advertising, media and even word of mouth.

4.3. Factors that Influence Perception at the Local Community Scale

Several authors have attempted to show the factors that influence perceptions at the local scale, especially in rural community settings. People's perceptions of conservation issues are likely to be influenced by an array of socio-economic issues such as state of environment, level of education, wealth status and such other; demographic (household size, age of household head), and geophysical factors (distance and terrain of household from the forest or markets) according to Dolisca *et al.*, (2007); Racevskis & Lupi (2006); McFarlane & Boxall (2000); Gillingham and Lee, (1999); Hill, (1998); Mehta and Kellert, (1998). Gaining an understanding of these factors can provide information necessary for designing targeted policy measures to address people's aspirations in conservation and sustainable natural resource management.

Another key debate has pitted 'intellectualist' against 'utilitarian' explanations of the prolific classification abilities of folk peoples. The former, which amounts to a form of psychological reductionism, holds that people are motivated by an instinctual and unconscious intellectual drive to recognise, categorise and name large numbers of plants and animals, many of them without any apparent use or cultural significance (Berlin, 1992). The latter, which amounts to a functionalist interpretation, contends that no group discriminates all of the biological organisms in their surrounding habitat and a truly exhaustive examination of the (direct or indirect) use or avoidance-value of this subset would find that the selection process was mostly determined by utilitarian or adaptive criteria (Hays, 1982; Hunn, 1982). However, perceptual and cultural salience may interact with each other. The very survival of the indigenous people has largely been based on their own ecological awareness and adaptation. As a general orientation to the concept of indigenous people, one could say that indigenous peoples are distinct peoples with their own languages, culture and territories who have lived in a country since times prior to the formation of the current nation state (Posey and Overal, 1990). These communities are the repositories of vast accumulations of traditional knowledge and experience that links humanity with its ancient origins. The inextricable link between culture and nature is well expounded by Posey (1990). Being closely associated with and dependent on nature, traditional societies have largely (though by no means always) shared a symbiotic and sustainable relationship with nature (Posey and Overal, 1990). Local communities relied heavily on the diversity of biological resources in order to meet their requirement; dependence on biodiversity helped lessen the pressures on any single components. Thus through trial and error, aided by natural selection, these communities have continuously enlarged their knowledge system on natural resources and have found several new uses for it (Posey and Overal, 1990).

Scientists, politicians, activists and others have stated that the intellectual heritage is valuable and relevant for the modern westernised world and urge that it be documented, preserved, utilised, and integrated with scientific knowledge (Maffi, 2001; Posey, 1999; Warren *et al.* 1995; Williams and Baines, 1993; Moock & Rhoades 1992; Warren *et al.* 1989). Despite the mounting accolades, the attitudes of the scientific community towards Indigenous Knowledge (IK) are still marked by considerable ambiguity, skepticism, contention, and debate. Redford & Stearman (1993) are skeptical that traditional people are natural conservationists. They argue that the present day traditional societies are to a large extent part of the global economy and have lost many of their traditional and cultural values. Nonetheless, many anthropologists defend the conservation mentalities of traditional communities (Clad, 1984; Bodley, 1976). Some analysts have advised that the IK of biodiversity and ecological relationships and indigenous resource management skills constitute valuable tools for conservation planning, implementation, and monitoring, and therefore recommend that these be documented and incorporated into such programmes (Posey, 1999; Moran, 1993; Plotkin and Famolare 1992; Brokensha *et al.*, (1980) cited in Agrawal (2008) warns that to ignore peoples knowledge is to ensure failure. Under the banner of a populist perspective, IK is portrayed as dynamic, experimental, innovative, adaptive, intelligent (but not perfect), locally-specific, and therefore a vital component of development strategy. Almost all the authors do agree that local communities are more likely to employ environmentally sustainable practices when they enjoy territorial security and local autonomy (Biehorst, 1994; Kalland, 1994; Alcorn, 1994; Redford and Stearman, 1993; Gadgil and Berkes, 1991). Unfortunately, there seems to be a rapid loss of this ecological knowledge. From their argument Agrawal (2008); World Bank (1998); Maffi (1996) strongly point out that IK is in danger of getting extinct and its disappearance will be a great loss to humanity. A lot of factors have contributed to the decline and loss of local knowledge, vernacular names being stigmatised and falling into disuse or became the province of 'backward rural populations'. Can local knowledge be supported, promoted, preserved and communicated without using vernacular names? There are many factors at play including population movements, culture contact and processes of environmental change.

Under the pervasive influences of modernisation, there has been significant usurpation of other knowledge bases. Local people are not indifferent to the importance of innovations. Everything is bound to change in ways that cannot be forecast properly/accurately, hence the need for humans to remain vigilant and adaptive. All 'tradition' in actuality is continuously undergoing revision. Innovation, adaptation and resilience are attributes of all cultures. However, imposing sudden, forceful and unwanted changes has proved dramatic for most local people- reduction of their territories, imposition of western laws over customary laws, destruction of key ecosystems and resources and general loss of control over their destinies. Since indigenous knowledge is learned and adapted through direct observations on the land, removing people from the land breaks the generation cycle of empirical study.

Deprived of routine direct interaction with the ecosystem, the indigenous peoples loose the means of transmitting old models and data as well as means of acquiring new knowledge. Maintaining the full empirical richness and detail of traditional knowledge depends upon continual use of the land as a classroom and laboratory. Thus traditional lifestyles are sustainable and compatible with the preservation of biodiversity as long as they are not forced to abandon their customary management practices in response to dispossession. The loss of traditional language and culture may also be hastened by environmental degradation- such as that caused by logging, mining, waste dumping, agribusiness, cattle raising and real estate development. These processes and the ensuing loss of control over native lands are among the main causes of disintegration if indigenous communities, a phenomenon that has been termed 'ecocide'- (Grinde and Johansen (1995). Land destruction undermines both the physical and spiritual bases for the maintenance of indigenous groups' identity as distinct people with their own languages and traditions. Molina *et. al*., (1993) finds that among his people, the Yoeme people of the Sonoran Desert in Arizona, the performance of ritual is hampered by the disappearance of many plant species that were traditionally employed in traditional ceremonies. This is due to the increasing settlement by the non Yoeme, unsound harvesting practices and conversion of the land to different uses.

The 'utilitarian' criterion is a factor in determining perceptions. The daily interactions that riparian communities have with their wetland environment help shape perceptions and whether these are right or wrong, they are essential in informing environmental policy. The local communities are not passive but are very much aware of their own environment and perceptions are informed either by observing or making use of that particular resource. The study agrees with authors who assert that due to modernisation as well as forceful relocation there has been a change in traditional ecological knowledge. This is exemplified at Lake Naivasha while Lake Bogoria presents a different scenario due to the entrenched traditional system.

4.4. Composite Indicators of Environmental Sustainability

Actions that steer the course of society and its economic and governmental organizations are largely tasks of making decisions and solving problems (Simon *et al*., 1986). This requires choosing issues that require attention, setting goals, finding or designing suitable courses of action, and evaluating and choosing among alternative actions. The first three of these activities—fixing agendas, setting goals, and designing actions—are usually called problem solving; the last, evaluating and choosing, is usually called decision making (Simon *et al.*, 1986). Indicators are particularly useful for decision making because they support the process (Hardi and Barg, 1997). Decision-makers as well as the general public would like to know at one glance what the environmental situation in a given country / region is. There is therefore a clear need for developing a single indicator that could serve as an overall measure of environmental sustainability. The literature points to the fact that scientists took the inspiration from the other two pillars of sustainable development, the Gross Domestic Product GDP and the Human Development Index in order to develop the 'environmental indicators'. The section below therefore discusses these in the context of 'Community Well – Being and Sustainability' to assess how environmental indicators evolved. Government agencies and academic scientists have developed reliable set of environmental indicators to assist in making environmental policy decisions. The trend has been driven in part by scientific advances and in part by policies that seek to justify environmental expenditures as likely to produce beneficial results that they intend (Moldan *et al.*, 2004). Environmental indicators offer the promise of applying science to help decision makers select tools that will produce predictable outcomes in measurable ways. The environmental indicators are central to this study.

4.4.1. Community Well- Being Indicators

Well-being is a concept describing the state of individual's life situation. Two well-known examples of indicators to gauge human progress are the Gross Domestic Product (GDP) and the Index of Leading Economic Indicators (ILEI) Prescott-Allen (2001). GDP has been in use since the 1944 Bretton Woods meeting. During 1940s, well-being conceptualizations were utilitarian and assessment of well-being was based on some measure of national income per capita such as GDP. It represents the total value of goods and services produced by economy over a certain period of time (a month, a season, a year, for example). It is a model of a very robust indicator very widely used. However, these utilitarian measures were soon criticized since income only catches one aspect of individual's well-being. Kusago and Kiya (2008) discuss well-being indicators and their applicability to community based development in Japan. The authors examined the association between conventional measures such as GDP and other social or subjective indicators such as Genuine Progress Indicator (GPI) and life satisfaction in Japan. By looking at the association, they discussed (i) whether GDP is a reliable measure of people's well-being at the community level, and (ii) if not, what kind of measures or approaches would be required to assess well-being in community-based development. Kusago and Kiya (2008) agree with critics who have pointed out that "income is a means, not an end." GDP is not a sufficient measure of people's well-being mainly because GDP captures only income level and it does not incorporate social costs such as environmental loss and other social costs well. On the other hand, GPI, developed to take those costs into account, shows totally a different picture of social progress from that of GDP's (Kusago and Kiya 2008). The body of knowledge stated above clearly points to the fact that life satisfaction does not accord with the attainment of high income level. This suggests that ideas and efforts to develop new measures of well-being and life satisfaction were needed so that policy makers could formulate policy effective to improve people's well-being than sole gains in GDP.

According to Cox *et al*., (2010), the term 'community wellbeing' encompasses the broad range of economic, social, environmental, cultural and governance goals and priorities identified as of greatest importance by a particular community, population group or society. Implicit in this definition is a recognition that community wellbeing priorities will vary across cultures and societies. The primary aim therefore is not to establish a single, universally agreed or 'objective' definition of wellbeing but rather to provide a common framework of concepts and measures which can assist citizens and communities arrive at working agreements about the goals.

Development of composite wellbeing or 'quality of life' indexes has evolved from frameworks and methodologies at national, regional and international level. The most successful and widely used composite indicator is Human Development Index (HDI), which was developed by the United Nations Development Program (UNDP) in 1990 (Cox *et al*., 2010). HDI combines income, life expectancy, adult literacy, and school enrollment (Cox *et al*., 2010).The literature review has shown that there are two schools thought; proponents of income as measure of wellbeing on one hand, and on the other for those who assert that income falls short of assessing the reality on the ground. The study agrees with the authors who take a holistic view. The undergoing provides an insight into sustainability indicators.

4.4.2. Sustainability Indicators

The use of GDP as a proxy measure of well-being has been challenged by some research especially on social capital and human capital (Boarini *et al.*, 2006). This has led to a focus over human well-being sustainability issues and happiness concern. A lot of this is also dependent on people's livelihood security. There are ongoing attempts to incorporate notions of sustainability into well-being measures. One way is to view sustainability in terms of inter-generational equity, which effectively requires that present and future generations should have the same opportunity to achieve basic well-being (Anand and Sen 2000).

Indicators of sustainability are different from traditional indicators of economic, social, and environmental progress. In his publication "The Wellbeing of Nations", Prescott-Allen (2001) addresses the shortcoming in the Community Well-Being (CWB) stated above by combining indicators of human wellbeing with those of environmental stability to generate a more comprehensive picture of the state of our world. This gave rise to the 'Barometer Approach', described in detail below. This study concludes this section by noting that though the Human Development Index (HDI) index was not developed as a sustainable development index; recent efforts have been made to supplement it with an environmental dimension to encompass explicitly the multiple dimensions of sustainability. Integrated environmental–economic accounting is a framework that is rapidly gaining prominence. Having discussed the Community Well Being Indicators and Sustainability Indicators, the study shifts to focusing on environmental indicators, which are central to the study.

4.4.3. Environmental Indicators at the Global Scale

The Organization for Economic Co-operation and Development (OECD) (1993) is credited with initiating indicator development work in 1989 (Larssonand Esteban, 2000; Noss, 1990). In the field of environmental sustainability several composite indicators have been proposed. This study evaluated six of them. Environmental Sustainability Index (ESI) published by the World Economic Forum (World Economic Forum, 2002) is a measure of the overall progress towards environmental sustainability, developed for 142 countries. The ESI scores are based upon a set of 20 core indicators each of which combines two to eight variables for a total of 68 underlying variables. The ESI permits cross-national comparisons of environmental progress in a systematic and quantitative fashion. It represents a first step towards a more analytically driven approach to environmental decision making. The European Union's Joint Research Center in Ispra developed the Dashboard of Sustainability (DS) as software which allows presenting complex relationships between economic, social and environmental issues in a highly communicative format aimed at decision-makers and citizens interested in sustainable development (JRC, 2004). The Consultative Group on Sustainable Development Indicators (CGSDI) published the "From Rio to Johannesburg" Dashboard for the WSSD, with over 60 indicators for more than 200 countries – a tool for elaborating assessment of 10 years since the Rio Summit). The Wellbeing index (WI) combines 36 indicators of population, health, , wealth, education, communication, freedom, peace, crime, and equity into the Human Wellbeing index, and 51 indicators of land, biodiversity, water quality and supply, air quality and global atmosphere, and energy and resource use pressures into an Ecosystem Wellbeing index. The two indexes are then combined into the Wellbeing/Stress Index (Prescott-Allen, 2001). This gave rise to the 'Barometer Approach'.

The study notes that the Barometer approach -or the Well-being approach- is a promising one in the sense it gives an immediate and easy to understand reflection of ecosystem and human well-being. Moreover, it allows the interested parties to define their own criteria for sustainability and thus the overall process to be participative. One of the most important points which should be self-evident in all the sustainable development measurement framework- is that there is no substitution between ecosystems and human-wellbeing; they are both prerequisites for sustainable development.

The Ecological Footprint (EF) of a specified population can be defined as the area of ecologically productive land needed to maintain its current consumption patterns and absorb its wastes with the prevailing technology (Wackernagel and Rees, 1996). People consume resources from all over the world, so their footprint can be thought of as a sum of these areas, wherever on the planet they are located (Wackernagel and Rees, 1996). The aim of the information generated by this indicator is to change human behaviour in ways that are less consumptive and more conducive to conservation. The Living Planet

Index (LPI) is an indicator promoted by the World Wildlife Fund (WWF). The LPI provides the general public, scientists and policy-makers with information on trends in the abundance of the world's vertebrates and offers insights into which habitats or ecosystems have species that are declining most rapidly. The LPI information can be used to define the impact humans are having on the planet and for guiding actions to address biodiversity loss (Loh, 2002). The Eurostat's material flow indicators are based on economy-wide material flow analysis, which quantifies physical exchange between the national economy, the environment and foreign economies on the basis of total material mass flowing across the boundaries of the national economy. Material inputs into the economy consist primarily of extracted raw materials and produced biomass that has entered the economic system (this biomass is composed of, for example, harvested crops and wood). Material outputs consist primarily of emissions to air and water, land filled wastes and dissipative uses of materials (e.g. fertilizers, pesticides and solvents).

The indicator of Direct Material Consumption (DMC) defined as a sum of all domestic extraction flows (extracted raw material, harvested biomass, etc.) including imported and excluding exported material flows (both raw materials, biomass and semi-manufactured/manufactured products) (Eurostat, 2001). Moldan *et al.*, (2004) present performance of the G-7 countries regarding the various indicators discussed above expressed as a rank (Table. 2-1). In an assessment of the level to which the indicators in Table 2-1 meet the important criteria such as salience, credibility and legitimacy, Moldan *et al.*, (2004) indicate that all these indicators fall short of expectation. As stated above, indicators of environmental sustainability should deal with some important links between the environmental and the other two pillars of sustainable development. The four indicators, namely the environmental part of the Dashboard, the Ecological Footprint, the Living Planet Index, and the Direct Material Consumption are, from this point of view, better suited for being accepted as the indicators of environmental sustainability. However, all of them are capturing only some partial elements of the environmental parameters (Moldan *et al.*, 2004); hence they do not meet the salience criteria. Salience means that the indicator is interesting, useful and relevant for the user. It must show something "that really matters". All the existing indicators have serious problems regarding the other two criteria, namely credibility and legitimacy. Probably the most important comment is that basically in all cases the selection of the sub-parameters of the indicators is arbitrary. The elements of all the indicators are certainly important ones designated by excellent experts but still the selection lacks clear scientifically objective base (Moldan *et al.*, 2004).

Table 2-1. Ranks of the G-7 countries based on selected indices (**Source:** Moldan *et al.*, 2004

	Canada	France	Germany	Italy	Japan	UK	USA
DMC[1]	7	4	5	2	3	1	6
WB[2]	1	6	2	5	3	7	4
EWB[3]	1	6	2	4	7	5	3
ESI[4]	1	2	4	6	5	7	3
EF[5]	6	4	2	1	3	5	7
EF-CO_2[6]	6	1	5	2	4	3	7
HDI[7]	1	5	6	7	3	4	2
DS-SDI[8]	3	4	1	7	5	6	2
DS-SDIenv[9]	2	3	1	6	5	7	4
GBL[10]	1	3	6	4	7	5	2
GDP[11]	2	7	3	5	4	6	1

Note: The lower the score, the better result

[1] DMC – Direct Material Consumption Indicator, 2000; Data source: Eurostat, 2002; Canada, USA, Japan – estimation EC EVG1-CT-2002-00083 (MOSUS)

[2]WB – Wellbeing Index, end of 90'ies; Data source: Prescott-Allen, 2001

[3]EWB – Ecological Wellbeing Index, end of 90'ies; Data source: Prescott-Allen, 2001

[4]ESI – Environmental Sustainability Index, 2002; Data source: World Economic Forum, 2002

[5]EF – Ecological Footprint, 1999; Data source: Living planet report, 2002

[6]EF-CO2 – CO2 Ecological Footprint, 1999; Data source: Living planet report, 2002

[7]HDI – Human Development Index, 2002; Data source: Human Development Report, 2004

[8]Ds-SDI – Dashboard of Sustainability, 2000; Data source: Dashboard of sustainability; UNCSD set

[9]Ds-SDIenv - Dashboard of Sustainability, 2000; Data source: Dashboard of sustainability; environmental part of UNCSD set

[10]GBL – GeoBiosphere Load, end of 90'ies;

[11]GDP – Gross Domestic Product, 2001; Data source: Human Development Report, 2004.

This objection is particularly valid regarding the Ecological Footprint. The resulting value of the indicator is dominated by the concept of the CO_2 absorption which can be questionable (Moldan *et al.*, 2004). In addition, the method of aggregation is in all cases not without problems (JRC, 2002). The legitimacy of all presented indicators is probably the main problem. However, legitimacy is something that may not be obtained easily and instantly but still it is possible to achieve gradually (Moldan *et al.*, 2004). If the scientific community brings some truly salient and credible indicator of environmental sustainability, the legitimacy may be finally earned. An encouraging example of such process is the ongoing effort to develop an "agreed set of sustainable development indicators" by OECD (1999) or the structural indicators used by the European Union.

The 'indicator evaluation criteria' as provided by scientist falls short in addressing the needs of the local communities. In their review of sustainability indicators, Swisher *et al.*, (2003), identified characteristics of good sustainability indicators which the study agrees with. Swisher *et al.*, (2003) assert that the indicators should reveal links between the economy, society and the environment; the indicator should be relevant to all sectors of the community; the indicators should address the carrying capacity of the community's natural resources and acknowledges ecological limits; the indicators should provide the long term view of the community for example looking forward 25-50 years rather than 5-10 years and that the indicator addresses the economic, social and environmental diversity. In addition, the indicator should be sensitive and adaptable to changing circumstances and conditions; the indicator should be simple, clear and unambiguous; reliable, providing adequate data and measuring what the community wants to measure; the indicator should demonstrate to community members how individuals contribute it to the overall picture; and the indicator should not at the expense of the other communities. Fresh initiatives oriented to capture complex interlinkages in the interactions between human activity and the environment, especially those related to pressure–state–response causalities, have been undertaken in recent years (Bossel, 1999, Meadows, 1998). Undoubtedly, all these efforts are needed to provide decision makers with information and operational criteria to assess current situations and evaluate strategic decisions. Furthermore, these efforts hold the additional promise of treating environmental problems within a framework that the key institutions and agencies in any government will understand. Having taken a look at indicator development at the global scale, the study gives a preview of Kenyan situation.

4.4.4. Environmental Indicators at the National Scale: BINU Pilot Project in the context of Kenya

A medium sized project led by UNEP- WCMC on biodiversity indicators for national use was supported by GEF in January 2002 (Brann, 2007). The project aimed at operationalising ecosystem-specific indicator frameworks and core sets of indicators for use at national level, using a case study approach and building on work already carried out under the Convention on Biological Diversity (Bubb *et al.*, 2005). Four countries were selected to participate in this Pilot Project. Kenya, alongside Ecuador, Philippines, and Ukraine were the countries that were selected to pilot this indicators development. In Kenya, the BINU project was being implemented by Kenya Wildlife Service under the Ministry of Environment and Natural Resources in collaboration with the National Museums of Kenya, Kenya Marine Research Institute, Department of Fisheries, Ministry of Planning and four national Universities. Kenya's approach to the development of indicators was based on four representative wetland types at a national level (Bubb *et al.*, 2005). Kenya formed four task forces to focus on each of the main wetland types in Kenya. Each task force targeted their work around four focal sites that represented each of the different wetlands types of wetlands in Kenya, namely: Lake Naivasha (freshwater lacustrine wetlands), Lake Nakuru (saline-alkaline lacustrine wetlands), Tana River (riverine wetland), and Yala Swamp (swamps and marshes). Each task force developed indicators representing their specific wetland type. This data was then aggregated to the national level in a national level workshop (Brann, 2007). The Kenyan BINU project identified the five key questions that the indicators should answer:

1. What are the wetland resources values, functions and status?
2. Who are the owners and users of wetland resources?
3. What are the threats to wetlands and their impacts?
4. Is there adequate policy, legislation and management framework for sustainable use?

This study agrees with authors such as Brann (2007) that considerable achievements were made by the BINU project in Kenya. The project helped create awareness about the importance of indicators as an important tool for decision making and gave impetus to this research. Another significant milestone was capacity building of diverse stakeholders working on biodiversity conservation-related issues within each country. Participating stakeholders found it very valuable to be able to increase their personal knowledge base and professional network through their involvement in the BINU project. In Kenya there has been some governmental uptake of the indicators, particularly by KWS, which was well positioned to utilize the indicator framework in its resource management mandate and also as the National Focal Point for the Ramsar Convention (Brann, 2007). The indicator framework in Kenya showed that biodiversity in wetland areas had severely declined. According to one source, this conclusion led to a direct and immediate policy result that no new tourism infrastructure development would be allowed in protected areas. This result could not be verified, but assuming that this policy action was the result of information provided by the BINU project, this policy shift would represent the one documented instance of BINU having a direct impact at the policy level. This success in Kenya was likely due to KWS's institutional positioning as a government body with significant independence.

The methodology for monitoring at the local level was elucidated and ecosystem specific indicator frameworks and core sets of national indicators using a case study approach were operationalised. BINU presented the first opportunity within the participating countries to put together an aggregate picture of biodiversity at the national level (Brann, 2007). The Kenya BINU project also involved stakeholders at a much broader level, including community groups and site-specific resource user groups. It was observed that in the project national start-up workshops in Kenya (as well as in the Philippines and Ukraine) policy-makers were generally absent (Brann, 2007). Many workshops and meetings were held to reach and involve the full-range of stakeholders. Involving such a broad range of stakeholders led to some challenges. It proved difficult in the process of key question development to find questions that fulfilled the priorities of all stakeholders. Policy makers have expressed the need to develop socio-economic indicators that are tied to biodiversity to effectively answer question on the importance of wetlands to national economy, indicators such as fish landings, water supply and wetland function have been proposed. Could the process by which indicators have been developed in Kenya be likened to a top – down approach? The top-down paradigm is rooted in scientific reductionism and advocates the use of explicit quantitative indicators (Reed *et al.*, 2005). This approach is expert-led, often refers to long-term analysis such as climate change, and is common in the fields of research such as landscape ecology, conservation biology, and soil science. This approach often fails to engage local communities. Reed *et al.*, (2005) advocate that sustainability indicators need to be linked to action that provides immediate and clear local benefits to enable the participation of local communities. These authors point out that indicators need to be relevant to local people and the methods used to collect, interpret and display data must be easily and effectively used by non-specialists so that local communities can be active participants in the process. The bottom-up paradigm, on the other hand, is community-based having an understanding of the local context and perceptions of the environment and society. It draws on the social sciences and emphasises the importance of the local context to setting goals and establishing priorities. Community participation is central to this process in order to gain relevant and meaningful perspectives on local issues, which enhances the communities and researchers capacity for learning and understanding (Reed *et al.*, 2005). In this spirit, this study has placed a strong emphasis on developing community based indicators.

4.4.5. Challenges and Prospects for Future Indicator Development Work

A number of challenges have been identified for indicator development. Gregory *et al.*, (2005) indicates that there are several reasons why progress has been limited. Recognizing what these are may be an important step towards overcoming the obstacles of the past. This study was aimed at addressing some of the key challenges in environmental indicator at the local level as highlighted below. First of all the problem lies in the fact that biodiversity encompasses everything about the living world. It is impossible to derive a simple and practical indicator that would reliably cover the genetic composition of populations to the structure and species richness, the structure of their habitats and the functioning ecosystem (Gregory *et al.*, 2005). Any indicator can therefore appear inadequate because it fails to reflect some particular aspect and this aspect may be particularly important to some community. Indicators must be specific to environmental, economic and social conditions (UNCSD, 1998). For instance, indicators of sustainable land use will vary greatly between deserts, mountains, agricultural lands and tropical forests. The UN asks a question of how then can generalised and comparable indicator sets be developed given this scenario?

The multiple facets of complex environment/development problems require many indicators to assure experts that all critical factors are being followed, yet politicians keep calling for a few simple indicators of policy relevance. The UNCSD (1998) and Gregory *et al.*, (2005) goes further to elaborate that insufficient political will to tackle the key issues about conserving biodiversity is a problem. This is because of the common perception that doing so would primarily mean additional costs and with the benefits being less to define in monetary terms. Someone has to choose the indicators to be used and this is a person with limited knowledge – what Meadows (1998) refers to as dependence on a false model and certain scientific and social background and therefore certain degree of subjectivity is inevitable (Bossel, 1999). Other problems include: lack of appropriate data which may result on missing vital information, this further could lead to measuring what is measurable rather what is important (Meadows, 1998); and overaggragation (Meadows, 1998) of too many things resulting in an unclear meaning and therefore bad communication and analysis capability. If indicators are not chosen carefully and as systematically as possible they will carry the wrong message resulting in misleading conclusions.

To illustrate the inadequacy of data, the UNCSD (1998) gives an example of one well-studied area of Canada where 39 dimensions of sustainability were defined, and 130 necessary data sets were identified, but adequate data was available only for 11.This data gap is often underestimated. Gregory *et al.*, (2005), states that poorly known habitats and ecosystems and poorly understood dynamics within natural systems can appear as obstacles to progress. Elsewhere, China's environmental policy-making has been long plagued by information gaps, asymmetries, and limited public access, among other challenges (Zhang *et al.*, 2010; Mol, 2009 and Wu, 2005). China still suffers from a number of key elements that characterize "information-poor" environments, which Mol (2009) defines as any context where information and informational processes linked to any issue are marginalized or suppressed. With respect to information regarding China's environmental conditions, these "information-poor" elements include economic constraints that result in inconsistencies in available monitoring systems and technical capacity; political factors that limit information flows and processes; and institutional and organizational constraints that hamper information collection, processing, and dissemination (Mol, 2009).

For many indicators that would be desirable or even essential to understand sustainability, there are essentially no relevant data collected (United Nations, 1998). In only a few cases are surrogate measures available. Whole new dimensions of human activity and of environmental characteristics need to be observed and monitored in order for them to be managed. Even the institutions to do this on a continuing operational basis are often lacking. Many environmental and social processes or impacts are not well understood, show random or chaotic behavior, are subject to interference or interaction with other factors, or are otherwise unpredictable. It may thus not yet even be clear what is important or measurable with indicators to address a particular problem.

Failing and Gregory (2009) list and discuss ten common mistakes in designing biodiversity indicators for forest policy. UNEP (WCMC) (2009) state that some of the indicators developed are 'too remote from the in country situation', 'some of the indicators are difficult to understand'. In Kenya, the BINU project did not achieve its objective of influencing policy. The reason attributed to this is that policy development and policy change is a multi-year process. This process requires a long-term targeted awareness and education effort to influence policy. Considering the initial low level of awareness and understanding of biodiversity among stakeholders in the BINU countries at the time the project began, having a significant influence on national planning and decision-making within the expected time frame of the project was not realistic. The level of anticipated policy impact was unrealistic for a project of this size and timeframe given the general low level of understanding and awareness of biodiversity indicators in the participating countries. Persons directly involved with the project's development concurred that the project document outlines objectives that were beyond the practical reach of the project. There is little or no evidence that the indicator frameworks developed have been used by countries other than those that participated directly in the project (Brann, 2007). Noting that the project ended in 2005 and still a number of African countries are not familiar with the indicator development process, the critique will provide some of the insights into the key obstacles for use of biodiversity indicators. Have the successful approaches identified by the project been adequately disseminated to strengthen the capacities of other countries, and to support global and regional development of indicators of biological diversity under the Convention on Biological Diversity? However, in Kenya some in-country replication did take place. After the BINU project was complete, KWS received additional funding to develop indicator frameworks for all other ecosystem in the country. This work was apparently completed very quickly due to the experience gained through BINU. Other than the limited example, there has been little to no replication.

The BINU project did build stakeholder ownership within each of the countries, but not at all levels. The intended users in Kenya are unaware of them and the indicators are often unsuitable to their needs. The reasons for these major flaws are irrelevance of the indicators to the policy needs, technical shortcomings in the context and presentation, failure to elaborate the strategies of engaging the users in the development process, non-existent dissemination strategies and lack of institutionalization to promote and update the indicators. The process of evaluation and selection of the potential indicators need further elaboration. Although there is an indication of the need to calculate the indicators, the BINU Project does not elaborate so as to provide guidance to would-be -users on how to arrive at this.

4.5. An Overview of Wetlands

4.5.1. Wetlands at the Global Scale

Wetlands are ecosystems that occupy about 9% of the world's land surface (United Nations, 1996). The term 'wetland' was developed out of a need to manage these specific areas, for which several definitions exist. The difficulty in defining a wetland arises partly because of their highly dynamic character, and partly because of difficulties in defining their boundaries (Abebe and Geheb, 2003: Mitsch and Gosselink, 2000). The official definition proposed by the Ramsar Convention (1971) reads as follows: "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 salt, including areas of marine water the depth of which at low tide does not exceed six meters". Wetlands are therefore both land ecosystems that are strongly influenced by water, and aquatic ecosystems with special characteristics due to shallowness and proximity to land (Roggeri, 1995).

A number of wetland classifications exist in the literature, and just as some disagreements on definitions of wetlands exist, there is also no universally agreed classification of wetland types. Wetlands have been classified on their sources of water and nutrients, according to their hydrological regime, soil type, vegetation structure, and so on. Differences between these classifications stem from reasons and regions for which the classifications have been developed (Roggeri, 1995). Roggeri (1995) characterizes wetlands according to geomorphological units (the main sources of water and nutrients) and ecological units, in particular vegetation. Another classification of wetlands is through soil and terrain characterization. The Ramsar Convention adopted the Ramsar Classification of Wetland Type at the Conference of the Parties in 1990 (Kabii, 1998). It divides wetlands into three main categories as a broad framework to aid rapid identification of wetland habitats: The main categories are marine/coastal wetlands, inland wetlands and man-made wetlands. These three classifications show the immense diversity of wetlands. Although wetlands are a common landscape feature across all continents, there is an uneven distribution in specific types.

Various authors have discussed the numerous services provided by wetlands (Roggeri, 1998; Barbier, 1993; Dugan, 1990; Adamus and Stockwell, 1983) and considerable research has been carried out on the specific roles wetlands play and how these interact with the local environment. Wetlands contain an enormous diversity of functions. The combination of this diversity in wetlands and within wetlands makes them such valuable ecosystems and authors such as Barbier (1993) described them as 'kidneys of the Earth' and as 'biological supermarkets'. Wetlands are complex ecosystems with multiple values, including ecological value, socio-esthetical value, intrinsic value and economic value. An example of ecological value in Africa is the fact that over 2,000 known species of indigenous freshwater fish are found in wetlands (Hails, 1996). Socio-aesthetical value is reflected, for example, in the tradition of some tribes to have initiation rites in wetland areas, while intrinsic value is the value residing in the wetlands themselves. Each of these values is known as a secondary value: the primary value of an ecosystem is its value as a life-supporting function (Turner *et. al.*, 1994). Despite their importance as articulated above, African wetlands are being modified or reclaimed in a rapid way– their resources are over-exploited, their lands are converted to other uses, or upstream developments alter the quality and flow of water feeding the wetlands. A major factor contributing to these activities is that decision-makers often have insufficient understanding of the economic values of wetlands, in which case the protection of wetlands may not be a serious alternative. Wetlands are often perceived to have little or no value as they seemingly do not have visible and immediate economic benefits. Decision-makers often perceive opportunity costs such as intensive abstraction for large scale agriculture or electricity generation as exceeding the benefits of wetlands.

Since 1900, more than half of the world's wetlands have disappeared (Barbier, 1993). These losses are generally caused by: (1) the public nature of many wetlands products and services; (2) user externalities imposed on other stakeholders; and (3) policy intervention failures due to a lack of consistency among government policies in different areas, including economics, environment, nature protection and physical planning (Turner *et. al.*, 2000). One major challenge is that numerous stakeholders have divergent claims which are detrimental to the wetland. To illustrate this, this study has modified the list of the nine groups of stakeholders as identified by Turner *et al.*, (2000) as shown in Box 2. In many cases, it is likely that the different interests of these stakeholders result in conflicts, so that policy-makers are faced with complex trade-offs. In 1975, the Ramsar Convention on Wetlands of International Importance entered into force thereby making wetlands as the only single group of ecosystems to have their own international convention (Turner *et. al.*, 2000).

This convention (also known as the Ramsar Convention after the Iranian city in which the treaty was signed) is an intergovernmental treaty aimed at the conservation and wise use of wetlands as a habitat for water birds. Since then, however, the Convention has developed to cover all aspects of wetland conservation for biodiversity and well-being of human communities. Although this and other conventions have significantly improved the status of wetlands around the world, including African wetlands, the present set of regulations does not seem to be sufficient (Turner *et. al.*, 1994).

Box 2: Wetland stakeholders (Source: Modified from Turner *et. al.*, 2000)

1. Direct extensive users.
2. Direct intensive users: have access to new technologies that allows harvesting more intensively, for example the fishermen who use modern equipment.
3. Direct exploiters: dredge sediments in the wetland, or exploit mineral resources, harvest fish resources, soda ash, clay, peat and sand, honey, mangroves, reeds, medicines, graze their livestock on the floodplains and wetland pasture or harvest trees for charcoal burning.
4. Indirect users: benefit from indirect wetland services, such as storm abatement and flood mitigation.
5. Agricultural producers: drain and convert wetlands to agricultural land.
6. Water abstractors: use wetlands as sources of drinking water, agricultural irrigation and flow augmentation.
7. Human settlements: wetlands as sites for human settlement expansions.
8. Nature conservation and amenity groups: groups whose objective is to conserve nature and groups who enjoy the presence of plant and animal species such as Site Support Groups and Water Resource User Associations.
9. Non-users: users that may attribute an intrinsic, future option and bequeath value to wetlands, for example eco- tourists, researchers.

Thus, wetlands are still being degraded in many parts of the world. Although Africa still has a significant number of pristine wetlands left when compared to Europe or parts of North America, many wetland areas are still experiencing immense pressures (Kabii, 1998). Further to the request by 8th meeting of the Conference of the Parties (COP 8) in Resolution VIII.26 and work by the Scientific and Technical Review Panel (STRP), an initial set of eight indicators of assessing the effectiveness of selected aspects of the Convention's implementation, developed for use where appropriate during the 2006-2008 triennium (Ramsar, 2005). The eight initial indicators provide a basis for evaluating some of the ecological outcomes resulting from implementation of the Ramsar Convention, hence giving some much-needed response to the fundamental question of whether or not the Convention is succeeding in achieving its mission. These indicators differ from the "process-oriented" indicators such as those in the COP9 National Report Format, the Convention's Strategic Plan 2003-2008, and the Strategic Framework for the Implementation of the Convention (Resolution IX.8). However, all of these different indicators are designed to operate in a linked and complementary way.

4.5.2. Wetlands in Kenya

Owing to Kenya's diverse climate and topography, the country is home to seven wetland types: riverine, lacustrine, palustrine, estuarine, marine, coastal wetlands and constructed or manmade dams (MEMR, 2012). Asymmetrical rainfall and geomorphological features are the principal determinants of the country's wetlands (MEMR, 2012). According to Finlayson & Davidson, (2001): Finlayson *et al.*, (1999), the inland wetlands outstrip those that are covered by marine and coastal counterparts. Riverine wetlands occur along the country's rivers and streams. The main water courses comprise of Nzoia, Yala, Mara, Turkwel, Kerio, Ewaso Ngiro South and Ewaso Ngiro North, Athi, Tana, Nyando, Sondu and Kuja (MEMR, 2012). Lacustrine wetlands occur in around lakes and are predominantly influenced by these water bodies, whether these are fresh or saline. As lakes are situated in topographic depressions, water is the dominant feature and they typically lack trees, shrubs and persistent emergents (MEMR, 2012).

The lacustrine wetlands are common in the Rift Valley region and Lake Victoria Basin. Palustrine wetlands comprise marshes, swamps, bogs and floodplains. As these wetlands lack flowing water, a defining character is that they are dominated by persistent emergent plants such as *Cyperus Papyrus* and *Typha spp*. Estuarine wetlands occur where fresh and salty water mix which includes the delta and mangrove swamps. According to MEMR (2012), Kenya's human made wetlands comprise a number of disparate artificial structures which are typical irrigation schemes such as in Mwea, Bunyala and Ahero or for hydro- electric generation. Other artificial wetland comprise saltpans, sewage oxidation farms and well as fish ponds. Marine wetlands are those exposed to the waves and currents of the open sea ocean and as such have a high level of salinity. Kenya also shares several drainage basins and wetlands with neighboring countries. These trans-boundary wetlands and water catchment areas present unique challenges in the sustainable management of wetland resources. Some of the wetlands in Kenya are recognized as important conservation areas like National Parks, National Reserves, Ramsar Sites, Important Bird Areas and World Heritage Sites (Crafter *et al.*, 1991). The area covered by each type of wetland has not been worked out at the national level.

As already mentioned in the foregoing, Kenya became party to the Ramsar Convention in 1990. Thus Kenya is obligated to ensure the wise use of wetlands, including conservation consideration in legal frameworks and national planning processes, to establish national reserves on wetlands as well as prioritize capacity building in wetlands research and management.. Kenya also undertook to designate qualifying wetlands for listing as Wetlands of International Importance (Ramsar Sites). The country also committed itself to international cooperation by consulting partner states with regards transboundary wetland, water systems and dependent flora and fauna (MEMR, 2012). Although the Ramsar Convention is the principal international instrument on wetland management, Kenya is also party to other Conventions for example, the United Nations Convention on Biological Diversity (ratified in 1992), the United Nations Framework Convention on Climate Change (ratified in 1994), the Kyoto Protocol, the United Nations Convention to Combat Desertification (ratified in 1997), the Convention on the Conservation of Migratory Species of Wild Animals also known as CMS or Bonn Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Agreement on the Africa Eurasian Migratory Water Birds (AEWA).

Prior to the ratification of the Ramsar Convention by the Kenyan Government, the country pursued a sectoral approach to conservation and development, which did not address the cross cutting environmental and conservation issues (MEMR, 2012; GoK, 2005a). This led to intersectoral inconsistencies leading to further loss of the country's natural resources including wetlands (MEMR, 2012; GoK, 2005a). The integrity of wetland ecosystems are very much dependent on the conservation of catchment areas which have suffered immensely as a result of encroachment and massive deforestation

(GoK, 2005b). At the national level, it is important to note that Kenya does not have a policy on wetlands although a draft exists. In the absence of a wetlands specific policy, Kenya has been making use of policies relevant to wetland management such as the National Land Policy (2009), Agriculture Policy (CAP 318), EMCA (1999), Fisheries Act (CAP 378), Forests Act (2005), Kenyan Maritime Authority Act (2006), Physical Planning Act (CAP 286), Water Act (2002), WildLife Act (CAP 376), The National Land Commission Act (2012), the Land Registration Act (2012) and the Land Act (2012). The Environmental Coordination and Management Act (EMCA, 1999) is accompanied by national wetland regulation whose major goal is to protect these valued ecosystems from destruction.

In recognition of the need to involve more actors to ensure an integrated and harmonized conservation and management by the government as well as the other affected players, the government has seen the need for a national policy framework on wetlands (GoK, 2007a). The policy as contained in the June 2013 draft document seeks to ensure that the plans and activities of the government and wetland stakeholders promote conservation and sustainable/ wise use of wetlands. It provides a framework for actions to improve institutional and organizational arrangements, address legislation and government policies, increase knowledge and awareness of wetlands and their values, review the status of and identify priorities for wetlands in a national context, and address problems at particular wetland sites. The development of this policy is in cognizance of the importance of wetlands nationally and Kenya's obligation under the Ramsar Convention (GoK, 2007). The policy takes into consideration the broader national environmental frameworks, particularly the Environment Management and Coordination Act (EMCA) 1999, the country's premier framework environmental law, the Water Act 2002, the Water Policy and the Forest Policy 2007. In the June 2013 draft 'National wetlands conservation and management policy' (GoK 2013), it is certain that the government is very clear about 'making use of local available appropriate technology for harnessing wetland resources and involving local communities where possible' in management decision making. The document however does not make reference to the indicator concept and the potential for its application in sustainable wetland management. Further to drafting a policy, a concerted effort has been made by the relevant stakeholders to develop sound management plans for wetlands. Management plans are considered to be vehicles for rural development and they have gained more acceptance in recent years. Each of the sites targeted by this research has developed a sound management plan. An outstanding factor that should be commended is that the plans strongly build their basis on a participatory and negotiated approach to issues, processes and decisions while taking into account the wide scope of stakeholders. By embracing certain key principles, the plans have to a large extent demonstrated an acceptance by the local authorities of a paradigm shift required for the sound conservation of biodiversity. However more needs to be done, especially with regards developing relevant biodiversity indicators in the monitoring ad evaluation of wetland management policies, programmes, plans and projects including conservation initiatives especially within the designated Ramsar sites and IBAs. The need to do more cannot be overemphasized especially noting the implications of the aspirations of 'Kenya's Vision 30' on the future of wetlands. This is a document that contains Kenya's long term economic aspirations whose principal objective is to transform Kenya into a competitive and prosperous nation whose citizens enjoy high standards of living (GoK, 2007b). Significantly, all earmarked 120 flagship projects in this strategic document directly or indirectly impact wetlands (MEMR, 2012).

