ECONOMIC VALUATION OF ECOSYSTEM SERVICES IN YALA SWAMP WETLAND KENYA USING DISCRETE CHOICE EXPERIMENT.

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A THESIS SUBMITTED TO THE SCHOOL OF BUSINESS AND ECONOMICS IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE CONFERMENT OF THE MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS AND RESOURCE MANAGEMENT OF MAASAI MARA UNIVERSITY

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DECLARATION

This Thesis is my original work and has not been presented for a degree or any other award in Maasai Mara University or any other institution.

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DEDICATION

This work is dedicated to my family, especially my siblings Kevin, Kandie and friends.

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ABSTRACT

Wetlands provide numerous ecosystem goods and services that are important to the development and survival of dependent communities. Through maintaining the wetlands, biodiversity is protected, and there is sustainable use and management of natural resources. The Yala swamp wetland is Kenya's largest freshwater wetland and has been recognized for its ecological and socio-economic services such as regulatory, provisioning, supporting, and cultural. The goods and services provided by Yala swamp are not priced in the market, and their value is not immediately apparent. By measuring the importance of the wetland, economic valuation is a powerful tool to express the value of wetland goods and services in the monetary unit. This study, therefore, attempts to estimate the economic value of ecosystem goods and services provided by the Yala swamp ecosystem wetland using the deliberative choice experiment as a first step toward providing an economic base for promoting sustainable utilization of the wetland. The objectives of this study were; to determine the household's preferences for ecosystem services in Yala Swamp Kenya and to estimate the willingness to pay level for the conservation of the Yala swamp ecosystem. The attributes assessed include fish richness and abundance (FISH), conservation of biodiversity area (IBA), Crop farming area (FARMING), grazing area (GRAZING), and Wetland Management (GOVERNANCE), payment vehicle (COST). 250 respondents drawn from five locations selected through systematic random sampling were engaged through focus group discussion. Fishery, farming, grazing, and governance are the factors that were found to be significant at a 5% confidence level thus affecting WTP. The mean willingness to pay for the improvement of governance attribute is the highest which is 3 bags of maize and it is significant at 5%. The mean willingness to pay for the improvement of IBA (Importance Bird Area) and farming is 0.04 and 0.17 bags of maize respectively. The respondents are willing to pay 2 bags of maize for the improvement of fishery attributes in the ecosystem. Finally, the respondents are willing to pay 0.12 bags of maize for the improvement of the grazing attributes. The research findings suggest that market-based conservation schemes aiming at improving the provision of ecosystem services through incentives for ecosystem services providers can be formulated to target specific interventions in the Yala swamp. Since fishery falls under agriculture which is a devolved function county governments and county assemblies need to allocate more funds for fisheries development. Some of these funds can be raised through public-private partnerships (PPPs) since the study has demonstrated that households have a high willingness to pay for fishery improvements. The study demonstrates that governance is an important issue among the local communities and needs to be resolved if meaningful wetland-based development is to take place. Poor involvement of local community members may explain the perceived low WTP for improvement of IBA (biodiversity conservation) and other livelihood activities. Findings from this study can inform community-based and community-led conservation education and wetland development programme, use policies and implementation of other environmentally sustainable and compatible low technology livelihood activities such as papyrus product industries, apiculture, raising tree seedlings and finger pond aquaculture.

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ABBREVIATIONS AND ACRONYMS

ASC Alternative Specific Constant

BT Benefit Transfer

CL Conditional Logit

CM Choice Modelling

CV Compensation Variation

CVM Contingent Valuation Method

ES Ecosystem Services

HEV Heteroskedastic Extreme Value

IBA Important Bird Area

IIA Independence of Irrelevant Alternatives

IID Independent and Identically

MWTP Marginal Willingness to Pay

MXL Mixed Logit

NOAA National Ocean and Atmospheric Administration

RP Revealed Preference

RPL Random Parameter Logit

RUM Random Utility Model

SDGs Sustainable Development Goals

SGR Standard Gauge Railway

SP Stated Preference

WTP Willingness to Pay

OPERATIONAL DEFINITON OF TERMS

Benefits transfer – the practice of using values estimated for an alternative wetland site as a basis for estimating a value for the site in question.

