FACTORS INFLUENCING RESOURCE USE BEHAVIOR IN EWASO NAROK WETLAND, KENYA

BY

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DECLARATION

Declaration

I declare that this thesis is my original work and has not been submitted for the award of a degree in any other university.

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This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

This thesis is dedicated to my husband Patrick and children Edel, Elwin, Eviana and Eustace for their patience and understanding throughout the study period.

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LIST OF ABBREVIATIONS

CAAC:	Catchment Area Advisory Committee
CBK:	Central Bank of Kenya
CI:	Cropping Intensity index
FRI:	Fallow Rotation Index
GoK:	Government of Kenya
IRTP:	Individual Rate of Time Preference
KWS:	Kenya Wildlife Service
LUI:	Land Use Intensity
MDG:	Millennium Development Goal
MEMR:	Ministry of Environment and Mineral Resources
MPL:	Multiple Price List
NEMA:	National Environment and Management Authority
OLS:	Ordinary Least Square
PCA:	Principle Component Analysis
SDG:	Sustainable Development Goals
SPSS:	Statistical Packages for Social Science
SURE:	Seemingly Unrelated Regression Estimator
TLU:	Tropical Livestock Units
WRMA:	Water Resources Management Authority
WRUA:	Water Resource Users Association.

ABSTRACT

Wetlands are areas permanently or seasonally flooded by water where plants and animals have become adapted over time. They provide critical ecosystem services and contribute to the national economy both directly and indirectly. The Ewaso Narok Wetland is an important ecosystem providing water, farming land and pasture for the livestock. Despite its importance, the wetland is threatened by human activities such as over-cultivation and overgrazing. Therefore, there is a need for sustainable management of the wetland in order to increase its contribution to livelihoods of the current and future generations. The objective of this study was to characterize the major wetland users, to assess the determinants of the individual rate of time preference and resource use behavior among the users. Stratified simple random sampling technique was used to select 99 pastoralists, 95 commercial and 106 small scale farmers in Ewaso Narok Wetland, Kenya. A questionnaire was used to collect household level data. Descriptive statistics, cross tabulations, one-way ANOVA with Tukey's HSD test were used to characterize the wetland users. Hyperbolic model was used in after the choice and matching tasks in calculating the individual rate of time preference while land use intensity index was used as a proxy for the resource use behaviour. Seemingly unrelated regression estimator (SURE) model was used to identify the factors influencing the individual rate of time preference and resource use behavior of the wetland users. Results show that the individual rate of time preference was influenced positively by the size of land area under crop, conflicts among the users, being a commercial farmer and the distance of a homestead to piped water. The resource use behavior was influenced positively by the individual rate of time preference, household size, the number of years of using the wetland and tropical livestock units and negatively by membership to credit lending groups, the level of education, and security of land tenure. The study concludes that the individual rate of time preference was the major contributor of the high intensity of land use and hence its determinants should be considered in sustainable management of the Ewaso Narok Wetland. Consequently, the study recommends that there should be a provision of title deeds to users in areas outside the wetland area to facilitate sustainable wetland use. Diversification into alternative income generating activities should be encouraged through groups and encourage infrastructural development like installation of piped water as an alternative source of resource to minimize dependency on the wetland.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The population of Kenya has doubled within the last 25 years to over 40 million people (World Bank, 2010). This has exerted pressure on the land in high potential areas and forced people to move to less populated arid and semi- arid areas in search of resources (Dzhumashev and Kazakevitch, 2013). Areas given priority for settlements in the arid and semi-arid zones are those with resources like water, pastures or fertile land which are mostly the wetland areas (Roden *et al.,* 2016; Sefidian *et al.,* 2016). Wetlands provide water for irrigation and pasture for livestock and are important in economic development; for example, the fisheries and aquaculture sector in Kenya contributed an estimated 0.54 percent of Kenya's national GDP in the year 2013 (FAO, 2016). If other products and services from Kenya's wetlands were valued, the contribution to GDP would be higher.

Wetlands are defined as areas permanently or seasonally flooded by water where plants and animals have become adapted over time (MEMR, 2012). They are part of larger ecosystems normally classified as aquatic and terrestrial (Mitchell, 2013). The terrestrial ecosystem includes forests, grasslands, mountains and deserts, while the aquatic ecosystems can either be marine or freshwater (MEMR, 2012). Wetlands are classified into six categories depending on their form and location. The categories are: riverine, marine, palustrine, lacustrine, estuarine, and constructed wetlands (MEMR, 2012).

The riverine wetlands occur in rivers and streams and Kenya they include: Tana river, Athi / Tsavo / Galana system, Ewaso ngiro north and south among others (MEMR, 2012 and Hughes *et al.,* 1992). The lacustrine wetlands are found around lakes and in Kenya they include: Lake Victoria, Lake Nakuru, and Lake Ol Bolosat among others (MEMR, 2012). Palustrine wetlands consist of: Marshes, swamps, bogs and floodplains (GOK, 2013).

Estuarine wetlands occur where fresh and salty water meet and examples are: Deltas, tidal marshes and mangrove swamps while the marine wetlands have a high level of salinity and are exposed to the waves and currents of the ocean (MEMR, 2012). Examples of the marine wetlands are: Lagoons, mangroves and coral reefs (GOK, 2013; MEMR, 2012 and KWF, 2010). This variability of wetlands in Kenya is due to the diverse climatic conditions and topography in the country.

Wetlands contribute to the national economy both directly and indirectly through provisioning, regulating and supporting ecosystem services in Kenya (Wasao, 2010). They contribute towards food security and livelihoods at the household level. For instance, they provide services such as fish farming, forestry, wildlife conservancies, pastoralism and crop farming (Mitchell, 2013; MEMR, 2012 and Thenya *et al.*, 2011). They also contribute to the national GDP through wildlife habitat that attracts tourists contributing to the realization of the Kenya Vision 2030 of achieving an economic growth of 10 percent per annum which relies on the use of natural resources (Wasao, 2010).

In spite of these benefits, wetlands are faced with several constraints especially in sub-Saharan Africa which include climate change, population pressure, siltation and pollution (Nonga *et al.*, 2010; Kafle *et al*., 2008). Ewaso Narok Wetland which serves a large number of users is not an exception to these constraints. The major constraints to Ewaso Narok Wetland include human encroachment, drought and flooding (Gichuki and Macharia, 2006). These lead to an over exploitation of the wetland resources with over 80 percent of the wetland area being currently under human activities (Thenya, *et al.*, 2011). In order to understand the constraints of human activities in wetlands, several concepts are important including human behavior, resource use behavior and individual rate of time preference. Human behavior refers to the

practices or observable actions performed by an individual in achieving their objectives (Viet gung *et al.,* 2007). Human behavior influences the utilization of resources by reducing or increasing their values (Fischer *et al.,* 2012 and Milner-Gulland, 2012). The resource use behavior refers to the economic activities undertaken by users in and around a resource using the available abilities to achieve their different objectives (Viet gung *et al.,* 2007).

Human behavior is influenced by both internal and external factors. The internal factors include socio-economic factors and individual rate of time preference (Sullivan, 2011) while the external factors are policies and institutional factors (Sidibe, 2010; Mulligan, 2007). Time preference is the tendency of a user to consider current consumption before future consumption (Gunatilake *et al.,* 2009). There is a need for sustainable management of a resource in order to reduce the negative impact of human activities. In Kenya, management of natural resources such as wetlands is the mandate of government agencies like the National Environmental Management Authority (NEMA), Kenya Wildlife Services (KWS) and Water Resources Management Authority (WRMA) to ensure conservation and sustainable use (MEMR, 2012).

The ultimate goal of managing wetlands is to maximize social welfare of both the present and future generations. Technically, this is referred to as sustainable use meaning that a resource meets the needs of the present generation without reducing the ability of the resource to meet the needs of future generations (Cooley, 2009). Although Sidibe, (2010) and Mulligan, (2007) noted that the sustainable management of natural resources is influenced by institutional and policy factors such as security of land tenure, Sullivan, (2011) concluded that in making resource management decisions, individual rate of time preference should be considered. Individual rate of time preference varies for different individuals and it affects sustainable use of a resource.

A low rate of time preference (discount rate) induces a user to delay consumption (Frederick *et al.,* 2002). The average individual rate of time preference compares to the market interest rate and depends on the expectation a consumer has for future income (Varian, 2010). A high rate of time preference prompts more of a resource to be harvested in the present time as opposed to the future (Di Falco, 2013; Gunatilake *et al.,* 2009). The concept of the individual rate of time preference explains the behavior of a particular user in terms of extraction or conservation of a resource. Understanding the determinants of the current use of wetland resources is one way of facilitating sustainable management. Considering the current wetland use in environmental sustainability optimizes social welfare for the future generation.

1.2 Statement of the research problem

Ewaso Narok Wetland is diverse ecosystem supporting food production among the wetland users through crop farming, livestock grazing and providing water and other wetland resources like building poles and firewood. However, there is an increase in human encroachment owing to the high and growing population. For example, up to 80 percent of the wetland area is currently under human activities (Thenya *et al.,* 2011). The pressure of human activities has resulted in the depletion of most resources like pasture and water which endangers the wetland sustainability. As a result, the sustainable management of the Ewaso Narok Wetland is necessary in order to maximize the benefits to both the current and future generations. This will ensure continued utilization of the wetland resources. There is certainty of the users to utilize the resources in the wetland for current benefits only. This state of affairs leaves an information gap on the factors which influence the resource use behavior in Ewaso Narok Wetland.

1.3 Purpose and objectives

The purpose of this study was to assess the factors influencing the individual rate of time preference and the resource use behavior among Ewaso Narok Wetland users in Kenya.

1.3.1. Specific objectives

The specific objectives of this study were to:

1. Characterize the major users of Ewaso Narok Wetland.
2. Assess the factors influencing the individual rate of time preference of Ewaso Narok Wetland users.
3. Evaluate the factors influencing the resource use behavior of Ewaso Narok Wetland users.

1.4 Hypotheses of the study

The hypotheses tested were that:

1. There is no difference in the characteristics among users of Ewaso Narok Wetland.
2. Socio-economic and institutional factors do not influence the individual rate of time preference.
3. Socio-economic and institutional factors do not influence the resource use behavior.

1.5 Justification of the study

This study is of benefit to wetland users, wetland managers and policy makers. The users will understand the considerations to put in place in sustainably using the wetland. The wetland managers will benefit by focusing on the factors which influence the resource use behavior in the management of the wetland. The policy makers will benefit in acknowledging the attributes of the users and influencing factors in order to formulate appropriate policies for the sustainability of the wetland.

1.6 Organization of the thesis

Chapter one presents the importance and threats facing wetlands in Kenya. The chapter also illustrates the research problem being addressed as well as the objectives and hypotheses of this study. Chapter two reviews the literature on policies governing wetlands in Kenya and the factors that influence resource use. Chapter three presents the conceptual, theoretical and empirical frameworks used in this study. The study design, sampling, data collection and analysis methods are also discussed in this chapter. Chapter four discusses the findings of the study while chapter five provides the summary, conclusions, recommendation and suggestions for future research.

1.7 Limitations of the study

There was a challenge of conducting interviews among hostile pastoralist communities which increased the number of days spend on data collection. A village elder had to intervene to calm down the villagers who were protesting against giving information. This study only reported the resource uses which more than half of the respondents had benefited from the wetland. The nomadic nature of pastoralists made it impossible to be registered as wetland users and therefore they could not be predetermined in the data collection. The data was collected from available individuals at the time.

CHAPTER TWO: LITERATURE REVIEW

This chapter reviews literature on policies governing wetlands in Kenya and the factors that influence resource use with a purpose of identifying the research gap.

2.1 Policy framework governing wetlands in Kenya

Due to their importance, wetlands were the first ecosystems to receive international recognition through the Ramsar convention which was ratified in 1990 (GOK, 2013). The important wetlands in Kenya according to the convention are Lake Naivasha, Lake Nakuru, Lake Elmenteita, Lake Bogoria and Lake Baringo (KWF, 2010). Wetlands in Kenya are regulated by the Water Resources Management Authority and the Water Services Regulatory Board (WASREB) which are instituted in the Ministry of Environment and Mineral Resources (GOK, 2013). The two agencies are under the water Act of 2002 with their key mandate being to manage, conserve, use and control water resources (Yatich *et al.*, 2007).

The WASREB ensures water conservation and implements water management strategies such as issuing licenses and setting water standards. The agencies are advised on the water resources by the Catchment Area Advisory Committees (CAACs) while the mandate to identify and register water users is by the Water Resources Users Association (KIPPRA, 2013). The WRMA manages the Ewaso Narok Wetland which is a public resource through developing water allocation procedures, ensuring the quality of the water resource is maintained by controlling oil spillage, pesticides and fertilizer use and also ensuring that information on water conservation is availed.