4.6. Significance of Important Bird Areas in Wetland Conservation

One of the best known functions of wetlands is to provide habitat for birds and humans have known of the link between birds and wetlands for thousands of years. Prehistoric people drew pictures of birds and wetlands on cave walls, scratched them onto rocks, and used them in the design of artifacts; and Native American lore provides accounts of bird hunts in wetlands (Stewart, 2007). The relation between wetlands and birds is shaped by many factors. These include the availability, depth, and quality of water; the availability of food and shelter; and the presence or absence of predators (Stewart, 2007). Birds that use wetlands for breeding depend on the physical and biological attributes of the wetland. They also have daily and seasonal dependencies on wetlands for food and other life-support systems.

The value of a wetland to a specific bird species is affected by the presence of surface water or moist soils and the duration and timing of flooding. Water might be present during the entire year, during only one or more seasons, during tidal inundation, or only temporarily during and after rainfall or snowmelt. At times water might not be present at the land surface, but might be close enough to the land surface to maintain the vegetation and foods that are needed by birds. Birds may use wetlands located in depressions in an otherwise dry landscape, along streams, or in tidally influenced areas near shorelines (Stewart, 2007). Because of the great variety of wetlands, bird's adaptation to and use of wetland environments differs greatly from species to species. Birds' use of wetlands during breeding cycles ranges widely and some birds depend on wetlands almost totally for breeding, nesting, feeding, or shelter during their breeding cycles. Those that need functional access to a wetland or wetland products during their life cycle, especially during the breeding season, can be called "wetland dependent". Others use wetlands only for some of their needs, or they might use both wetland and upland habitats.

Kenya has one of the richest avifauna in Africa. According to the National Environmental Management Authority-NEMA (2012), there are 1100 bird species recorded in Kenya out of which some 200 live in or near wetlands or depend on them and are generally referred to as waterbirds. It is estimated that almost 30% of all birds in Kenya are found in wetlands. Of the more than 1,900 bird species that breed in North America, about 138 species in the conterminous United States are wetland dependent (American Ornithologists' Union, 1983). An inventory in the United States during the early 1950's showed that of 74.4 million acres of wetlands, 8.8 million acres had a high value for waterfowl, 13.6 million acres were of moderate value, 24.1 million acres were of low value, and 27.9 million acres were of negligible value (Shaw and Fredine, 1956).

4.7. The Important Bird Areas (IBA) Concept

The Important Bird Areas concept was developed in Europe by Birdlife International in 1985 as an objectively defined and practical tool for conservation that would be agreed internationally and applied globally (Birdlife International, 2008). The concept is intended to stimulate and strengthen the protected area network at national and global level. As a practical tool for conservation, selection of IBA sites is based on the following objectives: (1) they must be sites of international significance for conservation of birds at the global, regional or sub-regional level, (2) they must be practical tools for conservation, (3) they must be chosen on the basis of standardised, agreed criteria applied with common sense, (4) wherever possible, they must be large enough to support self-sustaining populations of those species for which they are important, (5) they will preferentially include, where appropriate, existing protected area networks, and (6) they must form part of a wider integrated approach to conservation that embraces sites, species and habitat protection (Birdlife International, 2008).

Furthermore, in the IBA concept each IBA criterion is supported by a list of 'trigger' species, and, where appropriate, population thresholds. Trigger species are the bird species that determine if a site should be designated as an IBA. The trigger species can be classified under the following categories; Threatened, Restricted-range, Biome-restricted and/or Congregatory species, whose regular presence at a site in numbers exceeding relevant thresholds qualify it as an IBA (BirdLife International, 2008). Thus each of the wetlands that have been selected for this study has been designated according to scientifically and internationally agreed criteria. These sites also have significant biological value. The main IBA concept focuses on the taxonomy of 'birds' and the reason is that birds act as excellent barometers, or indicators, of trends in the state of wildlife and nature and thus of the sustainability of human use of landscapes and resources. They occur in all habitats, can reflect trends in other animals and plants and can be sensitive to environmental change (Butchart *et al.*, 2010; BirdLife International, 2008; Butchart *et al.*, 2004; Furness and Greenwood 1993). They respond quickly to variation in habitat quality, through changes in breeding output, survival or dispersal. Since most bird species are relatively easy to identify and count, are geographically widespread, are abundant and active during daytime, and are extremely well counted and recorded annually, they are often used as indicators of environmental change.. Birds are easy to survey and they have a real connection with people and their lives. Based on the concept and the realization of the importance of birds as indicators, BirdLife International instituted an important bird areas programme. In Africa, the programme started in 1992, with an initial focus on identifying and documenting IBAs in Africa and its associated islands. By 2001, a network of 1,200 IBAs covering 2 million km^2 (7% of the continent's land area) had been identified across Africa, as detailed in the Regional IBA Directory by Fishpool and Evans (2001). According to BirdLife International (2013), as of 15th of January 2014, the number of internationally recognised IBAs in Africa had increased to 1,236 these include both terrestrial (including inland and coastal wetland) and marine IBAs.

Table 4-2 is a summary of the information as of 15 January 2014. The IBA concept elucidates the participation of the grassroot local communities in the management of birds and habitats. Thus, the IBA Programme offers opportunities to engage volunteers in monitoring and conservation projects at IBAs, promoting local stewardship and advocacy. Conservation activities at IBAs reflect the unique circumstances of each site (for example. size, location, and ownership). For example, public areas may be conserved by open-space acquisition and by working with land managers to improve habitat management practices for key species of birds. Private lands may be conserved through public-private partnerships such as easements, and through landowner education. Generally, the IBA concept has been widely welcomed by many conservation practitioners and organisations. BirdLife's strategy to achieve this mission integrates species, site and habitat conservation with sustaining human needs, and is implemented by the BirdLife Partnership in over 100 countries and territories worldwide. The site-based component of this approach, the Important Bird Area (IBA) Programme, complements other programmes that focus on species and habitats (BirdLife International, 2010). Furthermore, the ground breaking work and success of BirdLife's IBA Programme has led several other institutions to emulate BirdLife's model and develop similar approaches for other taxonomic groups.

Table 4-2. Record of all internationally recognised IBAs

Region	Number of IBAs	Total area (km^2)	Number of bird records
Africa	1,236	2,267,350	30,009
Americas	2,299	3,489,098	21,540
Antarctica	137	190,300	344
Asia	2,381	2,515,051	12,886
Europe & C Asia	5,211	1,774,409	24,509
Marine	60	1,472,883	89
Middle East	388	287,879	2,799
Pacific	414	449,225	2,878
Total	**12,126**	**12,446,195**	**95,054**

NB: IBA totals exclude those IBAs that are yet to be confirmed. Bird record totals only include species populations that trigger one or more IBA criteria. **Source:** BirdLife International, 2013

Figure 4-1 shows the location of IBAs (both terrestrial and marine) in Africa

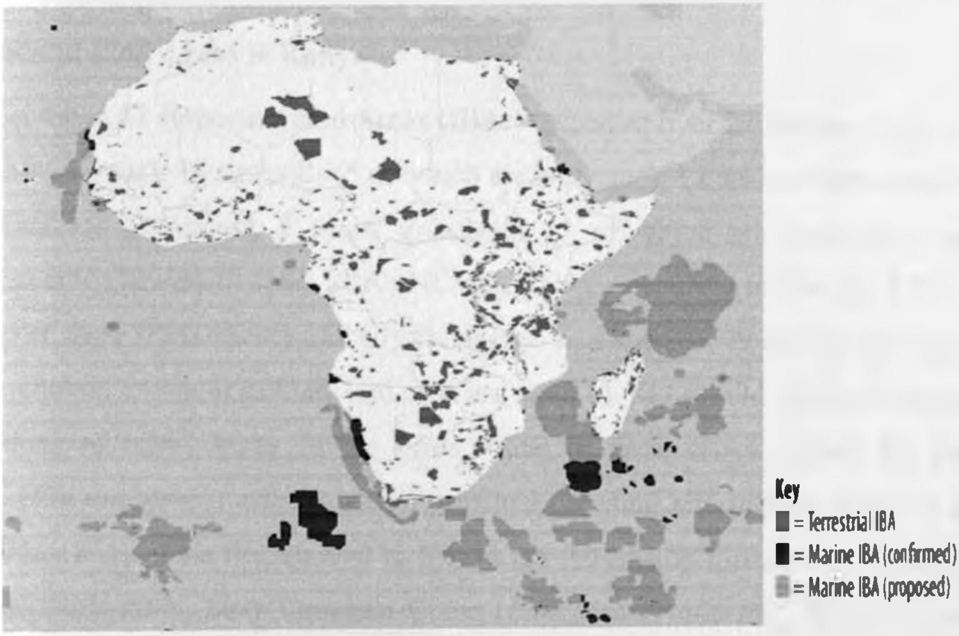


Figure 4-1: Location of IBAs in Africa **Source:** Brooks *et al.*, 2001

These include Important Plant Areas, the Alliance for Zero Extinction sites, Prime Butterfly Areas, IUCN's Important Freshwater Areas, and Key Biodiversity Areas identified through the Hotspot Profiling of the Critical Ecosystem Partnership Fund. The limitation, however, is that the concept is only a component of an integrated approach to the conservation of habitats and sites, and is, therefore, not appropriate for all species. To date, the process of marine IBA identification and delimitation has been guided by systematic, data-driven methods to ensure consistency of approach and comparability between species and regions. However there can be drawbacks with adopting expert led approaches. Ervin *et al.*, (2010) found that solely using expert opinion to optimize the connectivity of sites for multiple species requires effective group decision-making and leadership, a clear understanding of the needs of each species and the effects of different scenarios and tradeoffs, and, typically, is very time consuming. Baldwin *et al.*, (2008) found that expert recommendations reflected strongly the missions and goals of their parent organizations and recommended that expert opinion, if integrated into conservation planning research, be documented and interpreted according to qualitative research methods, so that practitioners and researchers may understand how planning decisions were made, and improve the replicability of conservation planning studies.

4.8. Important Bird Areas in Kenya

Kenya is home to 61 Important Bird Areas (IBAs) dispersed over 22 forests (20 of which lie in protected areas); 18 wetlands (5 of which are protected); 12 arid and semi-arid areas (7 of which are protected); 6 moist grasslands (3 of which are protected); and 3 unprotected sites (Mwinami *et al.*, 2010; NEMA, 2008). According to Bennun & Njoroge (1999), 46 of these IBAs shelter globally threatened bird species, 29 host range restricted birds, 32 contain biome-restricted bird species, and 13 IBAs hold globally important congregations of birds. Some of the birds found in these IBAs include the Lesser Flamingo (*Phoenicopterus minor)* whose principal breeding site in East Africa is Lake Natron. Other large birds that abound in Kenya are the ostrich *(Struthio camelus)*, Kori bustard *(Ardeotis kori)*, Gray Crowned-Crane (*Balearica regulorum)*, Black Crowned-Crane (*Balearica pavonina)*, Goliath Heron (*Ardea cinerea)*, Saddle-billed Stock (*Ephippiorhynchus senegalensis)*, African Fish Eagle (*Haliaeetus vocifer)* and the

Lammergeier *(Gypaetus barbatus)* (NMK 2010). Nature Kenya (NK) is the BirdLife Partner in Kenya that is spearheading the implementation of the IBA Programme in close collaboration with other key stakeholders such as the National Museums of Kenya (NMK), Kenya Forestry Services (KFS), Kenya WildLife Service (KWS) as well as the Site Support Groups (SSGs). Nature Kenya's conservation action for IBAs is both at national and site level.

Given Kenya's rich avifauna, it is therefore not surprising that birds play an important role in Kenyans' social, cultural and economic life. Over the millennia, birds have given human beings inspiration, imagery and companionship. Some of the most enduring cultural symbols are birds, reflecting the many qualities that human beings admire in them and aspire to in themselves. Given their ubiquity, activity, diurnal habits, colour and song, it is hardly surprising that birds feature so strongly in the country's painting, poetry and music. Many of the species aesthetically enrich landscapes, attracting international ornithologists. Bird watching, photography and art earn the country revenue some of which filters through to the grassroots. There are many Kenyans employed as driver-guides and at various levels in the country's burgeoning hotels and lodges. Ostrich farms in Kajiado, Naivasha, Elementaita and Laikipia also contribute to the country's GDP and is an important source of livelihood for rural communities. In the past and even today, wild birds such as quail and ducks are an important source of food for many of the rural communities in Kenya. The ecological services that birds provide to the Kenyan's are crucial and irreplaceable.

Birds are also keystone species in the life-supporting cycles. As voracious eaters of weed seeds, farm rodents and insect pests, as well as dispersing agents of fruit seeds, birds provide the Kenya communities with "free" ecological services. Many birds such as pigeons, hornbills and birds-of-paradise are important as dispersers of seeds, particularly in tropical forests, and some, including hummingbirds and sunbirds, are key pollinators of plants. In human societies birds are or have been put to a remarkable range of uses, including the disposal of corpses (vultures). Policy and legislative implementation failures resulting from weak institutional capacity, inadequate human and financial resources, encroachment into bird habitats, pollution, and climate change-induced habitat loss however continue to impede bird conservation in Kenya (Mwinami *et al.*, 2010). An assessment of some of Kenya's IBAs notably; Yala swamp, Kianyaga valleys and Busia grasslands reveals that some sites deteriorated during 2009 due to drought and overexploitation. Plans to convert the Dakatcha woodlands, Tana River delta and Yala swamp into large-scale food and bio-fuel plantations pose additional threats to these IBAs. Further, diversion of water from Lake Natron which is designated as a Global Biodiversity Hotpoint because it is the only known breeding spot of the lesser flamingo is threatening the very existence of these avian species (Mwinami *et al.*, 2010).

Birds are an important aspect of biodiversity in Kenya and efforts to address threats to their survival should be intensified. Community awareness should be enhanced to increase public participation in bird conservation. National and regional partnerships revolving around international obligations should be scaled up for better management of the country's IBAs. Institutions responsible for bird biodiversity should diversify their bird counts to better enable them to identify emerging trends well before these become crises. The above measures would, of course, necessitate the scaling up of bird conservation financing, particularly in the IBAs.

4.9. State of Avifauna at the Three Wetland Sites in Kenya

Significant numbers of migratory waterbirds, including red-listed ones, make use of the deltaic floodplains and, during favourable flood years, there are important colonies of breeding waterbirds (Duvail *et al.*, 2012; Hamerlynck *et al.*, 2011a; Bennun and Njoroge, 1999). Figure 4-2 is the trend analysis of some of birds in the Tana Delta for the period 2006-2010.

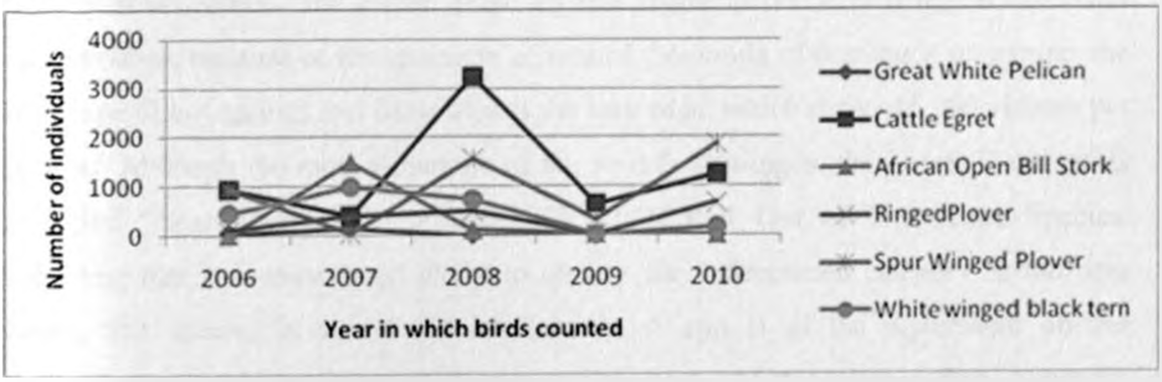


Figure 4-2: Trend analysis of flagship species at Tana Delta (2006-2010)

Source: Jackson (A ROCHA Kenya) http://www.tanariverdelta.org/tana

The rising sea level is resulting in significant and observed declines in the numbers of birds but also in reduced livelihood options (East African WildLife Society Blog, http://eawls.wildlifedirect.org/category/tana-delta). Local communities are also practicing slash-and-burn agriculture to a very large extent within the Kipini area. Clearing of land for agricultural purposes, logging and charcoal production are on the rise at Kipini. Plate 4-1 shows that the habitat at Ozi Village in the Tana Delta in critical for breeding birds.

Plate 4-1: Breeding nests for weaver birds at Mugombani wetland in Ozi village

Source: Reseacher, April, 2011

Previous studies have shown that the Lake Bogoria has high conservation value because of three bird species in particular – lesser flamingo, Cape teal and black-necked grebe (Harper *et al.*, 2003). The former provides real economic value in a region otherwise impoverished, because of the spectacle of tens of thousands of flamingos set against the landscape of hot springs and fumaroles at the lake edge, which draws 15 000 visitors per annum. Although the most numerous of the world's flamingos, the Lesser Flamingo is classified "Near Threatened" in the 2008 IUCN Red List of Threatened Species, indicating that it is considered likely to qualify for a threatened category in the near future. The species is also listed in Columns A and B of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) Action Plan, Appendix II of the Bonn Convention (CMS) and Appendix II of the CITES convention. Implicit in these agreements is the need for the production of a conservation action plan (Childress *et* *al*, 2008). According to Raini (2002), at one time, the flamingo population was around 2 million. But today, the number is half of that. Initial speculation was that the flamingos were starving, but recent information attributes the deaths to 4 other possible explanations: Avian tuberculosis, parasites and toxic alga at Lake Nakuru, heavy metal contamination (Raini, 2002). In September 1993, an epidemic among the lesser flamingos occurred in Lakes Nakuru and Bogoria (Raini, 2002). An estimated 30,000 flamingos died during this epidemic. In 1995, a second epizootic involving the lesser flamingo occurred at Lake Bogoria. Few mortalities occurred at Lake Nakuru, which was practically dry and the flamingo population was small (<10,000). Since July 1998, lesser flamingo deaths have occurred sporadically at Lakes Bogoria and Nakuru for several months particularly in the in the years, 2000, 2001 and 2003. Furthermore, according to Childress *et al.*, (2004) and Githaiga (2003) the number of individuals in a particular lake can double or halve in just two weeks further cementing the fact that the movement of these birds, their timings and patterns for individual lakes are unknown.

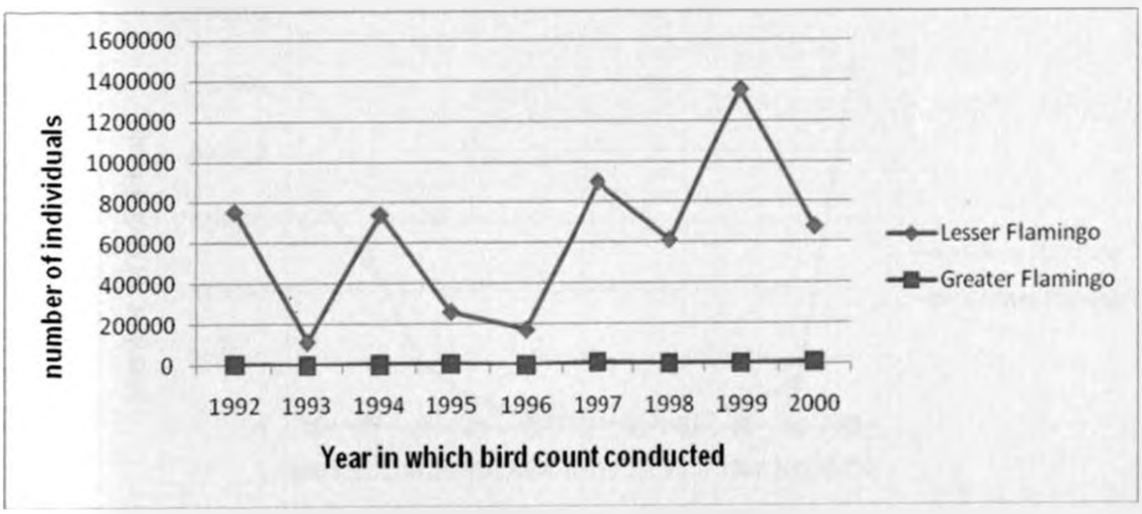


Figure 4-3: Trend analysis of flagship species at Lake Bogoria (1992-2000)

Source: Nature Kenya, 2008

The continuous data collection on water birds has made it possible to observe trends, and therefore measure the condition or status of the Rift Valley lakes over the years. Figures 4-3 and 4-4 show the trend analysis of the Lesser Flamingo (*Phoenicopterus minor)* and the Greater Flamingo (*Phoenicopterus roseus)* at Lake Bogoria, from 1992-2000 and 2000-2010 respectively. The annual water fowl census results from 2000 at Lake Bogoria National Reserve indicate there has been a decline in species such as the Great Crested Grebe (*Podiceps cristatus),*Great White Pelican *(Pelecanus onocrotalus)*, Great Cormorant (*Phalacrocorax carbo)*, Black Crowned Night Heron (*Nycticorax nycticorax)*, Hamerkop *(Scopus umbretta)*, White stork *(Ciconia ciconia)*, Sacred Ibis *(Threskiornis aethiopicus)*, Greater Flamingo (*Phoenicopterus roseus)*, Fulvous Whistling Duck (*Dendrocygna bicolor)*, Red Knobbed Coot *(Fulica cristata)*, Grey Crowned Crane *(Balearica regulorum)*,Africa Jacana *(Actophilornis africanus)*, Pied Avocet *(Recurvirostra avosetta)*, Water thick knee *(Burhinus vermiculatus)*, Little Ringed Plover (*Charadrius dubius)*, Little Stints *(Calidris minuta)*, among others.

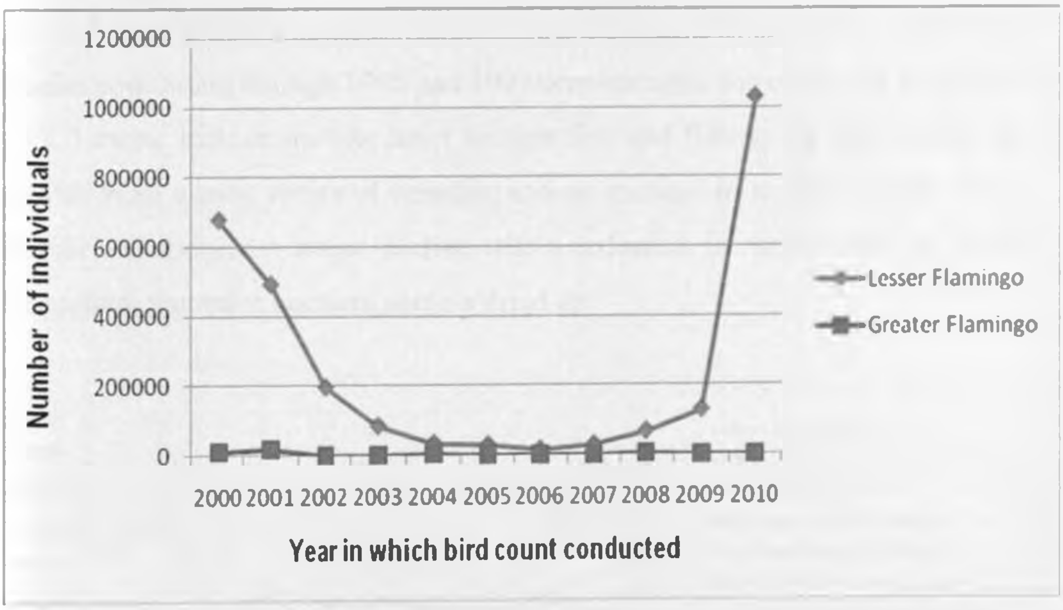


Figure 4-4: Trend analysis of flagship species at Lake Bogoria (2000-2010) **Source**: Nature Kenya, 2008

Lake Naivasha is a freshwater lake and is one of the major attractions for water birds. Being a freshwater lake, Naivasha has a fish population which attracts a variety of fish-eaters. These include among others Long-tailed Cormorants *(Phalacrocorax africanus)*, Great Cormorants *(Phalacrocorax carbo)*, African Fish Eagles (*Haliaeetus vocifer)* and Pied Kingfishers (*Ceryle rudis*). Over 150 different waterbirds have been recorded from the lake shores and Naivasha is internationally recognized as a major wintering refuge for large numbers of migratory duck and shorebirds (Owino *et al*., 2001, Bennun, & Njoroge (1999). For decades, it was also a major stronghold of Afrotropical waterbirds notably Great Crested Grebes (*Podiceps cristatus*), Great and Long-tailed Cormorants, African Darters *(Anhinga melanogaster)*, White-backed Ducks *(Thalassornis leuconotus)*, African Jacanas *(Actophilornis africanus)*, Purple Gallinules *(Porphyrio alba madagascariensis)* and Red-knobbed Coots *(Fulica cristata)*. The Fish Eagle population was one of the largest in the country, and frequently, large numbers of the regionally endangered Maccoa Ducks (*Oxyura maccoa*) occurred on the lake (Nasirwa, 2000, Nasirwa and Bennun 1994).

However, according to IUCN (2003), the African Fish Eagles (*Haliaeetus vocifer*) at Naivasha were in a state of serious decline throughout the 1990s until 1998. Many causes were advanced, including pesticide toxicity (Nasirwa, 2000, Nasirwa and Bennun 1994). Studies continuing through 1998 and 1999 demonstrated one of the few benefits of El Nino - a 3 metre increase in lake level brought fish and fishing habitats back to the lake, and with them a rapid return of breeding and an increase in resident eagles. But in 2008, the lake experienced a major decline with a reduction in surface area by almost 10% during which the entire northern section dried up.

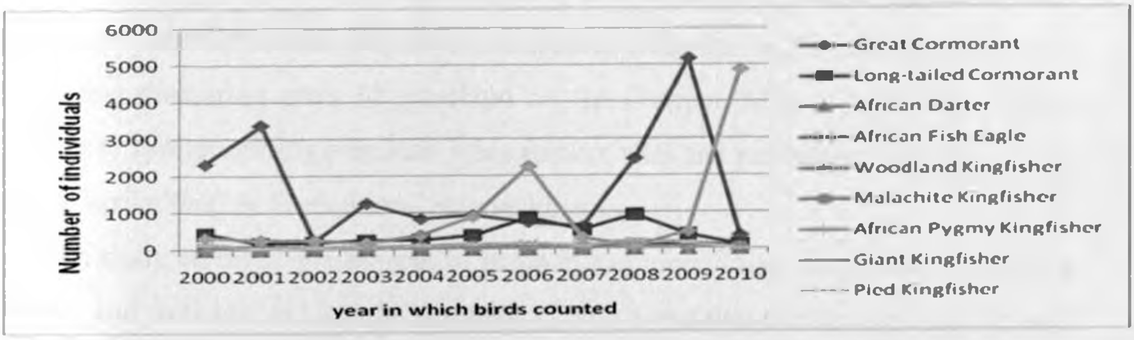


Figure 4-5: Trend of carnivores at Lake Naivasha (2000-2010) **Source**: Nature Kenya 2008

All the bird species shown in the Figure 4-5 feed on fish, perhaps further attesting the importance of the wetland IBA as a haven for fish compared to other wetland IBAs in the study. In 2013 and 2014 the water levels in Lake Naivasha climbed upto some of the highest ever witnessed in the last decade and the cause is unknown because precipitation has not increased dramatically. The extensive acacia woodlands in the area have changed little in the last hundred years or so, and in themselves are an important refuge for many hundreds of resident birds such as owls, cuckoos, rollers, wood-hoopoes, hornbills, barbets, honey guides, woodpeckers, babblers, thrushes, flycatchers, warblers, bush-shrikes, cuckoo-shrikes, starlings, sunbirds, weavers, waxbills, canaries and buntings, not to mention a remarkable variety of birds of prey such as the African Fish Eagle *(Haliaeetus vocifer)*. Currently 60 species of birds are recorded from the Naivasha Region.

In addition, the area is an important wintering area for many thousands of migratory birds notably Barn Swallows *(Hirundo rustica)*, House Martins *(Delichon urbicum)*, Yellow Wagtails *(Motacilla flava)* and Willow Warblers *(Phylloscopus trochilus)*, and in many ways, and often more importantly, the area is a major refuelling point for the hundreds of passage migrants that pause briefly in the Western Naivasha area en route to and from their wintering areas further south (Nasirwa, 2000, Nasirwa & Bennun 1994). The Grey-Crested Helmet-Shrike is a globally vulnerable species occurring in the western part of the Naivasha area, where it favours mixed acacia/leleshwa woodlands, while the area is home to breeding pairs of the Bat Hawk (*Macheiramphus alcinus)* and Southern Ground Hornbill (*Bucorvus leadbeateri)*. Sadly however, larks, pipits and cisticolas all totally depend on areas of pristine grassland (once plentiful in the Naivasha area) are now concentrated either in Hell's Gate National Park or in the few remaining areas of grassland on the Oserian, Mundui and Hippo Point estates. These few remaining grassland areas require vital and permanent protection from any future agricultural or horticultural encroachment.

In a study on niche preferences of birds in and around papyrus swamps in Kenya (Naivasha) and wetlands in Uganda, Maclean, (2001) noted that certain East African bird species are almost entirely restricted to papyrus. One of these, the Papyrus Yellow Warbler (*Chloropeta gracilirostris*) is threatened globally and is vulnerable. The Papyrus

Gonolek (*Lanarius mufumbiri*), White winged Swamp-warbler (*Bradypterus carpalis*) and Papyrus Canary (*Serinus koliensis*) are considered near threatened.

4.10. Research Gaps

Literature review has highlighted that there are many factors that affect the perceptions of local communities, given an insight into the work that has been done with regards to development of indicators for wetland management from the local community perspective. While the intent for these indicators differs, literature seems to agree that the involvement of local communities is key for policy making. The recent upsurge of interest in local community wellbeing indicators internationally reflects growing awareness of their importance as a platform for citizen engagement, community planning, and evidence based policy making. Currently in Kenya, some of the SSGs are associated with local communities. Good examples are the Friends of Kinangop Plateau in Nyandarua County and Kijabe Environment Volunteers (KENVO) in the Kikuyu Escarpment. According to an analysis conducted by BirdLife International (2009), Kenya had 15 SSGs in at least 13 IBAs, In Africa, the number of SSGs were 198 spread over 119 IBAs and efforts are still ongoing to ensure that the proportion of IBAs with SSGs increases.

More broadly community wellbeing indicators are part of an international movement towards rethinking the ways in which political priorities are debated and in which progress and wellbeing are defined and measured. The authors all seem to agree that a 'one size fits all' approach does not work when it comes to developing community wellbeing indicators, sustainability indicators and also the pressure-state-response indicators. The focus is also on the creation of indicators rather than development of an index. Furthermore- a 'bottom- up' approach is being emphasized in all instances.

An overview of the wetlands at the global scale as well as in Kenya was highlighted. The literature has shown that wetlands are facing a crisis, causing exponential degradation and destruction of the ecosystem. The crisis principally has arisen due to unwise human attitudes and practices. The literature also shows that while concerted efforts have been made by the relevant authorities with regards policy frameworks, the need for a substantive policy on wetlands can no longer be overlooked and Kenya is urged to ratify the policy and ensure it comes into effect. The 'draft' nature of the policy also gives room for the relevant authorities to consider elements that have not been adequately addressed so that Kenya is well set for managing its wetlands in an effective manner.

The importance of the Important Bird Area was highlighted as key sites for biodiversity conservation. The role of birds in conservation cannot be undermined and their ability to mirror what is happening i.e. threats to the broader environment is key. Literature reviewed indicated that to date at least 61 sites in Kenya have been designated as IBAs in accordance with the international criteria. Given that Kenya is a well resource endowed country, perhaps it is worthwhile to investigate the potential of additional wetlands to receive this category, with the hope that that attention towards the specific wetlands will draw attention, human resources as well as funding to address the challenges bedeviling many of Kenya's wetlands. The literature on sustainability indicators has shown that they fall into two broad methodical paradigms; one that is expert – led and top down and one that is community based and bottom up. There is increasing awareness and academic debate on the need to develop innovative hybrid methodologies to capture both knowledge repertoires (Batterbury *et al.*, 1997; Nygren, 1999; Thomas and Twyman, 2004). As yet, there remains no consensus on how this integration of methods can be best done.

4.11. Conceptual Framework for Sustainable Wetland Management

In order for meaningful community indicators to be developed, some form of framework or conceptual model that makes explicit both definitions and the relationships among the phenomena of interest and the indicators is required, Holdgate (1996). A critical conceptual analysis of the indicator development work done so far indicates that there is a lack of a structural, functional framework and model for the conceptualisation of local community engagement. What we need is in our notions of what the perceptions of the local community are with regards to the environment, with a specific purpose of coming up with indicators that can be easily understood.

This study aims to explicate the relationship between the wetland ecosystem and local knowledge of the people who live within the vicinity clarity of the habitat. There is special emphasis on the repertoire of knowledge regarding natural resources management, ecosystems, and modes of thought in a community and natural interaction context. The seamless relationship between local people and natural resources has given rise to a complex and sophisticated indigenous knowledge for resource management. The wetland and surrounding marginal vegetation are critical for the way of life of the people who live close to the area. The communities have a long history in the wetlands area; the local knowledge and social organization are closely attuned and adapted to wetlands ecology; and the conceptual framework for these wetland areas is inclined towards an ecological-*cultural* model, one which includes humans and their productive activities as a fundamental part of the ecosystem- biodiversity, water and land as shown in Figure 4-6. The community perception theories formed in part by expectancies, prior knowledge on one hand and the observable form or pattern influence the level of interaction with the environment.

Figure 4-6 shows that the knowledge the community has regarding natural resources and environment management, is a form of knowledge (re) produced from generations of experience and not explicitly formulated in scientific axiom. Thus cultural, social and economic issues that abound are central to defining use, access and management of the resources. The outputs are interconnected, leading through community participation to the overall goal of sustainable wetland management in the study sites. Based on the literature reviewed, the conceptual framework proposes an integrated approach to indicator development (Reed *et al*., 2005). The study considered the PSR framework because it is based on a concept of causality: human activities exert pressures on the environment and change its quality and the quantity of natural resources (the "state"). Society responds to these changes through environmental, general economic and sectoral policies (the "societal response"). The latter form a feedback loop to pressures through human activities". Accordingly, the PSR framework provides an opportunity for the development of three types of indicators: i) indicators of environmental pressures which describe the pressures posed on the environment by humans; ii) indicators of environmental status which describe the current state –the quality- of the environment; and iii) indicators of societal response which describe the society's response to environmental changes and concerns. There is need to assist local communities to develop capacities and capabilities for wetland conservation and sustainable use (goal) and for the benefit of people, habitats and birds.

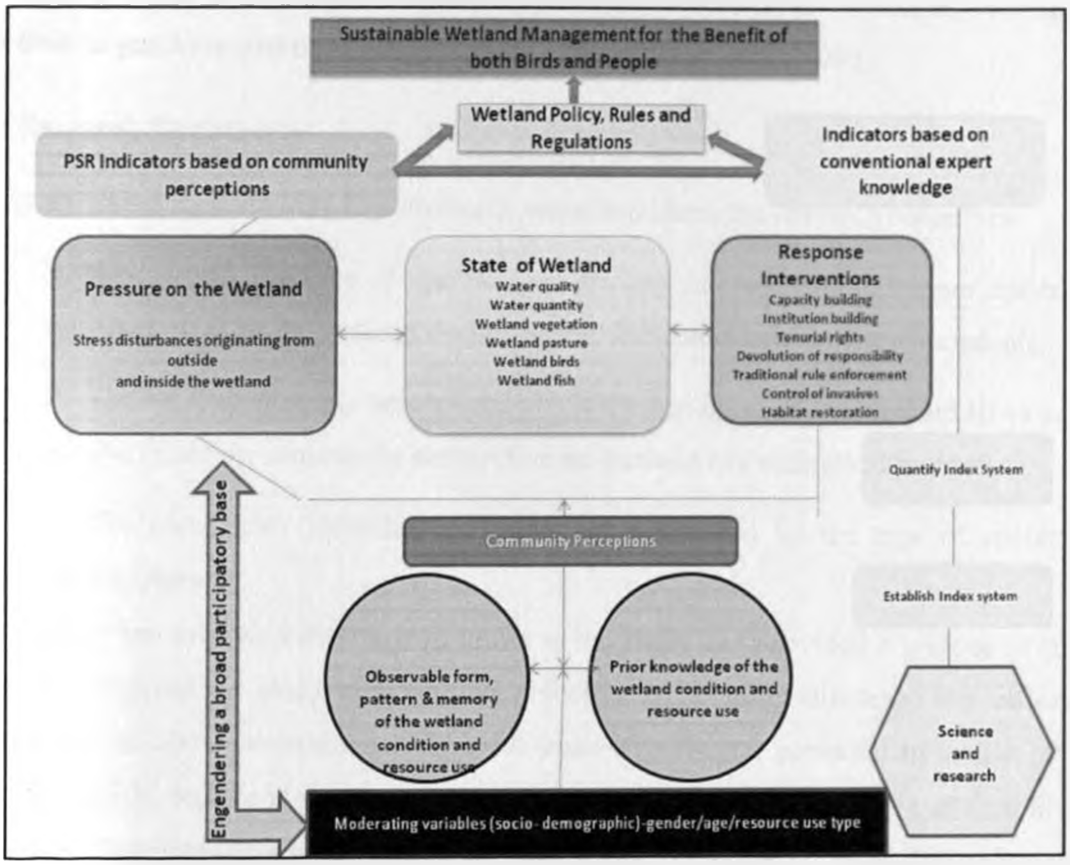


Figure 4-6: Conceptual Framework

Operational support for the resource users through financing of these processes is essential. This may in turn lead to behavioural change so that the patterns of use of wetlands and their natural resources become more sustainable. Deep engagement of all affected local communities in the IBAs, science and policy should be recognised as integral components to ensure people, birds and habitats benefit. Throughout the process, a simple but robust PSR monitoring programme should be in place to continue to provide an overview of the status and trends of biodiversity in the wetlands.This framework shows that the bottom –up paradigms (from a participatory paradigm to a combination of the qualitative and the quantitative methods) should complement the top-down and bottom-up paradigms, This approach emphasizes the importance of participatory approaches setting the context for sustainability assessment at local scales, but stresses the role of expert-led methods in indicator evaluation and dissemination (technical knowledge). Local involvement can also ensure that indicators are dynamic, evolving over time as goals are met or as circumstances change (Reed *et al.*, 2005).

4.12 Research Hypotheses

The study tested the following hypotheses in order to address the research objectives.

1. Gender, age and type of resource use are key determinants in the perceptions and/or choices of the wetland environmental indicators held by the respondents.
2. The local community perceptions about the condition of the wetland IBAs are similar based on community perspective on wetland environmental indicators.
3. The community identified indicators are influenced by the type of wetland environment

This chapter has reviewed literature pertinent to the study and provided a critique of the same with regards the study problem and objectives. The study discussed the various factors that influence perceptions at the local scale. The chapter provided an insight into the construction, logic and consistency of community indicators as well as sustainability indicators. Developments with regards environmental indicators at the global and local were discussed. The study also provided an overview of wetlands and wetland management regimes as they pertain to Kenya and attempted to demonstrate the symbiotic relationship between wetlands and birds. The chapter ended with an outline of the conceptual framework emphasizing the need for an approach that combines both the top down and bottom up approach. An integrated approach is a prerequisite in achieving hybrid knowledge required to provide a more nuanced understanding of environmental, social and economic system interactions that are required to provide more informed inputs to local sustainable development initiatives. The conceptual framework showed the factors that influence local knowledge and that these are key in the conduct of site assessment to ascertain the health of a wetland IBA.

Of the 252 respondents at Lake Naivasha, the 26-36 age group comprised of 44.1%, this was followed by the 37-47 age groups with 23.4%, the 15-25 age group comprised of 14.3%, and this was followed by the 59-69 age group which comprised of 9% of respondents. The 48-58 age groups comprised of 6.1% and the least number of respondents was in the 70-80 age groups.

Table 5. 1: Percentage of respondents in IBA Study Sites

Group Age Bracket	Percentage Composition of respondents in IBA Site by age brackets		
	Tana Delta	Lake Bogoria	Lake Naivasha
15-25 years	11.20%	18.20%	14.30%
26-36 years	7.30%	0.00%	44.10%
37-47 years	41.30%	18.20%	23.70%
48-58 years	13.40%	25.00%	6.10%
59-69 years	8.90%	9.10%	9.00%
70-80 years	17.90%	29.50%	2.90%
Total %	100%	100%	100%

5.2. Gender of Wetland Resource Users

Gender is an important socio demographic factor that cannot be ignored largely because social and cultural gender patterns are internalised to an extent where the interaction with wetland resources is partially determined by the fact that members of the riparian community are male or female. In analysing the results, frequencies were used and the data was tested for association and significance. Figure 5-2 shows that the 'all male' group comprised the largest crop of respondents with 72.6%, while the 'all female' group was 19.6%.

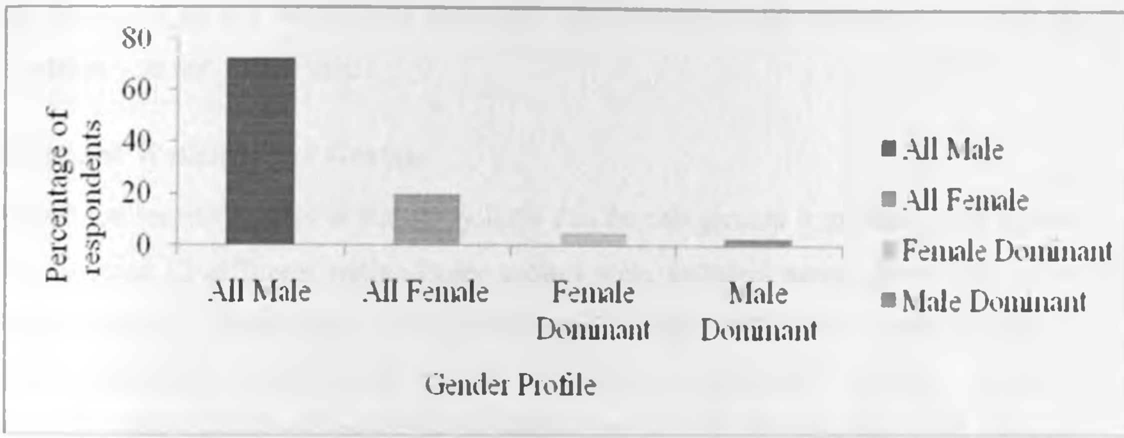


Figure 5- 2: Group Gender Profile at the Study Sites

The female dominant group was higher with a 4.6%, compared to the male dominant group of 3.2%. The highest number of the 'all male group' was at Lake Naivasha, with at least 193 respondents. The 'all male group' at Lake Bogoria was made up of 40 respondents, while Tana Delta was made up of 112. However in terms of dominance in a group with both male and female, Tana Delta had the highest number of the 'male dominant' with at least 15 respondents.

Table 5. 2: Mean scores according to gender profile

Group gender profile	Mean	N	Std. Deviation	Std. Error of Mean
All male	1.794	345	0.630	0.034
All female	1.570	93	0.579	0.060
Male dominant	1	15	0	0
Female dominant	1.636	22	0.492	0.105
Total	1.718	475	0.623	0.029

Table 5-2, shows that the 'all male group' had a higher response compared to the 'all female group'. The mean score for the 'all male group' was 1.794, whereas for the 'all female group' it was 1.570. In the groups in which were both sexes were represented, the results showed that the female dominant group had a much higher response at 1.636 compared to the male dominant group which had a response of 1. It should however be noted that although the women had some influence, the statistical difference between the two groups was not significant.

5.3. Type of Wetland User Groups

The wetland resource users at the study sites can be categorised into direct and indirect users. At least 12 different wetland user groups were sampled across three study sites. The participants comprised of agricultural farmers, livestock owners/livestock herders/pastoralists, coastal and inland fishermen, traditional healers, mangrove harvesters, reed harvesters, papyrus harvesters, carpenters, bee-keepers and charcoal producers (Table 5-3).

Table 5. 3: Percentage of Respondents according to Resource Use

Type of resource users	Type of IBA			Total
	Tana Delta	Lake Bogoria	Lake Naivasha	
Land cultivators	17.90%	18.20%	8.70%	13.10%
Livestock farmers	20.10%	29.50%	13.90%	17.70%
Coastal fishermen	6.70%	0.00%	0.00%	2.50%
Inland fishermen	5.00%	15.90%	48.40%	29.10%
Traditional healers	0.00%	9.10%	0.00%	0.80%
Mangrove harvesters	8.90%	0.00%	0.00%	3.40%
Reed harvesters	11.20%	0.00%	6.30%	7.60%
Papyrus harvesters	0.00%	9.10%	11.10%	6.70%
Carpenters	5.00%	8.00%	0.00%	1.90%
Bee-keepers	16.20%	9.10%	2.80%	8.40%
Charcoal burners	6.70%	9.10%	8.70%	8.00%
Traditional/spiritual leaders	2.20%	0.00%	0.00%	0.80%
Total	100.00%	100.00%	100.00%	100.00%

The percentage of respondents according to the different resource user groups was as follows: inland fishermen (29.10% / n=138), livestock owners/herders/pastoralists (17.70% / n=84) the land cultivators (13.10% / n= 62), bee-keepers (8.40% / n=40), charcoal burners (8%/ n= 38), reed harvesters 7.6% / n=36), papyrus harvesters (6.70% /

n=32), mangrove harvesters (3.4% / n16), coastal fishermen (2.5% /n =12), carpenters (1.90% /n= 9), and the traditional/spiritual healers (0.8% / n = 4). At the riverine IBA (Tana Delta), the livestock farmers comprised the largest group with at least 20.1%, followed by the land cultivators at 17.90% and the bee-keepers at 16.20%. The reed harvesters comprised of 11.20%, while the inland fishermen comprised of 5%. The least represented resource user group at the riverine IBA was the papyrus harvesters at 0%. At Lake Bogoria, the resource user group that had the highest number of respondents is the livestock owners/herders/pastoralists, represented by at 29.5%, followed by land cultivators at 18.2%. The land cultivators at Lake Bogoria were restricted mainly to irrigation farming and they relied on water from the springs. The inland fishermen at Lake Bogoria comprised of 15.9%, with a majority of respondents from Emsos where there is a thriving fishing industry owned and managed by the local community. The carpenters comprised of 8% and they relied mainly on harvesting prosopis to make household furniture. The papyrus harvesters, charcoal burners and the bee-keepers were equally represented at 9.10% each.

At Lake Naivasha, the situation was different with the inland fishermen comprising the largest group of respondents, with 48.40%, followed by livestock farmers at 13.90% and papyrus harvesters at 11.10%. %. The land cultivators and the charcoal burners were equally represented at 8.70% and the least resource user groups being the coastal fishermen, traditional healers, mangrove harvesters and the carpenters.

CHAPTER SIX

PERCEPTIONS ON THE CONDITION OF WETLAND RESOURCES

6.1 Community Perception on the Current State of Wetland Resources

6.1.1. Water Quantity

Water levels profoundly affect the quality of lives of riparian communities and the associated animals that depend on water, including breeding and migrating species of birds. Figure 6-1 shows the distribution of responses in terms of the current quantity of water at each wetland IBA. At the riverine IBA, 70.4 % (N=126) responded as follows; (very low-0%; low-8-0%); (average-17%); (high-0%); and (very high-0%); At the freshwater IBA, 98% (N=246) responded to this question and the percentage distribution was as follows; (very low-0%; low-93%); (average-7%); (high-0%); and (very high-0%). The scores recorded at the saline lacustrine IBA from 40 respondents (91%) are as follows; (very low-0%%; low-73%); (average-18%); (high-4%); and (very high-0%).

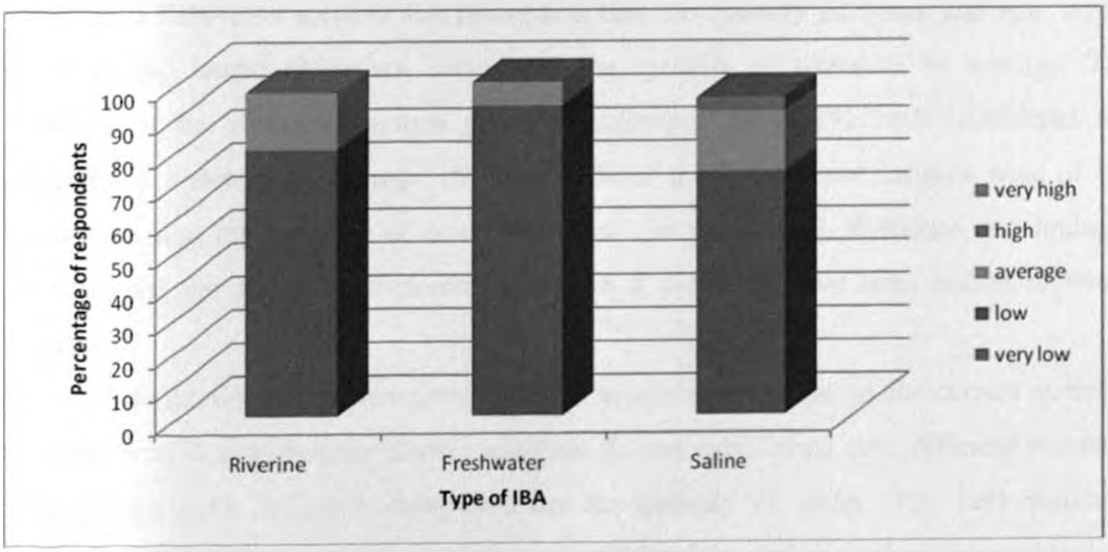


Figure 6-1: Perception on quantity of water

Plate 6-1 shows the impact of extreme climatic conditions as well as anthropogenic factors on one of the main freshwater water supplies for communities living in proximity to Lake Bogoria.

Plate 6-1: The dry river bed of the River Waseges, Lake Bogoria

Source: Reseacher, February 2011

According to resource user groups, at least 10.2% of the livestock owners/ herders/ pastoralists were of the perception that the quantity of water was high. At least 21.2% of the coastal fishermen were of the perception that the quantity of water was low, while 8.9% of the inland fishermen considered the quantity of water to be average. The majority of the charcoal burners and the beekeepers at 11.1% each considered the quantity of water to be average. At least 42% of the agricultural farmers were of the perception that the quantity of water was low. On the overall, therefore, the findings showed that the wetland environment was in a declining state with regard to water storage.

Community perception among IBA resource user groups on the current quantity of water varied significantly among resource. It was established that, different resource user groups have different viewpoints on the quantity of water. The Test Statistics (Kruskal-Wallis H), indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =37.728, P = 0. 000) with a mean rank of 220.81 for agricultural farmers, 193.01 for livestock keepers, 180.00 for traditional healers and

180.00 for charcoal burners. In order to examine the relationship between the type of IBA site and the community perceptions as grouped in different resource user groups on the condition of wetland resources, a contingency chi-square test of independence indicated that resource user groups and water quantity from different IBA sites had a significant relation, $\chi^2_{Cal} = 58$, df= 6, χ^2 cri 0.05= 12.592 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local resource user group's perceptions on the quantity of water in different IBA sites are not different was rejected. The overall findings showed that quantity of water resources were in decline at each wetland IBA type for example; riverine, saline and freshwater, thus compromising the livelihoods of the local community and the viability of wetland resources dependent upon the water.

6.1.2. Water Quality

As indicated in the literature review in this study, abundance of bird species at any given wetland are determined not only by the quantity of water but also the quality which has an effect on what birds feed on. Thus the study sought to analyse the perceptions of the wetland communities on the water quality in order to derive meaningful management actions. Figure 6-2 shows the distribution of responses in terms of the current quality of water at each wetland IBA. At the riverine IBA, a total of 158 (83%) responded as follows; (poor-23.4%); (marginal-25.3%); (fair-22.8%); (good-20.9%); (very good-2.53%) and (excellent-5.1%). At the freshwater lacustrine IBA, a total of 239 (95%) responded to this question and the percentage distribution was as follows: (poor-8.34%); (marginal-2.92%); (fair-3.6%); (good -79.8%); (very good-0%) and (excellent-0%). The scores recorded at the saline lake from 44 (100%) respondents were as follows: (poor-5.7%); (marginal-54.5); (fair-15.9%); (good -0%); (very good-0%) and (excellent 0%). On the overall, the findings showed that the state of wetlands in terms of water quantity was not in good condition throughout the study sites according to the local respondents.

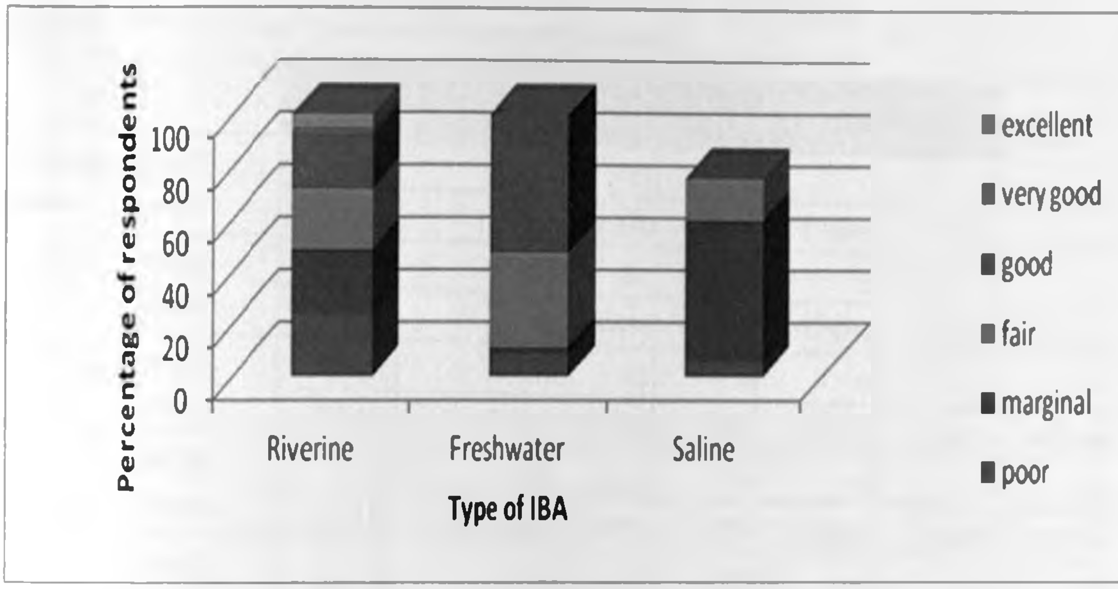


Figure 6-2: Perception on the quality of water

This study investigated whether the perception of the quality of water available for both domestic and livestock/wildlife/birds use differed or were identical between young and old individuals. The overall finding was that there was no difference in perceptions held by the young and old with regards the quality of water. Table 6.1 shows that both the young and old respondents considered the quality to be either poor or marginal.

A statistical analysis was conducted to investigate if there were differences in perceptions on the quality of water according to gender. Table 6.2 shows that gender did not influence the perception held by both the male and the female respondents. Concerning perceptions about the water quality, all the gender profiles indicated that this neither very good nor excellent. There was however a distribution of responses in each profile, with the 'all female' respondents having a majority of 52.9% in the 'fair category'. The 'female dominant' respondents however indicated that the water quality was largely poor, with a score of at least 68.2%. Generally, there was no difference in the perceptions held by both men and women as the statistical analysis showed that most of them thought that the water quality was poor, marginal or fair.

Table 6.1. Perception on water quality according to age

		Poor	Marginal	Fair	Good	Very Good	Excellent	Total
Group age bracket	15-25 years	12	8	35	0	0	0	55
		21.8%	14.5%	63.6%	0.00%	0.00%	0.00%	100.0%
	26-36 years	18	8	95	0	0	0	121
		14.9%	6.6%	78.5%	0.00%	0.00%	0.00%	100.0%
	37-47 years	56	15	48	4	0	0	123
		45.5%	12.2%	39.0%	3.3%	0.00%	0.00%	100.0%
	48-58 years	16	14	8	4	0	0	42
		38.1%	33.3%	19.0%	9.5%	0.00%	0.00%	100.0%
	59-69 years	18	8	16	0	0	0	42
		42.9%	19.0%	38.1%	0.00%	0.00%	0.00%	100.0%
	70-80 years	44	4	0	0	0	0	48
		91.7%	8.3%	0.00%	0.00%	0.00%	0.00%	100.0%
Total		164	57	202	8	0	0	0
		38.1%	13.2%	46.9%	1.9%	0.00%	0.00%	.0%

Table 6.2. Perception on water quality according to gender profile

		Poor	Marginal	Fair	Good	Very Good	Excellent	Total
Group gender profile	All male	121	41	150	4	0	0	316
		38.3%	13.0%	47.5%	1.3%	0.00%	0.00%	100.0%
	All female	32	8	45	0	0	0	85
		37.6%	9.4%	52.9%	0.00%	0.00%	0.00%	100.0%
	Male dominant	3	8	0	4	0	0	15
		20.0%	53.3%	0.00%	26.7%	0.00%	0.00%	100.0%
	Female dominant	15	0	7	0	0	0	22
		68.2%	0.00%	31.8%	0.00%	0.00%	0.00%	100.0%
Total		171	57	202	8	0	0	0
		39.0%	13.0%	46.1%	1.8%	0.00%	0.00%	0.00%

The study sought to establish the variation in community perception on current quality of water with the IBA sites. There was a significant variation resource user group perception on current state of water. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 21.927, P = 0. 00, with a mean rank of 220.98 for riverine, 193.96 for freshwater lacustrine and 238.00 saline lacustrine. Community perception among user group from different IBA sites on the current quality of water indicated a significant variation in respondents' perception. Statistical analysis showed that different user groups had a different view points on the current quality of water. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 104.866, P = 0. 000) with a mean rank of 221.48 for agricultural farmers, 134.52 for livestock keepers, 308.50 for traditional healers and 247.12 for charcoal burners.

6.1.3. Wetland Vegetation

Wetland vegetation has always been an important habitat for certain bird species in Kenya. Birds respond quickly to changes in habitat. Thus, birds are good bioindicators of wetland habitat quality, productivity, and stability. Birds often have correlation with their habitats and have also been used as surrogates for assessing the impact of habitat changes. It was thus imperative to investigate the perceptions of the respondents with regards the status of wetland vegetation in order to ascertain the health of the IBA sites under study. Figure 6-3 shows the distribution of responses in terms of the abundance of wetland vegetation at each wetland IBA. At the riverine IBA, a total of 158 (88.3%) responded as follows; (poor-18.4%); (marginal-35.4%); (fair-22.8%); (good -20.9%); (very good-2.5%) and excellent (0%). At the freshwater lacustrine IBA, a total of 239 (94.8%) responded to this question and it was as follows: (poor-16.3%); (marginal-81%); (fair-27.2%); (good-2.9%); (very good-0%) and excellent (0%). The scores recorded at the saline lacustrine IBA from 44 (100%) respondents are as follows: (poor-0%); (marginal-0%); (fair-25%); (good-65.9%); (very good-9.1%) and excellent (0%). Table 6.3 shows that with the exception of the respondents in the 37-47 and 70-80 age brackets, none of the respondents indicated that the state of wetland vegetation was in very good condition.

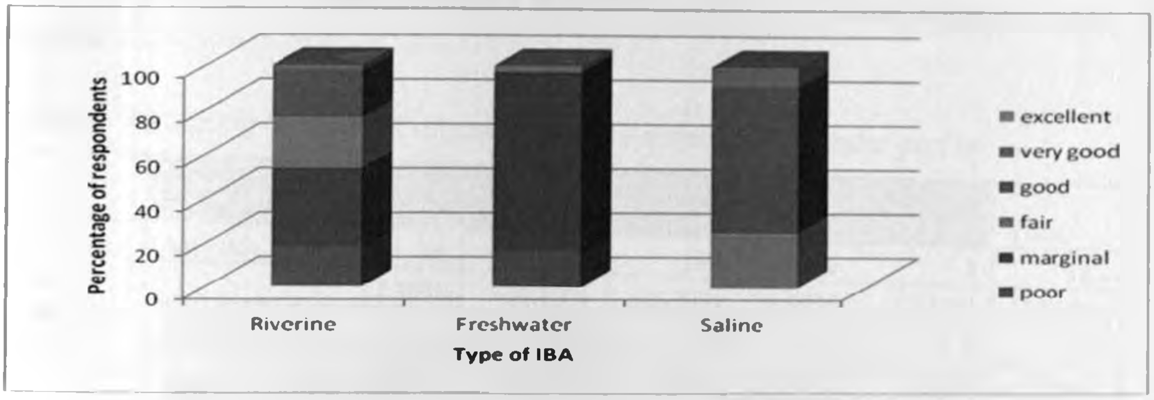


Figure 6-3: Perception on state of wetland vegetation

Table 6.3. Perception on wetland vegetation quality according to age

		Poor	Marginal	Fair	Good	Very Good	Total
Group age bracket	15-25 years	12	8	35	8	0	63
		19.0%	12.7%	55.6%	12.7%	0.00%	100.0%
	26-36 years	7	46	50	4	0	107
		6.5%	43.0%	46.7%	3.7%	0.00%	100.0%
	37-47 years	36	56	8	16	4	120
		30.0%	46.7%	6.7%	13.3%	3.3%	100.0%
	48-58 years	0	27	11	12	0	50
		0.00%	54.0%	22.0%	24.0%	0.00%	100.0%
	59-69 years	6	20	4	12	0	42
		14.3%	47.6%	9.5%	28.6%	0.00%	100.0%
	70-80 years	7	20	4	17	4	52
		13.5%	38.5%	7.7%	32.7%	7.7%	100.0%
Total		68	177	112	69	8	434
		15.7%	40.8%	25.8%	15.9%	1.8%	100.0%

A majority of respondents in the youngest age group of 15-25 indicated that wetland vegetation quality was fair with a score of 55.6%, closely followed by at least 46.7% of respondents in the 26-36 age bracket. The majority of respondents in the 48-58 age bracket with a score of 54% indicated that the quality of wetland vegetation was marginal.

Table 6.4. Perception on wetland vegetation quality according to gender profile

		Poor	Marginal	Fair	Good	Very Good	Total
Group gender profile	All male	56	110	104	45	8	323
		17.30%	34.10%	32.20%	13.90%	2.50%	100.00%
	All female	8	53	8	12	0	81
		9.90%	65.40%	9.90%	14.80%	0.00%	100.00%
	Male dominant	4	3	0	8	0	15
		26.70%	20.00%	0.00%	53.30%	0.00%	100.00%
	Female dominant	0	18	0	4	0	22
		0.00%	81.80%	0.00%	18.20%	0.00%	100.00%
Total		68	184	112	69	8	441
		15.40%	41.70%	25.40%	15.60%	1.80%	100.00%

Having established the variation in the state of wetland vegetation in different IBA sites and how it is perceived among different user groups, the study examines the vegetation as a habitat component to different bird species in the IBA site. The relationship between resource user group's perception on current abundance of wetland vegetation cover and different IBA sites was tested using the contingency chi-square test to discern any independence. The study established that there exists a significant relation between the type of IBA site and resource user groups perception on abundance of wetland vegetation cover, $\chi^2_{Cal} = 143$, df= 8, χ^2 cri 0.05= 15.507 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the resource user groups around the different IBA sites had different perception on the abundance of wetland vegetation cover. The ecological factors at the riverine and freshwater wetland IBAs contributed to the difference among user groups due the nature of their activities within the wetland area.

According to user groups, livestock farmers who constitute 52.9% of the respondents from the IBA sites perceived the current quality of wetland vegetation to be poor as 21.1% of agricultural farmers (crop) cultivators perceived the current quality of water as poor. A majority of inland fishermen respondents, represented by 51.9%, considered the quality of water to be fair. The mangrove harvesters and the beekeepers, each represented by 50%, indicated that the current quality of water was excellent. On the overall, the condition of wetland vegetation was considered marginal by the local respondents at the study sites. On the overall, vegetation abundance is higher in the freshwater lacustrine wetland and riverine wetland which can be supported ecologically.

The variation in community perception on abundance of wetland vegetation from one IBA to another was an important indicator in determining the local indicator. The study established a significant variation in community perception on current state of wetland vegetation. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 94.824, $P = 0.004$) with a mean rank of 227.92 for riverine, 187.18 for freshwater lacustrine and 379.88 for saline lacustrine wetland. From the variation above, the intrinsic characteristics of the IBA site have different indicator on the state of vegetation. This is a pointer to varying user groups and the extractive nature of wetland vegetation around the IBA sites. The variation in community perception as grouped in different user groups further depicts a very important phenomenon that different user groups have a varying perception on the abundance of wetland vegetation from the three IBA sites. The Test Statistics (Kruskal-Wallis H, indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 52.452, $P = 0.000$) with a mean rank of 235.74 for agricultural farmers, 193.01 for livestock keepers, 308.50 for traditional healers and 219.03 for charcoal burners. This is a pointer to the nature of interaction of different user groups with wetland vegetation in the course of extraction and utilization. For instance the variation in perception was highest among traditional healers, a clear pointer to diminishing of the wetland vegetation that is vital use to them.

6.1.4. Wetland Birds

Birds are the most conspicuous and significant component of freshwater wetland ecosystem. Presence or absence of birds may indicate the ecological conditions of the wetland area. Therefore the community perception on the different facets of bird's population and diversity is analysed taking into account the microclimate and habitat variables. Figure 6-4 shows the distribution of responses in terms of the perception on the abundance of wetland birds at each wetland IBA. At the riverine IBA, a total of 145 responded and the percentage distribution was follows; poor-66.9%; marginal-30.3%; fair-2.8%; good-0%; very good-0% and excellent-0%. At the freshwater lacustrine IBA, a total of 225 responded to this question and the percentage distribution was as follows; poor-27%; marginal-44%; fair-4.4%; good-0%; very good-0% and excellent-0%. The scores recorded at the saline lacustrine IBA from 44 respondents are as follows; poor-36.3%; marginal-0%; fair-0%; good-63.6%;very good-0% and excellent-0%.

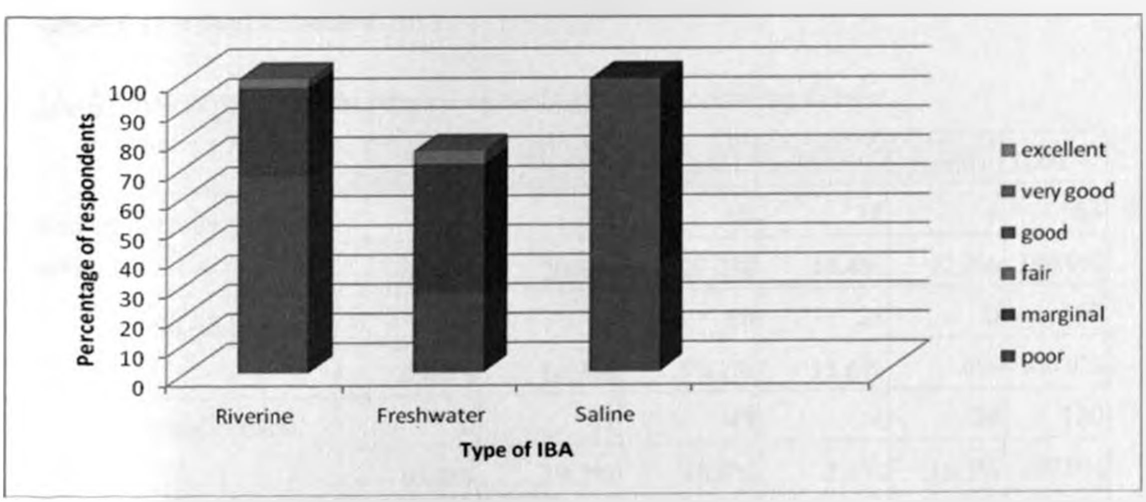


Figure 6-4: Perception on wetland birds

In order to derive meaningful interventions that would help develop robust environmental education awareness programmes amongst the young people, the study investigated whether there are were any differences in how the respondents in different age groups perceived the abundance of wetland birds in their vicinity. The statistical analysis showed that 44.4% of respondents in the 15-25 age bracket perceived the abundance of wetland birds to be fair compared to at least 39.2% of respondents in the 37-47 age bracket who classified this as poor. Noting tht the Lesser Flamingo is the flagship species that is evident to every common man at Lake Bogoria, a majority of respondents at Lake Bogoria classified the condition as good. Plate 6-2 shows the density of Lesser Flamingoes at the fringes of the northern part of the Lake.

Plate 6-2: Lesser Flamingos at one section of the northern part of Lake Bogoria

Source: Reseacher, February 2011

Table 6.5. Perception on abundance of wetland birds according to age

		Very Poor	Poor	Marginal	Fair	Good	Total
Group age bracket	15-25 years	0	13	14	28	8	63
		0.00%	20.6%	22.2%	44.4%	12.7%	100.0%
	26-36 years	0	11	60	36	0	107
		0.00%	10.3%	56.1%	33.6%	.0%	100.0%
	37-47 years	0	47	49	4	20	120
		0.00%	39.2%	40.8%	3.3%	16.7%	100.0%
	48-58 years	0	4	23	15	8	50
		0.00%	8.0%	46.0%	30.0%	16.0%	100.0%
	59-69 years	0	6	28	4	4	42
		0.00%	14.3%	66.7%	9.5%	9.5%	100.0%
	70-80 years	0	11	16	8	8	43
		0.00%	25.6%	37.2%	18.6%	18.6%	100.0%
Total		0	92	190	95	48	425
		0.00%	21.6%	44.7%	22.4%	11.3%	100.0%

A majority of respondents in the 37-47 and the 48-58 age brackets classified the abundance of wetlands as marginal with 40.8% and 46% respectively. The overall results showed that the younger people were more optimistic compared to the older respondents who classified the abundance of wetland birds as very poor, poor or marginal. Similarly a statistical analysis was conducted to assess perceptions according to gender. The 'all female' profile represented by at least 70.4% indicated that the abundance of wetland birds were in a marginal condition compared to the 'female dominant' profile represented by at least 50%. The 'all male' dominant group represented by at least 40% indicated that the abundance of wetlands birds were in a marginal condition. Overall, the statistical results showed that gender did not influence the perceptions held by the respondents on abundance of wetland birds as they all generally thoughts that the wetland birds were either in a poor or marginal condition.

Table 6.6. Perception on abundance of wetland birds according to gender profile

		Very Poor	Poor	Marginal	Fair	Good	Total
Group gender profile	All male	0	69	126	79	40	314
		0.00%	22.0%	40.1%	25.2%	12.7%	100.0%
	All female	0	12	57	8	4	81
		0.00%	14.8%	70.4%	9.9%	4.9%	100.0%
	Male dominant	0	4	3	4	4	15
		0.00%	26.7%	20.0%	26.7%	26.7%	100.0%
	Female dominant	0	7	11	4	0	22
		0.00%	31.8%	50.0%	18.2%	.0%	100.0%
Total		0	92	197	95	48	432
		0.00%	21.3%	45.6%	22.0%	11.1%	100.0%

In terms of resource user groups, 16.7% of the agricultural farmers perceived the state of birds to be good compared to 8.7% who indicated that the birds were in a poor condition. A majority of livestock farmers (at 30.4%) perceived the condition of birds to be poor, compared to while only 16.7% indicated the birds were in a good condition. At least 46.3%of the inland fishermen were of the perception that the birds were in a fair condition, while 17.4% indicated they were in poor condition. At least 18% of the charcoal burners were of the perception the birds were in good condition, while the majority of the traditional/spiritual leaders at 11.7% indicated that the condition was marginal. The overall finding was that most of the respondents considered the state of wetland birds to be fair. The study established that there exists a significant difference in community perception on the current state of birds in IBA sites. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 64.763, *P* = 0. 004) with a mean rank of 200.12 for riverine IBA, 204.95 for freshwater lacustrine IBA and 369.34 saline lacustrine IBA. The variation in mean ranks depicts different IBA sites are ranked differently by the user groups when assessing the current state of Birds. Different user groups have a different view points on the current state of birds. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =48.866, *P* = 0. 000) with a mean rank of 246.04 for agricultural farmers, 175.83 for livestock keepers, 191.00 for traditional healers and 226.65 for charcoal burners. The perceptions of the agricultural farmers on the current state of birds ranked highly at the wetland IBAs. The variation in perception among the users groups of IBA resources is a key indicator as the user groups exert varying pressure on the IBA state of Environment.

As for the relationship between resource user groups in the IBA sites and the perception on the current state of Birds in the IBA sites, a significant contingency chi-square of χ^2_{Cal} = 143, df= 33, χ^2 cri 0.05= 47.400α 0.05 was established. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the resource user groups in IBA sites did not have different perception on the current state of birds. This was depicted due to the saline condition at Lake Bogoria and the congregatory nature of the flamingos, the respondents was clearly more optimistic about the association between the wetland IBA and the trends in this bird species. At the freshwater wetland IBA, the conditions favour the abundance of significant bird populations. Generally, the abundance of birds was said to be fair as indicated above and this reflects that there is room for improvement in the management the wetland IBAs.

6.1.5. Wetland Pasture

The productivity levels of freshwater –wetland ecosystems are among the highest in the world and this productivity can support an astonishingly high number of animal species, often forming dense populations. Since the beginning of mammal domestication, the periodical exposure of good grazing lands within the wetlands has led to en masse feeding of cattle, sheep, goats and donkeys. In Kenya there are various bird species that are associated with wetland pasture and animals that feed on this vital resource. Therefore, several pastures are included in the Important Bird Areas network, a status that highlights their importance as critical habitat for the conservation of some key bird species. Pastures have become a landscape of hope for many of the grassland's beleaguered species. Thus this study examined the perceptions of the abundance of wetland pasture for both birds and people with the specific purpose of prompting the communities to consider whether pastures in Kenya require more coordinated oversight or long-term protection. Figure 6-5 shows the distribution of responses in terms of the perception on quality and quantity of wetland pasture at each wetland IBA. At the riverine IBA, a total of 161 responded as follows; poor-62.1%; marginal-25.5%; fair-9.9%; good- 2.5; very good-0% and excellent-0%. At the freshwater lacustrine IBA, a total of 253 responded to this question and the percentage distribution was as follows; poor-27.2%; marginal-48%; fair-25%; good- 0%, very good-0% and excellent-0%.

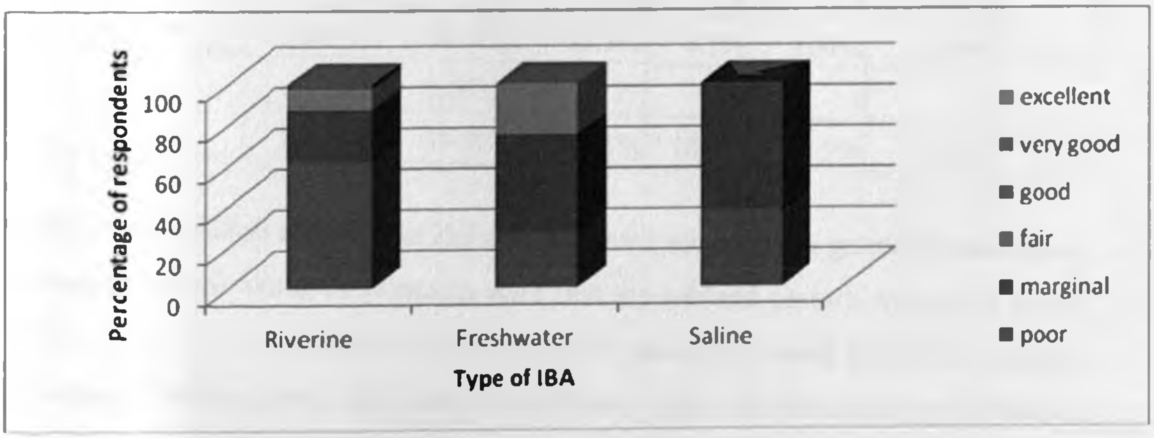


Figure 6-5: Perception on quality and quantity of wetland pasture

The scores recorded at the saline lake from 24 respondents are as follows; poor-37.5%; marginal-62.5%; fair-0; good-0%; very good-0% and excellent-0%. The statistical results showed that age was not a factor in influencing perceptions about the condition of wetland pasture as most responses depicted the poor state of the wetland pasture. However, there was a noticeable high response of 50.9% in the 15-25 age bracket which classified the wetland pasture as fair. Also 49.6% of respondents in the 26-36 age bracket considered the wetland pasture to be in a marginal condition.

Table 6.7. Perception on wetland pasture according to age

		Very poor	Poor	Marginal	Fair	Good	Excellent	Total
Group age bracket	15-25 years	0	19	8	28	0	0	55
		0.00%	34.5%	14.5%	50.9%	0.00%	0.00%	100.0%
	26-36 years	0	25	60	32	4	0	121
		0.00%	20.7%	49.6%	26.4%	3.3%	0.00%	100.0%
	37-47 years	0	58	58	7	0	0	123
		0.00%	47.2%	47.2%	5.7%	0.00%	0.00%	100.0%
	48-58 years	0	23	15	4	0	0	42
		0.00%	54.8%	35.7%	9.5%	0.00%	0.00%	100.0%
	59-69 years	0	18	20	4	0	0	42
		0.00%	42.9%	47.6%	9.5%	0.00%	0.00%	100.0%
	70-80 years	0	28	16	4	0	0	48
		0.00%	58.3%	33.3%	8.3%	0.00%	0.00%	100.0%
Total		0	0.00%	177	79	4	0	0
		0.00%	39.7%	41.1%	18.3%	0.9%	0.00%	100.0%

Similarly, the statistical results also showed that even according to gender classification, the perceptions held by the respondents were that the wetland pasture was not in a good condition. Table 6.8 is a reflection of this trend in perceptions held by the respondents, with scores at 0% for good, very good or excellent. Again, the statistical results showed that the perceptions about wetland pasture were not influenced by gender.

Table 6.8. Perception on wetland pasture according to gender profile

		Very Poor	Poor	Normal	Fair	Good	Excellent	Total
Group gender profile	All male	0	132	113	71	0	0	316
		0.00%	41.8%	35.8%	22.5%	0.00%	0.00%	100.0%
	All female	0	28	53	4	0	0	85
		0.00%	32.9%	62.4%	4.7%	0.00%	0.00%	100.0%
	Male dominant	0	7	4	0	4	0	15
		0.00%	46.7%	26.7%	.0%	26.7%	0.00%	100.0%
	Female dominant	0	11	7	4	0	0	22
		0.00%	50.0%	31.8%	18.2%	.0%	0.00%	100.0%
Total		0	178	177	79	4	0	0
		0.00%	40.6%	40.4%	18.0%	.9%	0.00%	0.00%

According to user groups, 29.2% of the livestock owners/herders/pastoralists who constitute 19.2% of the respondents from the IBA sites perceived the quality and quantity of grazing as poor, and 18% of the inland fishermen considered the quality of grazing as poor. Similarly, the agricultural farmers who constituted 11.4% were of the perception that the quality and quantity of grazing was poor. This is compared to 8.9 % of the charcoal burners, who considered the quality of grazing to be fair. The overall finding is that the quality of pasture is not in good state.

The varying nature of utilization of wetland resources around the IBA sites was assessed as to how different user groups ranked the quality and quantity of wetland pasture. The ranking of the quality and quantity of wetland pasture was significantly different from one IBA site to the other. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among user groups around the three IBA sites (H (2) = 42.711, $P =$ 0. 004) with a mean rank of 173.68 for riverine, 250.46 for freshwater lacustrine IBA and 200.44 saline lacustrine IBA. Freshwater lacustrine IBA sites had a high rank in among user group in quality and quantity of pasture. It was important for this study to further assess the variation in ranking of wetland pastures quality and quantity among different user groups around the IBA sites. Different user groups have a different view points on the quality and quantity of wetland pasture. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =69.166, P = 0. 000) with a mean rank of 109.15 for agricultural farmers, 263.21 for livestock keepers, 89.50 for traditional healers and 251.59 for charcoal burners. Livestock keepers as a resource user group around the IBA sites ranked highly the variation in quality and quantity of pastures around the IBA site. This can be attributed to the nature of their land use in relation to the IBA site. Being pastoralist, a change in IBA quality and quantity of pasture is readily noticed.

The local community IBA indicator on the state of wetland pasture was assessed along pasture quantity and quantity of wetland pasture. The community around the IBA sites categorized as resource user groups had their perception on the state of wetland pasture assessed and if their perception were different from different IBA sites. A significant contingency chi-square of $\chi^2_{Cal} = 68$, df= 6, χ^2 cri 0.05= 12.592 α 0.05 was depicted. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that there is no difference in perception among resource user groups on state of pasture around IBA sites was rejected. The community perceptions on the quality of wetland pasture were different across different communities around the different IBA site.

6.1.6. Fish Resources

Fish resources are essential not only for sustaining livelihood of communities living in proximity to wetlands but are also important for bird populations, especially waterbirds. If birds are to remain indicators of the health of wetlands, it is imperative that healthy populations of the fish resources be sustained. Thus, the study investigated the perceptions of the respondents with regards the abundance of fish resources in their respective wetlands. The study found out that the community's perception on fish resources varied across the different IBA sites. The study established that 74.8 % of the respondents around the riverine IBA perceived the quality and quantity of aquatic resources to be in a poor state, while 79.8% at the freshwater lake were of the perception that the quality of fish resources was fair. Figure 6-6 shows the distribution of responses in terms of fish resources at each wetland IBA. At the riverine IBA, a total of 110 responded as follows; poor-91.8%; marginal-40%; fair-15%; good-0%, very good-0% and excellent-0%. At the freshwater lacustrine IBA, a total of 246 responded to this question and the percentage distribution was as follows; poor-8.5%; marginal -54.5%; fair-91; good-37%; very good (0%) and excellent (0%). The scores recorded at the saline lacustrine IBA from 31 respondents are as follows: poor -42%; marginal -13%; fair-2.17%; good -0-0%; very good-0% and excellent (0%). Given that saline conditions are not ecologically feasible for fish to thrive, the Emsos community, with the assistance of NGOs identified mitigation measures to increase food productivity. Plate 6-3 shows one of the several ponds which have led to a thriving fish farming venture in an arid area.The fish ponds are fed by fresh water from the escarpment.

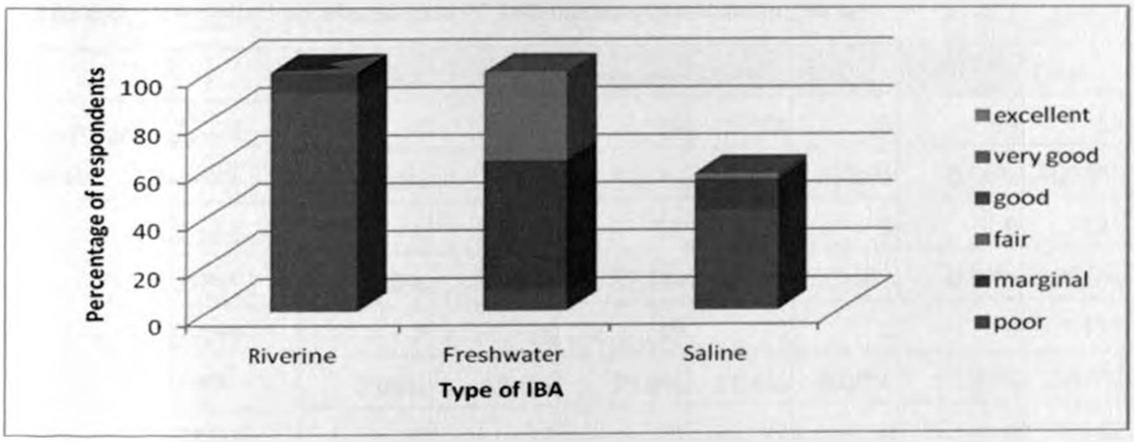


Figure 6-6: Perception on fish resources

As was noted in the statistical computation of the results according to age on other variables, this was not determining factor for the perceptions held about the respondents with regards abundance of fish resources for sustaining livelihoods and maintain healthy populations of bird species. Generally, the responses pointed to the fact that the fish resources were in a poor condition. However, the younger people aged between 15-25 years exhibited a more optimistic mood, with at least 50.9% holding the view that the fish resources were in a fair condition.