2.2 Determinants of resource use behavior

Land, pasture, water, wood fuel and firewood are the major resources obtained from Ewaso Narok Wetland (Thenya, *et al.*, 2011). Resource use among households is determined by the

individual rate of time preference, socio-economic and policy factors (Sullivan, 2011; Sidibe, 2010 and Solomon, 2004). The socio-economic factors influencing resource use include age, sex, market access, number of years of using a resource, membership to credit lending groups and household size among others (Sourya *et al*., 2015; Mnimbo, 2013; Mombo *et al*., 2012; Felix, 2012). The policy factors influencing resource use include type of land ownership (land tenure), availability and enforcement of wetland resource use institutions and infrastructural development (Sidibe, 2010; Taruvinga and Mushunje, 2010). The specific variable and their influence to resource use is discussed in the subsequent sub topics.

2.2.1 Individual rate of time preference (IRTP)

Individual rate of time preference had a positive effect on resource use. A high rate of individual time preference implies that the value attached to the current consumption of a wetland resource is higher than the value attached to future consumption (Gunatilake *et al.,* 2009; Holden *et al.,* 1998; Lahav *et al.,* 2010). The individual rate of time preference is a derived variable and is influenced by several socio-economic factors including education, a number of livestock owned, risk perception, income, land area, distance to extension services and conflict among users as discussed in the subsequent paragraphs.

Education level was reported to have a negative effect on the individual rate of time preference as more educated individuals have alternative resources and thus use less of wetland resources (Gunatilake *et al.,* 2009 and Chao *et al.,* 2009) however, the level of education did not have any effect on the individual rate of time preference according to Yesuf and Bluffstone (2008). The number of livestock was found to have a positive effect on the individual rate of time preference indicating that households with more livestock units use more of the wetland resources such as water and pasture (Yesuf and Bluffstone, 2008).

The risk perception of the users was found to have a positive effect on the individual rate of time preference such that the risk averse users have a high rate of time preference and tend to use more of the resources in the present time (Yesuf and Bluffstone 2008). Income has both negative and positive effect on the IRTP. Low-income households use more of the wetland resources in the present period because they have limited alternatives of survival (Gunatilake *et al.,* 2009). Higher income translates to delay in resource extraction and therefore lowers the individual rate of time preference (Dioikitopoulos and Kalyvitis, 2010).

Land area which a household utilizes has both a negative and positive effect on the individual rate of time preference. Although Yesuf and Bluffstone, (2008) found that the land area has a negative effect on the individual rate of time preference, Laury *et al.* (2012) found a positive effect of the land area on the individual rate of time preference. Households with a large land area for utilization in the wetland can either exploit or conserve a resource. Distance from a homestead to the extension services which is a proxy for education on wetland conservation and proper crop and livestock farming, it has a negative effect on the individual rate of time preference. Jamison *et al.,* (2012) acknowledged the positive impact of extension services to increase in crop yield which in turn translates to a lower individual rate of time preference.

Conflicts among wetland user had a positively affects the individual rate of time preference. A study by Voors *et al.* (2010) concluded that an increase in conflicts among individuals increases the individual rate of time preference. This means that individuals who are in the conflict have a high competition for the resources in the present period because the future is less assured. The resource use conflict between crop and livestock farmers was a major challenge especially in the Ewaso Narok Wetland and may influence the use the wetland (Thenya *et al.,* 2011).

2.2.2 Socio-economic factors influencing resource use behavior

Age has both a positive and negative effect on the use of resources. According to Felix (2012) who assessed the socio-economic factors influencing wetland resources conservation by households in Ngaciuma sub-catchment upper Tana in Kenya using correlation analysis, the age of the household head had a negative effect. Older household heads are expected to have more secure resource user rights such as title deeds for land and therefore conserve available resources more compared to their younger counterparts who have to wait to be allocated land as part of their inheritance.

Taruvinga and Mushunje, (2010) assessing the determinants of households' participation in wetland cultivation in river Ewaso ngiro basin, South Kenya using binary logistic model found a positive effect of the age of the household head and resource use in the wetland. This means that the older resource users utilize available resources which could be attributed to their experience in resource harvesting. Other studies such as Mombo *et al.* (2012) and Sourya *et al.* (2015) assessed the determinants of household use of wetland resources in Tanzania and West Bengal in India respectively using tobit and logit models found that age did not significantly influence the use of wetland resources.

The literature shows mixed results on the effect of education of the household head on the use of wetland resources. Sourya *et al.* (2015); Felix (2012) and Taruvinga and Mushunje (2010) concluded that more educated household heads use wetlands to a lesser degree because they have alternatives income sources particularly from formal employment. On the contrary, Mombo *et al. (*2012) assessed the determinants of access patterns in wetlands in Tanzania and impact on sustainable wetland management using probit model found a positive effect of the

level of education on the use of wetland resources. The positive effect was due to the use of sophisticated technologies like irrigation pumps in the extraction of resources in the wetland.

The sex of the household head has mixed effect on resource use. Taruvinga and Mushunje (2010) found that the sex of the household head was not significant in influencing the utilization of wetland resources in a study done in South Africa. Mombo *et al.* (2012) and Sourya *et al.* (2015) concluded that female household heads utilize more of wetland resources compared to their male counterparts because they lack adequate resources like access to credit to diversify to other activities outside the wetland.

Access to market has been reported to have a positive effect on the use of wetland resources like land and water. Parent and Child (2011) assessed market access and resource uses and Gunatilake *et al.* (2009) assessed time preference and national resources use by local communities. The two studies found that market access had a positive effect on the extraction of wetland resources. Improved market access increases the usage of resources like water and land because of the resulting income from the ready market of the products from wetlands.

Household size has both negative and positive effects on the use of wetland resources. One piece of land in the wetland area was allocated to one household; this implied that there was a restriction of resource use in the wetland per household explaining the negative effect (Felix, 2012; Taruvinga and Mushunje, 2010). Sourya *et al.* (2015) found positive effect of household size and the level of wetland cultivation and suggesting that with more household members, labor is available enabling the household to use more land in the wetland.

The number of livestock that a household owns has both negative and positive effects on the use of wetland resources. Taruvinga and Mushunje (2010) found a negative effect of the number of livestock owned on the use of wetland resources and concluded that the more livestock a farmer has, the less the demand for using resources in the wetland for cultivation. Sourya *et al.* (2015) found a positive effect between the number of livestock and the use of wetland resources because livestock relies on water and pasture from the wetland and thus, the more the livestock one has the more the use of the two resources in the wetland.

Membership to groups especially the credit lending groups has both positive and negative effects on the use of wetland resources. Mnimbo, (2013) assessed the effect of microcredit on maize productivity found that membership to groups is associated with access to loans for agricultural activities like purchase of inputs and also diversification into non-agribusiness activities. If the loan is used to purchase agricultural inputs like seeds and fertilizers, this intensifies the use of the wetland resources while diversification into other activities like business reduced the intensity of using the wetland resources. Sidibe (2010) assessed the demand for soil, water and forest conservation and found that membership to farmer groups increased the adoption of conservation practices and therefore reduce the resource usage intensity.

2.2.3 Policy factors

The type of land ownership influences the use of resources, for instance private ownership of land may have either a positive or a negative effect on the resource use (Tenaw *et al*., 2009; Waiganjo and Ngugi, 2001). The positive effect is because of subdivision of land among the family members which increases the intensity of using land. The negative effect is due to lack of competition in the resource use and hence the resources are conservatively used. According

to Tenaw, *et al*., 2009 communal ownership of land and government (public) owned land has a positive effect to resource use. This is because of free access and high level of competition for resources.

Saka *et al.* (2011) assessed the structure and determinants of land-use intensity among food crop farmers found that those renting land had higher cropping intensity than land owners because renting is usually for a short period and within which to maximize the resource. Solomon (2004) found a negative effect of land ownership in the use of wetland resources in Kemise Illubabore zone, South Western Ethiopia. The lack implementation of rules on anti-cultivation in wetlands has a positive effect on the use of wetland resources (Taruvinga and Mushunje, 2010). A study by Sidibe, (2010) concluded that individuals who have secure land tenure invested more in the conservation of resources.

The accessible road network has both positive and negative effects on the use of wetland resources. Charlery *et al. (*2016) in a study on the effects of new roads on environmental resource use using random effect models and Adam *et al.* (2012) in a study on forestry and road development found that road network links users to wetland resources and therefore increases their use. The availability of alternative resources outside the wetland reduces the intensity of using the wetland resources in the Niger Delta (Chukwu, 2016).

CHAPTER THREE: METHODOLOGY

3.1 Conceptual framework

The conceptual framework (Figure 3.1) explains the relationship between wetland resource use, individual rate of time preference of users, policy and institutional factors, socio-economic attributes of the wetland users and the resource attributes. The individual rate of time preference is influenced by both the policy factors such as the security of land tenure and user attributes such as level of income, distance to the resource, land area under crop in the wetland and the distance of a homestead to piped water. The wetland resources considered in Ewaso Narok Wetland were land for cultivation, pasture and fodder for livestock, water for domestic use and crop production, building poles, charcoal and firewood and roofing materials (reeds).

The wetland resource users aim at maximizing their food security in terms of food production and income generation from the activities they carry out in the wetland. The conceptual framework shows that the wetland resource use behavior is influenced by three categories of attributes: policy and institutional factors, individual rate of time preference and the socio-economic factors. The policy and institutional factors are like the security of land tenure and infrastructural development like installation of piped water. The socio-economic factors include membership to credit lending group, the number of years of education, household size, the number of livestock owned and the number of years of using the wetland. The individual rate of time preference is influenced by institutional and socio-economic factors. One of the institutional factors is the availability of piped water while the socio-economic factors include the size of the land area under crop, availability of conflict among the users and being a commercial farmer. This interaction promotes food security.

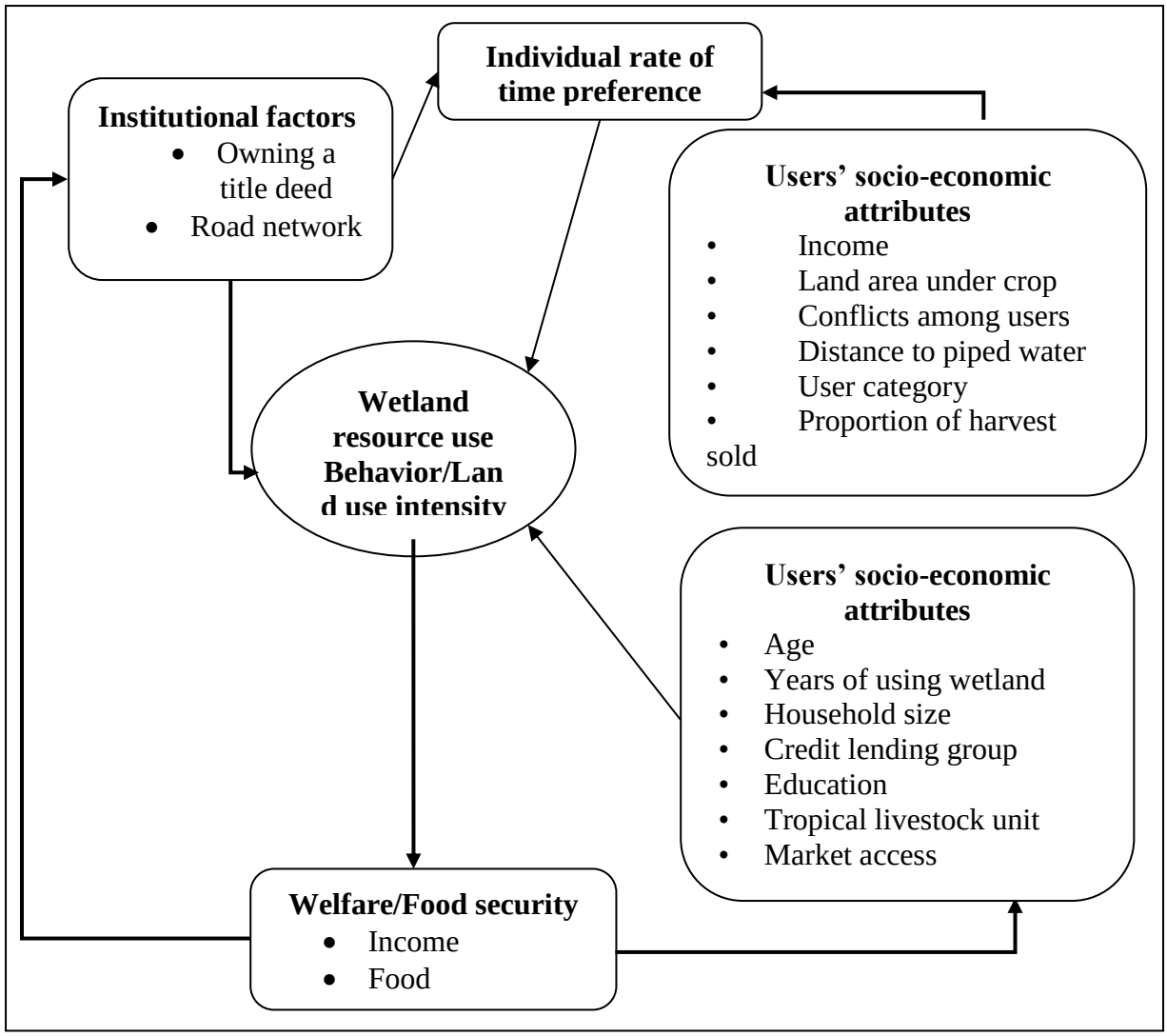

Figure 3.1: Conceptual framework of Ewaso Narok Wetland resource use

Source: Author, (2015).