Plate 6-3: Fish ponds at Emsos Village, Lake Bogoria

Source: Researcher, February 2011

Table 6.9. Perception on abundance of fish resources according to age

		Very Poor	Poor	Marginal	Fair	Good	Excellent	Total
Group age bracket	15-25 years	0	8	19	28	0	0	55
		0.00%	14.5%	34.5%	50.9%	0.00%	0.00%	100.0%
	26-36 years	0	12	63	39	7	0	121
		0.00%	9.9%	52.1%	32.2%	5.8%	0.00%	100.0%
	37-47 years	0	56	49	18	0	0	123
		0.00%	45.5%	39.8%	14.6%	0.00%	0.00%	100.0%
	48-58 years	0	12	23	7	0	0	42
		0.00%	28.6%	54.8%	16.7%	0.00%	0.00%	100.0%
	59-69 years	0	14	24	4	0	0	42
		0.00%	33.3%	57.1%	9.5%	0.00%	0.00%	100.0%
	70-80 years	0	33	4	11	0	0	48
		0.00%	68.8%	8.3%	22.9%	0.00%	0.00%	100.0%
Total		0	135	182	107	7	0	431
		0.00%	31.3%	42.2%	24.8%	1.6%	0.00%	100.0%

With regards perceptions on the abundance of fish resources, interestingly the study also showed there were no variations in perceptions according to gender as both the 'all male' and 'all female' gender profiles exhibited rather high responses which reflected the condition of fish resources as being in a poor state. However the 'all male dominant' and the 'all female dominant' groups exhibited major differences in perceptions, with the latter recording a high of 81.8% in the fair category.

Table 6.10. Perception on abundance of fish resources according to gender profile

		[illegible] Poor	Poor	Marginal	Fair	Good	Total
Group gender profile	All male	0	100	117	92	7	316
		0.00%	31.6%	37.0%	29.1%	2.2%	100.0%
	All female	0	24	61	0	0	85
		0.00%	28.2%	71.8%	0.00%	0.00%	100.0%
	Male dominant	0	7	4	4	0	15
		0.00%	46.7%	26.7%	26.7%	0.00%	100.0%
	Female dominant	0	4	0	18	0	22
		0.00%	18.2%	0.00%	81.8%	0.00%	100.0%
Total		0	135	182	114	7	438
		0.00%	30.8%	41.6%	26.0%	1.6%	100.0%

According to user groups, 37% of the livestock farmers from the IBA sites perceived the fish resources to be in poor condition compared to 55.3% of the inland fishermen who perceived the condition of the fish resources to be in fair. A majority of the agricultural farmers (13.2%) considered the condition of the fish to be fair. The overall finding is that the fish resources were either in a poor or marginal state.

The availability of fish in the IBA sites as an important indicator that the community can use to depict the status of the IBA site cannot be overemphasised. The study established a significant variation in user groups ranking of the availability of fish resources within the three IBA sites. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites ($H(2) = 121.065$, $P = 0.004$) with a mean rank of 141.78 for riverine, 272.35 for freshwater lacustrine IBA and 183.81 saline lacustrine IBA. User groups ranked high freshwater lacustrine IBA sites to have high fish resource when compared to the other IBA sites. However, there was variation among user groups on abundance within the three different IBA sites. The Test

Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 133.302, $P = 0.000$) with a mean rank of 232.86 for agricultural farmers, 151.54 for livestock keepers, 68 for traditional healers and 135.05 for charcoal burner. Agricultural farmers across the IBA sites ranked high the variation in fish resource; this was attributed to sedentary nature of agricultural farmers within the IBA sites making it easy to discern variation in fish diversity and abundance.

The availability of fish in the IBA site was considered as a critical indicator for the state of environment for the different IBA sites. Therefore the study sought to assess the relationship in resource user group's perception on fish population in the different IBA sites. The study established that a significant contingency Chi-square of $\chi^2_{Cal} = 149$ df= 6, χ^2 cri 0.05= 12.592 α 0.05 existed between resource user groups perception on fish population in the three IBA sites. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local community perceptions about the abundance of fish are not similar was rejected.

The community perceptions on fish resources were different across different communities around the different IBA site. For example, while the freshwater wetland IBA was synonymous with thriving fish markets, the fishing industry at the riverine wetland IBA was fair, while at the wetland IBAs such as Lake Bogoria there were no record of fish markets. Once again the ecological factors of each wetland IBA type had an influence on the abundance of fish resources, however generally there was a decline in fish records across the three wetland IBAs. A chi-square test of goodness-of-fit was performed to determine whether the community perception on fish from the three IBA sites were equally the same.

6.2. Distribution of Respondents on Pressures affecting Wetland Resources

6.2.1. Water Quantity

Factors within and outside the wetland environment have a tendency of determining the level of water supplies that can be used for people, livestock and birds. It was thus imperative to investigate how the respondents perceived the pressures that bear upon the abundance of water supplies. Figure 6-7 shows the distribution of responses in terms of the pressures on water quantity at each wetland IBA. At the riverine IBA, the responses were as follows; very low-0%; low-0%; moderate-2.7%; high-0% and very high-97.3%. At the freshwater lacustrine IBA, a total of 232 responded to this question and the percentage distribution was as follows; very low-0%; low-0%; moderate-0; high-0% and very high-100%. The scores recorded at the saline lacustrine IBA from 44 respondents are as follows; very low-0%; low-0%; moderate-0%; high-25%; very high-70.5%. According to user groups, 29.5% of the inland fishermen, 18.1% of the livestock owners/herders/pastoralists and 13.8% of the agricultural farmers were of the perception that the pressures on water quantity were very high. Overall, the respondents were of the perception that the pressures on the quantity of water available for use by downstream communities were very high.

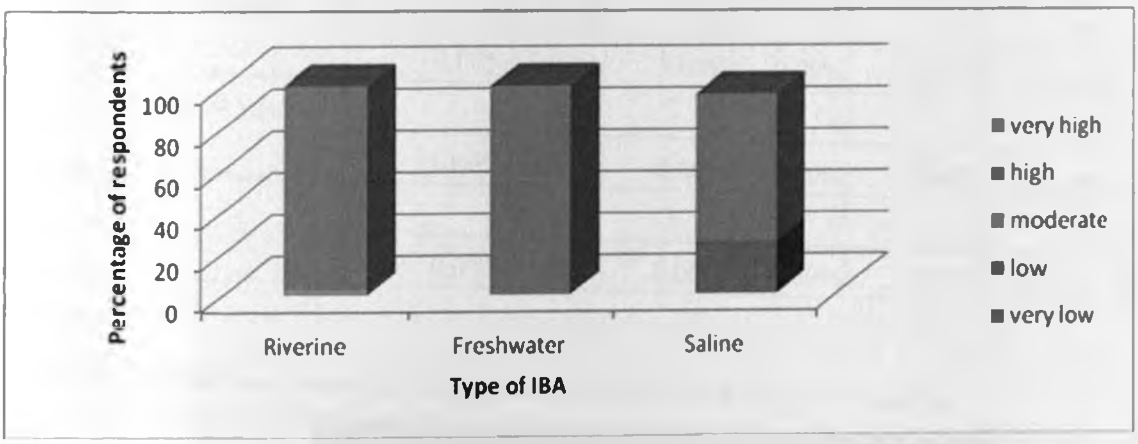


Figure 6-7: Pressures on water quantity

The community's perception on pressures on water quantity varied across the different IBA sites. The study established that 34.4% of the respondents around the riverine IBA perceived the pressures on water quantity to be very high, while 10.5% at the saline lacustrine IBA were of the perception that the pressures on water quantity were very high. Benchmarking the riparian communities' views with regards water quality to determine the state of the wetland IBA condition according to gender was also of paramount importance. Table 6.11 shows that all the age brackets reflected higher percentages on the very high category. The results show a unanimous view of the condition of the water quantity among and across the different age groups. This reflects on the magnitude of this threat to the maintaining healthy populations of water birds. Table 6.12 is an assessment of perceptions according to gender.

Table 6.11. Perception of water quantity pressures according to age

		Very Low	Low	Moderate	High	Very High	Total
Group age bracket	15-25 years	0	0	0	0	55	55
		0.00%	0.00%	0.00%	0.00%	100.0%	100.0%
	26-36 years	0	0	0	0	100	100
		0.00%	0.00%	0.00%	0.00%	100.0%	100.0%
	37-47 years	0	0	4	0	131	135
		0.00%	0.00%	3.0%	0.00%	97.0%	100.0%
	48-58 years	0	0	0	0	46	46
		0.00%	0.00%	0.00%	0.00%	100.0%	100.0%
	59-69 years	0	0	0	0	42	42
		0.00%	0.00%	0.00%	0.00%	100.0%	100.0%
	70-80 years	0	0	0	0	40	40
		0.00%	0.00%	0.00%	0.00%	100.0%	100.0%
Total		0	0	0	0	414	418
		0.00%	0.00%	0.00%	0.00%	99.0%	100.0%

Table 6.12. Perception of water quantity pressures according to gender profile

		Very Low	Low	Moderate	High	Very High	Total
Group gender profile	All male	0	0	4	0	302	306
		0.00%	0.00%	1.30719	0.00%	98.69%	100%
	All female	0	0	0	0	85	85
		0.00%	0.00%	0	0.00%	100%	100%
	Male dominant	0	0	0	0	12	12
		0.00%	0.00%	0	0.00%	100%	100%
	Female dominant	0	0	0	0	22	22
		0.00%	0.00%	0	0.00%	100%	100%
Total		0	0	4	0	421	425
		0.00%	0.00%	0.941176	0.00%	99.05882	100%

In this regard, both the female and male respondents held the same view that the pressures on water quantity were high. This serves to highlight that water shortage is a challenge for the differentiated roles between the female and male respondents in the study areas. The perception of the user groups on pressure exerted on different indicators of the state of environment around the wetland IBA site is an important starting point in determining the most appropriate indicator of decline in IBA state of environment for management. To this end the study established that respondent in different user groups have varied perception on the pressure they exert on water quantity. There was a significant variation in respondents' perception on current quantity of water. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 7.462, P = 0. 004) with a mean rank of 209.30 for riverine, 215.00 for freshwater lacustrine IBA and 215.00 saline lacustrine IBA. The user groups ranking riverine IBA site highest as under pressure is informed by user group perception that riverine fresh water is often abstracted for multiple agricultural and domestic use.

The contingency chi-square test of independence was performed to examine the difference in relationship between the type of IBA site and the wetland resource User groups' attitude on pressures on water quantity. The relation between these variables was significant, $\chi^2_{Cal} = 157$, df= 2, χ^2 cri 0.05= 14.067 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local resource user group's perception water quantity pressures are not similar was rejected. The user groups in different IBA sites had different attitude on pressures on water quality. This finding depicts, that user groups attitude pressures on water resource in different IBA sites is informed by the dominant land uses around the IBA which intern have a varying level of abstraction of water quantities.

6.2.2. Water Quality

The quality of water was an important indicator which determined the abundance of bird species. On the other hand, respondents associated various skin and water borne diseases with the quality of water indicating that their level of consciousness of what should be ideal/or is desirable was high. The study thus investigated the perceptions of the respondents on the quality of water with the intention identifying or recommending appropriate interventions that could be beneficial for both birds and people. Figure 6-8 shows the distribution of responses in terms of the pressures on water quality at each wetland IBA. At the riverine IBA, a total of 149 responded and the percentage was as follows; very low (0%); low-5.4%; moderate-32.2%; high-0% and very high-0. At the freshwater lacustrine IBA, a total of 232 responded to this question and the percentage was as follows; very low-0%; low-0%; moderate-10%; high-0% and very high-90.1%.

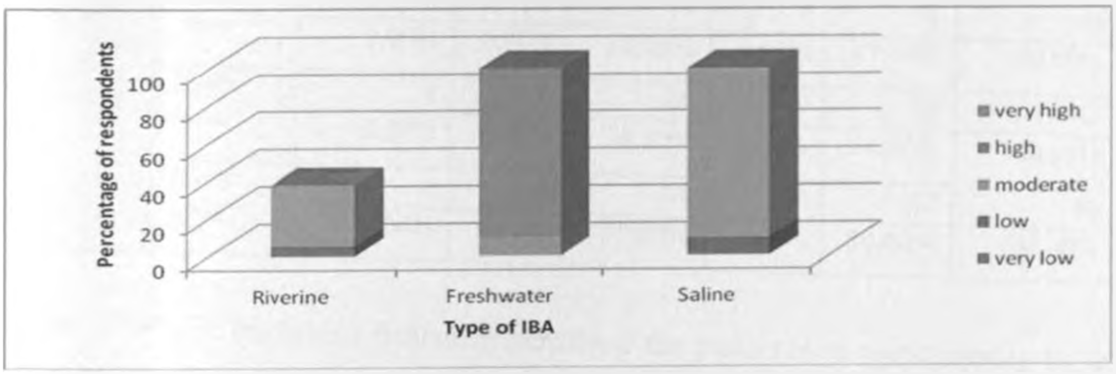


Figure 6-8: Pressures on water quality

The percentage of respondents at the saline lacustrine IBA from 44 respondents were as follows; very low (0%); low-9.1%; moderate -91%; high-0% and very high-0%. Both the young and old respondents indicated that the pressures on water quality were generally high. Notably variances were noted within the 37-47 age bracket signifying the degree to which this age group utilized water resources. The young and the old respondents in the study areas both indicated that the pressures on water quality were very high as shown in Table 6.13. The elderly were of the view that the pressures were moderate, with a high score of at least 70%. According to user groups, 13.2% of the livestock owners/herders/pastoralists from the IBA sites perceived the pressures on water quality to be very high, compared to 33.3% of the agricultural farmers who perceived the pressures on water quality to be low.

Table 6.13. Perception of water quality pressures according to age

		Very Low	Low	Moderate	High	Very High	Total
Group age bracket	15-25 years	0	4	12	0	39	55
		0.00%	7.30%	21.80%	0.00%	70.90%	100.00%
	26-36 years	0	0	4	0	96	100
		0.00%	0.00%	4.00%	0.00%	96.00%	100.00%
	37-47 years	0	8	36	0	91	135
		0.00%	5.90%	26.70%	0.00%	67.40%	100.00%
	48-58 years	0	0	15	0	31	46
		0.00%	0.00%	32.60%	0.00%	67.40%	100.00%
	59-69 years	0	0	16	0	26	42
		0.00%	0.00%	38.10%	0.00%	61.90%	100.00%
	70-80 years	0	0	28	0	12	40
		0.00%	0.00%	70.00%	0.00%	30.00%	100.00%

At least 37.4% of the inland fishermen perceived the pressures on water quality to be very high. The user group's perception on water quality in different types of IBA site is an important indicator on the eventual adaptation of appropriate resource use tailored mitigation measure. The study established a significant variation in user group mean ranking of water quality in the three IBA sites. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites ($H(2) = 153.588$, $P = 0.004$) with a mean rank of 193.59 for riverine IBA, 254.03 for freshwater lacustrine IBA and 62.41 saline lacustrine IBA. Table 6.14 shows that the 'female dominant' group had the highest percentage on the 'very high' category. Similarly, the 'all female' group with a percentage of 76.5% also indicated that the pressures on water quality very high.

Table 6.14. Perception of water quality pressures according to gender

		Very Low	Low	Moderate	High	Very High	Total
Group gender profile	All male	0	8	91	0	207	306
		0.00%	2.6%	29.7%	0.00%	67.6%	100.0%
	All female	0	4	16	0	65	85
		0.00%	4.7%	18.8%	0.00%	76.5%	100.0%
	Male dominant	0	0	0	0	12	12
		0.00%	0.0%	0.0%	0.00%	100.0%	100.0%
	Female dominant	0	0	4	0	18	22
		0.00%	.0%	18.2%	0.00%	81.8%	100.0%
Total		0	12	111	0	0.00%	425
		0.00%	2.8%	26.1%	0.00%	71.1%	100.0%

Community perception among user group from different IBA sites on the pressures on water quality indicated a significant difference in respondents' perception. The statistical analysis showed that different user groups have a different view points on the pressures on water quality. The Test Statistics (Kruskal-Wallis H), indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 66.847, P = 0. 000) with a mean rank of 199.05 for agricultural farmers, 176.68 for livestock keepers, 68.00 for traditional healers and 204.20 for charcoal burners. The mean ranks for user groups perception on pressures on water quality was high among charcoal burners, this attributed to the use of water by this user group who rely on the IBA for mainly domestic use such as drinking and cooking. Therefore, their perspective is informed by the mode of resource use of the available water.

Another important indicator of the IBA site was the user group's attitude on the IBA site water quality. A contingency chi-square was performed on the resource user group's attitude on the water quality and the type of IBA sites. The contingency chi-square depicted significant difference in the user groups attitude on water quality and the type of the IBA sites, $\chi^2_{Cal} = 157$, df= 4, χ^2 cri 0.05= 9.488 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the resource user group's perception on water quality is not similar was rejected. The community perceptions on the pressures on water quality were different across different communities around the different IBA site. This is an important finding as water quality is subjective to different resource users. Therefore the perception of resource user groups on what exerts intensive pressure on water quality differs from one user group in the three IBA sites.

6.2.3. Wetland Vegetation

The community's perception on pressures on wetland vegetation varied across the different IBAs. The study established that 65.3% of the respondents around the riverine IBA perceived the pressures on wetland vegetation to be very high, while 68% at the freshwater lake were of the perception that the pressures on wetland vegetation were low. Figure 6-9 shows the distribution of responses in terms of the pressures on wetland vegetation at each wetland IBA.

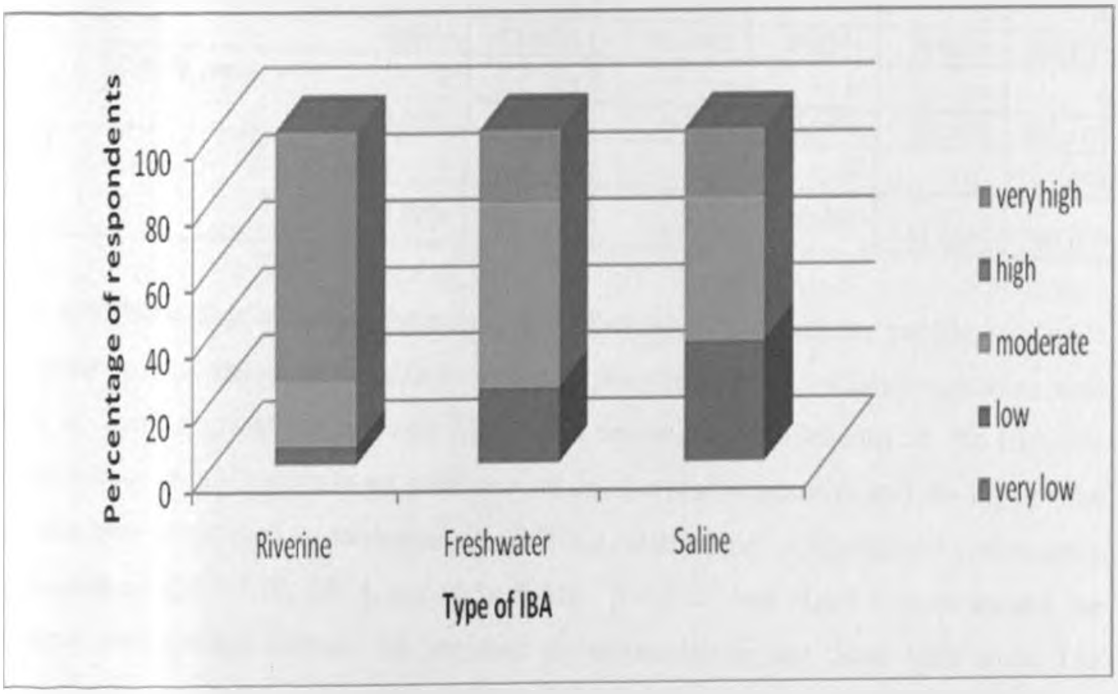


Figure 6-9: Pressures on wetland vegetation

Perceptions on the pressures on wetland vegetation were significantly distributed, indicating various categories as scored by the respondents in the same age group. According to Table 6.15, the 26-36 age group had the highest score of 70% on moderate pressures, while the oldest group of respondents had the highest score under 'very high'. This was followed by the 48-58 age group, of which 41.30% indicated that the pressures on wetland vegetation were very high.

Table 6.15. Perception on wetland vegetation pressures according to age

		Very Low	Low	Moderate	High	Very high	Total
Group age bracket	15-25 years	0	4	26	0	18	48
		0.00%	8.30%	54.20%	0.00%	37.50%	100.00%
	26-36 years	0	8	70	0	22	100
		0.00%	8.00%	70.00%	0.00%	22.00%	100.00%
	37-47 years	0	22	42	0	67	131
		0.00%	16.80%	32.10%	0.00%	51.10%	100.00%
	48-58 years	0	12	15	0	19	46
		0.00%	26.10%	32.60%	0.00%	41.30%	100.00%
	59-69 years	0	18	12	0	12	42
		0.00%	42.90%	28.60%	0.00%	28.60%	100.00%
	70-80 years	0	11	0	0	29	40
		0.00%	27.50%	0.00%	0.00%	72.50%	100.00%
Total		0	75	165	0	167	407
		0.00%	18.40%	40.50%	0.00%	41.00%	100.00%

Table 6.6 shows that although there were no differences in the gender profile, the 'male dominant' group was unanimous in its views on the pressures on wetland vegetation with 100% of them scoring this as 'very high'. The contingency chi-square on the IBA site resource user group's attitude on pressures on the wetland vegetation and the type of the IBA site was performed to determine the existing relationship. A significant contingency Chi-square of Cal = 118, df= 4, cri 0.05= 9.448. P = 0.05 was found to exist among the resource user groups attitude on pressure on vegetation in the three IBA sites. The calculated was found to be greater than critical hence the null hypothesis that the user group attitudes on pressures on wetland vegetation are not similar was rejected. The

community perceptions on the pressures on wetland vegetation were different from different communities around the different IBA site.

Table 6.16. Perception on wetland vegetation pressures according to gender profile

		Very Low	Low	Moderate	High	Very High	Total
Group gender profile	All male	0	56	123	0	120	299
		0.00%	18.70%	41.10%	0.00%	40.10%	100.00%
	All female	0	15	42	0	28	85
		0.00%	17.60%	49.40%	0.00%	32.90%	100.00%
	Male dominant	0	0	0	0	8	8
		0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
	Female dominant	0	4	7	0	11	22
		0.00%	18.20%	31.80%	0.00%	50.00%	100.00%
Total		0	75	172	0	167	414
		0.00%	18.10%	41.50%	0.00%	40.30%	100.00%

6.2.4. Wetland Birds

Noting the significance of birds as an indicator for a site of international recognition, the study investigated the perception of the riparian communities on the pressures that affect the healthy population of these bird species. The pressures on birds compromise the status of these IBA sites and thus it is important to know how the respondents perceived the situation. Figure 6-10 shows the distribution of responses in terms of the pressures on birds at each wetland IBA. At the riverine IBA, a total of 145 responded as follows; very low-0% low-2.8%; moderate-30.3%; high-0% and very high-66.9%. At the freshwater lacustrine IBA, a total of 225 responded to this question and the percentage distribution was as follows; very low- 0%; low-0; moderate-24.4%; high-0% and very high-75.6%. The scores recorded at the saline lacustrine lake from 44 respondents and the percentage distribution was as follows; very low-0%; low-36.4%; moderate-54.5%; high-0% and very high-9.1%.

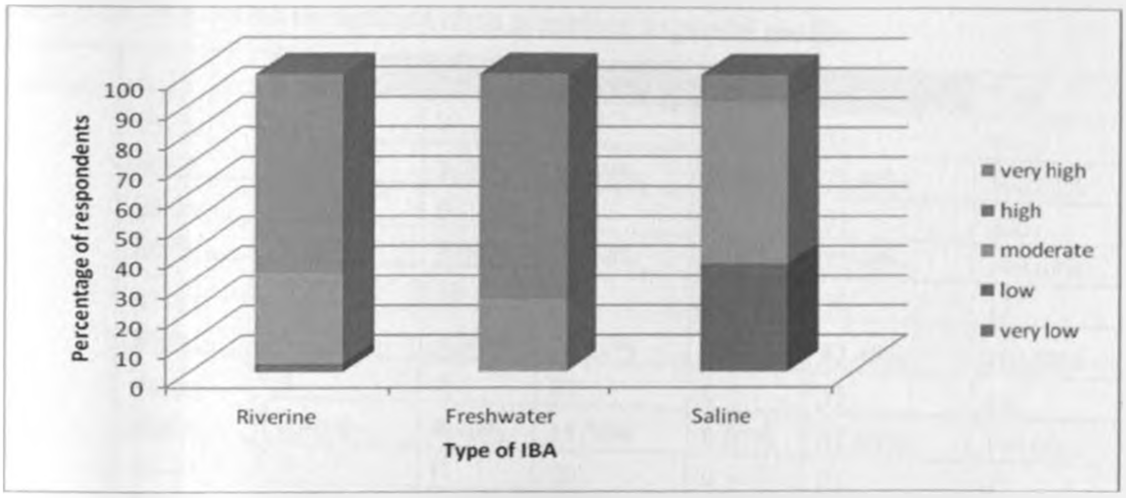


Figure 6-10: Pressures on birds

The study established that a significant difference existed between user group's attitude on pressure on birds and different IBA sites. The relation between these variables was significant, $\chi^2_{Cal} = 187$, $df = 8$, χ^2 *cri* 0.05=15.507 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local resource user group's perceptions about pressures on birds are not similar was rejected. This finding highlights the difference among user groups and type of IBA sites. These perceptions are influenced by the resource user group's interest on specific resources in the IBA site.

Table 6.17 is a summary of the statistical results showing the perceptions held by respondents according to age. The majority in the 15-25 age bracket, with a score of 68.8% indicated that the pressures on wetland birds were moderate, while at least 78% in the 26-26 age bracket indicated the same. However responses were distributed across each group, with respondents showing that they also perceived the pressures on wetland birds to be very high. The gender dimensions of perceptions on pressures exerted on wetland birds were almost similar between the male and the female respondents.

Table 6.17. Perception on wetland birds according to gender profile

		[illegible]	Low	[illegible]	[illegible]	[illegible]	Total
Group age bracket	15-25 years	0	4	33	0	11	48
		0%	8.30%	68.80%	0.00%	22.90%	100.00%
	26-36 years	0	0	78	0	22	100
		0.00%	0.00%	78.00%	0.00%	22.00%	100.00%
	37-47 years	0	12	49	0.00%	70	131
		0.00%	9.20%	37.40%	0.00%	53.40%	100.00%
	48-58 years	0	4	27	0	15	46
		0.00%	8.70%	58.70%	0.00%	32.60%	100.00%
	59-69 years	0	0	20	0	22	42
		0.00%	0.00%	47.60%	0.00%	52.40%	100.00%
	70-80 years	0	0	24	0	16	40
		0.00%	0.00%	60.00%	0.00%	40.00%	100.00%
Total		0	20	231	0	156	407
		0.00%	4.90%	56.80%	0.00%	38.30%	100.00%

Table 6.18. Perception of pressures on wetland birds according to gender profile

		Very Low	Low	Moderate	Very Low	Very High	Total
Group gender profile	All male	0	20	174	0	105	299
		0%	6.70%	58.20%	0.00%	35.10%	100.00 %
	All female	0	0	57	0	28	85
		0.00%	0.00%	67.10%	0.00%	32.90%	100.00 %
	Male dominant	0	0	0	0	8	8
		0.00%	0.00%	0.00%	0.00%	100.00%	100.00 %
	Female dominant	0	0	7	0	15	22
		0.00%	0.00%	31.80%	0.00%	68.20%	100.00 %
Total		0	20	238	0	156	414
		0.00%	4.80%	57.50%	0.00%	37.70%	100.00 %

The perception on pressures that affect bird diversity and population was evaluated in the three IBA sites and how it varies among different resource user groups within IBA sites.

The study notes that the pressure on birds emanating from different user groups impacts on birds' population and their diversity. For example, the trees wthin the Lake Bogoria National Reserve are ideal for setting bee- hives, thus making them susceptible to damage. According to the respondents in a focus group discussion, there was reportedly reduced forage for sustaining the colonies, as a result there is intense competition over water resources/forage or fodder/shade between livestock and bees as well as between human being and bees over water resources. According to the bee- keepers, the vegetation has indeed been declining over the years. Similarly, charcoal producers have exerted almost equal pressure on wetland vegetation as there are increasing demands for charcoal both within and outside the study areas.

Plate 6-4: Tree cutting and charcoal burning at Lake Bogoria

Source: Reseacher, February 2011

Different user groups have a different view points on the pressures on wetland birds. The Test Statistics (Kruskal-Wallis H), indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 76.565, $P = 0.000$) with a mean rank of 212.12 for agricultural farmers, 243.18 for livestock keepers, 139.5 for traditional healers and 149.57 for charcoal burners. Livestock keepers had high mean rank in their perspective on pressures on birds within the IBA sites. Their indication was that birds in the IBA sites are facing high pressure emanating from other resource user groups that affect the water quality, quantity and the destruction of IBA vegetation by agricultural farmers and charcoal burners. The local community perception with regards to pressure on birds is an important indicator on the status of the IBA site. However, the pressure on birds emanating from different user groups impacts on birds' population and their diversity. The study established that a significant difference existed between user group's attitude on pressure on birds and different IBA sites. The relation between these variables was significant, $\chi^2_{Cal} = 187$, $df = 8$, χ^2 *cri* $0.05=15.507 \alpha 0.05$. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local resource user group's perceptions about pressures on birds are not similar was rejected. This finding highlights the difference among user groups and type of IBA sites. These perceptions are influenced by the resource user group's interest on specific resources in the IBA site.

6.2.5. Wetland Pasture

The local community perception on pressure on wetland pasture is an important indicator on the status of the IBA site. The study established that 65.3% of the respondents around the riverine IBA perceived the pressures on the quality and quantity of wetland pasture to be very high, while 68% at the freshwater lake were of the perception that the pressures on the quality and quantity of wetland pasture were low. Figure 6-11 shows the distribution of responses in terms of the pressures on the quality and quantity of wetland pasture at each wetland IBA.

At the riverine lacustrine IBA, a total of 145 responded as follows; very low-0%; low-5.5%; moderate-19.3%; high-0% and very high-109. At the freshwater IBA, a total of 225 responded to this question and it was as follows; very low-0%; low-22.6%; moderate-55.6%; high-0% and very high-21.7%. The scores recorded at the saline lacustrine IBA lake from 44 respondents are as follows; very low-0%; low-36.4%; moderate-43.2%; high-0% and very high-20.5%.

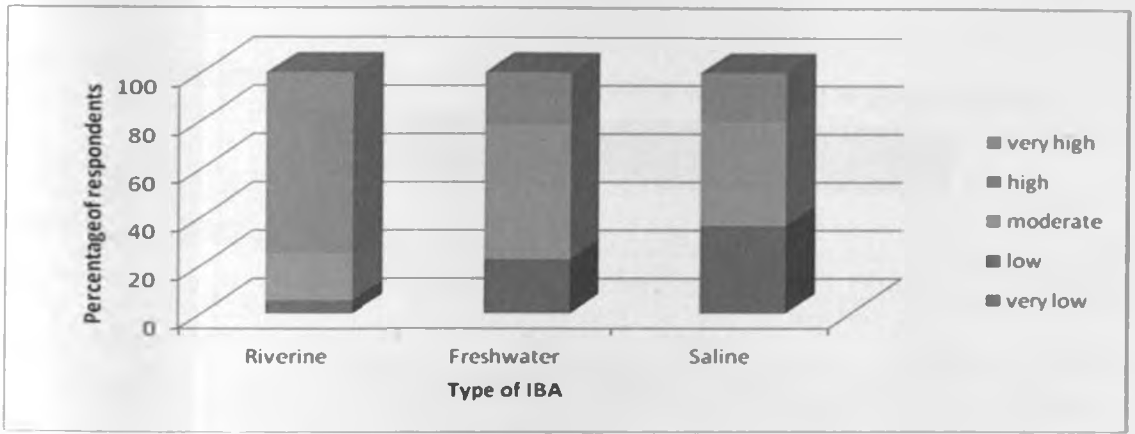


Figure 6-11: Pressures on wetland pasture

Table 6.19 shows the responses according to gender. The male dominant group held a unanimous perception that wetlands are under immense pressure, compared to the female dominant group, which at 50% showed that the pressures were very high.

Table 6.19. Perception of pressures on wetland pasture according to age

		Very Low	Low	Moderate	High	Very High	Total
Group gender profile	All male	0	56	123	0	120	299
		0.00%	18.70%	41.10%	0.00%	40.10%	100.00%
	All female	0	15	42	0	28	85
		0.00%	17.60%	49.40%	0.00%	32.90%	100.00%
	Male dominant	0	0	0	0	8	8
		0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
	Female dominant	0	4	7	0	11	22
		0.00%	18.20%	31.80%	0.00%	50.00%	100.00%
Total		0	75	172		167	414
			18.10%	41.50%		40.30%	100.00%

Table 6.20 shows that all the age groups held a common perception that the pressures on wetland pasture were very high.

Table 6.20. Perception of pressures on wetland pasture according to gender profile

		Very Low	Low	Moderate	High	Very High	Total
Group age bracket	15-25 years	0	4	26	0	18	48
		0.00%	8.30%	54.20%	0.00%	37.50%	100.00%
	26-36 years	0	8	70	0	22	100
		0.00%	8.00%	70.00%	0.00%	22.00%	100.00%
	37-47 years	0	22	42	0	67	131
		0.00%	16.80%	32.10%	0.00%	51.10%	100.00%
	48-58 years	0	12	15	0	19	46
		0.00%	26.10%	32.60%	0.00%	41.30%	100.00%
	59-69 years	0	18	12	0	12	42
		0.00%	42.90%	28.60%	0.00%	28.60%	100.00%
	70-80 years	0	11	0	0	29	40
		0.00%	27.50%	0.00%	0.00%	72.50%	100.00%
Total		0	75	165	0	167	407
		0.00%	18.40%	40.50%	0.00%	41.00%	100.00%

The pressures on wetland pasture emanating from different user groups impacts on birds' population and their diversity. The study established that a significant difference existed between user group's attitude on pressure on birds and different IBA sites. The relation between these variables was significant, $\chi^2_{Cal} = 187$, $df = 8$, χ^2 *cri* 0.05=15.507 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local resource user group's perceptions about pressures on birds are not similar was rejected. This finding highlights the difference among user groups and type of IBA sites. These perceptions are influenced by the resource user group's interest on specific resources in the IBA site. According to user groups, 28% of the livestock owners/herders/pastoralists from the IBA sites perceived the wetland pressures on pasture to be low, and 36% % of the agricultural farmers perceived the wetland pressures on the quality and quantity of wetland pasture to be low. Information obtained from the focus group discussions and through observation in the Tana Delta at Dida Waride indicated that despite the importance of these wetlands as habitat for birds and source of livelihoods, they were certain times of the years when they faced extreme pressures due to both anthropogenic factors and natural phenomenonas. Plate 6-5 shows the severe impacts of the transformation in the wetlands as massive livestock deaths were recorded during the month of April 2011. According to the respondents, livestock was thus moved to Assa and Galana Ranch areas in the hinterland as the area had received some rains earlier. Thus, the frequency or intensity of anthropogenic impacts on wetland pasture is key to determining the status of a site of global importance for birds.

Plate 6-5: Livestock Carcass at Dida Waride Village

Source: Researcher, April 2011

The quality and quantity of pastures around the different types of IBA sites form a critical component of the supportive ecological micro habitat for bird species. The user group's perception on the quality and quantity of pastures was examined in relation to the type of IBA site. A contingency chi-square test of independence was performed to examine the relation between the type of IBA site and the community's perception on pressures on the quality and quantity of wetland pasture. The relation between these variables was significant, $\chi^2_{Cal} = 118$, df= 4, χ^2 cri 0.05= 9.448 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local community perceptions about pressures on abundance of wetland pasture are not similar was rejected. The community perceptions on the pressures on the quality and quantity of wetland pasture were different from different communities around the different IBA site. The understanding of the difference is important in determining interventions that are tailored along resource user group perception.

6.2.6. Fish Resources

Wetland pressures can significantly contribute to declines in species richness and density of fish and the resultant effect is compromised livelihoods of riparian communities. Moreover, wetland pressures on fish resources are one of the major threats to important bird populations at IBAs. The results of the study showed that community's perception on pressures on fish varied across the different IBA sites. The study established that 50.8% of the respondents around the riverine IBA perceived the pressures on fish volume to be very high, while 71.7% at the saline lacustrine IBA were of the perception that the pressures on fish were low. Figure 6-12 shows the distribution of responses in terms of the pressures on fish at each wetland IBA. At the riverine IBA, a total of 145 responded as follows; very low-0%; low - 0%; moderate – 8.3%; high- 0% and very high - 91.7%; At the freshwater lacustrine IBA, a total of 225 responded to this question and the percentage distribution was as follows; very low-0%; low – 5.8%; moderate-36.9%; high-0%and very high – 57.3%. The scores recorded at the saline lacustrine IBA from 44 respondents are as follows; very low – 9.1%; low - ; moderate – 75%; high-0% and very high-0%.

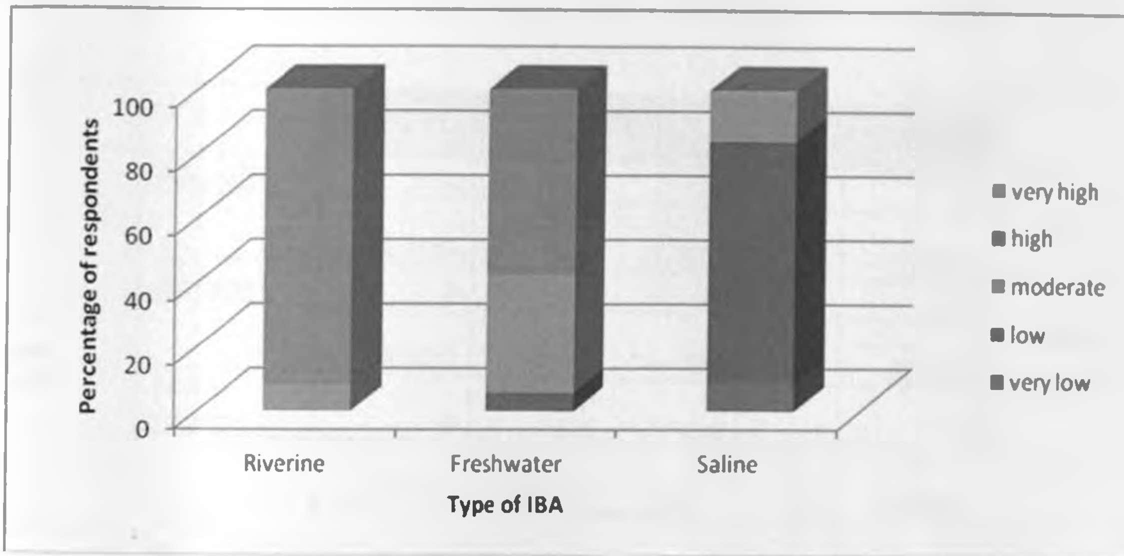


Figure 6-12: Pressures on fish resources

According to age, the study showed that the perceptions on the pressures on fish followed a similar trend to perceptions held on other resources. A majority of respondents in all the age groups indicated that the pressures were 'very high'. In terms of gender, Table 6.22 shows that the both the majority of respondents in the female dominant and the male dominant groups held the same perceptions.

Table 6.21. Perception of pressures on fish resources according to age

		Very low	Low	Moderate	High	Very High	Total
Group age bracket	15-25 years	4	4	11	0	29	48
		8.30%	8.30%	22.90%	0.00%	60.40%	100.00%
	26-36 years	0	6	30	0	64	100
		0.00%	6.00%	30.00%	0.00%	64.00%	100.00%
	37-47 years	0	15	24	0	92	131
		0.00%	11.50%	18.30%	0.00%	70.20%	100.00%
	48-58 years	0	4	15	0	27	46
		0.00%	8.70%	32.60%	0.00%	58.70%	100.00%
	59-69 years	0	4	22	0	16	42
		0.00%	9.50%	52.40%	0.00%	38.10%	100.00%
	70-80 years	0	13	0	0	27	40
		0.00%	32.50%	0.00%	0.00%	67.50%	100.00%
Total		4	46	102	0	255	407
		1.00%	11.30%	25.10%	0.00%	62.70%	100.00%

Table 6.22. Perception of pressures on fish resources according to gender profile

		Very low	Low	Moderate	High	Very High	Total
Group gender profile	All male	4	42	71	0	182	299
		1.30%	14.00 %	23.70%	0.00 %	60.90%	100.00 %
	All female	0	4	31	0	50	85
		0.00%	4.70%	36.50%	0.00 %	58.80%	100.00 %
	Male dominant	0	0	0	0	8	8
		0.00%	0.00%	0.00%	0.00 %	100.00%	100.00 %
	Female dominant	0	0	0	0	22	22
		0.00%	0.00%	0.00%	0.00 %	100.00%	100.00 %
Total		4	46	102	0	262	414
		1.00%	11.10 %	24.60%	0.00 %	63.30%	100.00 %

According to user groups, 16% of the agricultural farmers were of the perception that the pressures on fish were very high, compared to 28.3% of the inland fishermen who were of the perception that the pressures on fish were low. The community perception among user group from different IBA sites on the pressures on fish resources varied significantly in respondents' perception. Different user groups have a different view points on pressures on fish resources. The Test Statistics (Kruskal-Wallis H), indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 42.874, *P* = 0. 000) with a mean rank of 223.09 for agricultural farmers, 204.87 for livestock keepers, 27.50 for traditional healers and 164.69 for charcoal burners.

The study assessed the difference in user groups perception on pressures on fish resources across the three types of IBA sites and a contingency Chi-square depicted a significant, $\chi^2_{Cal} = 296$, $df = 6$, χ^2 cri 0.05= 12.592α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local community perceptions about pressures on fish resources are not different was rejected. The community perceptions on the pressures on fish resources were different across different user groups around the different IBA site. Thus, depending on the user group a respondent belongs, the respondents' perception on pressures on fish feasible depending on the extractive nature of activities within user groups within the IBA sites.

6.3: Community Perceptions on Response Interventions for Improved Wetland Management

As part of the Pressure-State-Response Framework, the study went on to investigate the perceptions on appropriate responses (management intervention and policy options) to some of the challenges with wetland management as stated in foregoing. The study conducted statistical analysis to ascertain perceptions in accordance with the wetland type, the age group, gender profile and the resource user groups.