3.2 Theoretical framework

This study is based on the producer theory which postulates that firms or producers either aim to maximize profits or minimize costs subject to technological constraints (Varian, 2010). To achieve this and determine the producer's response, two elements were important: The production function and producer behavior. The production function gives the technological relationship that exists between any particular combination of inputs and the resulting levels of outputs while the producer behavior gives the producers' behavior with respect to the choice

of inputs used to produce a desired level of output, given the prices of factors and products as well as the availability of fixed resources (Debertin, 1986). The inputs majorly considered in this study are land, water and pasture. Although most smallholder farmers make joint decisions on production and consumption for optimal production, given a desired output level that maximizes utility, the farmers will operate to minimize costs, especially costs of purchasing inputs when producing for own consumption with sale of excess.

3.3 Characterizing the major users of Ewaso Narok Wetland

Methods used to achieve this objective were one-way analysis of variance (ANOVA) and Chi-square tests to characterize the major wetland users. The one-way ANOVA was used to ascertain whether there were significant differences in the mean of age, years of education, the level of commercialization and household size of the user categories for each of the response variables gave the scenario of one response variable for multiple factor variables. The decision criterion is, if the F-statistic is significant; reject the null hypothesis that there is no significant difference in the mean characteristic of the user categories. One of the weaknesses of ANOVA is that it does not identify the specific mean that is different in the case at least one of the means is different (Field, 2009).

To address this weakness, this study used the Tukey's HSD because it reduces the chances of making type I error by taking into account sample size and the number of tests being carried out (Field, 2009). Chi-square test was used to ascertain whether the discrete attributes of the major wetland users differed with the user categories. The decision criterion is, if the Chi-square statistic is significant, the null hypothesis that there is no relationship between the characteristics of the users and the user categories are rejected (Greene, 2012). The specific

resource uses among the user categories were analyzed through descriptive statistics to show how the categories differ from each other in the use of resources.

3.4 Determinants of individual rate of time preference (IRTP)

Individual rate of time preference is estimated using two methods namely the exponential method and hyperbolic method. The exponential method regards IRTP as a constant value across time periods while the hyperbolic method assumes that the IRTP is not constant but declines across time. In real life it is expected that the IRTP vary from one person to another and over time (Di Falco, 2013). The formula for estimating the IRTP using the hyperbolic method is shown in equation 1;

$$r = \frac{\left(\frac{fut}{pre}\right)-1}{T} \quad \text{.....1}$$

Where *r* is the individual rate of time preference, *Fut* is the future value, *Pre* is the present value and *T* is the difference in two time periods.

To obtain the present and the future values used in the above methods, experimental approach of data collection is popularly used (Frederick *et al.,* 2002). The approach has four techniques namely choice task, matching task, pricing task and rating task (Hardisty *et al.,* 2013; Andersen *et al.,* 2008; Frederick *et al.,* 2002). The choice task involves asking the resource users to choose between a smaller value received in the current period, for example KES 1000, or a larger value received at a future period, for example KES 1150, in 6 months. If, the value received in the current period is held constant and the future value is increased in steps, the resource user can be asked to make a choice. This approach is referred to as multiple price list and it can be varied to compare choices for two values received in the future. For example, suppose the basic option has a constant value of of KES 1000 to be received after one month,

let this option be termed as current value. Suppose further that the resource user is asked to compare current period with future values progressively increased by KES 150 received after six months and 10 options are presented. The IRTP is determined by the critical point at which the resource user switches from choosing the current value to a specific future value. The weakness of this method is that the resource user can exhaust the ten future value options before making the switch (Hardisty *et al.,* 2013; Andersen *et al.,* 2008; Frederick *et al.,* 2002). The matching task method attempts to overcome this weakness.

In the matching task method the resource users is given a current value and a fixed time period in the future and asked to state the value they would prefer in that future period (Frederick *et al.,* 2002). The weakness of this method is that when the option of future value is left open, the respondents can exagerate the value, affecting the rate of time preference. Pricing tasks is another method of estimating IRTP which involves asking the resource users to state their willingness-to-pay in order to have an activity which increases their utility undertaken, or one that reduces their utility stopped (Hardisty *et al.,* 2013). The rating task involves an individual evaluating a given activity under a certain time period depending on its desirability and unpleasantness according to their opinion (Frederick *et al.,* 2002). This study employed both the choice task and matching task techniques.

The individual rate of time preference model was estimated using equation 2. The estimated individual rate of time preference was used as one of the explanatory variables in the estimating the resource use behavior (third objective). Land use intensity (LUI) index was used as a proxy for the resource use behavior and was estimated using principle component analysis. The test whether the error terms of the two models are correlated led to the choice of the seemingly unrelated regression estimator (SURE) model to assess the determinants of IRTP and LUI

index jointly. The individual rate of time preference model was estimated using equation 2 (Varian, 2010).

$$Y = \beta o + \sum_{i=1}^{n} \beta i Xi + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where Y is the individual rate of time preference calculated in the hyperbolic model formula, β_0 is the intercept, β_i are the coefficients to be estimated, X_I represents the explanatory variables and ε is error term. The variables used in the IRTP model, their description, units of measurement and expected sign as discussed in the literature review are shown in Table 3.1.

Table 3.1: Variables used to explain variation in individual rate of time preference of Ewaso Narok Wetland users

Variables	***Description***	***Expected sign***
Dependent variable		
IRTP (%)	Individual rate of time preference	
Independent variables		
Flood constraint(Yes=1)	Flood as a constraint to wetland use	-
Commercial farmer (Yes=1)	Wetland user being a commercial farmer	+
Pastoralist (Yes=1)	Wetland user being a pastoralist	+
Land area on crop (Ha)	Land area on crop in the wetland	+/-
Distance piped water (Km)	Distance from a homestead to piped water	+
Proportion of harvest sold (%)	Proportion of crop harvest sold	+
Total income (KES)	Total income of the household	-
Distance to ext service (Km)	Distance from a homestead to extension service	-
Conflicts among users (Yes=1)	Conflicts of user on the use of resource	+

3.5 Determinants of resource use behavior

Estimation of human behavior cannot be directly quantified and therefore, proxies are used. There are several proxies of measuring resource use behavior namely fallow rotation index, cropping intensity index and land use intensity index (Erb *et al.,* 2013; Saka *et al.,* 2010). The fallow rotation index (FRI) refers to the proportion of fallow land out of the total land area under crop for a given household according to Ruthenberg (1980). The advantage of this method is the ease of counting the number of rotations in a given field. The weakness of the proxy is that it only captures the intensity of resource use with regard to crop and excludes livestock keeping.

The cropping intensity index is used to estimate the intensity of resource use by measuring the proportion of years in which land has been under crops (Dayal, 1978). The index is calculated by multiplying the land area under crop with the period in months of cropping in a field and dividing with the optimal area of land under crop (Saka *et al.,* 2011). The advantage of this method is its accuracy in estimating the size of land and the number of months which a certain crop has been in the field. The limitation of the method is the bias to crop farming leaving out livestock keeping. This study employed the land use intensity (LUI) index as it considers both the crop and livestock.

The land use intensity index is used to estimate the level of human activity in an area using input use intensity and output intensity (Erb *et al.,* 2013; Dietrich *et al.,* 2012). The land use intensity was a composite index estimated using seven variables namely: capital inputs (KES/ha), labour input (man days/ha), livestock density (number), land area under crop (ha), quantity of harvest (Kg/ha), rate of organic and inorganic fertilizer application (Kg/ha). These variables were subjected to dimension reduction through the Principle Component Analysis

(PCA) approach which is a statistical method used to reduce the dimension of complex data that is highly correlated with a new variable (Kadir *et al.,* 2012; Pandey *et al.,* 2011 and Wu, 2006). The PCA was set such that the eigenvalue of one was used meaning each observed variable contributes one unit of variance to the total variance in the dataset; the factors with an eigenvalue of at least one were selected. To test the appropriateness of the factor analysis, the Kaiser-Meyer- Olkin test was used to measure sampling adequacy (KMO). The KMO statistic greater than or equal to 0.5 is adequate and acceptable (Field, 2009). The Bartlett's test should be significant meaning the correlation between the variables is significantly different from zero. The factors extracted explain the total variance and formed the LUI index which was used in the second model as the dependent variable.

The SURE model was used to estimate the determinants of the individual rate of time preference and resource use behavior jointly (Varian, 2010). Equation 3 was used to estimate the land use intensity index.

$$W = \varphi_0 + \sum_{i=1}^{n} \varphi_i Z_i + \varepsilon \quad \text{.....3}$$

Where W represented the LUI index, φ_0 is a constant φ_I are the coefficients estimated and Z_i represents the explanatory variables and ε is the error term. The variables used the land use intensity model, their description and expected signs are presented in Table 3.2.

Table 3.2: Variables used in land use intensity model of Ewaso Narok Wetland user

Variables	*Description*	*Expected sign*
Dependent variable		
LUI (Index)	Land use intensity	
Independent variables		
IRTP (%)	Estimated individual rate of time preference	+
Land tenure (Secure=1)	land ownership type	-
Market access (Km)	Distance from a homestead to the nearest shopping center	+
Household size (Number)	Household size	+
Education (Years)	Level of education of the household head	-
Membership to credit lending (Yes=1)	Household member being in a credit lending group	-/+
Wildlife danger (Yes=1)	Danger of wildlife in wetland	-
Age (Years)	Age of the household head	-/+
TLU (Number)	Tropical livestock unit	+/-
Years wetland use	Number of years of using the wetland	+

3.6 Study area

Ewaso Narok is a riverine wetland that lies at the center of Northing 00^0 32'55.5'' and Easting 036^0 61'00.2'', with an elevation of 1796 meters above sea level. It is the largest wetland in Laikipia of 23km long in a semi-arid area of Rumuruti Ward (Thenya *et al.*, 2011). The Wetland is situated in Ewaso Ngiro north drainage basin and it drains from Aberdares ranges and flows northwards then eastwards towards the Lorian swamp (Thenya, 2001). The study considered households within and around the wetland who utilized the wetland resources. Figure 3.2 presents a map of wetlands in Upper Ewaso Ng'iro Drainage with Ewaso Narok Wetland shown by the arrow.

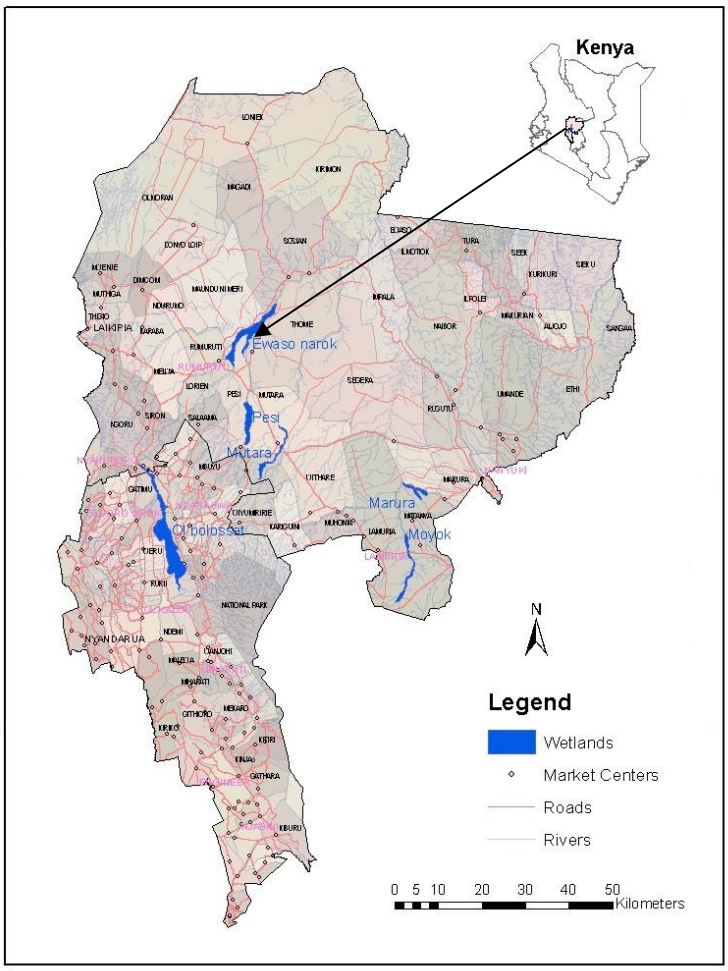

Figure 3.2: Map of Wetlands in upper Ewaso Ng'iro Drainage

Source: CETRAD (2011) as cited by Thenya *et al.*, (2011) Page 8.