6.3.1. Conservation Education and Awareness Raising

Table 6.23: Percentage of respondents on awareness raising

Type of IBA site	Response to conservation education and awareness raising from community perspective						Total
	None	Very low	Low	Average	High	Very High	
Riverine	35.7	28.8	24.1	31.8	11.1	100	33.2
Freshwater Lake	64	56.2	41.4	4.50	0.00	0.00	56.7
Saline Lake	0.30	15.10	34.50	63.60	88.90	0.00	10.10

The community's perception on awareness raising varied across the different IBA sites. The study established that 35.7% of the respondents around the riverine IBA perceived there was no awareness raising, compared to 88.9% of respondents at the saline lake who perceived awareness raising to be high. At least 60.1% of the respondents at Tana Delta indicated that there was no awareness raising activities that were conducted to address the environmental challenges, while 76% of the respondents were of the perception that there was no awareness raising with regards to wetland management at Lake Naivasha, with 16% indicating that this was very low. At least 31.8% of respondents at Lake Bogoria indicated that awareness raising was average, while, 25% indicated that it was very low.

Those who classified raising awareness as low numbered 10 representing 22.7% of the total respondents at Lake Bogoria. Thus compared to the other two wetland types, the communities at Lake Bogoria were consciously aware of the awareness raising efforts that have been made with regards to wetland management. At the riverine IBA, a total of 145 responded as follows; (None-106); (Very low-21); low-8; average-8-; high-1 and very high-1. At the freshwater IBA, a total of 246 responded to this question and it was as follows; (None-189); (Very low-43); low-13; average-1-; high-0 and very high-0. The scores recorded at the saline lake from 31 respondents are as follows; (None-1); (Very low-10); low-7; average-18-; high-8 and very high-0.

According to age, the study showed that a majority of the respondents from the 26-36 age bracket were of the perception that conservation education and awareness raising as a response intervention was negligible. This was represented by 89.1%. Table 6.24 summarizes the statistical results according on the age bracket.

Table 6.24: Perception on awareness raising according to age

		None	Very low	Low	Average	High	Very High	Total
Group age bracket	15-25 years	37	11	7	4	0	0	59
		62.7%	18.6%	11.9%	6.8%	0.00%	0.00%	100.0%
	26-36 years	98	4	7	1	0	0	110
		89.1%	3.6%	6.4%	0.9%	0.00%	0.00%	100.0%
	37-47 years	84	29	9	4	1	0	127
		66.1%	22.8%	7.1%	3.1%	.8%	0.00%	100.0%
	48-58 years	23	9	2	7	0	0	41
		56.1%	22.0%	4.9%	17.1%	0.00%	0.00%	100.0%
	59-69 years	31	4	1	3	2	1	42
		73.8%	9.5%	2.4%	7.1%	4.8%	2.4%	100.0%
	70-80 years	20	16	3	3	6	0	48
		41.7%	33.3%	6.2%	6.2%	12.5%	0.00%	100.0%
Total		293	73	29	22	9	1	427
		68.6%	17.1%	6.8%	5.2%	2.1%	0.2%	100.0%

At least 18.6% of respondents from the 15-25 age bracket indicated this was very low, compared to the 22.8% in the 37-47 age bracket. Generally, all respondents from all age brackets indicated that conservation education and awareness response interventions were negligible. At least 17.1% of the respondents from the 48-58 age bracket were more optimistic as they classified this as low. According to gender, the statistical results showed that with regards conservation education and awareness raising as an appropriate response intervention, the 'all male group' of respondents represented by 66% was of the perception that this was negligible. At least 88.8% of the 'all female' respondents indicated that this was also negligible. The 'female dominant' group was more optimistic with at least 45.5% indicating that this was very low. Table 6.25 shows a summary of the responses on conservation education and awareness raising according to gender profile. Overall, the results show that according to gender, both females and male respondents were of the perception that conservation education and awareness raising was negligible, however the females were more optimistic than the male respondents.

Table 6.25. Perception on awareness raising according to gender profile

		None	Very low	Low	Average	High	Very High	Total
Group gender profile	All male	212	59	25	18	7	0	321
		66.0%	18.4%	7.8%	5.6%	2.2%	0.00%	100.0%
	All female	71	3	1	2	2	1	80
		88.8%	3.8%	1.2%	2.5%	2.5%	1.2%	100.0%
	Male dominant	9	1	0	1	0	0	11
		81.8%	9.1%	0.00%	9.1%	0.00%	0.00%	100.0%
	Female dominant	8	10	3	1	0	0	22
		36.4%	45.5%	13.6%	4.5%	0.00%	0.00%	100.0%
Total		300	73	29	22	9	1	434
		69.1%	16.8%	6.7%	5.1%	2.1%	0.02%	100.0%

Variation measures were also conducted between the type of user groups and the variables. Community perception among user groups from different IBA sites on education and awareness raising indicated a significant difference in respondents' perception. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =42.66, P = 0. 000) with a mean rank of 219.10 for agricultural farmers, 250.47 for livestock keepers, 275.63 for traditional healers and 195.43 for charcoal burners. The study sought to establish the variation in community perception on each response interventions and the type of wetland IBA. There was a significant difference in respondents' perception on education and awareness raising. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 133.251, P = 0. 004) with a mean rank of 205.93 for riverine IBA, 194.24 for freshwater lacustrine IBA and 385.42 for saline lacustrine IBA. The study undertook to determine the statistical relationship that exists between different user groups and community perception on education and awareness raising. A negative spearman's rank correlation of -0.122 at p=0.05 existed between the two variables. This shows that the different user groups consider education and awareness to be very weak or negligible.

6.3.2. Institutional Capacity Building

Table 6.26: Percentage of respondents on institutional capacity building

Type of IBA site	Response to institutional capacity building from community perspective					Total
	None	Very low	Low	Average	High	
Riverine	35.80	25.00	34.60	16.70	100.00	33.40
Freshwater Lake	63.90	52.90	11.50	5.60	0.00	56.50
Saline Lake	0.30	22.10	53.80	77.80	0.00	10.10

The community's perception institutional capacity building varied across the different IBA sites. The study established that 35.8% of the respondents around the riverine IBA perceived there was no institutional capacity building, while 77.80 % at the saline lake were of the perception that the institutional capacity building was average. At the riverine IBA, a total of 145 responded as follows; none-115; very low-17; (low-9); (average-3) and high -1. At the freshwater IBA, a total of 245 responded to this question and it was as follows; none-205; very low-36; (low-3); (average-1) and high -0. The scores recorded at the saline wetland from 44 respondents are as follows; none-1; very low-15; (low-14); (average-14) and high -0.With regards perceptions on institutional capacity building as a response intervention, Table 6.27 shows that the majority of all the age brackets indicated that this was negligible, with 20.8% of respondents in the 70-80 age bracket indicating that this was average, while at least 6.8% the respondents in the 15-24 age bracket indicated that this was low. Only 2.4% of respondents in the 59-69 age group indicated that strengthening of institutions for wetland management were either average or high.

Table 6.27. Perception on institutional capacity building according to age

		None	Very low	Low	Average	High	Total
Group age bracket	15-25 years	46	7	4	2	0	59
		78.0%	11.9%	6.8%	3.4%	0.00%	100.0%
	26-36 years	97	9	3	0	0	109
		89.0%	8.3%	2.8%	0.00%	0.00%	100.0%
	37-47 years	91	29	4	3	0	127
		71.7%	22.8%	3.1%	2.4%	0.00%	100.0%
	48-58 years	24	9	7	2	0	42
		57.1%	21.4%	16.7%	4.8%	0.00%	100.0%
	59-69 years	31	5	4	1	1	42
		73.8%	11.9%	9.5%	2.4%	2.4%	100.0%
	70-80 years	25	9	4	10	0	48
		52.1%	18.8%	8.3%	20.8%	0.00%	100.0%
Total		314	68	26	18	1	427
		73.5%	15.9%	6.1%	4.2%	0.02%	100.0%

The same pattern of responses was noted from the statistical computation with regards how local respondents perceived institutional capacity building from a gender perspective.

Table 6.28. Perception on institutional capacity building according to gender profile

		Nil	Very Low	Low	Average	High	Total
Group gender profile	All male	228	55	20	17	0	320
		71.2%	17.2%	6.2%	5.3%	0.00%	100.0%
	All female	72	3	4	1	1	81
		88.9%	3.7%	4.9%	1.2%	1.2%	100.0%
	Male dominant	11	0	0	0	0	11
		100.0%	0.00%	0.00%	0.00%	0.00%	100.0%
	Female dominant	10	10	2	0	0	22
		45.5%	45.5%	9.1%	0.00%	0.00%	100.0%
Total		321	68	26	18	1	434
		74.0%	15.7%	6.0%	4.1%	0.2%	100.0%

In table 6.28, all the gender profiles indicated low scores; with both the 'all male' and 'all female' indicating that this was negligible. However, 4.9% of the 'all female' group indicated that this was low and similarly at least 9.1% of the 'female dominant' profile indicating the same.

There was a significant difference in respondents' perception on institutional capacity building. The Test Statistics (Kruskal-Wallis H), indicated at .2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites ($H(2) = 154.536$, $P = 0.004$) with a mean rank of 206.13 for riverine IBA, 193.61 for freshwater lacustrine IBA and 387.99 for saline lacustrine IBA. A negative spearman's rank correlation of 0-.114 at p=0.05 existed between the two ordinal variables, namely resource user groups and community perception on institutional capacity building.

6.3.3. Security of Land/Resource Tenure

The Community's perception on provision of security of land/resource tenure varied across the different IBA sites. The study established that 36.6% of the respondents around the riverine IBA perceived the provision of security of land/resource tenure to be negligible, while 90.9% at the saline lake were of the perception that provision of security was average.

Table 6.29: Percentage of respondents on security of land/resource tenure

	Response to provision of security of land/resource tenure from community perspective					Total
Type of IBA site	None	Very low	Low	Average	High	
Riverine	36.60	13.90	20.00	9.10	0.00	33.40
Freshwater Lake	62.10	36.10	13.30	0.00	0.00	56.70
Saline Lake	1.30	50.00	66.70	90.90	0.00	9.90

At the riverine IBA, a total of 145 responded as follows; (None-136); (very low-5); (low-3) and average-1. At the freshwater IBA, a total of 246 responded to this question and it was as follows; (none-231); (very low-13); (low- 2) and average-0. The scores recorded at the saline lake from 31 respondents are as follows; ((None-5); (very low-18); (low- 10) and average-10.

Plate 6.5: A newly established pastoralist village at Kipini

Source: Researcher, April 2011

Lack of or inadequate security of tenure undermined the confidence levels of the riparian communities in terms of managing the wetland resources. Wetland tenure insecurity is common in some areas such as Kipini which experiences periodic invasion by pastoralists from other areas (Plate 6.5). This was reflected by the statistics which showed that there were no major differences in how the younger and older generations perceived this aspect. Table 6.30 shows that even though all the age groups recorded high scores which showed that wetland pasture was not in a desirable state, the most active 26-36 year old respondents haboured serious concerns about the pressures on wetland, with a high of 92.7%.

Table 6.30: Perceptions on security of land/resource tenure according to age

		None	Very low	Low	Average	High	Total
Group age bracket	15-25 years	47	10	1	1	0	59
		79.7%	16.9%	1.7%	1.7%	0.00%	100.0%
	26-36 years	102	6	2	0	0	110
		92.7%	5.5%	1.8%	0.00%	0.00%	100.0%
	37-47 years	115	7	4	1	0	127
		90.6%	5.5%	3.1%	0.08%	0.00%	100.0%
	48-58 years	32	6	2	2	0	42
		76.2%	14.3%	4.8%	4.8%	0.00%	100.0%
	59-69 years	36	3	2	1	0	42
		85.7%	7.1%	4.8%	2.4%	0.00%	100.0%
	70-80 years	33	4	4	6	0	47
		70.2%	8.5%	8.5%	12.8%	0.00%	100.0%
Total		365	36	15	11	0	427
		85.5%	8.4%	3.5%	2.6%	0.00%	100.0%

The statistical results also showed that both the male and female respondents equally shared the same opinion about the inadequacy of tenurial rights. The results imply that both men and women at the study sites would like to be accorded tenurial rights to guarantee their use of the wetland resources. There was a significant difference in respondents' perception on security of tenure. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 221.197, $P = 0.004$) with a mean rank of 188.26 for riverine IBA, 264.72 for freshwater lacustrine IBA and 101.08 for saline lacustrine IBA. A negative spearman's rank correlation of -0.074 at p=0.05 existed between the between the variables on different user groups and community perception on security of tenure. This statistical results corresponds with the information above on gender brackets as it reflects that the resource user groups were of the perception that security of tenure was very, very weak or negligible.

Table 6.31: Perceptions on security of land/resource tenure according to gender

		None	Very Low	Low	Average	High	Total
Group gender profile	All male	266	32	13	9	0	320
		83.1%	10.0%	4.1%	2.8%	0.00%	100.0%
	All female	76	2	1	2	0	81
		93.8%	2.5%	1.2%	2.5%	0.00%	100.0%
	Male dominant	11	0	0	0	0	11
		100.0%	0.00%	0.00%	0.00%	0.00%	100.0%
	Female dominant	19	2	1	0	0	22
		86.4%	9.1%	4.5%	0.00%	0.00%	100.0%
Total		372	36	15	11	0	0
		85.7%	8.3%	3.5%	2.5%	0.00%	0.00%

6.3.4. Devolution of Authority

Table 6.32: Percentage of respondents on devolving authority to lower levels

	Response to devolving authority to lower levels from community perspective					Total
Type of IBA site	None	Very low	Low	Average	High	
Riverine	35.50	22.60	40.90	20.00	0	33.40
Freshwater Lake	63.90	50.00	4.50	0.00	0	56.70
Saline Lake	0.60	27.40	54.50	80.00	0	9.90

The Community's perception on devolving authority to lower levels varied across the different IBA sites. The study established that 40.9% of the respondents around the riverine IBA perceived devolving authority to lower levels to be low, while 63.9% at the freshwater lake were of the perception that devolving authority to lower levels was negligible.

Table 6.33: Perceptions on devolving authority to lower levels according age

		None	Very Low	Low	Average	High	Total
Group age bracket	15-25 years	48	7	2	2	0	59
		81.4%	11.9%	3.4%	3.4%	0.00%	100.0%
	26-36 years	98	11	1	0	0	110
		89.1%	10.0%	0.9%	0.00%	0.00%	100.0%
	37-47 years	94	29	1	2	0	126
		74.6%	23.0%	0.8%	1.6%	0.00%	100.0%
	48-58 years	29	4	8	1	0	42
		69.0%	9.5%	19.0%	2.4%	0.00%	100.0%
	59-69 years	32	4	4	2	0	42
		76.2%	9.5%	9.5%	4.8%	0.00%	100.0%
	70-80 years	27	7	6	8	0	48
		56.2%	14.6%	12.5%	16.7%	0.00%	100.0%
Total		328	62	22	15	0	427
		76.8%	14.5%	5.2%	3.5%	0.00%	100.0%

At the riverine IBA, a total of 145 responded as follows; (none-119); (very low-14); (low-9) and (average-3). At the freshwater IBA, a total of 246 responded tó this question and it was as follows; (none- 214); (very low- 31); (low-1); (average-0). The scores recorded at the saline lake from 43 respondents are as follows; (none- 2); (very low-17), (low-12) and average-12. Generally, all the age groups indicated that there has been not been sufficient devolvement of authority to the lower levels to enable them to determine access, use and management of the wetland resources. However, there was optimism amongst the middle aged to the older generation, for example, at least 19% of the respondents from the 48-58 age bracket indicated that this was low inferring that they considered that some level of responsibility was being devolved, for example the role played by the water resource users authorities. At least oldest respondents, 70-80 years considered that this was average. This could be attributed to recognition of traditional structures in communities surrounding at Lake Bogoria. Overall, the results implied that access and control over wetland resource is still largely determined by the existing top-down, command-control, bureaucratic management regimes. Table 6.34 shows a summary of statistical results according to gender.

Table 6.34: Perceptions on devolving authority to lower levels according gender

		None	Very Low	Low	Average	[illegible]	Total
Group gender profile	All male	240	50	17	13	0	320
		75.0%	15.6%	5.3%	4.1%	0.00%	100.0%
	All female	73	3	3	2	0	81
		90.1%	3.7%	3.7%	2.5%	0.00%	100.0%
	Male dominant	11	0	0	0	0	11
		100.0%	0.00%	0.00%	0.00%	0.00%	100.0%
	Female dominant	11	9	2	0	0	22
		50.0%	40.9%	9.1%	0.00%	0.00%	100.0%
Total		335	62	22	15	0	434
		77.2%	14.3%	5.1%	3.5%	0.00%	100.0%

According to user groups, 40 % of the livestock owners/Herders/pastoralists perceived that devolving authority to lower levels was average, with 31% of the inland fishermen indicating that this was negligible. At least 13.30% of the charcoal burners perceived devolving authority to lower levels as average. The study sought to establish the variation in community perception on devolving authority to lower levels at the IBA sites. There was a significant difference in respondents' perception on current state of wetland vegetation. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 162.110, P = 0. 004) with a mean rank of 207.45 for Riverine, 193.99 for Freshwater lacustrine IBA and 385.87 Saline lacustrine IBA. Community perception among user group from different IBA sites on devolving authority to lower levels indicated a significant difference in respondents' perception. Different user groups have a different view points on the devolving authority to lower levels. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 30.844, P = 0. 000) with a mean rank of 233.83 for agricultural farmers, 225.16for livestock keepers, 387.50 for traditional healers and 215.32 for charcoal burners.

A negative spearman's rank correlation of 0-.095 at p=0.05 existed between the two variables on different user groups and community perception on devolving authority to lower levels. The analytical results of the spearman rank correlation also correspond with the information above as the resource user groups considered the devolution to be very weak and required to be improved. A chi-square test of independence was performed to examine the relation between the type of IBA site and the community's perception on devolving authority to lower levels. The relation between these variables was significant, Cal = 194, df= 6, cri 0.05= 12.592. The calculated was found to be greater than critical hence the null hypothesis was rejected. The community perceptions on devolving authority to lower levels were different across different communities around the different IBA site.

6.3.5. Enforcement of Traditional rules

The Community's perception on enforcement of traditional rules in accessing, using and managing wetland resources varied across the different IBA sites. Table 6.35 shows that 35.7% of the respondents around the riverine IBA perceived enforcement of traditional rules to be negligible and similarly 95.5% at the Saline lacustrine IBA were of the perception that enforcement of traditional rules was negligible. At the riverine IBA, a total of 145 responded as follows; none -91%; very low – 5.5%; low – 2.8%; average – 0.7% and high – 0%. At the freshwater lacustrine IBA, a total of 247 responded to this question and it was as follows; none – 95.5%; very low – 3.6%; low – 0.8%; average – 0.00% and high – 0.00%. The scores recorded at the saline lake from 44 respondents are as follows; none – 4.5%; very low – 5.3%; low – 3.4%; average – 4.8% and high – 1.67%.

Table 6.35. Responses on perceptions on enforcement of traditional rules

		None	Very Low	Low	Average	High	Total
	Riverine	91.00%	5.50%	2.80%	0.70%	0.00%	100.00%
	Freshwater	95.50%	3.60%	0.80%	0.00%	0.00%	100.00%
	Saline Lake	4.50%	13.60%	20.50%	45.50%	15.90%	100.00%
Total		370	23	15	21	7	436
		84.90%	5.30%	3.40%	4.80%	1.60%	100.00%

In Table 6.36 all the age groups were of the percecption that there was no enforcement of traditional rules in wetland management. This perception was highest amongst the 26-36 year age group, with a record of 97.30%. Other age groups, with the excepton of the 26-36 years and 59-69 years had 0% responses under the category 'high'. Table 6.36 also showed a similar trend when the prceptions on enforcement of traditional rules were assessed according gender.

Table 6.36: Perceptions on enforcement of traditional rules according age

		None	Very Low	Low	Average	High	Total
Group age bracket	15-25 years	52	2	2	2	1	59
		88.10%	3.40%	3.40%	3.40%	1.70%	100.00%
	26-36 years	108	1	2	0	0	111
		97.30%	0.90%	1.80%	0.00%	0.00%	100.00%
	37-47 years	108	10	2	4	3	127
		85.00%	7.90%	1.60%	3.10%	2.40%	100.00%
	48-58 years	28	5	4	3	2	42
		66.70%	11.90%	9.50%	7.10%	4.80%	100.00%
	59-69 years	34	3	2	3	0	42
		81.00%	7.10%	4.80%	7.10%	0.00%	100.00%
	70-80 years	33	2	3	9	1	48
		68.80%	4.20%	6.20%	18.80%	2.10%	100.00%
Total		363	23	15	21	7	429
		84.60%	5.40%	3.50%	4.90%	1.60%	100.00%

Table 6.37: Perceptions on enforcement of traditional rules according gender

		None	Very Low	Low	Average	High	Total
Group gender profile	All male	272	14	12	17	7	322
		84.50%	4.30%	3.70%	5.30%	2.20%	100.00%
	All female	74	1	2	4	0	81
		91.40%	1.20%	2.50%	4.90%	0.00%	100.00%
	Male dominant	11	0	0	0	0	11
		100.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	Female dominant	13	8	1	0	0	22
		59.10%	36.40%	4.50%	0.00%	0.00%	100.00%
Total		370	23	15	21	7	436
		84.90%	5.30%	3.40%	4.80%	1.60%	100.00%

According to user groups, 42.9% of the livestock owners/herders/pastoralists from the IBA sites perceived the enforcement of traditional rules to be high, and 33.50% of the inland fishermen perceived the enforcement of traditional rules to be negligible. At least 42.9% of the Agricultural farmers perceived the enforcement of traditional rules was high. The study sought to establish the variation in community perception on traditional rules enforced at the IBA sites. There was a significant difference in respondents' perception on traditional rules enforced. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 268.113, P = 0. 004) with a mean rank of 203.90 for Riverine IBA, 194.40 for Freshwater lacustrine and 401.89 Saline lacustrine IBA.

Community perception among user group from different IBA sites on enforcement of traditional rules indicated a significant difference in respondents' perception. Different user groups have a different view points on traditional rules. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 51.08, P = 0. 000) with a mean rank of 242.65 for agricultural farmers, 223.99 for livestock keepers, 234.63 for traditional healers and 227.59 for charcoal burners . To determine the statistical relationship that exists between different user groups and community perception on traditional rules enforced, a Spearman's rank correlation analysis was conducted. The study revealed that there was a negative correlation of -0.049 at p=0.05 between these two variables. This negative correlation is a reflection that according to the respondents, traditional enforcement is very weak or negligible.

6.3.6. Control or Eradication of Invasive Species within the Wetland Environs

Table 6.38: Percentage of respondents on control or eradication of invasive species

	Response to control or eradication of invasive species from community perspective					Total
Type of IBA site	None	Very low	Low	Average	High	
Riverine	36.80	20.50	0.00	0.00	0.00	33.90
Freshwater Lake	62.60	33.30	11.10	0.00	0.00	57.70
Saline Lake	0.50	46.20	88.90	100	100.00	8.40

The Community's perception on control or eradication of invasive species varied across the different IBA sites. In Table 6.38, the study shows that 36.8% of the respondents around the riverine IBA perceived the control or eradication of invasive species to be negligible, while 88.9% at the saline IBA were of the perception that control or eradication of invasive species was low. At the Freshwater Lake, a majority of respondents represented by 62.6% were of the perception that the control or eradication of invasive species was negligible. The study determined the distribution of responses in terms of control or eradication of invasive species at each wetland IBA.

At the riverine IBA, a total of 145 responded as follows; none-137; very low-8; (low-0); (average-0) and high-0. At the freshwater IBA, a total of 247 responded to this question and it was as follows; none-233; very low-13; (low-1); (average-0) and high-0. The scores recorded at the saline lake from 36 respondents are as follows; none-2; very low-18; (low-8); (average-7) and high-1. The broader subject of invasive species is not commonly discussed in the study areas, however, the presence and extent to which the prosopis continue to affect the quantity of water resources is slowly emerging as a topical issue amongst riparian communities. While some of the respondents felt that the prosopis provided habitat for some species of birds and provided raw materials for household furniture, a majority felt that there was inadequate attention to control the fast spreading invasive. The statistical results in Table 6.39 showed that both the young and the older respondents shared the same view about the management of the invasive species. Table 6.40 is a cross tabulation of the gender profile and the perception on the control or eradication of invasive species. The 'male dominant' group and the 'female dominant' group both reflected high percentages with regard the 'none' and very low categories. Within the 'all male' gender profile, the responses were varied, with at least 10.8% to below 3% indicating that there was very low, low, average and high intervention.

Table 6.39: Perception on control or eradication of invasive species according to age

		None	Very Low	Low	Average	High	Total
	15-25 years	88.1%	6.7%	1.69%	3.389831	0.00%	100
	26-36 years	105	5	1	0	0	111
		94.6%	4.5%	0.9%	0	0.00%	100
	37-47 years	113	8	2	3	1	127
		88.98%	6.29%	1.57%	2.36%	0.79%	100
	48-58 years	30	9	1	2	0	42
		71.43%	21.43%	2.38%	4.76%	0.00%	100
	59-69 years	36	4	1	0	0	41
		87.8%	9.76%	2.44%	0.00%	0.00%	100
	70-80 years	29	9	3	0	0	41
		70.73%	21.95%	7.32%	0.00%	0.00%	100
Total		365	39	9	7	1	421
		86.69%	9.26%	2.14%	1.66%	0.24%	100

Different user groups have a different view points on control or eradication of invasive species. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =34.608, P = 0. 000) with a mean rank of 230.32 for agricultural farmers, 216.63 for livestock keepers, 237.88 for traditional healers and 233.96 for charcoal burners.

Table 6.40: Perception on control of invasive species according to gender

		None	Very Low	Low	Average	High	Total
Group gender profile	All male	265	34	8	7	1	315
		84.10%	10.8%	2.50%	2.20%	0.30%	100.00%
	All female	76	3	1	0	0	80
		95%	3.80%	1.20%	0.00%	0.00%	100.00%
	Male dominant	11	0	0	0	0	11
		100%	0.00%	0.00%	0.00%	0.00%	100.00%
	Female dominant	20	2	0	0	0	22
		90.9%	9.10%	0.00%	0.00%	0.00%	100.00%
Total		372	39	9	7	1	428
		86.9%	9.10%	2.10%	1.60%	0.20%	100.00%

There was a significant difference in respondents' perception on control or eradication of invasive species. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 239.257, $P = 0.004$) with a mean rank of 197.84 for riverine, 198.24 for freshwater lake and 393.14 for saline lake. There was a significant difference in respondents' perception on restoration.

The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 183.487, $P = 0.004$) with a mean rank of 206.41 for riverine IBA, 193.39 for freshwater lacustrine IBA and 385.20 for saline lacustrine IBA. The study undertook to determine the statistical relationship that exists between different user groups and community perception on control or eradication of invasive species. A negative spearman's rank correlation of -0.018 at p=0.05 existed between the two variables. This statistical results affirms the respondents perceptions that they consider the management efforts towards addressing invasives that could potentially change the habitat of birds to be very weak or negligible.

6.3.7. Habitat Restoration

Habitat restoration is a critical management intervention not only for birds but also for the riparian communities. Thus, the study investigated the extent to which the local respondents viewed the level of intervention in this regard, with the aim of raising the importance of habitats. Table 6.41 shows that the community's perception on habitat restoration varied across the different IBA sites. The study established that 35.3 % of the respondents around the riverine IBA perceived restoration to be negligible, while 66.7% at the saline lake were of the perception that restoration was average. The study determined the distribution of responses in terms of habitat restoration at each wetland IBA.

Table 6.41: Percentage of respondents on habitat restoration

	Response to restoration from community perspective					Total
Type of IBA site	None	Very low	Low	Average	High	
Riverine	35.30	33.30	17.60	33.30	0	34.40
Freshwater Lake	64.20	35.90	0.00	0.00	0	58.50
Saline Lake	0.60	30.80	82.40	66.70	0	7.10

At the riverine IBA, a total of 145 responded as follows; none-128; very low-13; (low-3) and (average-1). Plate 6-6 shows a portion of land at Kipini on the shores of Tana River where mangrove replantation is taking place as part of efforts to restore habitats.

Plate 6-6: Reclaiming part of the shoreline at Kipini on the Tana River

Source: Researcher, 2011

At the freshwater IBA, a total of 247 responded to this question and it was as follows; none-233; very low-14; (low-0); (average-0).The scores recorded at the saline lake from 30 respondents are as follows; none-2; very low-12; (low-14); (average-2). A cross tabulation between each group age bracket and habitat restoration was conducted, with the results significantly showing that all age groups shared the same view that there was negligible or very low intervention in this regard (Table 6.42). This perhaps signifies that riparian communities are concerned about the small and large scale decimation of habitats.

Table 6.42: Perceptions on habitat restoration according to age

		None	Very low	Low	Average	High	Total
Group age bracket	15-25 years	52	3	2	0	0	57
		91.2%	5.3%	3.5%	0.00%	0.00%	100.0%
	26-36 years	105	6	0	0	0	111
		94.6%	5.4%	0.00%	0.00%	0.00%	100.0%
	37-47 years	109	10	5	3	0	127
		85.8%	7.9%	3.9%	2.4%	0.00%	100.0%
	48-58 years	29	8	4	0	0	41
		70.7%	19.5%	9.8%	0.00%	0.00%	100.0%
	59-69 years	35	3	1	0	0	39
		89.7%	7.7%	2.6%	0.00%	0.00%	100.0%
	70-80 years	26	9	5	0	0	40
		65.0%	22.5%	12.5%	0.00%	0.00%	100.0%
Total		356	39	17	3	0	415
		85.8%	9.4%	4.1%	0.7%	0.00%	100.0%

The male and female respondents equally shared the same view, with both gender profiles indicating higher percentages in the 'none', 'very low' and 'low' categories as shown in Table 6.43.

Table 6.43: Perceptions on habitat restoration according to gender

		None	Very Low	Low	Average	High	Total
Group gender profile	All male	259	33	16	3	0	311
		83.3%	10.6%	5.1%	1.0%	0.00%	100.0%
	All female	75	2	1	0	0	78
		96.2%	2.6%	1.3%	0.00%	0.00%	100.0%
	Male dominant	11	0	0	0	0	11
		100.0%	0.00%	0.00%	0.00%	0.00%	100.0%
	Female dominant	18	4	0	0	0	22
		81.8%	18.2%	.0%	0.00%	0.00%	100.0%
Total		363	39	17	3	0	0
		86.0%	9.2%	4.0%	0.7%	0.00%	0.00%

Community perception among user group from different IBA sites on habitat restoration indicated a significant difference in respondents' perception. Different user groups have a different view points on habitat restoration. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups ($H(2) = 24.035$, $P = 0.000$) with a mean rank of 230.14 for agricultural farmers, 209.41 for livestock keepers, 296.50 for traditional healers and 226.97 for charcoal burners table below.

Community perception among user group from different IBA sites on habitat restoration indicated a significant difference in respondents' perception. Different user groups have a different view points on habitat restoration. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups ($H(2) = 24.035$, $P = 0.000$) with a mean rank of 230.14 for agricultural farmers, 209.41 for livestock keepers, 296.50 for traditional healers and 226.97 for charcoal burners. A positive spearman's rank correlation of 0.004 at $p=0.05$ existed between the two variables on different user groups and community perception on habitat restoration.

This statistical results shows the respondents were a little bit more optimistic with regards this form of intervention at the site level compared to other forms.

6.4. Distribution of Respondents on Future Scenarios of the Wetland Condition

6.4.1. Water

Figure 6-13 shows the distribution of responses in terms of the state of water in the future at each wetland IBA. At the riverine IBA, a total of 169 respondents (100%) indicated that there will be a decrease in the condition of water in the future. At the freshwater IBA, a total of 238 (100%) respondents indicated that there will be a decrease in the condition of water in the future. At the saline lacustrine IBA from 44 respondents the percentage distribution is as follows; increase = 56.8%; decrease – 18.2% and 25% indicated the condition of water in the future is likely to remain constant.

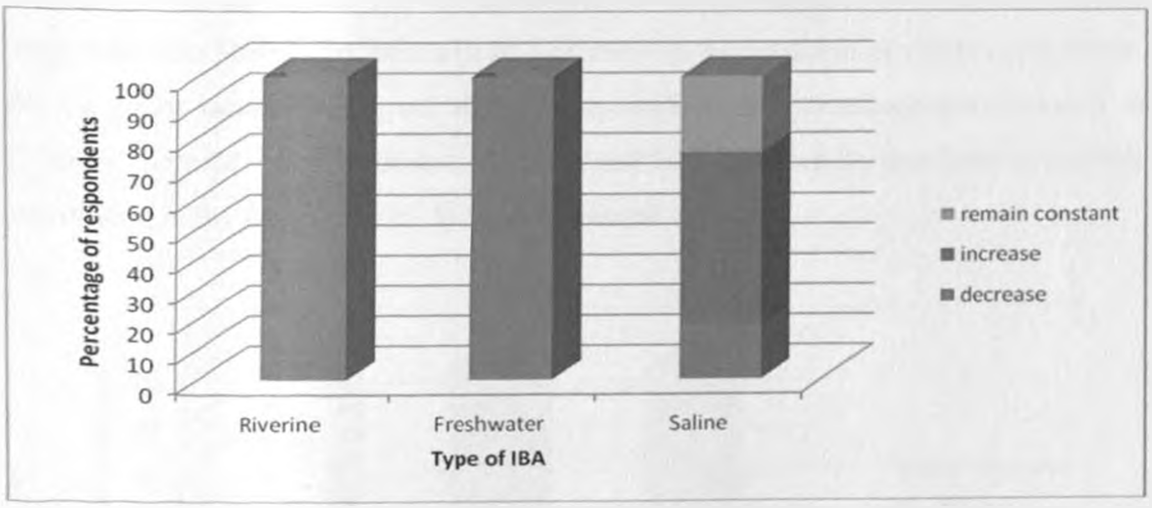


Figure 6-13: State of water in the future

The inland fishermen were more optimistic that should there be a redress in the current challenges facing water management, the condition of water resources would remain constant. At least 63.6% of the inland fishermen perceived that the condition of water resources would remain constant, compared to 13.4% of the livestock owners/herders/pastoralists from the IBA sites who perceived that there would be a decrease in the condition of water resources. The study sought to establish the variation in community perception on the condition of water in the future at the IBA sites. There was no significant difference in respondents' perception of the condition of water resources in the future. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was no statistically significant difference among respondents from the three IBA sites ($H(2) = 4.562$, $P = 0.004$) with a mean rank of 224.50 for riverine IBA, 224.50 for freshwater lacustrine IBA and 239.88 saline lacustrine IBA.

6.4.2. Wetland Vegetation

Figure 6-14 shows the distribution of responses in terms of the condition of wetland vegetation in the future at each wetland IBA. At the riverine IBA, a total of 169 (100%) respondents indicated that there will be a decrease in the abundance of wetland vegetation in the future. At the freshwater lacustrine IBA, a total of 231 (100%) respondents indicated that there will be a decrease in the condition of plants in the future. At the saline lacustrine lake out of the 44 respondents, the percentage distribution is as follows; increase = 18.2%; decrease – 56.8%and 25% indicated the condition of wetland vegetation in the future is likely to remain constant.

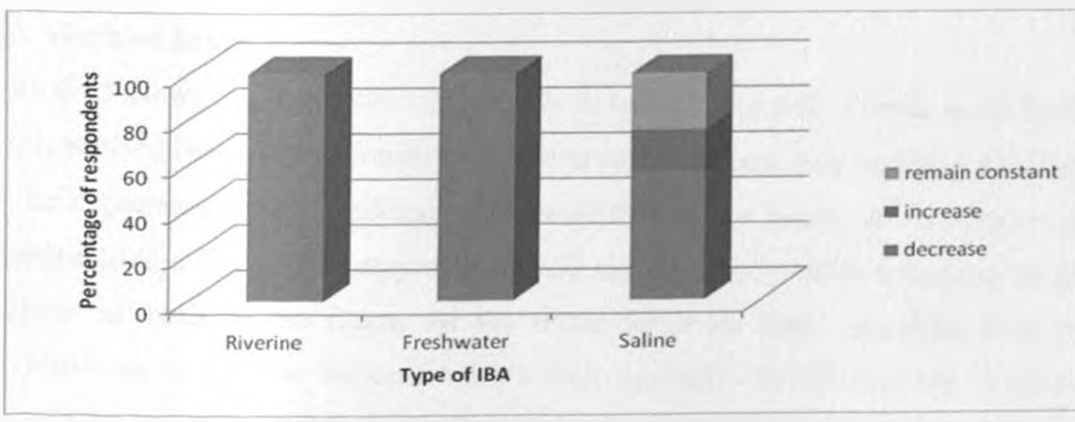


Figure 6-14: Condition of wetland vegetation in the future

The community's perception on the condition of wetland vegetation in the future did not vary much across the different IBA sites. The study established that a majority of the respondents at all the IBA sites perceived that there would be a decrease in the condition (quality and quantity) of wetland vegetation. At the saline lacustrine IBA, 11 respondents were of the perception that the condition of water would remain the same and 8 respondents indicated that the condition would increase. According to user groups, 63.6% of the inland fishermen perceived the condition of wetland vegetation would remain constant, compared to 18.8% of the livestock owners/herders/pastoralists from the IBA sites who perceived that there would be a decrease in the condition of wetland vegetation in the future. Even though the wetland vegetation is under threat, the communities are yet to acquire or make use of sophisticated machinery that could completely transform the landscape. This could partly explain the results of this study with regards wetland vegetation. The study sought to establish the variation in community perception on the condition of wetland vegetation in the future of the IBA sites. There was no significant difference in respondents' perception on the condition of wetland vegetation. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was no statistically significant difference among respondents from the three IBA sites (H (2) = 4.487, $P = 0.004$) with a mean rank of 221.00 for riverine IBA, 221.00 for freshwater lacustrine IBA and 236.14 for saline lacustrine IBA. A negative spearman's rank correlation of --0.170 at $p=0.05$ existed between the two variables and this indicates that the strength of the linkage between the different user groups and the condition of water resources in the future is a perfect negative.

6.4.3. Wetland Birds

Figure 6-15 shows the distribution of responses in terms of the state of birds in the future at each wetland IBA. At the riverine IBA, a total of 169 respondents indicated that there will be a decrease in the condition of birds/wildlife in the future. At the freshwater lacustrine IBA, a total of 238 respondents indicated that there will be a decrease in the condition of birds in the future. At the saline lacustrine lake, responses from 44 individuals are as follows; increase = 8 (18.2%); decrease - 25 (56.8%) and 11 (25%) indicated the condition of water in the future is likely to remain constant.

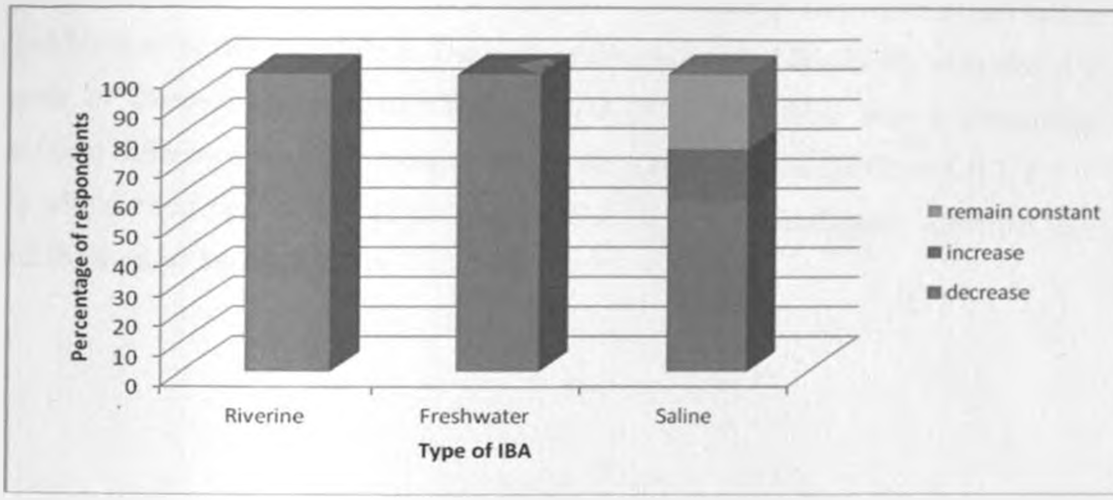


Figure 6-15: State of birds in the future

According to user groups, 27.3% of the inland fishermen perceived the numbers of birds would remain constant, compared to 13.6% of the Agricultural farmers from the IBA sites perceive that there would be a decrease in the condition of birds/wildlife. The community's perception on the condition of wetland vegetation in the future did not vary much across the different IBA sites. The study established that a majority of the respondents at all the IBA sites perceived that there would be a decrease in the condition (quality and quantity) of wetland vegetation. At the saline lacustrine IBA, 11 respondents were of the perception that the condition of water would remain the same and 8 respondents indicated that the condition would increase. According to user groups, 63.6% of the inland fishermen perceived the condition of wetland vegetation would remain constant, compared to 18.8% of the livestock owners/herders/pastoralists from the IBA sites who perceived that there would be a decrease in the condition of wetland vegetation in the future.

Even though the wetland vegetation is under threat, the communities are yet to acquire or make use of sophisticated machinery that could completely transform the landscape. This could partly explain the results of this study with regards wetland vegetation. The study undertook to determine the statistical relationship that exists between different user groups and community perception on the condition of wetland birds in the future. A negative spearman's rank correlation of -0.170 at $p=0.05$ existed between the two variables. There was a significant difference in respondents' perception on condition of birds in the future. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites ($H(2) = 4.487$, $P = 0.004$) with a mean rank of 221.00 for riverine IBA, 221.00 for freshwater lacustrine IBA and 236.14 saline lacustrine IBA.

CHAPTER SEVEN

PERCEPTIONS ON PRESSURE–STATE–RESPONSE INDICATORS

7.1. Typology of Community Identified Indicators Informed by Local Knowledge

In identifying which indicators from the community perspective should be considered for effective wetland management, the study found out that while there were some commonalities in the type of indicators, there were also differences largely due the typology of the wetland. Figures 7-1, 7-2 and 7-3 show the typology of indicators at Tana Delta, Lake Bogoria and Lake Naivasha respectively.

7.1.1. Typology of State Indicators

Figure 7-1 shows that at least four out of the eight state indicators at the riverine IBA, namely number and diversity of fish, abundance of wetland pasture and level of flooding regime were rated as high priority by at least 95% of the respondents. At least 84% of the respondents rated the indicator on the size of wetland as high priority. The indicator on water quality was rated as high by at least 82% of the respondents. The indicator on the number and size of traditional rice farms was rated as second priority by at least 78% of the respondents.

The indicator on the number and diversity of mangroves was rated by at least 20% of the respondents as high priority, while at least 78% rated it as second priority. A majority of respondents, more than 70% rated the indicator on abundance of wetland birds as low priority. Only 12% indicated that this was a second priority, while only 10% indicated that this was a high priority.

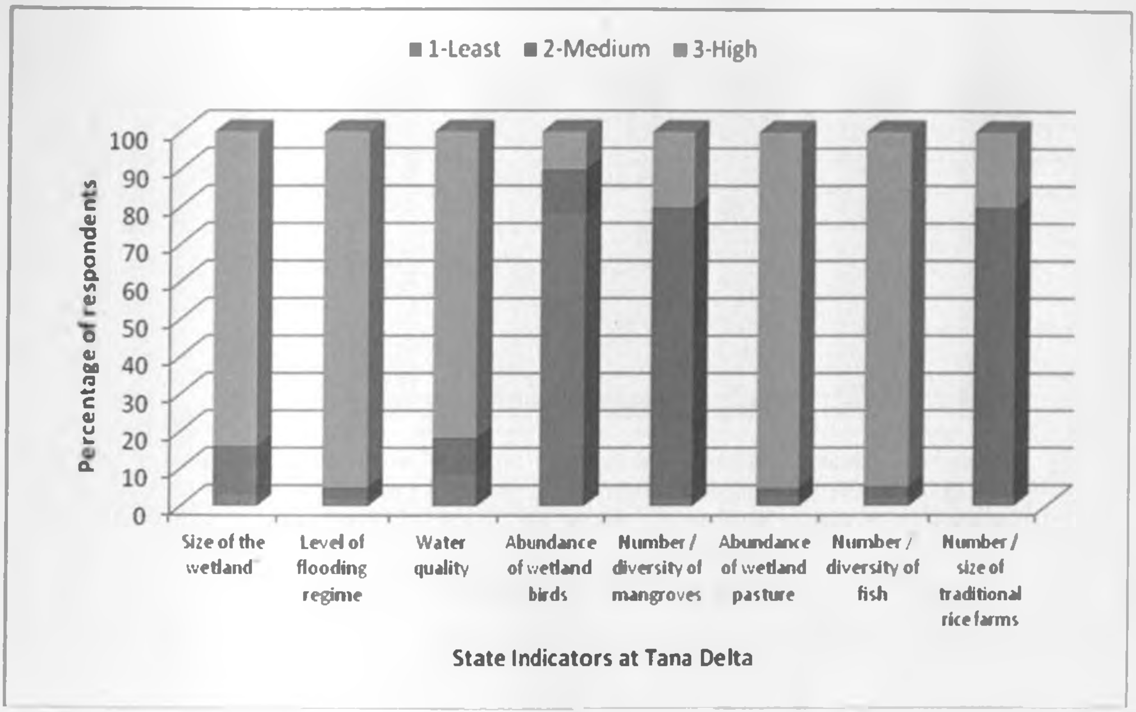


Figure 7-1: State indicator at Tana Delta

Figure 7-2 indicates that at Lake Bogoria, respondents identified at least seven indicators describing the state of the wetland condition. The state indicators at Lake Bogoria were as follows; number of springs, state of flooding regime, water quality, trends in wetland birds, numbers/diversity of medicinal plants, abundance of wetland pasture and abundance of fish resources. Of these, the state indicator on trends in wetland birds was rated as high priority by at least 88% of the respondents. The indicator on water quality was rated as high priority by at least 86% of the respondents, while the indicator on the number and diversity of medicinal plants as well as size of the wetland was rated as high priority by at least 77% of respondents. The indicator on the number of springs was rated as high priority by at least 77% of the respondents. The indicator on wetland birds scored the least at Lake Bogoria with at least 86 % of the respondents indicating that this was lowly rated.

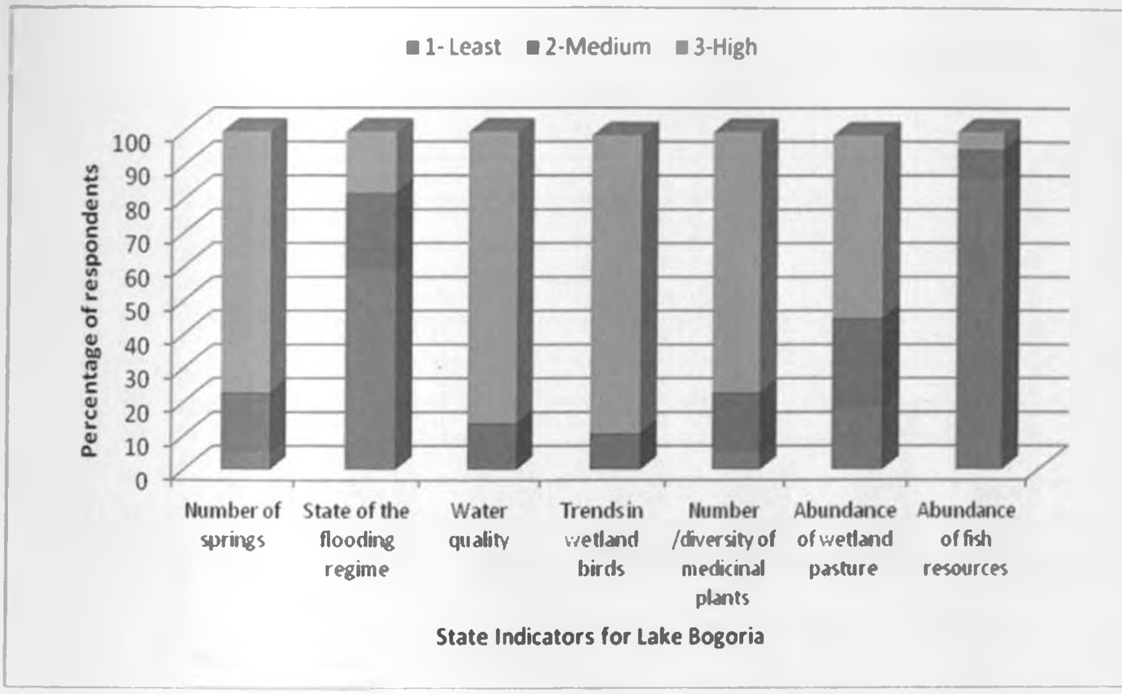


Figure 7-2: State Indicators for Lake Bogoria

For the freshwater lake, a total of seven state indicators were identified by the local respondents. These included; size of wetland, level of flooding regime, water quality, abundance of wetland birds, abundance of wetland vegetation, abundance of wetland pasture and abundance of fish resources. The discussion from the focused groups at Lake Naivasha indicated that respondents were more concerned about the size of fish population, diversity of birds, the size of the wetland (quantity of water and encroachment of the lake area) as well as the quality of water. Figure 7-3 below shows that in comparison to the other two sites, the indicators on the abundance of wetland birds, fish resources and quality of water were highly rated with at least 100% of respondents affirming this was very important for the wetland. On the other hand, the indicator on abundance of wetland vegetation and abundance of wetland pasture showed that perceptions on these indicators were not equally distributed.

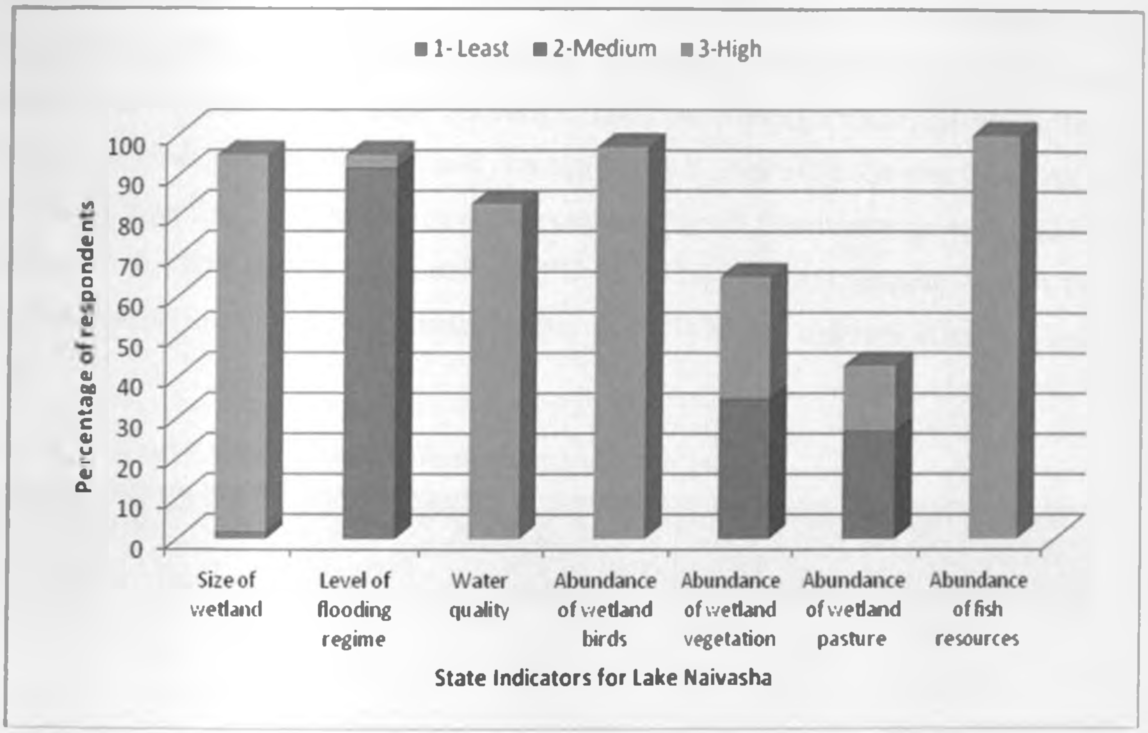


Figure 7-3: State indicators scores at Lake Naivasha

The study sought to establish the variation in community perception on state indicators at the IBA sites. There was a significant difference in respondents' perception on state indicators. The Test Statistics (Kruskal-Wallis H), indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 153.588, $P = 0.004$) with a mean rank of 193.59 for Riverine IBA, 254.03 for Freshwater lacustrine IBA and 62.41 Saline lacustrine IBA (Table 7.1).

Table 7.1. Mean Ranks of the State Indicators at each wetland type

	Type of IBA site	N	Mean Rank
Wetland State Indicators	Riverine	149	193.59
	Freshwater lacustrine	232	254.03
	Saline lacustrine	44	62.41
	Total	425	

Community perception among user group from different IBA sites on the state indicators indicated a significant difference in respondents' perception. Different user groups have a different view points on the state indicators. The Test Statistics (Kruskal-Wallis H), indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 66.847, P = 0. 000) with a mean rank of 199.05 for agricultural farmers, 176.68 for livestock keepers, 68.00 for traditional healers and 204.20 for charcoal burners (Table 7.2).

Table 7.2: Mean Ranks on State Indicators for each user group

	Type of IBA resource user group	N	Mean Rank
State indicators	Agricultural farmers	58	199.05
	Livestock herders	76	176.68
	Coastal fishermen	12	116.33
	Inland fishermen	124	256.18
	Traditional healers	4	68.00
	Mangrove harvesters	16	171.25
	Reed harvesters	32	222.88
	Papyrus harvesters	32	248.69
	Carpenters	8	171.25
	Bee-Keepers	36	205.67
	Charcoal burners	27	204.20
	Total	425	

Using the Spearman Correlation analysis, the study showed the statistical relationship that exists between different user groups and community perception on state indicators. A positive spearman's rank correlation of 0.097 at p=0.05 existed between the two variables.

7.1.2. Typology of Pressure Indicators

At least 95% of respondents at the Tana Delta rated the pressure indicator on uncontrolled water abstraction as a high priority. At least 88% of the respondents were concerned with the loss of flooding regimes and they rated this pressure indicator as of high priority. The indicator on overstocking was rated as of high priority by at least 88% of respondents, while 84% of the respondents rated agricultural pollutants as a high priority. At least 10% of respondents indicated that the pressure indicator on shore line erosion was of high priority, compared to 78% who indicated that this was of least priority. The pressure on overharvesting of mangroves at the Tana Delta was rated as a second priority, with at least 50% of the respondents classifying it in this category. The pressure indicator on the rise in sea level had a similar score with the pressure indicator on saltwater intrusion, with at least 39% indicating that this was of medium priority. At least 49% of the respondents indicated that the pressure indicator on overfishing was of medium priority, with at least 13% indicating that this was of low priority.

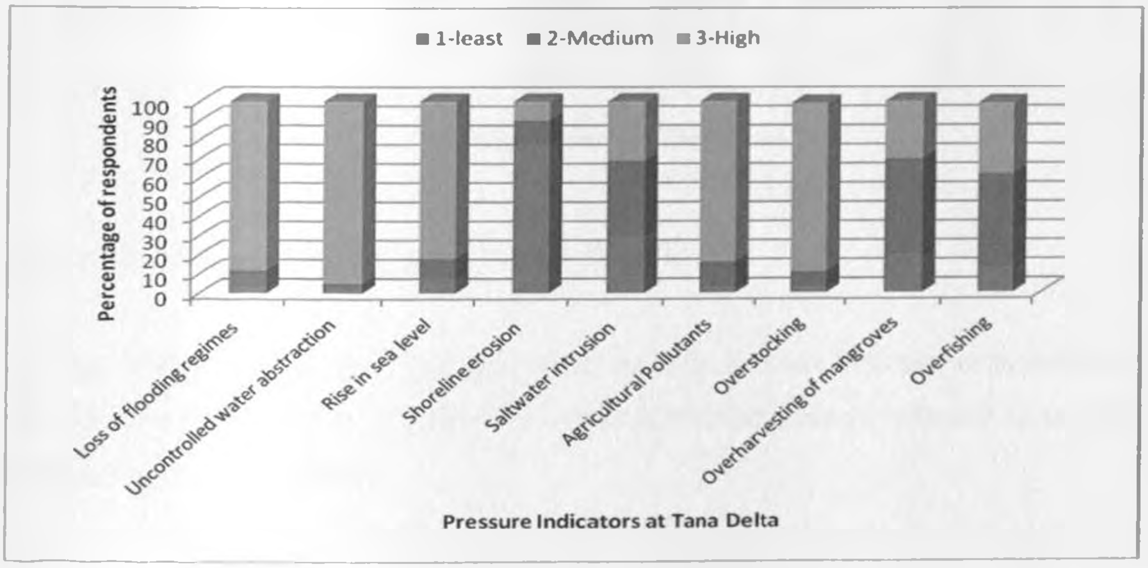


Figure 7-4: Pressure indicator scores at Tana Delta

The pressure indicator on overstocking at Lake Bogoria was rated as of high priority by at least 82% of the respondents, while at least 59% of respondents rated the indicator on fire outbreaks as of high priority compared to 9% who indicated this was of least concern.

At least 84% of respondents rated the pressure indicator on influx of invasives on wetlands, especially the prosopis as of high priority. At least 59% respondents indicated that the indicator on overharvesting of papyrus was of high priority, compared to 9% who rated it as low priority. The encroachment into wetland areas, especially the through agricultural expansion and settlements was rated by a majority of respondents as being medium, with at least 11% rating it as of high priority.

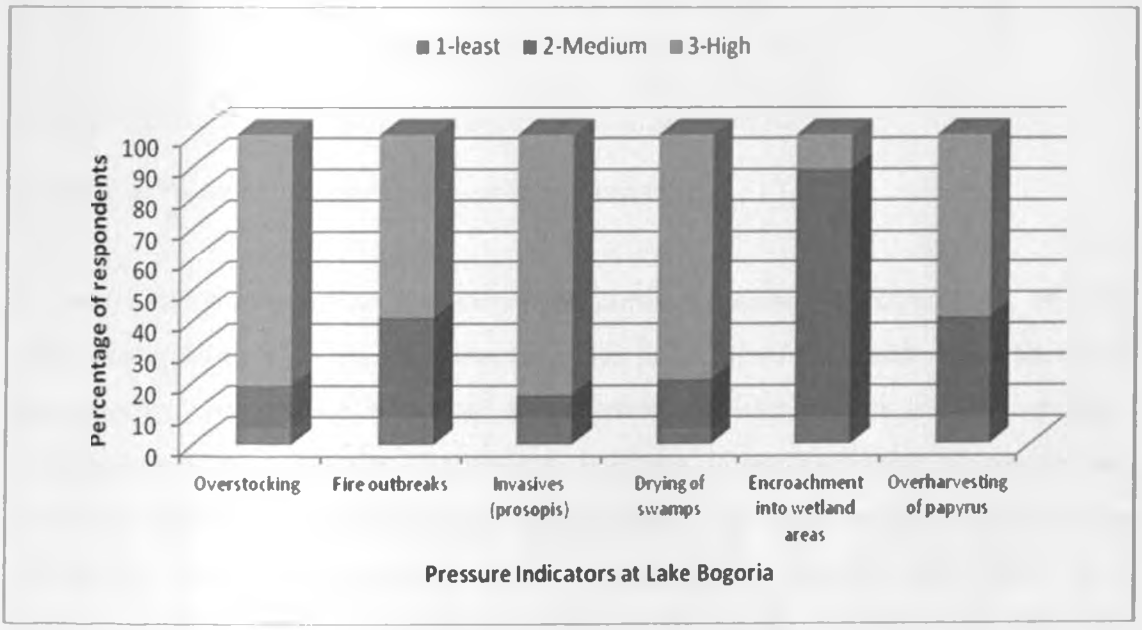


Figure 7-5: Pressure indicator scores at Lake Bogoria

At Lake Naivasha, at least 93% of respondents rated the pressure indicator on agricultural pollutants as of high priority, while 78% indicated that the pressure indicator on sewage pollution was of high priority.

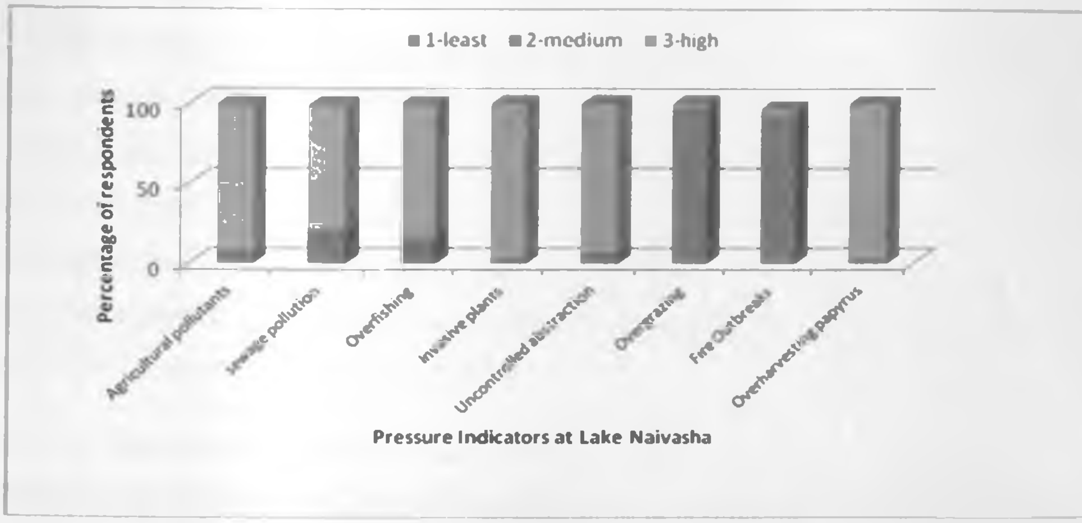


Figure 7-6: Pressure indicator scores at Lake Naivasha

At least 83% of respondents considered the pressure indicator on overfishing to be of high priority, while 97% indicated that the influx of invasives, especially hyacinth was of high priority. Overgrazing, 97% rated the indicator as of least concern and 92% rated fire outbreaks as of least concern. The pressure indicator on overharvesting of papyrus was rated by a majority of respondents as a high priority. The study sought to establish the variation in community perception on pressure indicators at the IBA sites. There was a significant difference in respondents' perception on pressure indicators. The Test Statistics (Kruskal-Wallis H, indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 153.588, P = 0. 004) with a mean rank of 193.59 for Riverine IBA, 254.03 for freshwater lacustrine IBA and 62.41 saline lacustrine IBA (Table 7.3).

Table 7.3: The mean rank of the pressure indicators at each wetland type

	Type of IBA site	N	Mean Rank
Wetland Pressure Indicators	Riverine	149	193.59
	Freshwater lacustrine	232	254.03
	Saline lacustrine	44	62.41
	Total	425	

Community perception among user group from different IBA sites on the pressure indicators indicated a significant difference in respondents' perception. Different user groups have a different view points on the pressure indicators. The Test Statistics (Kruskal-Wallis H) as shown in Table 7.9, indicated at 10 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) = 66.847, P = 0. 000) with a mean rank of 199.05 for agricultural farmers, 176.68 for livestock keepers, 68.00 for traditional healers and 204.20 for charcoal burners (Table 7.4).

Table 7.4: Mean Ranks on Pressure Indicators according to the type of user group

	Type of IBA resource user group	N	Mean Rank
Pressure indicators	Agricultural farmers	58	199.05
	Livestock owners/Herders/pastoralists	76	176.68
	Coastal fishermen	12	116.33
	Inland fishermen	124	256.18
	Traditional healers	4	68.00
	Mangrove harvesters	16	171.25
	Reed harvesters	32	222.88
	Papyrus harvesters	32	248.69
	Carpenters	8	171.25
	Bee-Keepers	36	205.67
	Charcoal burners	27	204.20
	Total	425	

The study undertook to determine the statistical relationship that exists between different user groups and community perception on pressure indicators. A positive spearman's rank correlation of 0.097 at p=0.05 existed between the two variables.

7.1.3. Typology of Response Indicators

In terms of type of responses, the respondents at Tana Delta (Figure 7-7) indicating that establishing upper limits to how much water can be abstracted by users, especially the large scale commercial farmers and those in the mining industry was of paramount importance. This lays credence to the fact that communities are aware that adequate environmental flows to maintain the ecological balance of the ecosystem as well as well as security of livelihoods is dependent on the amount as well as the quality of the water that flows downstream. Release of adequate water is necessary to maintain appropriate flooding regimes as these are essential for communities to be able to use the floodplain in a productive manner.

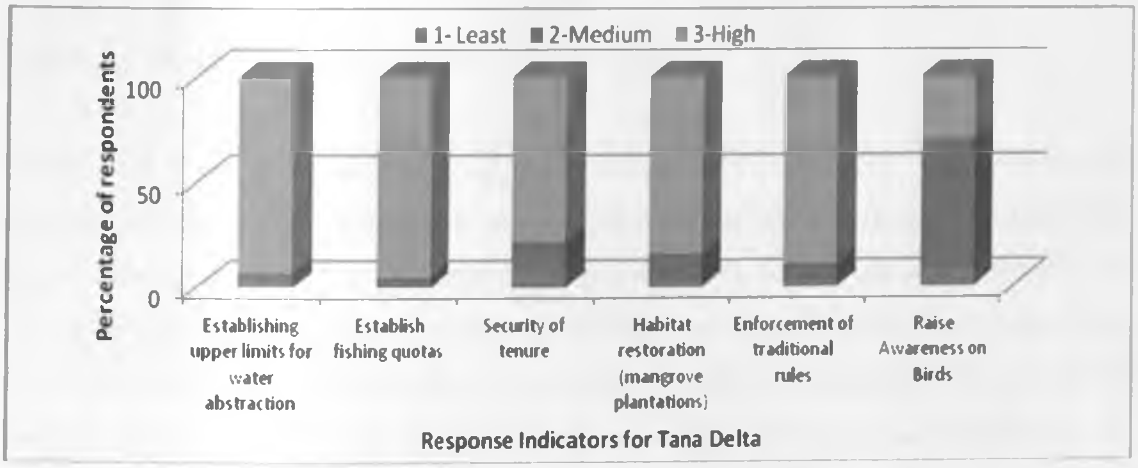


Figure 7-7: Response indicator scores at Tana Delta

At least 82% of respondents at Lake Bogoria rated the indicator on livestock rates as high priority, compared to 14% and 5% who rated it as medium and least priority. At least 59% of respondents were favour of the response indicator on fire control measures, whereas an overwhelming 80% of respondents rated the response indicator on habitat restoration as of least priority. At least 80% of respondents were of the opinion that the response indicator on increased diversity of medicinal plants was of high priority and at least 82% of respondents were in favour of the response indicator on traditional rule enforcement as a high priority.

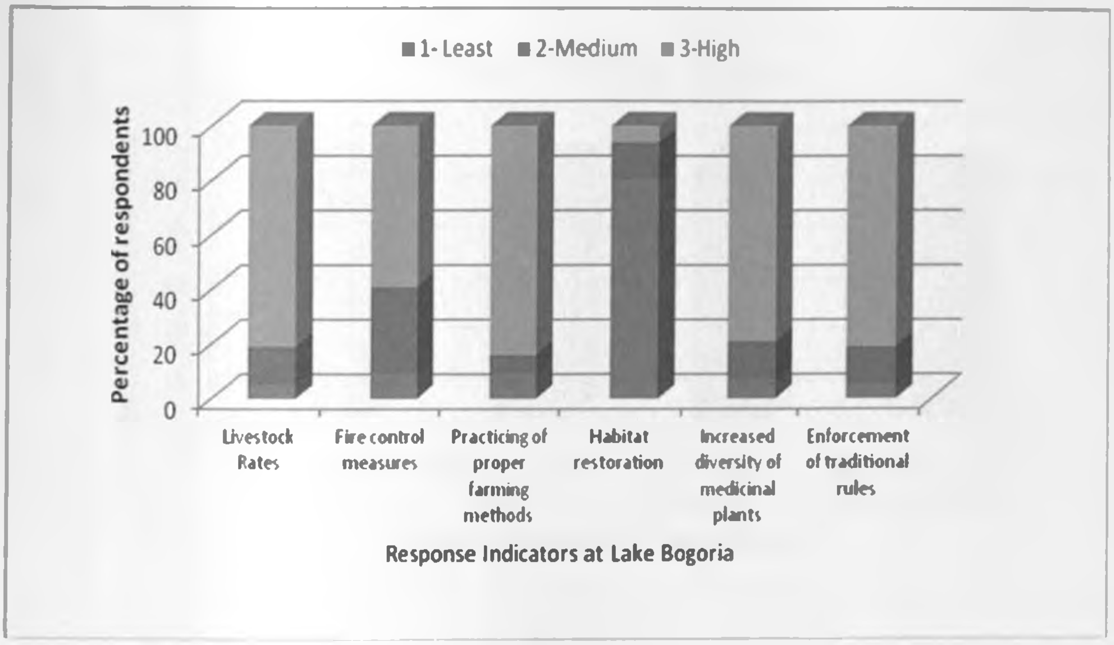


Figure 7-8: Response indicator scores at Lake Bogoria

Figure 7.9 shows the percentage of responses at Lake Naivasha with regards the appropriate site level inteventions to the condition of the wetland. To signify the importance of fish stock to the riparian communities at Lake Naivasha, at least 93% of the respondents indicated that the response indicator on establishing and adhering to fish harvesting quotas was of high priority, compared to only 2% that indicated this was of least priority. At least 79% of the respondents were of the view that that the indicator on enforcing upper limits was of high priority, compared to 18% and 3% who rated it is medium and low priority respectively. At least 83% of the respondents confirmed that controlling invasives, especially the fast spreading hyacinth was a high priority. Unlike at Lake Bogoria, the indicator on the enforcement on traditional rules was lowly rated, with at least 93% respondents stating that it was of least concern.

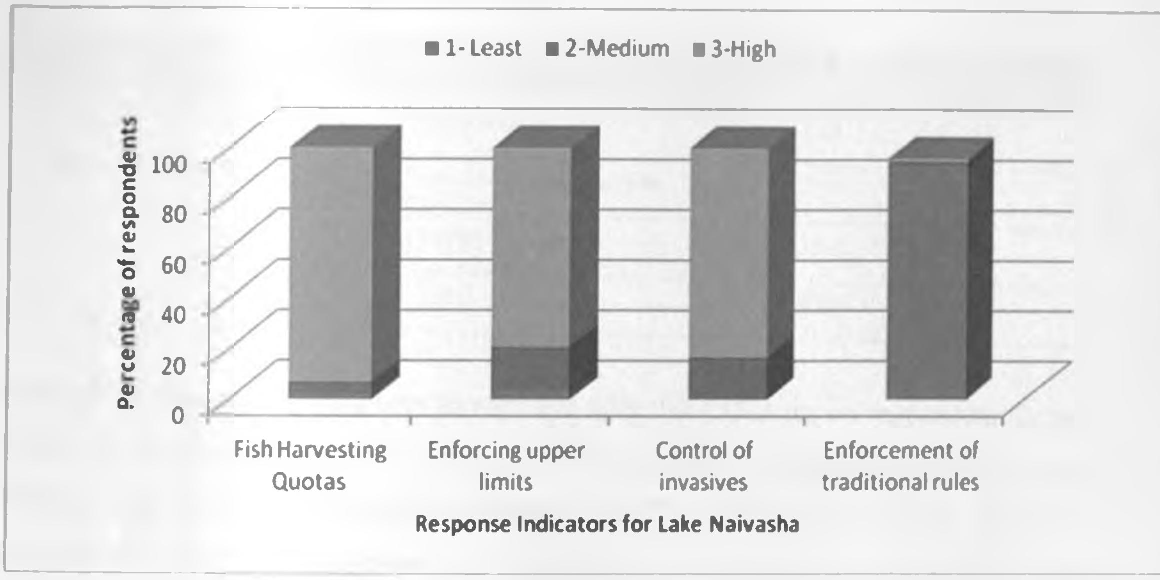


Figure 7-9: Response indicator scores at Lake Naivasha

A chi-square test of independence was performed to examine the relation between the type of IBA site and the community's perception on the response indicators. The relation between these variables was significant, χ^2_{Cal} = 143, df= 33, χ^2 cri 0.05= 47.400 α 0.05. The χ^2 calculated was found to be greater than critical χ^2 hence the null hypothesis that the local community identified response indicators are not influenced by the type of wetland environment was rejected. The community perceptions on the response indicators were different across different communities around the different IBA site. The study sought to establish the variation in community perception on response indicators at the IBA sites. There was a significant difference in respondents' perception on response indicators. The Test Statistics (Kruskal-Wallis H) in Table 7-12, indicated at 2 degrees of freedom and the significance level (0.05) that there was a statistically significant difference among respondents from the three IBA sites (H (2) = 64.763, P = 0. 004) with a mean rank of 200.12 for riverine, 204.95 for freshwater Lake and 369.34 for the saline lake (Table 7.5). When the Spearman Rank Correlation was applied to understand the statistical relationship that exists between different user groups and community perception on response indicators, it was noted that it was a positive correlation of 0.052 at p=0.05.

Table 7.5: Mean rank on response indicators

	Type of IBA site	N	Mean Rank
Community's perception on Response Indicators	Riverine	158	200.12
	Freshwater lacustrine	239	204.95
	Saline lacustrine	35	369.34
	Total	432	

Community perception among user group from different IBA sites on response indicators indicated a significant difference in respondents' perception. Different user groups have a different view points on response indicators. The Test Statistics (Kruskal-Wallis H), indicated at 11 degrees of freedom and at a significance level of (0.05) that there was a statistically significant difference among respondents from different user groups (H (2) =48.866, P = 0. 000) with a mean rank of 226.04 for agricultural farmers, 175.83 for livestock keepers, 191.00 for traditional healers and 246.65for charcoal burners (Table 7.6).

Table 7.6: The mean rank on response indicators according to the user group

	Type of IBA resource user group	N	Mean Rank
Community's perception on Response Indicators	Agricultural farmers	50	226.04
	Livestock farmers	75	175.83
	Coastal fishermen	12	191.50
	Inland fishermen	124	243.46
	Traditional healers	4	191.00
	Mangrove harvesters	12	143.33
	Reed harvesters	36	247.61
	Papyrus harvesters	32	186.58
	Carpenters	9	46.50
	Bee-Keepers	40	240.39
	Charcoal burners	34	246.65
	Traditional/spiritual leaders	4	191.00
	Total	432	

CHAPTER EIGHT

DISCUSSION

8.1. Socio- Demographics of the Study

Previous studies have shown that age has been a key differentiating variable since the 1980s, as younger survey respondents are generally more supportive of environmental issues than other age groups (Mohai and Twight, 1987). At the same time, age has been found consistently to have the strongest association with environmental concern. This was supported in subsequent studies by Arcury and Christianson (1990); Mohai and Twight (1987). According to these authors age connotes experience and perhaps an accumulation of wealth and thus older people may not depend heavily on wetlands resources.

By and large age indicates level of maturity, in that sense, age becomes more important to examine the perceptions about the wetland environment. Age as a sociodemographic determinant was more evident at Lake Bogoria, where only the older members of the society are permitted to enter the reserve at a particular time of the year for harvesting medicinal plants. The field research for this study coincided with the annual inspection of the water points and grazing resources by the Council of Elders and the Warden for Lake Bogoria National Reserve. The researcher had the rare priviledge of accompanying a group of elders into the reserve and it was noticeable that this assignment was not only reserved only to men but specifically the elderly.

This study however showed that perceptions on the state of the wetland environment were not influenced by the age of the respondents. In communities, such as the Endorois of Lake Bogoria, where the traditional systems influence much of what happens in the area even in this day, it was evident that the young people had a close connection to their elders. Even in public places such as shopping centres where there is usually a mix of different cultures, one could discern that the young people were grounded in their tradition. Both the elders and the young people indicated that environmental issues/cultural issues are discussed at homes, and the majority of the young people are still benefiting from the traditional storytelling and other forms of knowledge transfer in their interactions with grandparents, parents or elders. Children were only able to give no more than a third of the local names of the most common plants and wild animals. Other elders because of living far away from their home and regularly working in the farms did not have much knowledge about the names of wildplants. They still knew the language but had lost the context of use of the traditional biosystematics lexicon- cultural assimilation and language shift. This was however not the case for the pastoralists communities, especially the Maasai as tradition still dictates the lives of the community. Most of the fishermen at Lake Naivasha were young to middle aged men. In the Tana Delta, fishing was also mainly done by children and young men. Gender refers to the roles and expectations attributed to men and women in a given society. These roles usually change over time, place, and life stage. Given the interconnectedness of the biological and the social, it might prove pragmatic to consider that gender encompasses both sex differences and the social constructs that give rise to gender differences. Both women's and men's occupational and behavioural roles are largely constrained by social norms. At a population level, in most countries of the world, women have more limited access to, and less control over, resources than do men. The impact of gender as a social determinant of resource use is likely a composite of the effects of relative power, autonomy, poverty, and marginalization, within, and across, societies and cultures. According to UNDP (2005), African countries generally rank very low in the Gender-related Development Index (GDI): they constitute 35 out of the 40 countries with the lowest GDI ranking (UNDP, 2005).

In a comparative study of forest management across four countries in East Africa and Latin America: Kenya, Uganda, Bolivia, and Mexico, Mwangi *et al*, (2011) found higher proportions of females in user groups. User groups dominated by females performed less well than mixed groups or male dominated ones. The authors cite gender biases in technology access and dissemination, a labor constraint faced by women, and a possible limitation to women's sanctioning authority as the principal causes. Consequently, the authors recommended that mixed female and male groups offered an avenue for exploiting the strengths of women and men, while tempering their individual shortcomings.

Two recognised reviews of gender difference in environmental attitude and behaviours conducted more than a decade ago (Van Liere and Dunlap, 1980), (Hines *et. al.*, 1986) concluded that research on the relationship between these variables is meager and inconsistent. In concurrence, Mohai (1992) stated that 'no firm conclusions can be drawn about the effects of gender on concern about environmental issues and more analysis and explanation clearly needs to be done in this area'. Other studies on the relationship between environmental concern and gender have also produced conflicting results (Arcury and Christianson 1990; Blocker and Eckberg, 1989; Samdahl and Robertson, 1989; Mcstay and Dunlap, 1983). A new meta-analysis of psycho-social determinants of pro-environmental behaviour was done by Bamberg and Guido Mo¨ ser, (2006) at least 20 years after the research by Hines *et al.*, (1986). Those who predict differences between men and women with regard to environmental concern generally argue from socialisation or structural theories.

The most commonly used arguments from socialization theory posit that females are directed toward the caregiver role, thereby encouraging women to be more compassionate than men (Chodorow, 1974). This 'motherhood' mentality extends to protective attitudes towards nature as females see themselves as embedded in their community and in the larger world. Male socialization presumably stresses an economic provider role, which encouraged men to be rationale, masterful and competitive than women. Structural theories focus on the 'market place mentality' in which men have held the breadwinner role. It is argued that while women would accept the goals of economic growth, they would show greater concern about harmful effects to the environment.

The study sites are largely considered risk areas in terms of human–wildlife conflict, thus certain roles which require access into the IBAs are reserved for men. At Lake Bogoria, only the members of the Council of the Traditional Leaders comprising only of men have the task of inspecting water resources and condition of grazing for livestock. This task requires traversing the length and breadth of the reserve as was witnessed during the course of the field research. In the study area, gender has an important bearing on both the levels and types of goods obtained from the wetland directly or manufactured from swamp products. For example, fishing is traditionally an exclusively male practice and male harvesters were also responsible for harvesting more papyrus than females. In general however, females were more likely to make crafts from papyrus, although this is item specific, with males making more fish traps. Extraction of water resources is largely done by women and children. The differential access and control of natural resources by men and women determine how much influence they have on environmental management.

In conducting a socio-economic baseline survey of communities adjacent to Lake Bisina/ Opeta and Lake Mburo / Nakivali wetland systems in Western and Eastern/North-Eastern Uganda (IUCN, 2010), a deliberate effort was made to give consideration to gender in the sampling process to choose respondents in the survey. This was based on the background that women and men interface with wetlands differently and the associated challenges that come with this interaction are different for women from men. Although it was not possible for the authors to balance the numbers in the distribution, views of 118 women were captured out of the total 320 respondents to the survey questions.

The results of the study sites have shown that the 'all male' group comprised the largest with 72.6%, while the 'all female' group was 19.6%. The study recognises that the cultural factors could have resulted in the 'male' group being more dominant than the female group. In this case, the sampling strategy of study was biased towards the male members of the community. Given this probability of biases in gender selection, the statistical analysis shows that there was not much difference in the perceptions of the 'All Males Group' and the 'All Females Group'. Even though the numerical difference between the males and females was high (72.6%, while the 'all female' group was 19.6%), the statistical difference was very small (1.7 versus 1.5). This study concludes that even though there was evidence to show that access to wetland resources was limited by gender, this did not influence the perceptions about the condition of the wetland resources.

Wetlands in general and in Africa specifically have multiple uses according to Crafter *et. al.*, (1991). The wetlands in Kenya are no different and the wetlands of focus in this study were dominated by 1) inland fishermen, 2) livestock owners/herders/pastoralists and 3) agricultural farmers. In order to ensure sustainable management of wetland resources, it is imperative to understand that the involved 'community' is not generally restricted to a particular user group as this study has clearly illustrated the diverse groups. Management of wetland resources seldom takes the form of rational control by one or even two groups (Ribot, 1999). In practice, it is generally better understood as a process in which a variety of groups are struggling for access to, or control of, different wetland resources. Different groups are often interested in quite different aspects of the wetland (Mermet, 1991). The struggle may be overt, though this is less likely when groups are interested in different resources in the wetland. More often the actors do not fully realise the extent of the impacts that they are likely to suffer as a result of management of the wetland area for a resource other than the one in which they are interested.

Bromley and Cernea (1989) argue that for Common Property Resources Management to function well, 'the size of the resource user group should be small, the users are reasonably homogenous in important socio- economic characteristics and the users reside close to the resources'. The size of the resource group and its location relative to the resource matters significantly, especially if it is not a fugitive resource or a 'multi- jurisdictional resource' (Buck, 1989). The study argues that the respondents at the three study sites are bound by common socio - characteristics, most of the resources with the exception of avifauna are confined to one location and most of people live within a radius of 5km of the wetland, which is reasonably close to allow daily interaction.

It is also important to recognize that there are mainly two categories of wetland uses: consumptive and non- consumptive. The consumptive user groups are highly likely to transform the wetland environment compared to non-consumptive user groups such as wetland ecotourism. Consumptive demand applies significant upward pressure on rural land values and plays an important role in determining wetland structure. Consumptive water use causes diminishment of the source at the point of appropriation. Diminishment is defined as the process of making smaller or less in quantity, quality, rate of flow, or availability. Surface water use is non-consumptive when there is no diversion from the water source or diminishment of the source. Additionally, when water is diverted and returned immediately to the source at the point of diversion following its use in the same quantity as diverted and meets water quality standards for the source, the water use is classified as non-consumptive. This would be the normal case with hydro-electric power generation. Where water is used largely for irrigation purposes such as is the case in the flower farming industry at Lake Naivasha, this is classified as a consumptive use that can potentially have a negative effect on the downstream communities and there is need for action.

Due to the favorable farming conditions, the largest number of agricultural farmers in the study was drawn from the Tana Delta, whereas Lake Bogoria had the least number of respondents from this category. The land cultivators at Lake Bogoria are restricted mainly to irrigation farming where they rely on water from the springs. As already mentioned above, the inland fishermen comprise the largest resource use group among the respondents. Most of the respondents in this category were drawn from the study sites at Lake Naivasha. Some of the fishermen at Lake Bogoria were found at Loboi and Lorwai swamps, with no fishing taking place within the lake due to its saline conditions. Amongst the livestock farmer respondents, Tana Delta had the largest number followed by Lake Naivasha. The coastal fishermen were only located mainly at Kipini and Ozi in the Tana Delta. The Delta is extremely rich in fish with more than 40 species recorded in it and being a major breeding site for a number of them. The statistical analysis shows that there were differences in perceptions due to the type of resource use. The traditional healers, perhaps due to the entrenched historical links, affiliation and in-depth specialisation on herbal life, recorded a much higher perception than the rest of the resource users. Notably, the inland fishermen (1.992754), agricultural farmers (1.612903), livestock herders (1.72619) reported slightly higher perceptions that the other resource groups.