3.7 Sampling design and data collection

A list of 5000 registered wetland users formed the sampling frame of the study and was obtained from the Water Resource Users Associations (WRUA). The stratified random sampling method was used to sample the Wards, then the sub locations and finally the villages of interest. A cross-sectional survey used semi-structured interview schedules. The respondents were drawn from the households in the villages proportional to size using the simple random sampling. The sample size was generated using the formula presented in equation 4 adapted from Kothari, (2004).

$$n = \frac{p(1-p)z^2}{E^2} \quad \text{.....4}$$

Where n is sample size, p is sample proportion commonly assumed to be 0.5, z is confidence interval and E is the margin of error. Calculation of the sample size it was assumed at z = 95%, p = 0.5 and the E was estimated at = +/- 5.66% in order to achieve the sample size of 300 respondents as shown in equation 5. Given the sampling frame a sample of 300 respondents was considered to be representative.

$$n = \frac{(1.96)^2 * 0.5(0.5)}{(0.0566)^2} \quad \text{.....5}$$

The sample was distributed across the three categories of users as follows: small-scale farmers, commercial farmers and pastoralist were 106, 95, and 99 respectively. This sample was randomly distributed across the wards and villages.

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter presents and discusses the descriptive and empirical results of the study. Section 4.1 discusses the characteristics of users in the wetland. The chapter progresses by discussing the empirical results of the SURE model to assess the factors influencing the individual rate of time preference and the resource use behavior in Ewaso Narok Wetland.

4.1 Characteristics of the major users of Ewaso Narok Wetland

The characteristics were based on the three major user categories namely small-scale and commercial farmers and pastoralists as presented in literature. Further, the characteristics were divided into socio-economic attributes and the different uses of the wetland.

4.1.1 Socio-economic characteristics of users in Ewaso Narok Wetland

The mean age of the small-scale farmers was 51 years, while that of commercial farmers and pastoralists was 44 and 42 years respectively. The average number of years of formal education for small-scale farmers, commercial farmers and pastoralist were about 5, 8 and 3 years respectively whereas the household size was 5 persons for the small-scale farmers, 4 persons for commercial farmers and 7 persons for pastoralists. The mean level of commercialization for small-scale farmers, commercial farmers and pastoralist were 0.37, 0.89 and 0.19 respectively. The level of commercialization as an economic factor among the user categories was also analyzed using the proportion of crops harvested and sold. As expected, the pastoralists practiced crop farming for own consumption only while commercial farmers sold most of their produce. The crop production by commercial farmers was market driven and therefore they used more inputs like 76% of them used fertilizers and 71% used pesticides.

To compare the mean differences in the age, years of education and household size among the user categories, one-way ANOVA was used. The results of the one-way ANOVA were: age (F=9.96; P=0.00), years of education (F=27.46; P=0.00), household size (F= 7.64; P= 0.00) and level of commercialization (F=1.039; P=0.357). The results supported the rejection of the null hypothesis that there is no difference in the characteristics above except for the level of commercialization. The study concluded that there was a difference in the means of age, years of education and the household size among the user categories. To identify the specific user category whose mean was different, the Tukey's HSD test was used and the results are presented in Table 4.1.

Table 4.1: Mean difference in the age, years of education and household size among users of the Ewaso Narok Wetland

Variable	User category	Mean	User category	Mean	Mean difference	P value
Age (years)	Small scale farmers	50.7	Commercial farmers	43.7	7.02**	0.00
	Small scale farmers	50.7	Pastoralist	41.9	8.80**	0.00
	Commercial farmers	43.7	Pastoralist	41.9	1.78	0.76
Education (years)	Small scale farmers	5.3	Commercial farmers	7.4	-2.16**	0.00
	Small scale farmers	5.3	Pastoralist	2.6	2.69**	0.00
	Commercial farmers	7.4	Pastoralist	2.6	4.86**	0.00
Household size (Number)	Small scale farmer	5	Commercial farmers	4	1.00	0.00
	Small scale farmers	5	Pastoralist	7	-2.00**	0.00
	Commercial farmers	4	Pastoralist	7	-3.00**	0.00

Tukey's HSD test

Source: Author's Survey, (2015)

The study found that small-scale farmers were older than commercial farmers and pastoralists by about 7 and 9 years respectively. Younger farmers are likely to be more educated and therefore have better farming techniques and thus are attracted to commercial farming as opposed to the older generation. This finding contradicts Fule (2013) who found the commercial farmers to be older than small-scale farmers. The discrepancy could be as a result of the intensive capital requirements of commercial farming limiting the number of young farmers who can afford to invest in it.

Small-scale farmers spend 2 years lesser in school compared to commercial farmers and 3 years more than pastoralists (Table 4.1). Commercial farmers, on the other hand, spend 5 years more in school compared to the pastoralists (Table 4.1). The fewer number of years in school by the pastoralists could be as a result of their nomadic way of life making it difficult especially for the young boys to stay in school after they attain teenage and become active in cattle keeping. The relatively many years of formal education by the commercial farmers can be explained by the sophisticated skills required in commercial farming like pesticide use and as a result, commercial farming attracts farmers with a higher level of education.

The average household size of small scale farmers was one person more than commercial farmers and two people less than that of the pastoralist. The pastoralists had the highest household sizes among the other two categories of wetland users. The household size of the commercial farmers was the smallest among the wetland user categories. This could be due to better education of the commercial farmers which leads to the adoption of family planning method (Eliason *et al*., 2014). In addition, the pastoral communities commonly practice polygamy further explaining the large size of their household.

To compare the differences in sex, membership to credit lending group and owning a title deed among the wetland user categories, the Chi- square test was used. The null hypothesis tested was that there is no association between an attribute, for example, sex and the category of wetland users. The Chi -square results are presented in Table 4.2. There was an association between the wetland user categories and all the attributes of the household head (Table 4.2). A test of the relationship in the number of men and women users of the wetland revealed that male users were more compared to their female counterparts ($\chi^2(1) = 27.47$; P=0.00). A large percentage of the female-headed households practiced small-scale farming.

Table 4.2: Differences in the sex, credit lending group and owning a title deed attributes among Ewaso Narok Wetland Users

Attribute		*Small scale farmers*	*Commercial farmers*	*Pastoralists*	*Chi-square*	*P value*
Sex	**Female**	36	7	12	27.47	0.00
	Male	70	88	87		
Membership to credit Lending group	**No**	85	64	93	21.97	0.00
	Yes	21	31	6		
Owning title deed	**Yes**	14	36	2	28.75	0.00
	No	85	58	50		

Source: Author's Survey, (2015)

The study, in addition, found that there was an association between the wetland user categories and membership to a credit lending group despite fewer farmers being group members (Table 4.2). The results showed that being a member of a credit lending group was significantly low among the wetland users. The pastoralists have the lowest proportion of users being group

members because of their nomadic way of life which may not allow them to group together. The involvement of commercial farmers in groups as compared to the small-scale farmers could be a risk management strategy because their investments are more compared to small scale farmers.

Furthermore, it was found that there was a relationship between the user categories and owning a title deed. The majority of the wetland users had no land title deeds a finding that could be due to the fact that, the Ewaso Narok Wetland is a public land. Commercial farmers had the highest proportion of farmers who owned title deeds because they are resource endowed and can meet the legal and transaction costs of owning a title deed. Pastoralists had the least proportion of users with title deeds as can be explained by the mobile nature, therefore, do not need to settle in the same parcel of land for long. This is disincentive of incurring the cost of owning a title deed.

4.1.2 Use based characteristics of the users of Ewaso Narok Wetland

Further to the socio-economic characteristics discussed in section 4.1.1, this study characterized the wetland users based on the different ways in which they utilize the wetland as shown in Table 4.3. The wetland resources majorly were land for cultivation, pasture and fodder, water, roofing material, building poles and firewood. The wetland uses were taken to be those reported by over 50 percent of the respondents. These were the use of the wetland as land for rainfed crop production; drawing water for crop irrigation, harvesting wood and reeds as roofing materials, livestock grazing. Almost half (48 percent) of the small-scale farmers were using the land in the wetland for rain-fed crop production compared to 14 percent of pastoralists.

Pastoralists are mainly involved in livestock keeping explaining the small proportion of the livestock keepers involved crop production. The large proportion of small-scale farmers involved in rainfed crop production is as a result of the free access nature of the wetland since it is a public land. In addition, the wetland has restrictions on the size of land that a household can own limiting the commercial farmers. More than half (65 percent) of the commercial farmers used the wetland for drawing water for irrigation compared to 28 percent of small-scale farmers and 7 percent of pastoralists. Most of the commercial farms are located further from the wetland explaining why the majority of the commercial farmers use water from the wetland for irrigation. The capital investment in irrigation agriculture is high and commercial farmers who are largely resource endowed can afford such an investment.

Table 4.3: Uses among the major user categories in Ewaso Narok Wetland

Uses	User category		
	Small-scale farmers (%)	***Commercial farmers (%)***	***Pastoralist (%)***
Rain fed crop production	48	38	14
Livestock grazing	18	23	59
Roofing materials	30	18	52
Irrigation water	28	65	7

Source: Author's Survey, (2015).

As expected, the majority of the pastoralists (59 percent) were using the wetland for livestock grazing. This is due to their large number of animals as compared to the small-scale and commercial farmers. For instance, the pastoralists had 35.2 TLUs compared to 19.3 and 8 TLUs owned by the commercial and small-scale farmers respectively. Fifty-two percent of the pastoralists use the wetland as a source of roofing materials such as papyrus reeds to construct

temporary shelter as they move from one area to another in search of pasture and water for their livestock. The commercial farmers use less of the wetland as a source of roofing materials because most of them have built permanent houses using iron sheets.

4.2 Determinants of Individual rate of time preference and Resource use behavior

4.2.1 Diagnostic tests results

The study tested for the correlation of the error terms using the Breush-Pagan test of independence. The results show that the error terms were correlated (P= 0.027). Therefore, the null hypothesis that the error terms are not correlated in the two models was rejected and the study concluded that the seemingly unrelated regression estimator (SURE) was an appropriate technique as it would give efficient estimates as opposed to ordinary least squares (Greene, 2012). Further, the study tested for multicollinearity, the resulting VIFs were less than 10 reflecting no evidence of multicollinearity amongst the independent variables (Gujarati, 2003). The results are presented in Appendix 1. To test whether the models fit the data well, the R-squared was computed. The overall adjusted R-squared as computed for the IRTP and LUI models was 0.50 and 0.62 respectively.

4.2.2 Individual rate of time preference

The individual rate of time preference was calculated using the hyperbolic model (Equation 4) and the results are presented in Table 4.4. The average individual rate of time preference for the three use categories was 20.05 percent. According to the CBK, (2015), the average market interest rate in Kenya for the year 2015 was 11.50 percent which was lower than the average individual rate of time preference of users in Ewaso Narok Wetland. This comparison with average market interest rate was as postulated by Varian, (2010). A high individual rate of time preference implies that users are extracting more of the wetland resources in the current period.

The commercial farmers had the highest average individual rate of time preference of 32.69 percent while the pastoralists had the lowest average individual rate of time preference of 6.55 percent reflecting less use of resources in the present time.

An analysis of the factors influencing the individual rate of time preference found that the distance from a homestead to piped water, availability of user conflicts, land area under crop and user commercialization significantly influence the individual rate of time preference. The results of the factors influencing the individual rate of time preference are presented in Table 4.4.

Table 4.4: Factors influencing the individual rate of time preference of Ewaso Narok Wetland users

Variables	***Coefficient***	***Std. Error***	***P value***
Dependent variable			
Individual rate of time preference(log)			
Independent variables			
Intercept	-0.05	0.49	0.91
Distance from a homestead to piped water (Km)	0.03***	0.01	0.00
Distance from a homestead to extension services (Km)	0.22	0.20	0.19
Land area under crop in the wetland (Ha)	0.33**	0.15	0.03
Proportion of harvest sold (%)	0.66	0.62	0.28
Total household Income per annum (KES)	-0.06	0.06	0.29
Floods constraint (Yes=1)	-0.54	0.29	0.19
Being a commercial farmers	0.67**	0.32	0.03
Being a pastoralists	0.41	0.27	0.65
User conflicts (Yes=1)	0.47*	0.31	0.09

*, **, *** means significance at 10%, 5%, 1% respectively.

Source: Author's Survey, (2015)

To test for differences of the wetland user category which contributes to the specific significant variable, Table 4.5 was generated.

Table 4.5: Factors influencing individual rate of time preference among different user categories in Ewaso Narok Wetland

Variables	*Small scale farmer*	*Commercial farmer*	*Pastoralists*
Dependent Variable			
Individual rate of time preference(log)			
Independent variables			
Intercept	-1.05	-1.44	-0.91
Distance from a homestead to piped water (Km)	0.13*	0.28**	0.02
Distance from a homestead to extension services (Km)	0.25	0.64	0.28
Land area under crop in the wetland (Ha)	0.31**	0.22	0.26
Proportion of harvest sold (%)	0.29	0.42**	0.01
Total household Income per annum (KES)	-0.17	-0.48	0.09
Floods constraint (Yes=1)	-0.34	-0.56	-0.22
User conflicts (Yes=1)	0.37*	0.19	0.33**

*, **, *** means significance at 10%, 5%, 1% respectively.