8.2. Condition of the Wetland Resources

According to Mwinami *et al.*, (2010), the state of Kenya's Important Bird Areas was classified as poor. According to the authors, this is attributed to increased pressures, including: severe drought; continued negative impacts of post-election violence such as increased demand for construction materials and fuel wood; overuse of forest and papyrus habitats; conversion of grasslands into crop land; clearing of forests for bio-energy and food production; fire incidents; and general negative effects driven by poverty and lack of development planning. The threat which recorded the highest change was natural events linked to climate change and severe weather, more than doubling from 21% in 2008 to 51% in 2009 (Mwinami *et al.*, 2010). On the overall, the study found out that there was a general decline in the quantity of water resources at the study sites. Studies at Tana Delta (Nature Kenya, 2008) attest to the fact that the area has experienced falling water levels. Literature attests to the fact that flood plains are among the most altered landscapes worldwide and they continue to disappear at an alarming rate, since floodplain 'reclamation' (i.e. elimination) is much higher than for most other landscape types (Vitousek *et al.*, 1997; Olson and Dinerstein 1998; Ravenga *et al.*, 2000). The net result is vast constriction of flood plains, sometimes by more than 50% of the historic expanse (Snyder *et al*,. 2002). The statistical analysis shows that there is generally a shortage of water for both livestock and people across all the three types of wetlands. The shortage also impacts on the 'environmental flow'- a level of water that can be maintained to ensure that the resources such as wetland vegetation and other aquatic life are available. The shortage of water is attributed to various reasons, with surface run-off and groundwater recharge rate being influenced by rainfall intensity, soil types, vegetation cover and presence or absence of wetlands.

Of the three studied wetlands, Lake Naivasha and Tana Delta are mainly available for all uses. The saline Rift Valley Lake Bogoria is not available for most forms of uses on account of chemistry thereof. The results of the study have shown that local communities at Lake Bogoria are aware that over the years although the lake has been receding, it has never been dry. As confirmed by Harper *et.al.*, (2003), water abundance in the main lake is relatively higher than at other sites in the Rift Valley. Comparison of the areas of the Loboi Swamp between 1969 (aerial photographs) and 2002 reveals a dramatic reduction of about 60% (Ashley *et al.*, 2004). Studies conducted by the African Conservation Centre (2011) at Lake Naivasha show that there has been a significant reduction of the lake (by 23 %) within a span of 25 years.

Through Focus Group Discussions, local communities at the Tana Delta were of the opinion that there is intensive use of pesticides by the large scale agricultural farmers and this has an impact on the quality of water resources. The impacts manifest themselves in diminished returns for the local communities. Coastal waters are receiving massive and increasing quantities of industrial, agricultural and sewage effluents through various pathways (Vitousek *et al.*, 1997). The World Bank -GEF (2002) also notes that most industries in East Africa are based on agriculture and the organic wastes are discharged into sewers and directly in the ocean and rivers. Also studies by Smayda (1989) made a compelling case for an increase in blooms of some HAB species being a result of coastal eutrophication.

According to the research findings, the quality of water at Lake Bogoria is generally poor. Although various studies have been conducted on the African Rift Valley saline lakes, these have largely focused on the chemistry, the biodiversity or explanations for the deaths of large numbers of lesser flamingos and little is known about their pollution. The degree of pollution in these environments by the most common organochlorines compound used for pest control, Dichloro Diphenyl Trichloroethane (DDT) has been highlighted in studies conducted by Kishimba *et al.*, (2004), Mavura and Wangila (2004), Gitahi *et al.*, (2002) and Koeman *et al.*, (1972). In Africa, pesticides have been used for combating agricultural pests and controlling disease vectors for more than 50 years (Mansour, 2009). The poor state of the water in the Sandai-Waseges River which is the principal source of freshwater supplies at the study site is also attributed to soil erosion. When unprecedented deaths of flamingos were recorded at Lake Bogoria, the Environment News Service (2001) reported that pollution by heavy metals was suspected to be the primary cause of these deaths, resulting from contamination of the lake by sewage, industrial effluent and organochlorines, which are present in agricultural runoff. Previous studies have shown that there is growing concern about eutrophication at Lake Naivasha due to an increase in agricultural nutrients inflow both from the commercial farms and from the upper catchment (Everard and Harper 2002).

According to findings in this study, all the major land use cover patterns in the Tana Delta with the exception of bare lands have decreased significantly over the last 40 years. Literature confirms that these adverse changes are attributed to various reasons. According to Hamerlynck *et al.*, (2010) the people that had to abandon their fields due to the World Bank/ Global Environment Fund investment of 6.7 million $US in the Tana River Primate Reserve (TRPR) between 1996 and 2001 were compensated by land in the forests east of Kipini. In addition, illegal logging in forests near Kipini threatens to wipe out the only remaining elephant corridor in Lamu and Tana Delta districts (Mwinami *et* *al.*, 2010). Maingi and Marsh (2002) also assert that floodplain productivity declined in the face of reduced flooding as a result of large scale irrigation, mainly the Tana Delta Irrigation Project in combination with the demographics but without great advances in technology or economic processes. The net result has been continued conversion of forest to agricultural land and a decline of the quality of the remaining forest habitat (Maingi and Marsh, 2002). According to the Tana River Delta Conservation and Development Management Plan (Nature Kenya, 2010), the decline in the mangroves has been to an estimated 51,600ha. In Kenya, a study conducted by UNEP WCMC (2003) has shown that mangrove areas have declined to the extent that export -quality poles are no longer found in the country.

The increased human and livestock population over the years at Lake Bogoria has had a detrimental effect on the natural vegetation at Lake Bogoria. This is further compounded by unfavourable climatic conditions. Furthermore, to curb the rates of lands degradation, the authorities introduced two types of the invasive species- the prosopis, widely known as 'Mathenge' of which two types occur in the area- Prosopis pallida and P. juliflora (Mwangi and Swallow, 2008). As the study has shown, the local communities at Lake Naivasha perceived that there was a significant change in wetland vegetation. Authors such as Harper and Muchiri (1987) confirmed that the ecology of Lake Naivasha is forever changing According to the authors, the changes are brought about by alien invasive floating aquatic weed species (S. molesta, E. crassipes and to a limited extent, P. stratiotes) among other factors. The weeds have infested the lake ecosystem in the last three decades, suppressed and occupied ecological niches previously inhabited by native flora such as papyrus and water lilies, and thus disrupted plant-animal-physical environment interactions and balance. In the 1980s, the local people started noticing some changes. The local respondents at all the three sites indicated that there has been a reduction in the size of the areas under papyrus. Everard and Harper (2002) have shown that the reduction in the lake's papyrus fringe has been dramatic. Furthermore, Harper *et al.*, (2003) also conducted a study of the papyrus on the fringes of Lake Naivasha, which confirmed that there has been a decline of papyrus on the fringes of the Lake. This was also confirmed in studies undertaken by Goldson (1993).

The community's perception on current state of birds varied across the different IBA sites. From the group discussions, the main reason for the classification of the condition as poor at the riverine IBA (Tana Delta) was the intensive large scale agricultural activities. This resulted in clearing of large tracts of areas inhabited by birds, use of modern techniques such as aero planes to decimate certain bird species considered as pests, for example, weaver birds. The communities indicated that due to abandonment of the traditional rice farms as a result of inundation by salt water, the numbers of the Tana River Cisticola has reduced.

The focus group discussions revealed until very recently the rangelands were considered by the local communities to be one of the best grazing lands in the Lower Tana Delta. The adverse changes that have taken place on the key grazing landscapes such as the flood plains and the seasonal *lagas* (dry streams) and the impacts this has had on livestocks and livelihoods have also been corroborated by other researchers. According to a study conducted by Oba (2011), on the Orma rangelands, the conclusion was that these were heavily overgrazed. In a study on pasturing territory of Jalloubé - in the north central In-land delta of the Niger River in Mali which is the largest flood-plain pastures of West Africa, Vedeld (1997) noted that more than 1 million cattle and 2 million small-stocks utilize these areas for dry season grazing 7-8 months per year, from October/November to May/June. Similar impacts of livestock watering on wetlands have been noted by Belsky *et al.*, (1999), Robertson and Rowling (2000) and Staton and O'Sullivan (2006). Uncontrolled grazing and watering of livestock in wetland areas also often results in increased stream turbidity, as well as increased input of nutrients and bacteria into the stream, which affects the quality of water available to downstream users. Impacts of livestock wastes contaminating streams with faecal organisms contained in the wastes, which lead to health problems for humans, have been noted by Miner *et al.*, (1992). Such effects are very significant in Uganda, where more than 80% of the population directly uses water from wetlands (Wetlands Management Department, 2009). The local communities at the study sites confirmed that pollution of water sources was prevalent.

Naivasha grasslands have been subjected to sustained agricultural pressures since the mid 1980's resulting in a loss of several bustards, coursers, larks, pipits and widowbirds, all prime grassland indicator species (Nature Kenya, 2008). In addition these grasslands formerly supported large stands of Leonotis plants, the energy supplying food plant for all sunbird species in the area, and essential to those high altitude species (Tacazze, Golden-winged and Malachite) that regularly descend to lower altitudes in the Rift Valley during the cold season months of June, July and August. According to Kioko and Okello (2010), the wetland pasture around Lake Naivasha, may be currently suffering from the tragedy of the common syndrome, where the long term viability of the rangelands is ignored (Hardin, 1968) as it is not clear who is responsible for managing the rangelands. The study found out that the perceptions of the local communities are not different from the assessments by the scientists. For example, with regards to the occurrence of fires at Lake Bogoria, active fire data from the NASA funded Fire Information for Resource Management System (FIRMS), which is published by the European Union Joint Research Centre on its website, there is evidence of occurrence of fires during the dry period.

In the focus group discussions, respondents at Tana Delta attributed overfishing, illegal fishing, by- catch as major causes for the decline of the fish resources over the years. This information was also confirmed through a key informant interview with the Tana Delta District Fisheries Officer who indicated in 2008 there was an influx of foreigners, numbering as many as 2002 on the fishing grounds at Kipini and this resulted in the local fishermen issuing an official complaint through the local office. At Kipini and Ozi, the fish catch still continues to decline and species like mud fish, cat fish and the labeos have become rare species attributed by low breeding rates due to reduced floods. Floods determine the level of fish breeding because during this time; conducive environments are created including sites. Prolonged droughts therefore limit the fish breeding rates. At Lake Moa, the major challenge to the fishing industry is the pollution of the water sources.

As mentioned previously, due its saline conditions, Lake Bogoria is not a conducive habitat for fish and this partly explains the reason why the local communities classified the status of the resource as poor. This also partly explains why there have not been many studies on fish resources in this area. There are however sources of freshwater supplies at Loboi and Emsos where fishing is thriving and the perceptions held by the respondents at these two areas are corroborated by well-established institutions that have been operational in the area for a number of years. For example, WWF in its 2008 report indicates that fish farming especially at Emsos is generally doing well and that the status of fish is fairly good. The Standard Newspaper, (2012) also confirmed this by indicating that the pastoralists had to embrace alternative ways of life as they can no longer totally depend on cows, sheep and goats. The perceptions of the communities about the state of fish resources are thus shared by other researchers. The study has shown that local communities at Lake Naivasha are of the perception that there has been a general decline in fish resources. According to Hickley and Harper (2002), the fish catch at Lake Naivasha has varied substantially over the last 40 years. The CBD SBSTTA (2005) also confirmed that the perceptions held by the local respondents. Figure 6-19 shows that the fish catches were at their highest level between 1960-1970, followed by a steep decline in 1998 and 2001.

The results of the statistical analysis for the study sites showed that there was a significant relationship between the types of IBA and the response interventions. According to Hamerlynck *et al.* (2010); Mathooko *et al.*, (2009) inadequate formal (and informal) education as well as other factors such as political-tribal mediated insecurity; ineffective governance; different use of resources by different ethnic groups; division of labour along gender and age lines; poverty and inability to diversify resources are all challenges impeding prudent management of wetlands. Promoting conservation education and awareness of the importance of the wetlands and natural values has been known to change people's attitudes towards the wetlands for the better. Hardin (1968) concluded that the only way humans can nurture nature is through education and awareness, which can counteract the natural tendency to do the wrong thing and the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed. According to BirdLife International (2003), education and partnerships are needed to save birds and nature. The perceptions held by the local communities correspond with the assertions of various authors in recent literature about the importance of institutions. Authors such as (Mazzucato and Niemeijer, 2002; Agrawal, 2001; Pretty and Ward, 2001; Blunt and Warren, 1996; Rasmussen and

Meinzen-Dick, 1995; Ostrom, 1990) have demonstrated the empirical evidence of a relationship between local institutions and sustainable community- based natural resources management (CBNRM).; Blunt and Warren, 1996). The resource users at the study sites command varying degrees of organizational capacity when it comes to resource use, the informal rules and regulations associated with institutions are ultimately about power. Watson *et al.*, (1999) note that recent academic work on 'every day' forms of resistance highlights how behaviour that deviates from a prescribed code of rules can itself become institutionalized.

A burgeoning body of work by social scientists in recent years has focused on the notion of 'institutions' as a social practice in relation to natural resource management (Berry, 1989; Leach *et al.*, 1997; Uphoff, 1992; Mehta *et al.*, 1999; Ribot,1999; Mazzucato and Niemeijer, 2002. Although the term 'institutions' can refer to the organizations involved in natural resource management, in this context the concept is employed in a wider sociological sense to refer to 'regularised patterns of behaviour between individuals and groups in society' (Leach *et al.*,1997), and also links to other groups and individuals at higher and lower levels. In this broader sense, institutions include the formal and informal mechanisms that play a defining role in shaping the access that a group has to natural resources, and may also determine who has the rights to resources within that group (Watson, 2001).

Locally developed institutions that include rules and regulations, common values and mechanisms of conflict resolution are increasingly regarded as adaptive solutions to resource management problems at the grass-roots level (Pretty and Ward, 2001). Since they are rooted in community social capital rather than in external, top-down decision making, they are seen as being dynamic, flexible and responsive to societal and environmental change and, as such, they promote sustainability (Dixon and Wood, 2007).

The study shows that a majority of respondents would like to have tenurial rights over their wetland resources. According to Rihoy (1995), tenure is defined as the 'control over resources or the way in which people hold, or do not hold, individually or collectively, exclusive rights to land and all or part of the natural resources upon it. Tenure is one of the principal factors determining the way in which resources are managed and used, and the manner in which the benefits are distributed. The need for security of tenure is commonly identified as the most significant determinant of a sustainable tenurial system (Rihoy, 1995; Doré, 1993). The respondents at the study sites envisage a situation where their use rights, transfer rights and exclusion rights are guaranteed. The focus group discussion revealed that before colonialism, the Maasai community enjoyed unfettered access to Lake Naivasha and its environs. With the advent of colonialism and new tenurial arrangements under post- independence governance systems, the Maasai lost their traditional pastures which were in the drainage basin. According to the Chairman of the Endorois Welfare Council at Lake Bogoria, Mr. Charles Kamuren, the Endorois which is a minority indigenous community were adversely affected by the gazetting of the National Reserve.

The statistical results show that the local communities desire that there be devolution of responsibility for wetland management to grassroot level. This call for increased devolution corresponds with the view of authors such Wyckoff-Baird (1997) who support the need for a paradigm shift in conservation and natural resource management from state centred control towards approaches in which local people play a much more active role - often referred to as devolved, or community based natural resource management (CBNRM). This shift in thinking has been brought about by increasing recognition that centralised decision making, control and enforcement of NRM through government agencies, have often proven ineffective and brought about resource degradation rather than sustainable use (Wyckoff-Baird, 1997).

The study findings show the need for advocating for greater participatory involvement through establishment of Water Resource User Associations (WRUAs). The Water Act (2002) of Kenya already provides the legal basis for establishing these institutions. It is important to note that this is part of a global water resource management paradigm shift aimed at ensuring self-sustainability in the water sector, equitable allocation and distribution of the resource, decentralisation and participatory management and integrated water resources management. Should more of these institutions be established in Kenya, they will enable people within a community to pool their resources together in order to more effectively carry out water related activities. Members are thus expected to benefit from addressing local needs and priorities. As Hardin (1985:144), advised 'Never globalise a problem if it can possibly be dealt with locally'. The differences that emerged from the statistical analysis between study sites show that there are divergent views on whether traditional rules are appropriate in modern day management of wetlands. Despite the differences that existed in the perceptions, the local communities still felt that traditional rules have a role in natural resource management. The differences in opinion are also reflected in literature as authors such as Bromley (1991) have debated whether traditional rules comply with generally accepted principles of common property management. In other words: do traditional institutions offer a solution for the sustainable management of natural resources held in common?. Bromley (1991) has argued that, with the advent of colonialism and markets, "the spread of private land—and the attendant individualisation of village life—have undermined traditional collective management regimes over natural resources."

In this interpretation of history, the individualization of property led to the breakdown of traditional authority and community regulation over common resources. As a result, common property resource regimes degenerated into open access. Some scholars therefore believe that a return to the pre-colonial situation, when traditional institutions once prevailed, will empower communities to manage their resources more sustainably. The implicit assumption being that traditional systems of land tenure were characterized by collective action and common property management regimes. The first difficulty with this view is that it differs materially from the literature on the reinvention of tradition (Ranger, 1993). The second difficulty arises from the presumption that natural resources in pre-colonial societies in Africa were actually "managed."

According to Ranger, the economics of property rights tells us that communities would have had little incentive to create rules governing the use of resources, first, if there was a relative abundance of that resource – where supply is perfectly elastic – and, second, if the costs of enforcing exclusive use exceeded the benefits. Traditional rules do not comply with the principle of exclusivity of common property regimes and, hence, do not in themselves offer a lasting solution to sustainable resource use (Ranger, 1993). This is especially true under conditions of growing human and livestock densities. But more than this, Ranger (1993) in his analysis tried to show that history matters.

This study argues that where conducive conditions prevail to promote enforcement of traditional rules; this should be encouraged and facilitated by the authorities. For example, the setting at Lake Bogoria Nature Reserve allows for such a management option to exist and be of use to wetland resource management. There is a vibrant Council of Elders that has kept its ear on the ground with regards to the state of biodiversity within the lake environs. Moreover, the area is predominantly Endorois. This may however not be the case in places like Naivasha, where flower farms, commercial businesses such as hotels and shops have virtually taken over the place, annihilating any form of traditional systems. In the Tana Delta, the complexity is with regards to a multiple ethnic groups and the question would be; which traditional rules should be applied in a diverse society such as the Tana?.

Literature review showed that Kenya has numerous environmental laws as provided for by the constitution of the country. The study notes that laws and regulations, no matter how good or benign to citizens' wellbeing and development, are meaningless and cannot contribute to sustainable development without a transparent, efficient and effective judicial system to enforce them. The statistical analysis shows that the local communities are aware of the consequences of the fast spread of invasives hence the relationship between the type of IBA sites and this variable was significant. Biologists are issuing dire warnings in response to the threats from Non Indigenous Species (NIS). According to the 'tens rule', one introduced species in ten appears in the wild, one in turn of these become established and one in ten of established NIS becomes an invasive species (Gherardi and Angiolini, 2004). Invasive species have dramatic effects on native population, species, communities and ecosystems and invoke huge economic costs. According to Gherardi and Angiolini (2004), the difference between eradication and control is only one of grade; these two strategies are part of a gradient of interventions and both share the purpose of annulling or (if not feasible) decreasing the impact exerted by invasive species.

According to BirdLife International (2013), habitat restoration and the removal of invasive plant species by the BirdLife Partner in Portugal has helped save the Azores Bullfinch from extinction. Sadly due to lack of technological advances, Lake Bogoria which is heavily infested with the prosopis is having difficulties in controlling the fast spreading invasives which are having an effect on the limited fresh water supplies. According to numerous authors (Börjeson *et al.*, 2006; Dreborg, 2004; Dreborg, 1996), studies of the future basically range into three categories: those that explore respectively (i) probable futures, (ii) possible future and (iii) preferable future. These three different 'future approaches' respond to three questions someone may ask about the future: 'What will happen?', 'What can happen?' and 'How can a specific target be reached?' (Börjeson *et al.*, 2006). In response, three corresponding classical or even archetypal 'modes of thinking' have developed: the predictive, the explorative (or eventualities), and the normative (or visionary) mode of thinking (Dreborg, 2004). To make informed strategic decisions and actions, it is desirable to anticipate the future trends in the state of the environment. This is better done by understanding the ongoing, emerging and latent developments that will drive the future. Tools that offer an insight into the future (like environmental scenarios and outlooks) help to explain the discontinuity and uncertainties of future developments (Alcamo, 2001; Raskin, 2005). Scenarios are consistent and coherent descriptions of alternative hypothetical futures that reflect different perspectives on past, present, and future developments, which can serve as a basis for action and a means of handling uncertainty. Contemporary scenario practise varies and is indicated by a wide range of use in many aspects of socio-economic development, including environmental assessment. Environmental scenario analysis is becoming a commonly used approach for supporting forward-looking assessments in integrated environmental assessments. They offer a framework for bringing together insights from a range of perspectives and disciplines to assess the complex interactions between socio-economic and environmental developments (Alcamo and Henrichs, 2008; Börjeson *et al.*, 2006). Many recent international assessments have conducted high profile scenario exercises to combine the latest understanding of environmental research with society's concerns about environmental changes. For example, many assessments regarding climate change (IPCC 2007), the future of ecosystem services or the interplay between environment and development have been undertaken.

Further, at national and regional levels, a host of environmental scenarios have been developed and analysed, and many current environmental outlooks make use of scenario analysis. A growing number of countries in Africa now include scenario analysis as part of their environment outlook reports.. They are no longer developed and applied on an ad hoc basis, but have become an integral part of state of the environment reporting in order to inform policy option formulation and assessment. The Kenya SoE process identified seven major drivers of environmental change, namely: demography, economic development, social change, culture, climate change, technology and governance.

Climate change is recognized as a major threat to the survival of species and integrity of ecosystems worldwide (Foden *et al.*, 2013; Duncan *et al.*, 2012; Foden *et al.*,2008; Hulme, 2005). The body of literature on the ecological and hydrological impacts expected to result from climate change has grown considerably over the past decade. Pressures on wetlands are likely to be mediated through changes in hydrology, direct and indirect effects of changes in temperatures, as well as landuse change (Ferrati *et al.*, 2005).

Examples of impacts resulting from projected changes in extreme climate events (Ramsar (STRP) 2002) include: change in base flows; altered hydrology (depth and hydroperiod); increased heat stress in wildlife; extended range and activity of some pest and disease vectors; increased flooding, landslide, avalanche, and mudslide damage; increased soil erosion; increased flood runoff resulting in a decrease in recharge of some floodplain aquifers; decreased water resource quantity and quality; increased risk of fires; increased coastal erosion and damage to coastal buildings and infrastructure; increased damage to coastal ecosystems such as coral reefs and mangroves and increased tropical cyclone activity. Under currently predicted future climate scenarios, the spread of exotics will probably be enhanced, which could increase pressure on watersheds and ecosystems (Root *et al.*, 2003). Climate change will affect the hydrology of individual wetland ecosystems mostly through changes in precipitation and temperature regimes with great global variability (Erwin, 2009). These views are also corroborated by the World Resources Institute in the Millennium Ecosystem Assessment (2005).

According to Rasmussen (2005), narrative scenario building is increasingly being used and scenarios are ideal for involving people and exploring socio technical system possibilities in complex environments. 'Story telling is an excellent way of weaving together the relatively certain aspects of the future with imagination about the uncertain' asserts Rasmussen (2005). Dreborg (2004) argues that the time horizon should be sufficiently far off to permit 'real change' to take place. The idea is that this time horizon should allow participants to free themselves of present trends and make it easier for them to identify interesting options. Thus the study took this into account and the local communities were able to build scenarios about the condition of their wetlands in the future. Generally, the local communities were in agreement with what has been stated by the various authors. The local communities and researchers do agree that there will be a decline in most, if not all the wetland resources.

According to a new State of the World's Birds: 'Indicators for Our Changing World' by the world's largest Partnership of conservation organisations, BirdLife International, the status of the world's birds continues to get worse with many species slipping towards extinction and others in steep decline. Birds are facing threats on many fronts related to habitat destruction and degradation, owing to changes in agriculture, as well as direct impacts from invasive species are the major causes (BirdLife International, 2013). Other studies show that avian diversity is hanging in the balance (Dyke *et al.*, 2011). According to BirdLife International, a high proportion of IBAs have no legal recognition/protection. Nearly half of all IBAs are in danger of losing their natural habitats. A more detailed analysis of pressure data provided in early 2013 by the BirdLife network for 95 countries and territories as well as the high seas, has identified a set of IBAs at extreme risk of losing their biodiversity value. Differential responses to global change also shape the future of avian diversity (Dyke *et al.*, 2011).

8.3. Pressure-State-Response Indicators

The more different resource user groups identified an indicator the more common it is. The following classes are distinguished, high (common), medium (semi- common) and least (unique). The common and unique indicators reflect the fact that while the resource user groups may have a shared opinion on certain aspect of wetland management, they have their own independent viewpoints on other factors and this is what constitutes their presumably differences in perceptions on wetland conditions. It was observed that there is no indicator that was identified by all resource user groups. Therefore commonality in this case does not mean unanimous agreement on one value, but rather a majority view/shared perspective.

The study has shown that the indicators are different from one wetland to another. The typology of the wetland is however not the only factor that has an influence on the choice of indicators. The study recognises that there are hundreds if not thousands of indicators that could potentially be used to measure sustainable wetland management. Deciding how many and which ones to use can be difficult. More is not always good; less is not better. The right number depends on factors including what type of audience the indicator report will have, how much time is available to research the data, the number of issues involved, and the specific needs of the community (Communities Committee Homepage).

Authors such as McElfish and Varnell (2006) argue that application of the indicators outside the ecological scale may ultimately dilute the utility of the information and lead to ineffective policy development and implementation. This lays credence to the fact that due to the unique attributes of each wetland, the communities would have different indicators. The salient differences in perceptions brought upon by the unique biophysical features of the wetland need to be taken into account if environmental policy is to be effective. There is a common language among the various people involved as a result of the defined factors at the local scale i.e. the resources they identify with. In addition, just as important as how many indicators are needed is what type of indicators are needed. Because there are many different stakeholders in a community as was shown in this study, there is a need for different types of indicators and a way to balance the interests of those stakeholders. The selected indicators reflect all the key aspects of community wetland management, not just a subset of the issues. Is this different compared to the global scale?

Literature shows that the scientific community has identified the range of the wetland/ size of the wetland as an indicator for assessing the availability/quantity of water. From previous studies, low hydrology scores have been attributed to inappropriate or inadequate water sources of hydrology or established grades that were consistent with the hydrologic regime of that site. In areas which reflect favourable hydrology and suitable soil conditions, natural recruitment of wetland vegetation has been observed. The site size, age of the wetland and source of hydrology has been some of the variables commonly assessed by the scientific community (Balzano *et al.*, 2002). For that reason, scientist advice that in order to maintain the size of the wetland at a desirable level, continued focus should be on avoiding impacts to wetlands and minimizing permitted activities on wetlands. The depth of wetland is also a determinant and scientists have the requisite tools for ascertaining this (EPA, http://water.epa.gov/type/wetlands/assessment/herps.cfm). Perhaps the most important indicator of the ability of a wetland to detain flow is the frequency and magnitude of connection to other basins (Adamus and Brandt, 1990).

In order to inform any sustainable water resources management, by any country or state, internationally acceptable measurements and quality standards are vital. Water quality variables are normally used with other measures of biotic indices (index of biodiversity intergrity), hydrological indices (wetted perimeter, discharge and velocity) for example. In Kenya, the most preferred parameters are pH, dissolved oxygen, turbidity, temperature, conductivity, and to a lesser extent biological chemical demand, chemical oxygen demand and nutrients (National Environment Management Authority, 2012). The scientific community has developed water quality indices.

On the other hand, the water quality indicators identified by the local communities highlight variables that affect that their general livelihoods and specifically health and nutrition. Water quality as a traditional indicator of environmental health, reveals little about the residential, commercial or industrial activities that may be causing the pollution, potential health problems associated with poor water quality, or the effects of water pollution on local biodiversity and the riparian communities. With regards to wetland vegetation, literature shows that the scientific community would normally select the following as indicators; area of specific habitat, patterns, abundance/density, vegetation alteration, habitat value to wildlife, endangered/threatened species, plant species/diversity richness, extent of invasive species, dominant vegetation and degree of interspersion (National Environment Management Authority, 2012). Examples of indicators used in sustainable forest management in the USA are as follows; genetic diversity of tree species; vegetation and habitat types; sensitive and endemic species, stand structure, patch size; fragmentation and habitat turnover rates among others (Williams and Marcot, 1991).

On the other hand, the Ministry of Agriculture and Forestry in Finland (1997) identify the following; stands managed for genetic resources; tree species composition (dominant species, exotics, number of species); changes in number and percentage of threatened species; number and volume of decaying trees; area and change in area subject to forest fires and prescribed burning and area of forest subject to erosion. The Forestry Commission in the UK (1998) identifies the following; protection of designated sites and sensitive areas for threatened or rare species; inclusion of 10-20% open space in new planning; management of edge structure; damage to the hydrology of wetlands of conservation value and effects of grazing by wild and domestic herbivores. With regards to wetland vegetation, the indicators identified by the community in the study areas focus mainly on issues related to their health for example the abundance of medicinal plants.

In Kenya, BINU indicators such as 'Bird trends on Lake Naivasha' have supported national policies in a number of ways, for example:- Fishery in Lake Naivasha was stopped for one year because of overfishing - Indicators were used to underpin the new Kenyan wetlands policy - BINU results were used as input for the 2005 State of the Environment report. Indicators are now seen as a standard tool for reporting on the environment.

The Global Wild Bird Index (WBI) aims to measure population trends of a representative suite of wild birds, to act as a barometer of the general health of the environment and how it is changing (Biodiversity Indicators Partnership, http://www.bipindicators.net/wbi),. The methodology for producing WBIs is well developed; European WBIs have already been produced and are being used to measure progress towards the headline target of the new EU Biodiversity Strategy to 2020 - Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss. They are used by nearly twenty national governments in Europe within strategies to assess sustainability and environmental health. WBIs have recently been published for North America, and WBI initiatives have begun in Africa (particularly in Botswana, Kenya and Uganda) and Australia. The WBI measures biodiversity change in a similar fashion to the Living Planet Index, the main difference is that the WBI only incorporates trend data from formally designed breeding bird surveys to deliver scientifically robust and representative indicators. The requirement for robust data, however, means that data coverage is currently patchy and the WBI is not presently applicable at a global scale. The British Trust for Ornithology (BTO) notes that in the UK there has been considerable development in the use of wild bird indicators as proxies for the health of wildlife in the wider countryside, most using the approach of a composite indicator composed of population trends of species grouped by geographic region or ecological associations. The best example is the UK Sustainable Development Strategy indicator reported annually showing patterns of change in farmland, woodland, wetland and marine/coastal birds, but similar indicators are produced annually for England and its regions, Scotland and Wales. The concept behind using populations of common birds as indicators of the state of the environment is based on the assumption that there will be commonalities in the spatial and temporal patterns of abundance among different taxa and in their responses to major environmental drivers. Wild bird indicators in the UK were first developed by the BTO and RSPB in 1999, using an approach of combining measures of population change for as many species as possible in a composite index, categorised by broad habitat groupings (e.g. farmland, woodland, coastal, urban). Sources of data varied, but most are generated from two of the BTO's major monitoring schemes – the Breeding Bird Survey for terrestrial species, and the Wetland Bird Survey for wintering waterbirds.

The original bird indicator, was adopted and published by Defra in 2000, as part of a suite of 15 headline Quality of Life indicators alongside measures of human health, education standards and housing, and continues to be used today. Importantly, the UK government adopted a Public Service Agreement (PSA) target in 2002 to reverse the long-term decline in farmland birds by 2020, as measured by this index, and to be assessed in annual updates. Secondly, the woodland index was adopted by the Forestry Commission as an index of sustainable forestry. Since then, there has been a proliferation of indicators developed for geographical regions within the UK. The indicators from the local community with regards birds are not well defined, calling for a greater awareness on avifauna and the importance of birds. Apart from Lake Bogoria, the respondents at other sites did not strongly associate themselves with what was going on with regards to birds. In a study focusing on managing stock in wetland grazing, Holmes *et al.*, (2009) noted that having indicators to decide when to graze and when not to graze is important. Groundcover assessment is one indicator. Groundcover includes any material on or near the soil surface that protects the soil against the erosive action of raindrops, overland water flow and wind (Jessop *et al.* 2008). It includes all: vegetation, leaf litter and plant debris. Groundcover is not necessarily palatable pasture. Groundcover protects the soil by enhancing pasture survival, during dry periods; intercepting are also quick to note that raindrops; slowing water flow; increasing water infiltration to soils; reducing evaporation from soil surfaces; and slowing wind speed and covering fine soil particles. Methods to estimate ground cover include visual assessment; step point method; and pointed stick technique. Holmes *et al.*, (2009) groundcover is not the only indicator that should guide grazing management.

Other indicators include: stocking rates to be matched to carrying capacities; pasture growth rates and number of paddocks used in the rotation (Holmes *et al.*, 2009). In studies carried out in New Zealand by Reeves and Champion (2004), the 'Stock Unit' or 'SU' rate is used as an indicator. This indicator is accompanied by qualitative measures of grazing intensity classified under 'low' or 'high'. The authors however argue that even where qualitative measures are used, there is no consensus on what stocking rates constitute different levels of grazing intensity. When applied to the study to the areas in this research, one can deduce that the this could partly explain the cause for the intensity of conflicts that arise as herders want to outweigh each other with regards the size of the stock, there is no common consensus on what is the acceptable level although most respondents agree there is overgrazing.

The respondents in the study areas indicated that they practice seasonal livestock grazing movements using mobility in response to ecological indicators for decision making for indigenous wetland and rangeland management. This is also substantiated in a study conducted by Oba (2009) amongst the Orma pastoralists in the Lower Tana delta. Stock grazing patterns are also useful indicators on wetland pasture management. A better understanding of stock grazing patterns help graziers manage for economic and environmental outcomes. For example, the observations of graziers suggest that cattle prefer some species over others. Once determined, this sort of information can be used to more accurately predict appropriate stocking rates for long-term sustainability. The above

-mentioned study by Holmes *et al.*, (2009) notes that cattle, unlike sheep, congregate on riparian wetland habitats during hot weather for much of each 24-hour period. Riparian and riparian wetland habitats are the coolest areas during hot weather, and they provide the most succulent forage for cattle. Local cattlemen have been incapable of "herding" cattle away from these areas during hot weather. Various enticements, such as placing salt blocks at some distance from water, have been employed with little effect. Most cattle use on public lands occurs during the hot season when cattle seek cooler areas while foraging, such as riparian wetlands. Therefore, riparian wetland sedges and other riparian wetland vegetation frequently become over grazed.

Stock performance is another indicator. However Holmes *et al.*, (2009) note that very little scientific information is available that describes the performance of different stock or breeds in flooded wetlands. Graziers in Australia reported that livestock that are born in and around wetlands perform better than trade cattle in flooded areas. The reduced performance of cattle introduced to grazing in wet muddy landscapes has been reported previously by Petty and Poppi (2008) as: smaller live weight gains; and reductions in the number of cattle grazing at any point in time. From the local community perspective, the size of the herd is the mark of a man and the larger the stock, this gives one the ability to marry and be of influence in society. Therefore, when livestock die, do not produce as much milk yield, they look lean, the communities identifies this as a sign that there is inadequate pasture in the floodplains for the valuable resource. The frequency and magnitudes of the conflicts between agriculturalists and herdsmen, amongst local and outside pastoralists are issues that manifest themselves more at the local level and communities are able to monitor or keep track of these issues.

Scientists also consider wetland grazing indicators from the perspective of what the value of grazing is. Generally, grazing on wetlands is to provide food for livestock especially where this is seasonally unavailable in more terrestrial habitats that for any conservation benefit. The ability of cattle grazing to prevent succession to woody vegetation and to control dense mats of sprawling of invasives means that cattle grazing can offer some conservation value (Reeves and Champion, 2004). Avian richness and abundance has been used by both the scientific and local communities to assess the extent to which wetland grazing affects other wildlife. In the study area in Lake Bogoria, respondents noted that prior to overstocking which subsequently led to overgrazing there was a variety of birds on the wetland areas. The general indicators used by the scientific community with regards to fish resources are as follows; number of fish landings, number of fishing boats and fishermen, length of nets, age structure of the fish and species diversity and abundance (National Environment Management Authority, 2012). The local community identified indicators ranged from; number of fishermen using appropriate fishing gear; records of inappropriate gear observed or confiscated, quotas set and observed per season/per fisherman; reduced cases of trawling; The amount of time at which fish can be caught reduced; increased numbers of the mud fish, cat fish and the labeos at Kipini and Ozi; increase in the number of fingerlings; increase in the number of breeding areas; records of disturbances to breeding areas reduced; reduced numbers of fish deaths due to unexplained reasons.

CHAPTER NINE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The background information to this study showed that wetlands are facing numerous challenges, most which are anthropogenic factors. An overview of the wetlands at the global scale as well as in Kenya was highlighted. The literature has shown that wetlands are facing a crisis, causing exponential degradation and destruction of the ecosystem. The crisis principally has arisen due to unwise human attitudes and practices. The study is cognisant that natural wetland protection is a key wetland management strategy and the review of the wetland management regimes in Kenya attests to this. These areas have received protection because of their recognised natural, ecological and/or cultural values. They are the cornerstones of virtually all national and international conservation strategies. They are areas set aside to maintain functioning natural ecosystems, to act as refuges for species and to maintain ecological processes that cannot survive in most intensely managed landscapes and seascapes. These sites are cultural artifacts, and their story is entwined with that of human civilization.

The literature also shows that while concerted efforts have been made by the relevant authorities with regards policy frameworks, the need for a substantive policy on wetlands can no longer be overlooked and Kenya is urged to ratify the policy and ensure it comes into effect. The 'draft' nature of the policy also gives room for the relevant authorities to consider elements that have not been adequately addressed so that Kenya is well set for managing its wetlands in an effective manner. The study recognises the importance of describing the environment as local people themselves construe it according to the categories of their ethno science. In order to have a full understanding of ecological change, the study notes that this must incorporate lived human experiences of the world and show how this experience translates into behaviour that in turn influences ecological conditions. Thus the role and importance of community perceptions in wetland management cannot be underestimated.

The importance of the Important Bird Area was highlighted as key sites for biodiversity conservation. The role of birds in conservation cannot be undermined and their ability to mirror what is happening i.e. threats to the broader environment is key. Literature reviewed indicated that to date at least 61 sites in Kenya have been designated as IBAs in accordance with the international criteria. Given that Kenya is a well resource endowed country, perhaps it is worthwhile to investigate the potential of additional wetlands to receive this category, with the hope that that attention towards the specific wetlands will draw attention, human resources as well as funding to address the challenges bedeviling many of Kenya's wetlands.

Literature showed that indicators from the scientific community came from some form of ecosystem components such as physical and chemical parameters, while those developed by the local community highlighted the issues central to their livelihoods. In addition to the scientific indicators, these are considered as a valuable mechanism to improve decision making, monitoring and evaluation in planning. Involvement of community information in wetland decision making has been a major limitation for wetland management throughout the world but especially in Africa and this study provides a platform for integrating community decisions into the decision making processes. Both categories of indicators seek to address wetland management. Overall, the function of indigenous wetland management knowledge would appear comparable to conventional wetland management, while they differ only on emphasis. The following is a section on the summary of findings in accordance to the study objectives.

9.1. Socio –Demographic Characteristics Influencing Perceptions in the Study Area

The study has indicated that there are two schools of thought about age as a social determinant of environmental opinion. While some authors hold a strong view that age is a key determinant, others have identified discrepancies regarding this relationship. Literature has shown that results based on gender have produced inconclusive and inconsistent results.

Given the multiple ways in which environmental management is gendered, the study has shown that the concern for the quality of the wetland IBAs is not a gendered phenomenon. Furthermore, in many studies, gender differences have been hitherto given much less attention than other socio demographic factors. Analysis by some authors indicated that socio-demographic variables were ineffective in explaining any of the variables measured. They recommended that further research might benefit most by exploring underlying belief structures rather than demographic characteristics of the population. With regards to this study, there was some anomaly with a small part of the data. This concerned the comparisons between the gender groups. There are possibilities that the sample for the female respondents was too small. It was considered that this was an incongruity where further research might prove useful. In this study, there is no statistical evidence to suggest the perceptions about the wetland environment are influenced by age and gender.

Statistical evidence however showed that there were differences in perceptions due to resource use. The study argues that it is important for the policy makers to make use of information on the state of wetland resources and the potential indicators at the local scale. It is however also necessary to establish the users to who benefits and costs accrue. It is important to recognise which sectors of the society are responsible for exploiting resources. Successful local level wetland resource management relies on the identification of true stakeholders. It is only when stakeholders are known that management options such as 'co-management' can be factored into any strategy. This is not the village as administrative entity, but the groups of people bound by similar interests in a wetland resource. Only by recognizing/understanding the motives and predicaments facing the user groups, can sustainable solutions be found. It is imperative to know whether uses are on a consumptive or non-consumptive basis as this is useful for planning purposes.

9.2. State of Wetland Environment (SoE) from the Local Knowledge

Chapter Six gave an insight into the perceptions held by the local respondents with regards the state of the wetland environment by using the Pressure- State- Response Framework. The perceptions assessed pertain to condition of wetland resources, namely, the quantity and quality of water resources, abundance of wetland vegetation, abundance of wetland birds, the quality and quantity of wetland pasture and abundance of fish resources. The overall findings showed that for each wetland IBA type (riverine, saline and freshwater) the quantity and quality of water, wetland vegetation, wetland pasture and fish resources were in decline thus compromising the livelihoods of the local community and the viability of wetland resources. The conclusion is that since various trait groups of birds such as aerial, ground, aquatic, canopy and shrub are also heavily reliant on these resources, their condition is also naturally in the decline. This trend, if not reversed, will bring into question what has to date been a remarkable milestone in conservation-the Important Bird Area Brand. Human kind has no choice but strive for better management of these sites because 'what is good for birds is also good for the people'.

Statistical analysis to ascertain perceptions in accordance with the wetland type, the age group, gender profile and the resource user groups showed a general pattern with regards the perceptions that the respondents hold regarding the state, pressures and response interventions for wetland management. When the study applied the Spearman Rank Order Correlation coefficient as a measure of the strength and direction of association that exists between two variables measured on an ordinal scale, the results were largely negative affirming the respondent's perceptions that the response interventions were very weak or negligible. Generally, respondents were less optimistic, perhaps raising the question of why not enough is being done to address wetland management issues.

9.3. Wetland Indicators from the Community Perspective

Chapter Seven provided the first quantitative information relating to the community based indicators for management of wetland Important Bird Areas in Africa. In total, at least 38 PSR indicators were identified across the three wetland types (19 Pressure; 7 State; 12 Responses). The study analysed the relationships between the type of IBA site and the community state, pressure and response indicators. Indicators for wetland management vary between riverine, freshwater and saline wetlands. There was evidence to show that the type of indicators while informed by the type of wetland, where also closely linked to the livelihoods/cultural tendencies of the respective community.