Source: Author's Survey, (2015)

An increase in the distance from a homestead to piped water by one kilometer increases the individual rate of time preference by 3 percent. Piped water from county government was used as a proxy of an alternative source of water which is an important resource in the wetland. This finding implies that the use of water from the wetland would reduce if alternative sources of water are provided promoting sustainable use of the wetland. The crop farmers are mostly

affected by the distance from the homestead to piped water as opposed to the pastoralist who may not be relying on alternative sources of water besides the wetland.

An increase in the land under crop production by one hectare increased the individual rate of time preference by 33 percent. Households that have a larger area of land on crop utilizes more of the wetland resources such as water than households that have a smaller land area under crop. This contradicted the findings of Yesuf and Bluffstone, (2008) which concluded that land area under crop had a negative effect on the individual rate of time preference which could have been due to the diversified use of land resources. The small scale farmers are the major users of land within the wetland area for cultivation as opposed to commercial farmers who use the large tracks of land surrounding the wetland for cultivation.

Being a commercial farmer increased the individual rate of time preference by 68 percent. Most of the small-scale farms were located within the wetland and mostly used rudimentary technologies such as bucket irrigation which is more conservative in water use. As expected, commercial farmers have a higher proportion of harvest sold compared to small scale farmers and pastoralist. This explains the large percentage of a positive contribution to individual rate of time preference. This means commercial farmers use more of the wetland resources like water compared to the other two categories of users.

User conflicts increases the use of resources in the present period by 47 percent. The major conflicts are between the small scale farmers and the pastoralist who compete for the resources like land for either crop cultivation or pasture for livestock within the wetland at a given time. This is consistent with the findings of Thenya *et al*., (2011) that crop farmers and livestock

farmers conflict on the use of resources in the wetland. This conflict increases the competition in the extraction of resources as every user wants to maximize the benefits available.

4.2.3 The factors influencing resource use behavior

Land use intensity (LUI) was used as a proxy for measuring resource use behavior. The Principle Component Analysis (PCA) was used to reduce the individual factors into a single variable index which was then used as the dependent variable. To test whether the individual variables were highly correlated to be used in a PCA, the KMO test was used and gave a value of 0.524 while Bartlett's test was significant at $p<0.000$ implying the correlation between the variables was significant implying that the variables could be reduced using PCA. The factors extracted were explaining 72 percent of the total variance of the variables and the predicted variable formed the LUI index.

To generate a comparable indicator of wetland use intensity among the users, the land use intensity index was normalized in a scale of 0 and 1. The values tending towards 0 represent low land use intensity and the values tending towards 1 represent high land use intensity. The mean land use intensities for the commercial farmers, small-scale farmers, and pastoralists were 0.69, 0.44 and 0.26 respectively. This means that the commercial farmers use the land in the wetland more intensely followed by small-scale farmers. Pastoralists are the least intense users of the land. This could be because the pastoralists often move from one area to another as they look for pasture allowing the wetland resources such as water and pasture time to rejuvenate. In addition, pastoralists do not use inputs like fertilizer or irrigation pumps reflecting low land use intensity.

Several factors were found to influence the LUI in Ewaso Narok wetland as shown in Table 4.6. The individual rate of time preference had the highest magnitude in influencing the land use intensity followed by membership to credit lending group and a farmer owning a title deed.

Table 4.6: Determinants of land use intensity for Ewaso Narok Wetland users

Variables	**pooled**	**Small scale farmer**	**Commercial farmer**	**Pastoralist**
Dependent variable				
Land use intensity (index)				
Independent variables				
Intercept	-1.69	-1.07	-1.41	-0.27
Individual rate of time preference	1.65***	0.83*	1.46**	0.39*
Group membership(credit lending)	-1.24***	-0.89*	-0.40*	-0.28
Owning a title deed	-0.94**	-0.44	-0.69**	-0.32
Household size (Number)	0.60*	0.40*	0.35	0.21*
Education (Years)	-0.11**	-0.10	-0.15*	0.43
Age (Years)	-0.01	-0.21	-0.38	-0.59
Tropical livestock units (Number)	0.01***	0.11	0.24	0.03**
Danger of wildlife (Yes=1)	0.66	0.67	0.44	0.49
Years of using the wetland	0.05**	0.45**	0.34	0.32
Distance to the shopping center (Km)	-0.03	-0.03	0.02	0.20

*, **, *** means significance at 10%, 5% and 1% respectively.

Source: Author's Survey, (2015)

One unit increase in the individual rate of time preference increased the land use intensity by 1.65 units. Individuals with a high rate of time preference use more of the land resources in the

wetland. This is consistent with Gunatilake *et al.,* (2009) and Di Falco, (2013) findings that those with high individual rate of time preference harvested more of a specific resource in the present time with minimal conservation. The commercial farmers use more of the wetland resources followed by small scale farmers then lastly pastoralists.

A household head being a member of credit lending group reduces the land use intensity by 1.24 units. This could be due to the access to credit through being a member of a group, which facilitates diversification to other activities outside the wetland use, for instance, small businesses. In turn, such a diversification can promote sustainable use of the wetland. This finding is consistent with Mnimbo, (2013) found that group membership improved the level of income through access to credit and encouraged diversification into non-agricultural based businesses. As expected, the crop farmers are more into membership of credit lending groups as opposed to pastoralists who are move from one area to another in search of water and pasture for their livestock

Having a land title deed as a proxy for secure land tenure decreases the intensity of land use by 0.94 units. The wetland users with title deeds were mostly located further from the wetland. These were the commercial farmers who owned the title deeds as most of their pieces of land were outside the wetland area which is a government land. This reflects the fact that users with secure land user rights use the wetland resources conservatively as opposed to users who had insecure land tenure because of the assured private ownership of the land. This result was in contradiction to that of Taruvinga and Mushunje, (2010) who found a positive effect of owning a title deed on the use of wetland resources.

An increase in the family size of a wetland user increased the intensity of land use by 0.60 units. Larger households have more available labor that can be allocated to a wide range of activities. This is similar to the findings of Sourya *et al.,* (2015) who found a positive relationship between household size and the use of the wetland resources. The small scale farmers and pastoralist have larger household size as compared to commercial farmers. A year increase in the level of education reduces the land use intensity by 0.11 units. High level of education of an individual is associated with higher income according to Gunatilake *et al., (*2009) which in turn leads to diversification to alternative ways of earning. This was consistent with the findings of Felix, (2012) which found a negative effect of education on wetland resource use. As expected, the commercial farmers are more educated than small scale farmers and pastoralists.

A unit increase in the tropical livestock unit among the wetland users increased the land use intensity by 0.01 units. This implies that, households which have a large herd of livestock use more wetland resources like pasture and water than those with fewer animals. This finding is consistent with the findings of Sourya *et al*., (2015) who found a positive relationship between the number of livestock owned and wetland use. The pastoralists had larger number of livestock and therefore, they contributed more to the intensity of using the land through livestock grazing. An increase in the number of years of using the wetland increased the intensity of resource use by 0.05 units. This means that those users who had used the wetland for many years used it more intensely as compared to those that had used it for fewer years. According to Thenya *et al.,* (2011) some households had used the resource for over three decades improving their skills of extracting as much of the wetland resources. The small scale farmers have used wetland for more years than pastoralists and commercial farmers.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Ewaso Narok Wetland is a diverse ecosystem supporting livelihoods through crop farming and livestock grazing. The wetland is faced with a challenge of increase in population pressure which leads to human encroachment with over 80 percent of the wetland area having human activities. This affects the sustainability of the wetland and therefore it is important to understand the determinants of the current resource use behavior to facilitate sustainable management. Consequently, the objectives of this study were to characterize the major users of the wetland, assess the determinants of their individual rate of time preference and the resource use behavior.

A list of 5000 registered wetland users provided by the Water Resource Users Associations (WRUA) formed the sampling frame of the study. Stratified random sampling was used to the wards, sub location and villages forming the strata. Respondents were drawn from the villages proportional to the number of user per village using the simple random sampling method. A sample of 300 respondents consisting of 106 small scale farmers, 95 commercial farmers, and 99 pastoralists was selected. A structured questionnaire was used in a survey to collect the data and analysis was done using SPSS and STATA.

The analysis combined descriptive analysis such as the use of cross tabulations, parametric analysis such as ANOVA. The individual rate of time preference was estimated using both choice task and matching task on the hyperbolic model. Land use intensity index (LUI) was used as a proxy to measure the resource use behavior. Two econometric models were analyzed jointly using the seemingly unrelated regression estimator; to determine the factors that

influence the individual rate of time preference and to determine the factors that influence the resource use behavior.

The study found that the average age of the Ewaso Narok Wetland users was 47 years with the small-scale farmers being the oldest with 51 years and the commercial farmers being the youngest at 42 years. Younger farmers are energetic implying more extraction of the wetland resources. The average number of years of education among the user categories was 5 reflecting that most of them have not completed primary education and therefore their chances of formal employment are few. The average level of education for the small scale farmers was lower (5 years) than that of the commercial farmers (8 years) and higher than that of pastoralist (3 years). A Higher level of education is associated with the use of sophisticated technologies such as tractors and irrigation machines suggesting more extraction of the wetland resources by the commercial farmers compared to the other user categories.

Pastoralist had the highest number of household members which is associated with their polygamous culture. The mean household size of the commercial farmers was the lowest among the categories which are associated with higher education influencing the use of family planning methods. There was an association between the sex of the household head and the wetland user categories. The men were more involved in using the wetland compared to women. The women were more involved in small scale farming as they concentrate on food provision for the household.

There was an association between the membership to credit lending group and the wetland user categories. The majority of the wetland users were not members of groups which is associated with access to finance enabling the users to diversify into activities like business reducing the

level of use of the wetland. There was a relationship between the user category and owning a title deed by a famer. The majority of the users in the wetland had no title deed on their land because the wetland is a public property. The farms with title deeds are located farther from the wetland and thus were not majorly used. Insecure land tenure is associated with over-extraction of resources which means that the land tenure of all the wetland users should be secured.

The average individual rate of time preference of the users was 20.05 percent, higher than the mean market interest rate of 11.05 percent in 2015 indicating that the users are extracting more of the wetland resources in the present time. The commercial farmers had the highest average individual rate of time preference of 32.69 percent while the pastoralists had the lowest average individual rate of time preference of 6.55 percent reflecting less use of resources in the present time. The individual rate of time preference had the highest effect in influencing the land use intensity (the proxy for resource use behavior in this study). As a result, the factors which influence the individual rate of time preference should be given a high priority in consideration for sustainable management of the wetland. Other factors that influence the resource behavior were group membership, tropical livestock units, owning a title deed, education and number of years of using the wetland.

5.2 Conclusion and Recommendation

In conclusion, the wetland users are heterogeneous differing on several socio-economic and use characteristics, for example, the average age of the users was 47 years with the small-scale farmers being the oldest and the commercial farmers being the youngest. The average level of education for the small scale farmers was lower than that of the commercial farmers and higher than that of the pastoralist. More than half (65 percent) of the commercial farmers used the

wetland for drawing water for irrigation compared to 28 percent of small-scale farmers and 7 percent of pastoralists. The majority of the pastoralists (59 percent) were using the wetland for livestock grazing. This is due to their large number of animals as compared to the small-scale and commercial farmers. For instance, the pastoralists had 35.2 TLUs compared to 19.3 and 8 TLUs owned by the commercial and small-scale farmers respectively.

The current average individual rate of time preference of the wetland users is higher than the average market interest rate reflecting a high extraction of the wetland resources in the present time calling for policy interventions that can reverse this trend. Individuals with a high rate of time preference use more of the land resources in the wetland. In order to reduce the intensity of land use in the wetland, the drivers of the individual rate of time preference should be addressed for the sustainable management of the wetland. The therefore, recommends the number of commercial farmers should be reduced, land area under crop allocated per household should be minimized and conflicts among the different users should be controlled. In order to sustainably manage the wetland alternative sources of resources like piped water should be provided near the wetland area. The piped water should be for both domestic use and crop irrigation in the upland area. This will reduce the rate of extraction of the water resource from the wetland.

The land use intensity is high driven by the increased use of resources in the present period and other socio-economic factors such as a farmer owning a title deed and membership to credit lending group. The study therefore recommends provision of land title deeds to ensure secure land tenure. This will encourage sustainable use of resources in the wetland as the farmers attain private user rights. Membership to credit lending groups enhances diversification into other activities outside the wetland and therefore, wetland users should be encouraged to be

members of credit lending groups. In addition, the study also concludes that better education is a positive contributor to reduced land use intensity; therefore, the study recommends the provision of better and accessible education facilities including for adult learning. Number of livestock grazing in the wetland increases the intensity of land use and therefore the study recommends the number of livestock per household which are allowed to graze in the wetland at a time should be limited to facilitate sustainable management.

5.3 Suggestion for further research

Further research can be done to ascertain the optimal amount of land required for crop production and the number of livestock that can be allowed within the wetland area to enhance sustainable management.

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APPENDICES

Appendix 1: Test for Multicollinearity; Individual rate of time preference model

Variable	VIF	1/VIF
Distance from the homestead to piped water	1.49	0.67
Distance from the homestead to extension service	1.28	0.78
Commercial farmer	1.48	0.67
Pastoralist	1.28	0.77
Income	1.39	0.71
User conflicts	1.24	0.80
Proportion of harvest sold	1.13	0.88
Household size	1.20	0.83
Land area under crop	1.10	0.90
Mean VIF	1.23	

Land use intensity Model

Variable	VIF	1/VIF
Individual rate of time preference	8.97	0.15
Age	1.38	0.72
Membership to credit lending group	1.19	0.84
Owning a title deed	1.47	0.68
Years of using the wetland	2.74	0.36
Household size	1.78	0.56
Danger of wildlife	1.24	0.80
TLU	1.81	0.55
Education	3.75	0.26
Distance to the shopping center	2.03	0.49
Mean VIF	2.93	

Source: Author's Survey, (2015)

Appendix 2: Survey Instrument

University of Nairobi/GlobE Wetlands in East Africa Project

Ewaso Narok Wetland Users Household Survey 2015

"We are part of a team at University of Nairobi and other collaborators, who are studying aspects on how communities benefit from wetlands in the Laikipia County. You have been randomly selected to take part in this survey and therefore your participation in answering these questions is very much appreciated but purely voluntary and free to withdraw anytime during the interview. Your responses will be COMPLETELY CONFIDENTIAL. Your responses will be added to those of 300 other households and analyzed together. If you indicate your voluntary consent by participating in this interview, may we begin?

SECTION A: PRELIMINARIES

Survey Date: (dd/mm/yy) **SURDATE** _____		**HHID** _____
HH Name _____**HHNAME**	Cell phone number	**CELLPH**_____
Respondent(s) _____**RESPO**		**MEM** _____

(**Enumerator Instruction**: Record the member number of the Respondent from the demography table on **section K** after the survey is completed.)

Identifying Variables:		
Supervisor:_____		**SNUM** _____
Enumerator:_____		**ENUM** _____
County_____		
Sub-county:_____		**SCONT** _____
Ward: _____		**LOC** _____
Sub-Location:_____		**SUBLOC** _____
Village: _____		**VIL** _____
GPS coordinates:		
	(1=North 2=South) **NS**_____	**Northing :** _____' _____**dd**)
	East **_**	**Eastings** : _____' _____**dd**)
		Alt : Altitude **m. a.s.l** (_____)
User Category: 1= Small holder non- commercial farmer 2=Commercial farmer 3=Pastoralist		**[_____]**

SECTION B: WETLAND UTILIZATION

B1. When did you start using the wetland (year)? **wetstart** [_____]

B2. For the different ways in which you use the wetland, please answer the following questions

(ENUM: the *First probe for all uses then ask the questions that follow***)**

Wetland use	Have you used the wetland for this purpose within the last 10 years? **1= Yes; No=2**	Which year did you start using the wetland for this purpose?	Indicate the frequency of using the wetland for this purpose (see codes below)	Why do you prefer using the wetland for this purpose? (**ENUM**: *List the first two in order of importance*)		Other than the wetland, do you usually obtain these products/service from elsewhere? **1= Yes; No=2**	If **others =1**, what are the alternative sources (almost 2)
Wetuse	**Wetused**	**Yearstart**	**times**	**period**	**Prefere1-2**	**othersrc**	**Altesrc**
1=Crop Production							
2=Livestock grazing							
3= Domestic Water							
4=Medicinal plants							
5=Fuel (firewood, charcoal.)							
6=Weaving and Basketry							
7=Building poles							
;8=Roofing materials							
9=Cut and curry fodder							
10=Brick making							
11=Irrigation water							
12=Fishing (natural)							
13=Fish ponds							
14=Other(specify)_____							
15=Other(specify)_____							

Codes: Period: 1= Day 2=Week 3= Month 4=Semi-annually 5=Annually 6=Other Specify_____

Prefer1-2 1=the only source 2=Conducive environment 3=Its a public resource 4=It´s my land 5=Its close to my home 6=Quality fodder 7=Land is scarce 8=Scarcity of fodder 9=Other (specify) _____

altsrc : 1=Government land 2=Own farm-upland 3=Hired land –upland 4= River 5=Communal land 6=Other(specify)_____

B3: Indicate your opinion on the following statements, indicating to what extent you either agree or disagree with the statements

	Statement	**1=Strongly Agree**	**2=Agree**	**3=Neutral/Don't know**	**4=Disagree**	**5=Strongly disagree**
1	Compared to the past, the use of the wetlands in this area has increased					
2	Compared to the past, the level of fertility in the wetland has declined					
3	People in this community would support efforts to conserve the wetland(s)					
4	Compared to 10 years ago, the amount of water in the wetlands in this area has declined					
5	Compared to the last 10 years, the amount of food production in the wetland has increased					
6	People in this area feel that they own the Ewaso Narok wetland					
7	People in this area care about public natural resources					
8	I have witnessed some form of conflict over wetland resources in the past					
9	Government officials are effective in protecting the wetland					
10	It is safe to leave my home unattended because no one can steal anything					
11	People in this area feel generally secure when dealing with outsiders					
12	If I drop my wallet/purse somewhere within this village, I am likely to get it back					
13	People in this area have strong traditional attachment to the wetland					

SECTION C: CROP PRODUCTION

RAIN-FED CROP PRODUCTION: MAIN SEASON 2014 (March-June 2014)

C1. Did this household have any cropping activity in **wetland fields** during **the MAIN CROP Season 2014?** (1= yes; no=2)
MAINCROPWET_____

C2. Did this household have any cropping activity in **upland fields** during **the MAIN CROP Season 2014?** (1= yes; no=2)
MAINCROPUP_____

C3. If C1=1 and/or C2 =1, go to Table below; Otherwise move to the short season crop.

Crop code	Parcel No.	Field No.	Field Location 1=Wetland 2=Upland	Size of the field (Acres)	Tenure	Fertility status: 1=poor 2=fertile 3=very fertile	Main land prep type 0=none 1=manual 2=oxen 3=tractor	Hired land prep cost (Ksh)	**Planting/ Seed Type** 1=Purch /New Hybrid 2=Retained Hybrid 3=OPV 4=local var 5=local seedling/cuttings/splits 6=improved seedling /cuttings /splits 7=hybrid & local var 8=hybrid purc+retained	Quantity of seed used & cost, if purchased this season			1st Fertilizer used			2nd Fertilizer used			3rd Fertilizer used			Harvest -777=not yet harvested		Sales			**For the largest Sale**				Quantity that spoiled after harvest **(Use harvest units)**	Reasons for spoilage 1=pests 2=floods 3=animal destruction 4=Rains 5=Moulds 6=No market 7=Other (specify)
										Qty	Unit	Cost per unit	Type	Qty	Unit	Type	Qty	Unit	Type	Qty	Unit	Qty	Unit	Sold? 1=yes 2= No	Quantity sold **(Use harvest units)**	Month 1= Jan. …….. 12=Dec	Price received per unit	Buyer type	Km to point of sale		
crop		**field**	**Fldloc**	**acres**	**tenure**	**ferts**	**land prep**	**Lpcost**	**Sdtype**	**sqt**	**sunit**	**scost**	**ft1**	**fq1**	**fu1**	**ft2**	**fq2**	**fu2**	**ft3**	**fq3**	**fu3**	**hvt**	**Hunit**	**sold**	**sqty**	**month**	**price**	**buyer**	**Km**	**posthar v**	**spoil rea**

Unit codes:
1=90 kg bag
11=50 kg bag
2=Kgs
3=Litre
4=crates
5=numbers
6=bunches(bananas
9=gorogoro
10=tonnes
12=debe
13=grams
14=wheelbarrow
15=cart
16=canter
17=pickup
18=2kg packet(seed)
19=bale

Fertilizer codes:
0=None
1=DAP
2=MAP
3=TSP
4=SSP
5=NPK (20:20:0)
6=NPK (17:17:0)
7=NPK (25:5:+5S)
8=CAN (26:0:0)
9=ASN (26:0:0)
10=UREA (46:0:0)
11=SA (21:0:0)
12=Other (specify)___
13=manure
14=foliar feeds
15=NPK (23:23:23)
16=NPK (20:10:10)
17=DAP + CAN
18=compost
19=magmax lime
20=DSP
21=NPK(23:23:0)
22=NPK(17:17:17)
23=NPK(18:14:12)
24=NPK(15:15:15)
25=mavuno-basal
26=kero green
27=rock-phosphate
28=NPK 14:14:20
29=mijingu 1100
30=UREA+CAN
31=Mavuno-top dress
32=Blended fertilizers

Buyer type codes:
1=small trader
2=large trader
3=KTDA
4=coffee coop
5=NCPB
6=miller
7=other coop
8=NGO
9=consumer
10=Exporter
11=processor
12=supermarket
13=cereal bank
14=pyrethrum board
15=Institutions
16=Other -specify

Tenure codes
1=owned w/ deed
2=owned w/o deed
3=rented in
4=owned by parent/ relative
5=government/communal/co-operative/road reserves
6=Leasehold
7=Other(specify)_____

RAIN-FED CROP PRODUCTION SHORT SEASON 2014 (October-December 2014)

C4. Did this household have any cropping activity in **wetland fields** during **the SHORT CROP Season 2014?** (1= yes; no=2)
SRTCROPWET_____

C5. Did this household have any cropping activity in **upland fields** during **the short CROP Season 2014?** (1= yes; no=2)
SRTCROPUP_____

C6. If C4=1 and/or C5 =1, go to Table below; Otherwise move to the Irrigated crops Table. Crop code	Parcel No.	Field No.	Field Location 1=Wetland 2=Upland	Size of the field (Acres)	Tenure	Fertility status: 1=poor 2=fertile 3=very fertile	Mainland prep type 0=none 1=manual 2=oxen 3=tractor	Hired land prep cost (Ksh)	**Planting/ Seed Type** 1=Purch /New Hybrid 2=Retained Hybrid 3=OPV 4=local var 5=local seedling/cuttings/splits 6=improved seedling /cuttings /splits 7=hybrid& local var 8=hybrid purc+retained	Quantity of seed used & cost, if purchased this season	1st Fertilizer used	2nd Fertilizer used	3rd Fertilizer used	Harvest-777=not yet harvested	Sales	**For the largest Sale**	Quantity that spoiled after harvest **(Use harvest units)**	Reasons for spoilage 1=pests 2=floods 3=animal destruction 4=Rains 5=Moulds 6=No market 7=Other (specify)

crop		**field**	**Fldloc**	**acres**	**tenure**	**ferts**	**landprep**	**lpcost**	**Sdtype**	**sqt**	**sunit**	**scost**	**ft1**	**fq1**	**fu1**	**ft2**	**fq2**	**fu2**	**ft3**	**fq3**	**fu3**	**hvt**	**Hunit**	**sold**	**sqty**	**month**	**price**	**buyer**	**Km**	**postharv**	**spoilrea**

Unit codes:
1=90 kg bag
11=50 kg bag
2=Kgs
3=Litre
4=crates
5=numbers
6=bunches(bananas
9=gorogoro
10=tonnes
12=debe
13=grams
14=wheelbarrow
15=cart
16=canter
17=pickup
18=2kg packet(seed)
19=bale

Fertilizer codes:
0=None
1=DAP
2=MAP
3=TSP
4=SSP
5=NPK (20:20:0)
6=NPK (17:17:0)
7=NPK (25:5:+5S)
8=CAN (26:0:0)
9=ASN (26:0:0)
10=UREA (46:0:0)
11=SA (21:0:0)
12=Other (specify)___
13=manure
14=foliar feeds
15=NPK (23:23:23)
16=NPK (20:10:10)
17=DAP + CAN
18=compost
19=magmax lime
20=DSP
21=NPK(23:23:0)
22=NPK(17:17:17)
23=NPK(18:14:12)
24=NPK(15:15:15)
25=mavuno-basal
26=kero green
27=rock-phosphate
28=NPK 14:14:20
29=mijingu 1100
30=UREA+CAN
31=Mavuno-top dress
32=Blended fertilizers

Buyer type codes:
1=small trader
2=large trader
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4=coffee coop
5=NCPB
6=miller
7=other coop
8=NGO
9=consumer
10=Exporter
11=processor
12=supermarket
13=cereal bank
14=pyrethrum board
15=Institutions
16=Other -specify

Tenure codes
1=owned w/ deed
2=owned w/o deed
3=rented in
4=owned by parent/ relative
5=government/communal /co-operative/road reserves
6=Leasehold
7=Other(specify)_____