The following key 'people centred' indicators were identified as the most prominent among the local communities at Tana Delta; quality and quantity of grazing exemplified by the variables on milk yield and numbers of livestock deaths, magnitude of resource conflicts between humans and humans/humans and wildlife. At Lake Bogoria, the quality of water exemplified by the healthy populations of flamingos not only as a cultural symbol but also for economic reasons, as well as the quantity of plants for medicinal purposes as well as sustaining a vibrant beekeeping industry were mentioned. The quality of water also determines the abundance of the salt deposits which are used for livestock licks and for medicinal purposes. At Lake Naivasha, the prominent indicators were number of fishermen using appropriate fishing gear; records of inappropriate gear observed or confiscated, quotas set and observed per season/per fisherman; the amount of time at which fish can be caught reduced; numbers of fish deaths due to unexplained reasons. There was no statistical evidence to show that the PSR indicators identified were not influenced by the type of wetland. For example, due to its importance as a freshwater source, Lake Naivasha communities expounded variables that were mainly related to fish as well as wetland avifauna.

The study has shown that wetland pasture has significantly deteriorated in the Tana Delta as the flood plains that sustain thousands of livestocks are no longer receiving adequate water supplies. The inclusion of an indicator on maintaining the flood regimes in the Tana Delta could lead to a direct and indirect policy with regards the frequency and amount of water that can be abstracted by upstream users. As pointed earlier on, flooding in the Tana Delta does not occur as a result of precipitation rather as a result of inflows from Mt Kenya and the Aberdare Mountain catchments. Similarly, the size of the wetland as an indicator provides room for policy makers to design mechanisms that will ensure equitable use i.e. review current water distribution policies that significantly impact on environmental flows for the benefit of both people and environmental resources, especially birds. Authors such as Brown and Dinsmore (1986) found empirical evidence for the existence of minimum wetland size for particular bird species. As wetland size increases, the number of individuals and species increase in some pattern, often a sigmoid curve as well. This indicator is particularly important at the freshwater IBAs such as Lake Naivasha as this also has implications on the number and diversity of fish as well as livelihoods of the riparian communities. However food resources for the birds are also important as seen at Lake Bogoria. The indicator on the coverage of number and diversity of mangroves would entail close collaboration with neighbouring states in use and management of mangroves, while the indicator on the number of traditional rice farms may require the responsible authorities to revisit the agricultural policies. The fact that birds did not receive a high priority in the Tana Delta and yet it is a biologically significant site should prompt policy makers to review the policies that have led to the significant decline in bird species as well as outreach and educational policies. The planned large scale investments in the Delta will result in the further decline of the already compromised resources. At Lake Bogoria, similarly to the findings of the BINU Project, this study recommends that the indicator on healthy flamingo populations be considered by the policy makers. Trends in wetland birds, especially maintaining healthy flamingo populations remain a significant indicator which can easily be monitored with much involvement of the local community members.

Furthermore, the study recommends indicators on the number of swamps, number and diversity of herbal plantsas well as frequency of fire incidences, all which can easily be tracked by the local community. The indicator on fish harvesting quotas as identified by the local community at Lake Naivasha and Tana Delta resonates with the scientific indicator on Catch per Unit Effort (CPEU) as identified by the BINU project. The difference is the manner in which the community indicator is stated and this makes it easy for community members to be able monitor the indicator as it is feasible to maintain sustained records over a period of time. The indicator identified by the local community on the size of the wetland is almost similar to the change in lake levels. Other indicators that are crucial for the freshwater wetland IBA are the trends in waterbirds, coverage of papyrus, number and diversity of fish stocks and quality of water.

9.4. CONCLUSIONS

This study has indicated that local knowledge is important in understanding the ecological changes that could have happened in the past and can be linked with the actual ecological information obtained through physical inventory or imagery acquired data for better understanding of changes in the wetland. The population and diversity of bird species and other biological resources is significantly much higher in the areas that have been designated as Important Bird Areas and have some form of protection status compared to areas outside. The study has shown that despite these sites being accorded some form of protection status/or being declared as RAMSAR sites, the habitat that is meant to support healthy populations of bird species is continuously under severe threat. The conclusion from the study is that conservation strategies, such as designation to protect biodiversity hotspots and site level interventions for example restoration of degraded habitats, have been effective but insufficient. This study concludes that no one single management option is adequate; rather an assessment should be done on the feasibility and applicability of each option. Furthermore, financial resources are required in order to save nature.

Six categories of age groups were used to analyse the age data, indicating that wetlands are valuable to most of the local communities irrespective of the age difference. Most studies on wetlands have focused mainaly on the adolescents to middle aged individuals as the assumption is that is this is the most active group and has thus more interaction with the wetlands. This study has shown that there is need to focus on the interphase between the elderly and the wetlands especially in traditionally driven societies. The traditional ecological knowledge that these elderly people hold should be an integral component of sustainable natural resource management. The upsurge in the use of herbal medicine at all levels, should give us a wake up call that all resource user age groups irrespective of their age can either have a positive or negative impact on the wetland resources.

Similarly, wetlands hold significant value for both female and male wetland users. As such, the information gathered by the study is considered representative of all community groups, since most of the respondents had responsibilities that were directly or indirectly connected to the wetland. Participation in wetland management is currently skewed towards male members of the society and yet the women also have a stake in the use and management of the reources. Given the roles that wetlands play in the lives of the riparian communities, the conclusion is that the importance of wetlands in Kenya cannot be underrated. For most of the riparian communities at selected study sites, local resources are the only source of biomass for fuel, building materials, and to a certain extent fodder; soil nutrients fertilizer/compost); medicines; and other necessities. Evidence from the study shows that there is continued strong local demand for wetland products, and market values for them exist and remain relatively high. This heavy demand coupled with weak resource management, sets the stage for localized over-exploitation (yields decreasing even as exploitation effort is increasing). Human actions have resulted in multiple changes on a local scale that often drive contemporary wetland health declines. Overall, this study concludes that despite the different results, the socio-demographics of a study population remain a key component of any research work and should be utilised as much as possible in natural resource management.

Given that the number of pressure indicators was considerably much more than for state and response interventions, the conclusion of the study is that the wetlands are facing unprecedented challenges both from anthropogenic as well as natural phenomenas. Unfortunately this is not matched by corresponding interventions to curb or slow down the rate of deterioration. The limited number and scale of response interventions at sites levels is indicative that a concerted effort is required to reverse the trend. The statistical results from the Chi- Square showed that the community perceptions on the PSR indicators were different across different communities. A chi-square test of goodness-of-fit determined that the perceptions on PSR indicators from the IBA sites were not equally distributed in the population (with the exception of the state indicator on fish resource at Lake Naivasha).

Similarly, there was a strong association between the PSR indicators and the different resource user groups. The conclusion from this study is that the selection of community environmental indicators is not by chance hence the study rejects the Null Hypotheses that the community identified indicators were not different. The common and unique indicators reflect the fact that while the respondents may have a shared opinion on certain aspect of wetland resource management, they have their own independent viewpoints on other factors and this is what constitutes their presumably differences in wetland resource management perceptions.

The importance of this work lies in the enhanced understanding of different resource user's expectation of a sustainable wetland IBA and therefore making a strong basis for the bottom-up consultation process useful in the collaborative wetland management of the wetland, which Africa in general and Kenya is looking up to for the good wetland IBA management. Understanding different perceptions and translating them into management objectives may assist wetland conservation practitioners to improve their wetland management strategies.

9.5. Recommendations

9.5.1 Policy Recommendations

Objective 1: Establish the influence of gender, age, type of resource use on community perspective on wetland environmental indicators.

a) The study recommends that young people at sites such as Lake Naivasha be an integral part of the decision making processs for wetland management.
b) More efforts should however also be made towards integrating traditional ecological knowledge into modern day wetland management and this implies consultation with not only the young people but the elderly as well.
c) The study recommends that women should be empowered to be able to participate more effectively in the development of site level action plans, be engaged in the development of by laws, policy processes and environmental decision-making with regards access, use and management of wetlands.
d) Related to a) above, there is need for a drive towards identification of true stakeholders/resource users as this lays a foundation for effective co-management.

Objective 2: Determine the state of wetland environments (SoE) and predict their future changes from the local knowledge and community perspective on wetland environmental indicators

a) Determine appropriate and relevant land and resource tenurial arrangements for wetland management.
b) Site effectiveness should correlate with basic management activities such as enforcement, boundary demarcation, and direct compensation to local

communities, suggesting that even modest increases in funding would directly increase the ability of sites to protect wetland biodiversity.

c) Regulations laws and guidelines formulated by policy makers should be complimented with engagement of local communities in decision making.

d) There is also need to review the various capacity building programmes by governments and NGOs and ensure that appropriate targets are identified and that solutions are 'need driven' for sustained wetland management. The study thus recommends a different capacity building model by NGOs, Governments and the Private Sector.

e) Community training needs must be met and awareness creation on wetland values intensified. Some of the training needs are the knowledge in bird identification and their importance of Important Bird Areas as well as skills on conducting regular bird and habitat monitoring at the site level.

f) While community participation is already being archived through formation of Wetland Resource User Associations (WRUA), sensitization and educational programs to empower local communities with knowledge and awareness particularly on the ecological roles of wetlands need to be scaled up to influence a positive shift of attitude and practices towards these ecosystems.

g) Increasing environmental awareness could see Kenyan environmental and climate action advocates focus on helping communities that have already experienced serious climate change damage understand the critical threats they face in the coming decades. These campaigns will work with residents to develop clear, powerful narratives capable of mobilising their communities in support of emergency action.

h) The study also recommends creating awareness on how climate, health of wetlands and people and livelihoods are intertwined. This study encourages that all individuals concerned with healthy wetlands should find ways to overcome the myths surrounding climate change, mobilise communities, and then build a national movement for a paradigm shift in the African climate politics. One key path to catalyse this process is to help local communities understand how climate and health and livelihood issues are intertwined, and why the current global climate change trajectory menaces their futures.

Objective 3: Determine the Pressure-State-Response indicators across different types of wetlands.

a) Promoting use of the PSR Framework in identifying indicators for wetland management. The results of the study demonstrate that PSR can significantly facilitate the process of indicator selection for wetland ecosystems using a systemic approach. With regard to its simple and illustrative structure, the suggested approach in this study can be served to managers and policy-makers in Kenya in order to design appropriate short-term wetland restoration plans, and to monitor the efficacy of implemented strategies in long-term perspectives.
b) Promote user-generated information that actively involves beneficiaries in the collection, production, and assessment of community perceptions. Due to the heterogeneity between communities it makes little sense to advocate a one size fits all approach to sustainable development.
c) Design a strategy of investigating community indicators using participatory methodologies.
d) The study recommends that as a trial, practitioners take into account at least three indicators from each wetland type. At least three state indicators that can be used on a trial basis for the riverine wetland IBA are: size of wetland; water, number and size of traditional rice farms. At the saline wetland IBA, state indicators on trends in wetlands birds, number of springs, number and diversity of medicinal plants are of paramount importance. For the freshwater lake, size of fish population, diversity of birds, the size of the wetland, are important indicators.
e) The study recommends that appropriate measures be put in place to establish upper limits to how much water can be abstracted by users and traditional rule enforcement be considered as a high priority for addressing challenges related to wetland management. Regular monitoring is a pre-requisite if the fishermen are to maintain the appropriate fish harvesting quotas.

f) Additionally, the study recommends that relevant authorities put in place mechanisms to monitor the indicators by the local community. Merely realizing that a community depends upon its natural resource base is not sufficient to ensure that those critical assets will continue to provide benefits to the community. Communities need a process for monitoring and evaluating the state of their wetland resources, making plans to maintain and enhance those resources and assessing the effective implementation of their plans and programs. Assessments and monitoring by the local community in conjunction with the technocrats will bring to light wetland trajectories of change.

g) Strengthen local institutional arrangements /structures which are a pre-requiste for driving the efforts towards regularly updating data. In the strategy for wetland management in Kenya, there is need to ensure that appropriate local level institutions such as the WRUA are supported and capacitated to monitor these indicators.

h) The study has shown that the 'drivers' of change to wetlands largely occur outside the areas of focus. There is therefore need for an intense dialogue on Important Bird Areas of which the environs are under private ownership and how private owners can be encouraged to develop indicators for the sound management and good health of the wetland IBA.

9.5.2. Further research

Objective 1: Establish the influence of gender, age, type of resource use on community perspective on wetland environmental indicators.

a. A research on the gender issues in wetland IBAs to help clarify contradictions in literature.
b. A research on the comparison of environmental attitudes between adolescents and adults at wetland IBAs
c. Investigate how human status is related with the wetland economy, considering its numerous functions and attributes.
d. Ascertain what the relationship is, if any, between the type of indicators and the level of income/wealth status.

Objective 2: Determine the state of wetland environments (SoE) and predict their future changes from the local knowledge and community perspective on wetland environmental indicators

a. Despite the positive effects of conservation and restoration efforts, biodiversity declines have not slowed. Thus, further investigation is needed to determine new conservation and restoration strategies.

Objective 3: Determine the Pressure-State-Response indicators across different types of wetlands.

a. Complete documentation of pressure-state-response indicators for wetland assessments should be conducted. Existence of such generalized principles of indigenous knowledge would provide important foundation for global applications of the knowledge across varied cultures.
b. .The study advocates that senior bureaucrats, government ministers, policy analysts and managers responsible for policy formulation and implementation should be encouraged to recognise the importance of consulting communities in the development of indicators. Local Strategic Environmental Assessments (SEAs) are important tools that can be used to feed into actual policy for wetland management.
c. The indicators of condition can show whether wetlands are moving towards some pre-determined cultural standard which reflects cultural values. Cultural information could be presented using graphics, computer generated diagrams, pictures or expressed orally at workshops. Furthermore developing map-based indicators would make different audiences appreciate more the differences existing between sites as this allows for comparison when maps are laid side by side.

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APPENDICES

Appendix 1: Study Questionnaire

District		Ward		Village	

	Name of IBA	Size of IBA	Type of IBA	Protection Status
A Identification	Tana Delta	130, 000ha	Riverine	Non-Protected
	Lake Bogoria	10,700ha	Saline	Reserve
	Lake Naivasha	15, 600ha	Freshwater	Protected

A **Identification**	Age	Gender	Location in relation to wetland	Ethnic Group	Religion
	1. 15-25 2. 26-36 3. 48-58 4. 59-69 5. 70-80	1. M 2. F	1: 0-1 km 2: 2-3km 3: 4-5km	1: Orma 2: Pokomo 3: Luo 3: Wardei 4: Somali 5: Kikuyu 6: Tugen/Kalenjin 7: Masaai	1: Christian 2: Muslim 3: None believer
	Level of Education	Residential Status	Number of	Employment	

B Characteristics	[illegible]	[illegible]	Years in village	Status
	1: No formal education 2: Primary Education 3: Secondary education 4: Advanced level 5: University	1: Permananent 2: Non- permanent	1: 1- 5 2: 6-10 3: 11-15 4: 15-20	1: Formal 2:Non-Formal

	Yes	No
Are you aware of the existence of IBAs		
Are you aware about the IBA status:		

1. **Determining the current state/condition of the wetland BA resources**

1.1: Determining the abundance

Water Quantity	Very Low	Low	[illegible]	High	Very High
Abundance of water					
Abundance of birds					
Abundance of fish resources					
Abundance of wetland vegetation					
Abundance wetland pasture					

Water Quantity	Poor	Marginal	Fair	Good	Very good	Excellent
Quality of Water						
Abundance of birds						
Abundance of fish resources						
Abundance of wetland vegetation						
Abundance wetland pasture						

1.2: Determining the pressures affecting the biodiversity resources

Water Quantity and Quality	None	Very Low	Low	Average	High
Over-abstraction					
Climate change					
Pollution by agricultural chemicals					
Pollution by sewage					
Pollution by oil spillage					
Siltation					
Wetland Birds	None	Very Low	Low	Average	High
Domestic hunting					
Change in habitat due to agriculture					
Change in habitat due to overgrazing					
Change in water resources					
Fish Resources	None	Very Low	Low	Average	High
Change in water resources					
Overfishing					
Invasives					
Wetland vegetation	None	Very Low	Low	Average	High
Overharvesting					
Illegal fires					
Conversion of areas under plant coverage					
Wetland Pasture	None	Very Low	Low	Average	High
Overgrazing					
Illegal fires					

1.3 Response Interventions

Response Interventions	None	Very low	Low	Average	High
Conservation Education and Awareness Raising					
Institutional capacity building					
Security of land/resource tenure					
Devolution of responsibilities to lower levels					
Enforcement of traditional rules					
Control of/ eradication of invasives					
Habitat restoration					

2.0: What are the predicted future changes from the local knowledge and community perspective in terms of state; density and occurrence?/ What can happen to biodiversity in the future i.e. in the next 20 years?

	0-Do not Know	1-Remain constant	2-Decrease.	3-Disappear	4-Increase
Water quantity					
Water quality					
Wetland Birds					
Wetland Vegetation					
Wetland Pasture					
Fish Resources					

3.0: Which indicators would be more suitable at the local scale? Rating: (1- Least; 2-Medium; 3-High)

State indicators at the sites	Scores
Size of the wetland	
Level of the flooding regime	
Water quality	
Abundance of wetland birds	
Number/diversity of mangroves	
Abundance of wetland pasture	
Number /diversity of fish	
Number and size of traditional farms	
Pressure Indicators at the sites	**Scores**
Excessive loss of flooding regimes	
Conversion of wetlands to agriculture and grazing land	
Uncontrolled abstraction upstream as well as diversion of water for use in irrigation farms	
Overgrazing	
Rampant fire outbreaks	
Rapid spread of invasives species	
Drying of swamps	
Agricultural pollutants and sewage pollution	
Overfishing through the use of inappropriate gear and fishing off season	
Soil erosion	
Excessive loss of flooding regimes	
Number of traditional farms lost due to inundation	
Response Indicators at sites	**Scores**
Establishing upper limits to how much water can be abstracted by users	
Quotas set and observed per season/per fisherman	
Security of tenure	
Habitat restoration	
Enforcement of traditional rules	
Raise awareness on birds and habitats	

Appendix II: Study Variables

Age	15-25; 26-36; 48-58; 59-69; 70-80
Gender	Consists of two text values: 'male' and 'female'
Resource users	A total of 12 different wetland user groups were sampled across three study sites. The participants comprised of agricultural farmers, livestock owners/livestock herders/pastoralists, coastal and inland fishermen, traditional healers, mangrove harvesters, reed harvesters, papyrus harvesters, carpenters, bee-keepers and charcoal burners.
Type of IBA	Riverine; Saline; Freshwater
Size of IBA	130 000ha; 10 700 ha; 15 600 ha
Protection Status	Protected; Reserve; Non- Protected
Distance from the wetland IBA	0-1 km;: 2-3km; 4-5km
Duration resident in village	1- 5 ; 6-10 ; 11-15 ; 15-20
Level of education	No formal education: Primary Education ; Secondary education: Advanced level ; University
Condition of the resource	State and pressure of the wetland resources mainly water, wetland vegetation, wetland birds, fish and grazing resources
Ethnic group	Orma; Pokomo; Luo; Wardei; Somali ; Kikuyu ;Tugen/Endorois/Kalenjin; Masaai
Response interventions for wetland management	Education and awareness raising, institutional capacity building, security of tenure, devolution of responsibility to lower levels, enforcement of traditional rules, control or eradication of invasive species and habitat restoration.
Future condition of wetland resources	Abundance of water, wetland vegetation, wetland birds, fish and grazing resources
Preferred indicators	Pressure- State- Responses with various attributes

Appendix III: Wetland classification system for East Africa

1.	**Marine**			
1.1.	Subtidal		i.	sea grass beds
			ii.	coral reefs
1.2.	Intertidal		i.	rocky marine shores, reefs
			ii.	mud flats, sand flats, salt flats
			iii.	intertidal vegetated sediments: salt marshes, mangroves
2.	**Estuarine**			
2.1.	Subtidal		i.	estuaries and marine deltas
2.2.	Intertidal		i.	mud flats, sand flats, salt flats
			ii.	estuarine marshes, salt marshes
			iii.	estuarine swamps, mangrove swamps
3.	**Sodic and/or saline water**			
3.1.	Lacustrine[a]	Permanent	i.	sodic lakes, salt lakes
		Temporary	i.	seasonally/occasionally inundated depressions, salt pans
3.2.	Palustrine[b]	Permanent	i.	sodic and salt marshes and swamps
			ii.	springs, soaks and resultant pools
4.	**Freshwater**			
4.1.	Riverine[c]	Permanent	i.	edges of perennial rivers, streams and waterfalls
			ii.	inland deltas (including deltas in lakes)
		Temporary	i.	seasonal/occasional rivers, streams and waterfalls
			ii.	riverine floodplains, river flats, deltaic plains, riverine grass lands, mbugas[d]

4.2.	Lacustrine	Permanent	i.	freshwater lakes (> 10 ha) including shores subject to seasonal or irregular inundation (drawdown floodplains)
			ii.	freshwater ponds, pools (< 10 ha)
		Temporary	i.	seasonal lakes (> 10 ha)
			ii.	seasonal ponds, pools (< 10 ha)
4.3.	**Palustrine**	Herbaceous	i.	permanent swamps, marshes, dambos[a]
			ii.	seasonal/occasional swamps, marshes, dambos
			iii.	peatlands, fens
			iv.	montane wetlands (including bogs)
			v.	springs, soaks
		Woody	i.	shrub swamps, thicket wetlands
			ii.	swamp forests
5.	**Man-made wetlands**			
5.1.	Aquaculture/mariculture		i.	fish ponds, prawn farms
5.2.	Agriculture		i.	farm ponds and dams
			ii.	irrigated lands, rice paddy, channels, canals, ditches
			iii.	seasonally flooded arable land
5.3.	Salt production		i.	salt evaporation pans
5.4.	Urban/industrial		i.	borrow pits, brick pits, mining pools, road impoundments, quarries
			ii.	wastewater treatment facilities
5.5.	Water storage		i.	ponds, dams, reservoirs

Source: *FAO (undated)*

Appendix IV: Populations of IBA trigger species for Tana River Delta

Species	Season	Period	Population estimate	Quality of estimate	IBA Criteria	IUCN Category
Vulturine Guineafowl *Acryllium vulturinum*	resident	1999	-	-		Least Concern
Yellow-necked Spurfowl *Francolinus leucoscepus*	resident	1999	-	-		Least Concern
Spur-winged Goose *Plectropterus gambensis*	winter	1993	5,400 individuals	-	A4i	Least Concern
Greater Flamingo *Phoenicopterus roseus*	winter	1993	2,240 individuals	-	A4i	Least Concern
Yellow-billed Stork *Mycteria ibis*	winter	1993	970 individuals	-	A4i	Least Concern
African Openbill *Anastomus lamelligerus*	winter	1993	3,530 individuals	-	A4i	Least Concern
African Spoonbill *Platalea alba*	winter	1993	3,680 individuals	-	A4i	Least Concern
Cattle Egret *Bubulcus ibis*	winter	1993	11,270 individuals	-	A4i	Least Concern
Great Egret *Casmerodius albus*	winter	1993	2,560 individuals	-	A4i	Least Concern
Intermediate Egret *Mesophoyx intermedia*	winter	1993	2,000 individuals	-	A4i	Least Concern
Great White Pelican *Pelecanus onocrotalus*	winter	1993	2,070 individuals	-	A4i	Least Concern
Pink-backed Pelican	winter	1993	2,500	-	A4i	Least

Pelecanus rufescens			individuals			Concern
Southern Banded Snake-eagle *Circaetus fasciolatus*	resident	1999	present [units unknown]	-	A1, A3	Near Threatened
Eastern Chanting-goshawk *Melierax poliopterus*	resident	1999	-	-		Least Concern
White-fronted Plover *Charadrius marginatus*	winter	1993	1,070 individuals	-	A4i	Least Concern
Lesser Sand Plover *Charadrius mongolus*	winter	1993	2,340 individuals	-	A4i	Least Concern
Marsh Sandpiper *Tringa stagnatilis*	winter	1993	1,690 individuals	-	A4i	Least Concern
Little Stint *Calidris minuta*	winter	1993	15,310 individuals	-	A4i	Least Concern
Curlew Sandpiper *Calidris ferruginea*	winter	1993	12,960 individuals	-	A4i	Least Concern
Sooty Gull *Larus hemprichii*	winter	1993	830 individuals	-	A4i	Least Concern
Slender-billed Gull *Larus genei*	winter	1993	490 individuals	-	A4i	Least Concern
Gull-billed Tern *Sterna nilotica*	winter	1993	1,450 individuals	-	A4i	Least Concern
Caspian Tern *Sterna caspia*	winter	1993	1,340 individuals	-	A4i	Least Concern
Lesser Crested Tern *Sterna bengalensis*	winter	1993	1,670 individuals	-	A4i	Least Concern
Saunders's Tern *Sterna saundersi*	winter	1993	3,610 individuals	-	A4i	Least Concern

Whiskered Tern *Chlidonias hybrida*	winter	1993	1,450 individuals	-	A4i	Least Concern
Black-faced Sandgrouse *Pterocles decoratus*	resident	1999	-	-		Least Concern
White-bellied Go-away-bird *Corythaixoides leucogaster*	resident	1999	-	-		Least Concern
Donaldson-Smith's Nightjar *Caprimulgus donaldsoni*	resident	1999	-	-		Least Concern
White-headed Mousebird *Colius leucocephalus*	resident	1999	-	-		Least Concern
Mangrove Kingfisher *Halcyon senegaloides*	resident	1999	present [units unknown]	-	A3	Least Concern
Abyssinian Scimitarbill *Rhinopomastus minor*	resident	1999	-	-		Least Concern
Von der Decken's Hornbill *Tockus deckeni*	resident	1999	-	-		Least Concern
Brown-breasted Barbet *Lybius melanopterus*	resident	1999	present [units unknown]	-	A3	Least Concern
Pale Batis *Batis soror*	resident	1999	present [units unknown]	-	A3	Least Concern
Four-coloured Bush-shrike *Telophorus quadricolor*	resident	1999	present [units unknown]	-	A3	Least Concern
Three-streaked Tchagra *Tchagra jamesi*	resident	1999	-	-		Least Concern
Long-tailed Fiscal *Lanius cabanisi*	resident	1999	-	-		Least Concern

Chestnut-headed Sparrow-lark *Eremopterix signatus*	resident	1999	-	-		Least Concern
Fischer's Greenbul *Phyllastrephus fischeri*	resident	1999	present [units unknown]	-	A3	Least Concern
Basra Reed-warbler *Acrocephalus griseldis*	winter	-	present [units unknown]	-	A1	Endangered
Scaly Chatterer *Turdoides aylmeri*	resident	1999	-	-		Least Concern
Rufous Chatterer *Turdoides rubiginosa*	resident	1999	-	-		Least Concern
Scaly Babbler *Turdoides squamulata*	resident	1999	present [units unknown]	-	A3	Least Concern
Black-bellied Glossy-starling *Lamprotornis corruscus*	resident	1999	present [units unknown]	-	A3	Least Concern
Golden-breasted Starling *Cosmopsarus regius*	resident	1999	-	-		Least Concern
Fischer's Starling *Spreo fischeri*	resident	1999	-	-		Least Concern
Kenya Violet-backed Sunbird *Anthreptes orientalis*	resident	1999	-	-		Least Concern
Mouse-coloured Sunbird *Nectarinia veroxii*	resident	1999	present [units unknown]	-	A3	Least Concern
Violet-breasted Sunbird *Nectarinia chalcomelas*	resident	1999	present [units unknown]	-	A3	Least Concern
White-headed Buffalo-weaver *Dinemellia dinemelli*	resident	1999	-	-		Least Concern

Golden Palm Weaver *Ploceus bojeri*	resident	1999	-	-		Least Concern
Zanzibar Bishop *Euplectes nigroventris*	resident	1999	present [units unknown]	-	A3	Least Concern
Purple Grenadier *Uraeginthus ianthinogaster*	resident	1999	-	-		Least Concern
Golden Pipit *Tmetothylacus tenellus*	resident	1999	-	-		Least Concern
Pangani Longclaw *Macronyx aurantiigula*	resident	1999	-	-		Least Concern
Malindi Pipit *Anthus melindae*	resident	1999	present [units unknown]	-	A1, A3	Near Threatened
A4iii *Species group - waterbirds*	winter	1993	-	unknown	A4iii	

Source: BirdLife International (2013) Important Bird Areas factsheet: Tana River Delta. *Downloaded from http://www.birdlife.org on 23/09/2013*

Appendix V: Populations of IBA trigger species Lake Naivasha

Species	Season	Period	Population estimate	Quality of estimate	IBA Criteria	IUCN Category
Little Grebe *Tachybaptus ruficollis*	winter	1997	1,500 individuals	-	A4i	Least Concern
African Spoonbill *Platalea alba*	winter	1997	412 individuals	-	A4i	Least Concern
Red-knobbed Coot *Fulica cristata*	winter	1991	19,400 individuals	-	A4i	Least Concern
Nyanza Swift *Apus niansae*	resident	1999	-	-		Least Concern
Grey-crested Helmet-shrike *Prionops poliolophus*	resident	1999	present [units unknown]	-	A1, A2	Near Threatened
Basra Reed-warbler *Acrocephalus griseldis*	winter	-	present [units unknown]	-	A1	Endangered
Brown Warbler *Sylvia lugens*	resident	1999	-	-		Least Concern
Little Rock-thrush *Monticola rufocinereus*	resident	1999	-	-		Least Concern
White-eyed Slaty Flycatcher *Dioptrornis fischeri*	resident	1999	-	-		Least Concern
Bronze Sunbird *Nectarinia kilimensis*	resident	1999	-	-		Least Concern
Golden-winged Sunbird *Nectarinia reichenowi*	resident	1999	-	-		Least Concern

Baglafecht Weaver *Ploceus baglafecht*	resident	1999	-	-		Least Concern
Speke's Weaver *Ploceus spekei*	resident	1999	-	-		Least Concern
Fire-fronted Bishop *Euplectes diadematus*	unknown	1999	unknown [units unknown]	-		Least Concern
Purple Grenadier *Uraeginthus ianthinogaster*	resident	1999	-	-		Least Concern
Serinus striolatus	resident	1999	-	-		Not Recognised
A4iii *Species group - waterbirds*	winter	-	20,000 individuals	unknown	A4iii	.

Source: *BirdLife International (2013) Important Bird Areas factsheet: Lake Naivasha. Downloaded from* *http://www.birdlife.org* *on 23/09/2013*

Appendix VI: Populations of IBA trigger species at Lake Bogoria

Species	Season	Period	Population estimate	Quality of estimate	IBA Criteria	IUCN Category
Yellow-necked Spurfowl *Francolinus leucoscepus*	resident	1999	-	-		Least Concern
Black-necked Grebe *Podiceps nigricollis*	winter	1997	3,700 individuals	-	A4i	Least Concern
Greater Flamingo *Phoenicopterus roseus*	winter	2001	18,540 individuals	-	A4i	Least Concern
Lesser Flamingo *Phoeniconaias minor*	winter	1999	1,070,000 individuals	-	A1, A4i	Near Threatened
White-bellied Go-away-bird *Corythaixoides leucogaster*	resident	1999	-	-		Least Concern
Donaldson-Smith's Nightjar *Caprimulgus donaldsoni*	resident	1999	-	-		Least Concern
Abyssinian Scimitarbill *Rhinopomastus minor*	resident	1999	-	-		Least Concern
Eastern Yellow-billed Hornbill *Tockus flavirostris*	resident	1999	-	-		Least Concern
Jackson's Hornbill *Tockus jacksoni*	resident	1999	-	-		Least Concern
Hemprich's Hornbill *Tockus hemprichii*	resident	1999	-	-		Least Concern
Black-throated Barbet *Tricholaema*	resident	1999	-	-		Least Concern

melanocephala						
Red-and-yellow Barbet *Trachyphonus erythrocephalus*	resident	1999	-	-		Least Concern
D'Arnaud's Barbet *Trachyphonus darnaudii*	resident	1999	-	-		Least Concern
Three-streaked Tchagra *Tchagra jamesi*	resident	1999	-	-		Least Concern
Somali Tit *Parus thruppi*	resident	1999	-	-		Least Concern
Mouse-coloured Penduline-tit *Anthoscopus musculus*	resident	1999	-	-		Least Concern
Pink-breasted Lark *Mirafra poecilosterna*	resident	1999	-	-		Least Concern
Grey Wren-warbler *Camaroptera simplex*	resident	1999	-	-		Least Concern
Rufous Chatterer *Turdoides rubiginosa*	resident	1999	-	-		Least Concern
White-breasted White-eye *Zosterops abyssinicus*	resident	1999	-	-		Least Concern
Magpie Starling *Speculipastor bicolor*	resident	1999	-	-		Least Concern
Brown-tailed Chat *Cercomela scotocerca*	resident	1999	-	-		Least Concern
African Grey Flycatcher *Bradornis microrhynchus*	resident	1999	-	-		Least Concern
Kenya Violet-backed Sunbird *Anthreptes*	resident	1999	-	-		Least Concern

orientalis						
Hunter's Sunbird *Nectarinia hunteri*	resident	1999	-	-		Least Concern
White-headed Buffalo-weaver *Dinemellia dinemelli*	resident	1999	-	-		Least Concern
Blue-capped Cordonbleu *Uraeginthus cyanocephalus*	resident	1999	-	-		Least Concern
Purple Grenadier *Uraeginthus ianthinogaster*	resident	1999	-	-		Least Concern
Grey-headed Silverbill *Lonchura griseicapilla*	resident	1999	-	-		Least Concern
Steel-blue Whydah *Vidua hypocherina*	resident	1999	-	-		Least Concern
Straw-tailed Whydah *Vidua fischeri*	resident	1999	-	-		Least Concern
Ethiopian Grosbeak-canary *Serinus donaldsoni*	resident	1999	-	-		Least Concern
White-bellied Canary *Serinus dorsostriatus*	resident	1999	-	-		Least Concern
Somali Golden-breasted Bunting *Emberiza poliopleura*	resident	1999	-	-		Least Concern
A4iii *Species group - waterbirds*	winter	-	-	unknown	A4iii	

Source: BirdLife International (2013) Important Bird Areas factsheet: Lake Bogoria National Reserve. *Downloaded from http://www.birdlife.org on 25/09/2013*

Appendix VII: Characteristics of the key drainage basins in Kenya

Key Basins	State	Drivers	Pressures	Impacts	Responses
Lake Victoria and associated wetlands (Lake Victoria shores, Yala Swamp, . Kanyaboli, Lake Simbi, Sondu Miriu Nyando and Nzoia Rivers)	High diversity of wetland types (Palustrine, Lacustrine and riverine) 34% of all the wetlands in the region are facing threats	Human, population, Poor governance, Inadequate management capacity, Poverty Climate change Lack of awareness	Inappropriate land use and over utilization, conversion of land for agriculture, unsustainable exploitation of resources, increased demand for resources Land subdivision and fragmentation	Pollution Loss of land cover, Invasive Species, Loss of water quantity and quality Loss of biodiversity, Flooding, Reduced fisheries,	• LVEMP initiative LBDA Initiative • EMCA (PEC & DEC) • Nile River Basin Initiative • E.A.C.-Environmental initiatives • Research, education and awareness • NGOs, CBO's, Initiatives • Relevant sectoral policies and Action plans
Rift Valley wetlands (Naivasha, Nakuru, Elementaita, Baringo, Bogoria, Solai, Magadi, Turkana)	Most of the wetlands are saline and rich in biodiversity particularly Avifauna. They are also experiencing fluctuating water levels and increasing pollution Several are protected and designated as Ramsar sites	Climate change, Poor governance, Human population, poverty, Inadequate management capacity, Lack of awareness	Urbanization, Inappropriate land use Conversion of land for agriculture, Unsustainable exploitation of resources, Increased demand for resources, Settlements Land subdivision and fragmentation	Loss of Catchments, Pollution, Loss of land/forests cover, Invasive species, Loss of water quantity and quality. Loss of biodiversity, Flooding, Reduced fisheries,	• Regional Development Authorities • (EWNDA,EWSDA) • ASAL Program • EMCA (PEC & DEC) • Research, education and awareness • NGOs, CBOs Initiatives • Relevant sectoral policies and Action plans • Recognized/designated conservation sites (Ramsar, National parks/Reserves, World heritage sites)
Ewaso Nyiro north and South (AMU Forest, Amala River, Ewaso Nyiro Rivers, Shompolle Swamps, Lake Natron, Lake Olbollosat, Habaswein swamps)	Riverine Trans-boundary wetland linking into a critical flamingo breeding area. Proposed HEP has potential to alter the ecology & hydrology of the Ewaso river south and Lake Natron Experiencing fluctuating water levels Several are Non protected	Climate change Poor governance, Human population, Poverty, Inadequate management capacity Lack of awareness	Inappropriate land use, Over-utilization of water, Conversion of land for agriculture, Overstocking Increased demand for resources, Settlements Loss of catchment forests Reduced water levels Land subdivision and	Pollution Soil erosion/siltation Loss of land/forests cover, Overgrazing, Soil erosion/siltation Reduced water volumes	• Regional Development Authorities (EWNDA, EWSDA) • ASAL Program • EMCA (PEC & DEC) • Research, education and awareness • NGO's CBOs Initiatives

	Mostly located in arid zones Rich in biodiversity esp. birds		fragmentation		• Relevant sectoral policies and Action Plans • Recognized and designated conservation areas • Increased catchment protection • EAC Cross-border protocols
Tana River basin wetlands (Aberdares and Mt. Kenya catchments, Man-made Reservoirs, Tana River, Tana Delta)	Largest riverine wetland Important for HEP, Biodiversity conservation and irrigation Provides lifeline support to neighbouring communities Fluctuating water levels Fluctuating flooding regimes	Climate change Poor governance, Human population, Poverty, Inadequate management capacity, Lack of awareness	Inappropriate land use and over-utilization of water, conversion of land for agriculture, Overstocking, Increased demand for resources, Settlements Reduced hydrological capacity Land subdivision and fragmentation	Pollution Severe soil erosion/siltation, Loss Of land/forests cover, Overgrazing, Reduced water volumes, Loss of critical habitats and species Reduced hydrological capacity	• Regional development Authorities • (TARDA & CDA) • ASAL Program • EMCA (PEC & DEC) • Research, education and awareness • NGOs, CBOs Initiatives • Relevant sectoral policies and Action plans • Recognized and designated conservation areas • Increased catchment protection • Increased species management

Source: NMK

Appendix VIII: 2010 Biodiversity Indicators Partners: Source, 2010 Biodiversity

STEERING COMMITTEE *Advise on the general direction of the 2010 BIP project, and review and provide advice on key outputs*	KEY INDICATOR PARTNERS *Develop and implement the biodiversity indicators*	ASSOCIATE INDICATOR PARTNERS *Assist in the development and implementation of the indicator suite, and/or provide support to the Partnership*	AFFILIATE PARTNERS *Work towards similar aims and objectives as the 2010 BIP, although at different scales*
Secretariat of the Convention on Biological Diversity (CBD) European Environment Agency (EEA) Food and Agriculture Organization of the United Nations (FAO) Global Environment Facility (GEF) International Union for Conservation of Nature (IUCN) Ramsar Convention on Wetlands United Nations Environment Programme (UNEP) United Nations Environment Programme World Conservation Monitoring Centre (UNEP WCMC)	Bioversity International BirdLife International Conservation International (CI) Food and Agriculture Organization of the United Nations (FAO) Global Footprint Network (GFN) Global Invasive Species Programme (GISP) Institute of Zoology, Zoological Society of London (ZSL) International Nitrogen Initiative (INI) IUCN Species Survival Commission (IUCN SSC) IUCN Sustainable Use Specialist Group IUCN World Commission on Protected Areas (IUCN WCPA) Organization for Economic Co-operation and Development	Convention on Migratory Species (CMS) Global Biodiversity Information Facility (GBIF) International Council on Mining and Metals (ICMM) Global Land Cover Facility, NASA/NGO Biodiversity Working Group Ramsar Convention on Wetlands Terralingua United Nations Environment Programme (UNEP) Wildlife Conservation Society	Countdown 2010 Circumpolar Biodiversity Monitoring Program (CBMP) Streamlining European 2010 Biodiversity Indicators (SEBI2010)

	(OECD) Royal Society for the Protection of Birds (RSPB) Sea Around Us Project The Nature Conservancy (TNC) TRAFFIC International University of British Columbia (UBC) Fisheries Centre United Nations Educational, Scientific and Cultural Organization (UNESCO) UNEP Global Environmental Monitoring System (GEMS) Water Programme United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) University of Queensland, Australia Wetlands International World Health Organization (WHO) World Wide Fund for Nature WWF		

Source: http://en.wikipedia.org/wiki/Biodiversity_Indicators_Partnership

Appendix IX: Factors Identified by Selected Authors as Affecting Local Organizations for Natural Resource Management

	Ostrom (*1990, 1992*)	*Wade (1998)*	*Oakerson (1986)*	*Bromley & Cernea (1989)*
Physical & technical characteristics of the resource system	Physical ☐ Structure: Size Clarity of boundaries	Boundedness of resource	Capacity of the resource	Nature of the resource
	☐ Flow patterns: Predictability in time, across space & in quantity ☐ Condition of the resource	Size	Excludability of the resource Subtractability / jointness	
	Technology ☐ For withdrawing resources ☐ For exclusion	Cost of exclusion technology	Divisibility - physical boundaries	
Characteristics of the group of users	Number of members Time horizon	Size of user group/number of members		Characteristics of the user of the resource
	Proximity to resource & between users	Boundaries of the group		
	Extent of interaction - individualized or collective action	Location of resource & residence of users		

	Skills & assets of leaders	Users' knowledge		
	Homogeneity vs heterogeneity of interests	Users' demand		
		Power structure		
	Norms of behaviour/culture			
		Mutual obligations		
	Stability			
Institutional arrangements	Design principles ☐ Member & access rules ☐ Resource boundary rules ☐ Appropriation (withdrawing) & provision rules ☐ Collective choice arrangements ☐ Monitoring & sanctioning rules ☐ Recognition of rights to organize by external agents ☐ "Nested enterprises" - multiple layers of nested enterprises	Existing arrangements for discussion of resource problems Punishment rules Relationship between users & state - external rules & intervention	Decision-making arrangements: ☐ Operational rules ☐ Collective choice rules ☐ External arrangements	Characteristics of the decision-making process ☐ Type of resource regime - property rights ☐ Legal, political environment
	Market conditions			

	for the resource			
Relationships		Noticeability: ease of detection of rule-breaking free riders		Ecological stress: supply & demand conditions

Source: Adapted from Rasmussen and Meinzen-Dick (1995)