CROP PRODUCTION: IRRIGATED CROPS

C7. Did this household have any irrigated cropping activity in **wetland fields** in the last cropping year (**2014/2015)?** (1= yes; no=2) **IRRCROPWET [_____]**

C8: If yes, what is the main method of irrigation used? 1=Drip 2=Furrow 3=Sprinkler/overhead 4=Bucket 5= (specify)_____ **IRRMTDUP**[_____]

C9. Did this household have any irrigated cropping activity in **upland fields** in the last cropping year (**2014)?** (1= yes; no=2) **IRRCROPUP** [_____]

C10: If yes, what is the main method of irrigation used? 1=Drip 2=Furrow 3=Sprinkler 4=Bucket 5=Other specify) _____ **IRRMTDUP** [_____]

C11: What is are the main ways through which you **abstract (draw) irrigation water**? 1=Water pump 2=Gravity 3=Bucket 4=other specify **WATERAB** [_____]

C12. If C7=1 and/or C8 =1, go to **Table** below;

Crop code	Parcel No.	Field No.	Field Location 1=Wetland 2=Upland	Size of the field (Acres)	Tenure	Fertility status: 1=poor 2=fertile 3=very fertile	Mainland prep type 0=none 1=manual 2=oxen 3=tractor	Hired land prep cost (Ksh)	**Planting/ Seed Type** 1=Purch /New Hybrid 2=Retained Hybrid 3=OPV 4=local var 5=local seedling/cuttings/splits 6=improved seedling /cuttings /splits 7=hybrid& local var 8=hybrid purc+retained	Quantity of seed used & cost, if purchased this season			1st Fertilizer used			2nd Fertilizer used			3rd Fertilizer used			Harvest -777=not yet harvested		Sales		**For the largest Sale**				Quantity that spoiled after harvest **(Use harvest units)**	Reasons for spoilage 1=pests 2=floods 3=animal destruction 4=Rains 5=Moulds 6=No market 7=Other (specify)
										Qty	Unit	Cost per unit	Type	Qty	Unit	Type	Qty	Unit	Type	Qty	Unit	Qty	Unit	Sold? 1=yes 2=No	Quantity sold **(Use harvest units)**	Month 1= Jan. ……. 12=Dec	Price received per unit	Buyer type	Km to point of sale		
Crop		**field**	**Fldloc**	**acres**	**tenure**	**ferts**	**landprep**	**Lpcost**	**Sdtype**	**sqt**	**sunit**	**scost**	**ft1**	**fq1**	**fu1**	**ft2**	**fq2**	**fu2**	**ft3**	**fq3**	**fu3**	**hvt**	**Hunit**	**sold**	**sqty**	**month**	**price**	**buyer**	**Km**	**postharv**	**spoilrea**

Unit codes:
1=90 kg bag
11=50 kg bag
2=Kgs
3=Litre
4=crates
5=numbers
6=bunches(bananas
9=gorogoro
10=tonnes
12=debe
13=grams
14=wheelbarrow
15=cart
16=canter
17=pickup
18=2kg packet(seed)
19=bale

Fertilizer codes:
0=None
1=DAP
2=MAP
3=TSP
4=SSP
5=NPK (20:20:0)
6=NPK (17:17:0)
7=NPK (25:5:+5S)
8=CAN (26:0:0)
9=ASN (26:0:0)
10=UREA (46:0:0)
11=SA (21:0:0)
12=Other (specify)___
13=manure
14=foliar feeds
15=NPK (23:23:23)
16=NPK (20:10:10)
17=DAP + CAN
18=compost
19=magmax lime
20=DSP
21=NPK(23:23:0)
22=NPK(17:17:17)
23=NPK(18:14:12)
24=NPK(15:15:15)
25=mavuno-basal
26=kero green
27=rock-phosphate
28=NPK 14:14:20
29=mijingu 1100
30=UREA+CAN
31=Mavuno-top dress
32=Blended fertilizers

Buyer type codes:
1=small trader
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8=NGO
9=consumer
10=Exporter
11=processor
12=supermarket
13=cereal bank
14=pyrethrum board
15=Institutions
16=Other -specify

Tenure codes
1=owned w/ deed
2=owned w/o deed
3=rented in
4=owned by parent/ relative
5=government/communal /co-operative/road reserves
6=Leasehold
7=Other(specify)_____

CROP CODES

Code	Crop	Code	Crop	Code	Crop	Code	Crop	Code	Crop
119	Apple	**19**	cowpeas leaves	**47**	macadamia, tc	**65**	pepper, bell	**3**	Tamarind
44	Arrowroots	**125**	Cucumber	**1**	maize, dry	**141**	pigeon peas	**189**	Tangawizi
201	Artemesia			**2**	maize, green	**133**	pineapples	**136**	Tangerine
97	Avocado	**192**	Dates	**4**	maize (fodder)	**121**	plums	**12**	Tea
50	avocado (grafted)	**183**	Dhania	**73**	Mangoes	**178**	pomegranate	**29**	tobacco
		182	dhania grains	**204**	mangoes (grafted)	**35**	poyo	**63**	tomatoes
18	Babycorn	**164**	dry peas	**45**	mangoes, tc	**76**	pumpkin		
10	Bananas			**120**	Matomoko	**172**	pumpkin leaves	**162**	tree tomato
202	bananas, tc	**71**	Eggplant	**9**	Millet	**17**	pyrethrum	**53**	trees (multi purpose),e tc
60	Barley			**148**	Miraa			**161**	Turnips
7	Beans	**20**	Flowers	**197**	Mkunga	**211**	ravaya	**5**	trees, commercial
221	Beetroot	**25**	french beans	**196**	Mkuyu	**31**	rice		
129	brinjals /biriganya			**220**	Mulberry	**86**	rosemary	**205**	vanilla
169	bulrush millet	**138**	garlic onion	**222**	medicinal plants	**171**	runner beans		
		62	Gourds					**69**	watermelon
93	Cabbage	**179**	Grapes	**80**	nappier /elephant grass	**36**	saina	**13**	wheat
200	chamomile	**34**	green grams	**165**	nathi (goose berry)	**40**	simsim (drought resistant)	**41**	wheat (drought resistant)
67	capsicum /sweet peppers	**167**	green peas	**147**	njahi (dolichos)	**78**	simsim	**163**	white suppoise
94	Carrots	**33**	Groundnuts	**37**	njugu mawe(Bambara bean)	**16**	sisal	**149**	wild berries
24	cashew nuts	**72**	Guava			**90**	snow peas		
28	Cassava			**83**	Oats	**8**	sorghum	**95**	yellow passion fruit(mero)
48	cassava, tc	**139**	indigenous grains	**77**	Okra	**39**	sorghum (drought resistant)	**81**	yams
146	castor oil	**140**	indig veg/amaranthus	**96**	Onions	**160**	soyabeans		
175	cauliflower	**27**	Irish potatoes	**61**	orange (grafted)	**66**	spinach	**174**	zambarao
26	Chickpeas			**75**	Oranges	**124**	squash		
131	chilli peppers	**210**	Karela	**22**	other fodder leaves	**190**	Stefani		
42	citrus, tc			**184**	Other leaves (bean,njahi)	**206**	stinging nettle		
23	Coconuts	**84**	lemon (grafted)			**177**	strawberries		
194	coconuts, copra	**207**	lemon grass	**59**	passion (grafted)	**187**	sugar beets		
193	coconuts, green	**74**	Lemons	**137**	passion fruit	**15**	sugarcane		
6	coffee, cherries	**173**	Lettuce	**46**	passion fruits, tc	**170**	sugarcane, chewing		
176	coffee, churned	**32**	Lucerne	**85**	pasture (not eleph/napier	**64**	sukuma wiki		
11	coffee, mbuni	**118**	Lugard	**58**	pawpaw(grafted)	**30**	sunflower		
168	corn flower			**70**	Pawpaws	**68**	sweet melon		
14	Cotton			**166**	Peaches	**43**	sweet potatoes		

21	Cowpeas	**135**	macadamia nuts	**134**	Pears	**49**	sweet potatoes, tc		

D2: What is the rental price (Ksh) for an **acre of land** in the wetland annually? **Rental wet [____]**

D3: What is the rental price (Ksh) for the same acre in the upland annually **Rental up**[____]

D4: For the largest fields in the wetland and upland, indicate the following historical details for the last 10 years

	Year	Number of months when the field was left fallow		Did you apply organic fertilizers on this field? 1=yes 2=no		Did you apply inorganic fertilizers on this field? 1=yes 2=no		Did you rent-in any land within the wetland in the year? 1=yes 2=no		If yes, what was the size of land rented-in (acres)?	
		Wetland field	**Upland Field**	**Wetland field**	**Upland Field**	**Wetland field**	**Upland Field**	**Wetland field**	**Upland Field**	**Wetland field**	**Upland Field**
		wetfallow	**Upfallow**	**orgwet**	**upwet**	**inorgwet**	**inorgup**	**rentwet**	**rentup**	**sizewet**	**sizeup**
1	**2014**										
2	**2013**										
3	**2012**										
4	**2011**										
5	**2010**										
6	**2009**										
7	**2008**										
8	**2007**										
9	**2006**										
10	**2005**										

SECTION E: LIVESTOCK PRODUCTION

E1: Did the household own any livestock in the last one year (i.e. February 2014-January 2015) (1= yes; no=2) **liveown [_____]**

E2: If Yes in E1 above, answer the following questions

Type of livestock owned	Average no. owned	System of rearing	If extensive system, where do you normally graze	
livetype	**Avno**	**Prodsyst**	**Grazefld**	
1=Cattle				
2=Goats				
3=Sheep				
4=Camels				
5=Chicken				
6=Other (specify)_____				

Codes: **Prodsyst: 1=**Free grazing-Pastoralist 2=Free grazing-Non Pastoralist 3=Paddocking 4=Strictly zero grazing/intensive system 5=Semi-zero grazing 6=Other, specify _____

Grazefld: 1=Own land-upland 2=Own land-wetland 3=School compound 4=Communal grazing land-upland 5=Public wetland 6=Public upland 7=Other, specify _____

ENUME: If Prodsyst=1, kindly follow up with the following questions *E3 – E9 are addressed to pastoralists ONLY*)

E8. Do you normally migrate your livestock to other areas? 1= yes 2= no **Migrout**[_____]
E9: If Yes in G8, where do you normally take your livestock? **Outmigloc** [_____]
E7 If Yes in G8, how **many times have you migrated** your livestock to other areas in the last two years? **migtimes**[_____]E8: On **average, how many months** do you stay in the areas where you migrate your livestock to? **migmonths**[_____]

LIVESTOCK PRODUCTS

E11: Did this household produce any **cow** milk during **February 2014 to January 2015?** (1=yes; 2=no, **go to Q12c1**) **MLKPRD_____**

		Avg No of animals producing milk	**Total Quantity produced and sold in each month (in litres)** Between **February 2014** and **January 2015**												**Buyer** type of **largest sale** 1=Cooperative societies 2=K.C.C. 3=Private processors /traders 4=Hawker /informal trader 5=Institutions/Hotels 6=Consumer /Neighbor /Farmer 7=Other , specify_____	What was the most common price you received? **Ksh/litre**	Km to point of sale for largest buyer
Product	**milk**	**cow**	**Fe14**	**Ma14**	**Ap14**	**My14**	**Jn14**	**Jl14**	**Ag14**	**Se14**	**Oc14**	**No14**	**Dc14**	**Ja15**	**Buyer**	**price**	**km**
Cow milk produced	**1**																
Fresh cow milk sold	**2**																
Sour cow milk sold	**3**																

E12: Other livestock products produced during the period **February 2014 to January 2015**

Livestock Product		**Average** number of animals producing over the year	Number of **months** of **production** per year	**Average** Quantity production/ month	**Unit** of Production. 2=Kgs 3=litres 22=Trays 5=Numbers 1=90kg bag 14=wheelbarrow 15=cart 16=canter 17=pickup	Number of **months** of **sales** per year	Average quantity **sold** per month	**Price** received per Unit (Kshs) on the **largest sale**	**Buyer** type of **largest sale** 1=Cooperative societies 2=K.C.C. 3=Private processors /traders 4=Hawker /informal trader 5=Institutions/Hotels 6=Consumer /Neighbor /Farmer 7=Honey refinery 8=Other, specify_____
liveprod		**animprod**	**mnthprod**	**avgprod**	**Unit**	**mnthsold**	**qtysold**	**Price**	**Buyer**
Goat milk	**1**								
Camel milk	**2**								
Honey	**3**								
Eggs (if not hatched)	**4**								
Hides and skin	**5**								
Fish (if have fish pond)	**6**								
Wool	**7**								
Manure (only if sold)	**10**								
Other, specify_____	**9**								

SECTION F: LABOUR INPUTS

F1: Did you have a **salaried** employee (s) during the last one year? Feb 2014-Jan 2015 (1=yes; 2=No; **If NO, skip to F4**) **salary** [____]

F2: If yes, how many **salaried** employees did you have in your farm? **Semploy**[____]

F2: If yes, what was your total **monthly expenditure** on salaried employees in Ksh **salexp** [____]

F3: How many months cumulatively between Feb 2014 and Jan 2015 did the salaried employees work on the **wetland largest field**? **salmon** [____]

F4: What is the daily wage rate for farm work in this area in Ksh? **Wage** [_____]

F5: For all the family and hired labour that was used in your wetland largest field in the **main season**, indicate the number of hours

Activity name		**Hired Labour**				**Family Labour (adults)**						**Family Labour (children)**			**Other Labour (ONLY if unpaid)**		
	Code	No hired	No of days per person	Kshs per person per day	Total KSh by contract	No of males	Total No of days worked by **ALL**	Average number of hours worked **per person per day**	No of females	Total No of days worked by **ALL**	Average number of hours worked **per person per day**	No of children <15 yrs	Total No of hours each	Total Hours for all days worked	No of workers	No of days worked each	No of hours per day each (on average)
	ACTIV	**LB01**	**LB02**	**LB03**	**LB04**	**LB05**	**LB06**	**LB07**	**LB08**	**LB09**	**LB10**	**LB11**	**LB12**	**LB13**	**LB14**	**LB15**	**LB16**
1st Ploughing	1																
2nd Ploughing	2																
Harrowing	3																
Planting	4																
1st Weeding	5																
Top-dressing	6																
2nd Weeding	7																
Field Dusting	8																
Harvesting	9																
Transport	10																
Drying	11																
Digging drainage	12																

F6: Relative to the labour input in the wetland, how much labour was applied on the upland largest field? **uplabour**[_____]

1= about the same 2=approx. 50% less 3= approx.50 % more 4=approx. 25% more 5=approx. 25% less 6= Other, specify_____

SECTION G: WETLAND CONSERVATION ACTIVITIES AND CHALLENGES

G1: Are there any conservation or protection initiatives on the Wetland that have been going on in the past one year? **(1=yes 2=No –Move to F3) wetconserve [____]**

G2: If Yes, indicate the details on such conservation initiatives

Type of Conservation Initiative See codes below	In which Year was this activity initiated? (-77=Can´t remember)	Who initiated the conservation activities? **(See codes below)**	Have you or any member of your household been involved in this conservation activity? 1=yes; 2=No	If no, give reasons why you have not been participating? See codes below
Consact	**Consyear**	**Consinit**	**Conspart**	**resnopart**

Codes:

Consact: 1=Boundary pegging 2=Stopping of farming in wetland 3=Fencing of wetland area 4=Removal of buildings from the wetland 5=other(specify)_____

Consinit: 1=Government organization 2=NGO 3=Community organization 4=Self 5=Other (specify)_____

Resnopart: 1=Not involved by the organizers 2=Not interested 3=the wetland doesn't belong to us 4=Other (specify)_____

G3: Do you face **challenges** when using the wetland?**1=yes 2=No** **wetchall**[_____]

G4: If Yes in F3 above, what are the **three major** challenges? **Wetchall1** [_____] **Wetchall2** [_____] **Wetchall3** [_____]

1=Restricted access 2=Danger of wild animals 3=Risk of contracting diseases 4=Floods 5=Conflicts with other users 6=Drought 7=Other, specify_____

G5: What are the **four most serious challenges** you face in **wetland crop** production **cropchall1**[___] **cropchall2**[_____] **cropchall3**[____] **cropchall4**[____]

1=Pests 2=Diseases 3=Low soil fertility 4=Soil acidity/alkalinity 5=Wild animals 6=water logging 7=Weeds 8=Floods 9=Other, specify_____

G6: What are the **four most serious challenges** you face in **upland crop** production **cropchall1** [____] **cropchall2** [____] **cropchall3**[____] **cropchall4**[____]

1=Pests 2=Diseases 3=Low soil fertility 4=Soil acidity/alkalinity 5=Wild animals 6=water logging 7=Weeds 8=Drought 9=Other, specify_____

SECTION H: RATE OF TIME PREFERENCE

Enume: First introduce the game and ensure that the respondent has understood the logic before proceeding

H1: Assume that you have two offers: The first offer is to receive some Ksh. 1000 one month from today (option A). The second offer is for you to receive some money that is more than Ksh. 1000 if you wait a bit longer (option B). I will tell you the offers and please tell me your willingness to either get the lower amount sooner or to wait a bit longer to get more money. [*ENUME*: *Go through the offers one by one*).

OPTION A **Ksh. to be paid one month from now**	**OPTION B** **Ksh. to be paid six months from now**		**Preferred option, please circle one**	
1000	**1150**	**timepref1**	**A**	**B**
1000	**1300**	**timepref2**	**A**	**B**
1000	**1450**	**timepref3**	**A**	**B**
1000	**1600**	**timepref4**	**A**	**B**
1000	**1750**	**timepref5**	**A**	**B**
1000	**1900**	**timepref6**	**A**	**B**
1000	**2050**	**timepref7**	**A**	**B**
1000	**2200**	**timepref8**	**A**	**B**
1000	**2350**	**timepref9**	**A**	**B**
1000	**2500**	**timepref9**	**A**	**B**
If No future amount is preferred, what is the amount that you would be willing to accept in the future to forego the current amount (KSh)				**PREF** _____

H2 : Consider four possible options for winning some money:
OPTION 1 : I toss a coin, if we get a head, you win Ksh 700 but if we get a tail, you win only Ksh. 25.
OPTION 2 : I toss a coin, if we get a head, you win Ksh 500 but if we get a tail, you win only Ksh. 50.
OPTION 3 : I toss a coin, if we get a head, you win Ksh 400 but if we get a tail, you win only Ksh. 125.
OPTION 4 : I toss a coin, if we get a head, you win Ksh 250 but if we get a tail, you also win Ksh. 250.
Which of these 4 options would you choose?

	Options	50%	50%
		KSh	KSh
	1	700	25
	2	500	50
	3	400	125
	4	250	250

	5	Don't understand or don't wish to respond	
			TIMPR4_____

SECTION J: HOUSEHOLD ASSETS (PROMPT for each item as listed below)

At present, how much/many of the following does this household **own** that are **usable/repairable**? (**Enumerator Instructions**: For value per unit, ask for the current purchase price of the asset as is or the current market value of the asset as it is.)

		Quantity	Current value per Unit (KSh)	If Value/Unit not known ask for Total Value			Quantity	Current value per Unit (KSh)	If Value/Unit not known ask for Total Value
CODE	**ASSET**	**QTY**	**VALUE**	**TOTVAL**	**CODE**	**ASSET**	**QTY**	**VALUE**	**TOTVAL**
1	Houses (residential)				31	Trailer			
2	Stores/barns				32	Ploughs for tractor			
3	Poultry houses				33	Harrow/tiller			
4	Piggery houses				34	Ridger/weeder			
5	Zero-grazing units				35	Planter			
6	Wheel barrow				36	Boom sprayer			
7	Chaff cutter				37	Sheller			
8	Radio				38	Combine harvester			
9	TV				39	Generator			
10	Solar panels				40	Power saw			
11	Battery				41	Grinder			
13	Mobile Phone				42	Jaggery unit			
14	Weighing machine				43	Cane crusher			
15	Pestle and mortar				44	Donkey			
16	Water tanks				45	Oxen			
17	Beehive				46	Animal traction plough			
18	Water pump				47	Cart			
19	Borehole				48	Posho mill			
20	Dam				49	Sewing/knitting machine			
21	Well				50	Fridge			
22	Irrigation equipment				51	Stove			
23	Cattle dip				52	Panga			
24	Spray pump				53	Jembe			

26	Bicycle				55	Other, specify			
27	Motorcycle				56	Other, specify			
28	Car				57	Other, specify			
29	Truck				58	Other, specify			
30	Tractor				59	Other, specify			

SECTION K: HOUSEHOLD DEMOGRAPHIC INFORMATION

K1: Indicate the following details for **all the household members** who **were home** for **atleast one month** within the **last one year** (**February 2014- March 2015).**

ID	Name	In which **year** was this person born?	Gender 1=male 2=female	**Relationship** to **current** head ***See codes below***	Marital Status ***See codes below***	Is..... **Currently** attending school? 1 = Yes 2 = No	What is the **highest** level of education completed? ***See codes below***	**How many months** in the period Feb 2014 to January 2015 has this person been living at home?	Is this person **still** considered **a member** of this household? 1 = Yes 2 = No	If this person is **not a member** of this household anymore, **why**? ***See codes below***	Did this person receive cash from **informal employment / business / kibarua / dividends** between Feb 2014 & Jan 2015? 1=Yes 2=No	If YES, monthly income estimate (KSh) for the months in which informal income was earned	Number of months in the past year in which this informal income was earned	Did this person receive cash or payment in kind from **salaried employment/ remittances or pensions** ? 1=Yes 2=No	If YES, monthly income estimate (KSh)	Number of months in the past year in which this salaried income was earned
MEM	**NAME**	**DA01**	**DA02**	**DA03**	**DA04**	**DA05**	**DA06**	**DA07**	**DA08**	**DA09**	**DA10**	**DA11**	**DA12**	**DA13**	**DA13**	**DA14**
1.																
2.																
3.																
4.																
5.																
6.																
7.																
8.																
9.																
10.																

Relation to head(DA03)		**Marital Status(DA04)**	**Education levels(DAO6)**			**Reason for absence (DA09)**	
1= head	9= grandchild	1 = single	-99=don't know	9= form1		1=left to find a job	9=Left to attend school
2= spouse	10=other relative	2 = married-monogamous	-9=None	…	20=univ 2	3=married away	10= Other, specify___
3= own child	11=unrelated	3 = married- polygamous	0=pre school	14=form 6	21=univ 3	4=deceased	
4= step child	12=brother /sister-in-law	4 = divorced	1=std 1	15= college 1	22=univ 4	5=divorced /separated	

5= parent	13=parent-in-law	5 = widowed	…	…	23=univ 5	6=living with other relatives	
6= brother /sister	14=worker	6 = separated	8=std 8	18= college 4	24=postgrad	7=another household	
7= nephew /niece	15=Other specify	7 = other, specify_____		19= univ 1		8=went missing	
8= son/daughter-in-law							

INCOME FROM OTHER SOURCES

K2: Did any member of the household earn some **income from other sources** between Feb 2014 and January 2015? **Otherinc** [_____]

K3: If yes, indicate the total amount earned within the period in the table below.

Income source	**Monthly income (Kshs)**	**Annual Income (Kshs)** *(Incase the income was earned once within the year)*
Remittances		
Rental income (Land)		
Rental income (Buildings)		
Income from farm outside the area		
Income from business		
Other(specify)		
Other(specify)		

K4. Is there a member of the household who is a member of any organized group in the community? 1=yes; 2=no -- *If NO, go to* ***SECTION L*** **GROUPMEM [_____]**

Household member ID from demog Table	Major **group activities** (up to 3) (*See codes below*)			Number of **active members** in the group	Frequency of meetings (*See codes below*)
MEMID	**GRUPACT1**	**GRUPACT2**	**GRUPACT3**	**GROUPSZ**	**MEETNG**
Activities:				**Frequency**:	

1=Collective labor (soil and water conservation); 2= Collective labor (other farm activities); 3=Collective crop marketing; 4=Savings and credit services; 5=Bee keeping; 6= Collective training on farming activities; 7=Collective learning on soil and water conservation; 8=Merry-go-round; 9=Other(specify)_____	1=Weekly; 2=Fortnightly; 3=Monthly; 4=Quarterly; 5=Semi-annually; 6=Annually; 7=When need arises; 8=Other (specify)_____

K5: Do you or any other member of household taken any insurance cover in the last 5 years? 1=yes; 2=No **insurance [_____]**

K6: If yes in F9, what kind(s) of insurance cover has the member taken? **Inccover1 [___] Inccover2 [____]**

Incover: 1= Motor vehicle 2=Life cover 3=Education plan 4= Index based Livestock/crop insurance 5=Other (specify)_____

K7: If No insurance cover was taken, give reasons **resnocover1 [___] resnocover2 [___] Resnocover1-2:** 1=Expensive 2=Not aware 3=No interest 4=No service providers available 5=No need 6=other (specify**) _____**

SECTION O: INFRASTRUCTURE

O1: What is the **distance** from your home to the nearest **shopping centre? Distshop** [____]

O2: What is the **distance** from your home to the nearest **tarmac road? Disttmk** [_____]

O3: What is the **distance** from your home to the nearest **health centre? disthc** [_____]

O4: What is the **distance** from your home to where you can **tap electricity? dstele** [_____]

O5: What is the **distance** from your home to where you can get **piped water? dstpipe**[____]

O6: What is the **distance** from your home to **public/private extension services**? **stext**[____]

O7: What is the **distance** from your home to **the nearest river/stream**? **dsrver**[____]

O8: What is the **distance** from your home to the **Ewaso Narok wetland**? **dswet**[____]

Thank the respondent for their time and co-operation and get any comments.