Choice modeling - this is a model that attempts to model the decision process of an individual or segment via revealed preferences or stated preferences made in a particular context or contexts.

Compensation Variation- is the adjustment in income that returns the consumer to the original utility after an economic change has occurred.

Contingent valuation – a valuation from a survey technique using direct questioning of individuals to estimate individuals' willingness to pay.

Cost-benefit analysis – the appraisal of all the social and economic costs and benefits accruing from a decision or project.

Direct use-value – the value derived from direct use or interaction with a wetland's resources and services, such as the value of fish catches.

Economic efficiency – Economic efficiency is the allocation of resources in the economy that yields an overall net gain to society as measured through valuation in terms of the benefits of each use minus its costs.

Ecosystem Services- as benefits people obtain from ecosystems and distinguishes four categories of ecosystem services, where the so-called supporting services are regarded as the basis for the services of the other three categories.

Impact analysis – an assessment of the damages inflicted on a wetland from a specific external environmental impact (e.g., oil spills on a coastal wetland).

Indirect opportunity cost – the time spent on an activity, such as harvesting, valued in terms of foregone rural wages.

Indirect use value – indirect support and protection provided to economic activity and property by the tropical wetlands' natural functions, or regulatory 'environmental' services, such as flood alleviation.

Market – A collection of transactions whereby potential sellers of a good or service are brought into contact with potential buyers and the means of exchange is available.

MWTP- Marginal Willingness to Pay- the additional amount consumers are willing to pay for one more unit of a particular good. This is marginal utility in monetary amounts.

Net present value – the discounted value of a financial sum at some point in the future due to financial flows over several years from, for example, interest.

Non-use value – the value derived neither from current direct nor from indirect use of the wetlands, such as cultural heritage.

Opportunity cost – the value of that which must be given up to acquire or achieve something.

Partial valuation – assessment of two or more alternative wetland use options (e.g., whether to divert water from the wetlands for other uses or to convert or develop part of the wetlands at the expense of other uses).

Public good – where one individual may benefit from the existence of some environmental good or service without reducing the benefit another individual can receive from the same good or service.

Social cost – the total cost to society of economic activity.

Total valuation – assessment of the total economic contributions, or net benefits, to society of the wetland system (e.g., for national income accounting or to determine its worth as a protected area).

Valuation – quantification of the values of a good or service.

Value – the worth of good or service, generally measured in terms of what we are willing to pay for it, less what it costs to supply it.

Wetland function – processes among and within the various biological, chemical and physical components of a wetland, such as nutrient cycling, biological productivity and groundwater recharge.

Willingness to pay – the amount that someone is prepared to pay to purchase a good or use of service regardless of whether there is a prevailing market price or the good or service is available free of charge.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Wetlands are ecosystems that fall along a transitional zone between permanently wet and dry habitats. Their boundaries may expand or contract over time depending on periodic inundation by water (Marais,2019). The most universally accepted definition of wetlands is given by the Ramsar Convention (1971, p.1) as:

"Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters"

Global inland and coastal wetlands cover 12.1 million km^2, an area almost as large as Greenland, with 54% permanently inundated and 46% seasonally inundated. Between 1970 and 2015, inland and marine coastal wetlands both declined by approximately 35%, which is three times the rate of forest loss (Gardner and Finlayson 2018). Wetlands include permanently or seasonally inundated freshwater habitats ranging from lakes and rivers to marshes, along with coastal and marine areas such as estuaries, lagoons, mangroves, and reefs. Wetlands can both be natural and man-made. Wetlands perform numerous social economic and environmental functions (Arneth et al 2021). They provide raw materials and genetic resources, including medicines. Further, wetlands also help to mitigate floods, protect coastlines, and store and sequester carbon. Many are important for culture, spiritual values, recreation, and inspiration. However, the contributions that wetlands make to human well-being have often been overlooked or underappreciated. Consequently, wetland management has been underplayed in development planning. Stakeholders in one sector make decisions based on narrow and short-term interests, losing opportunities to achieve multiple benefits, and causing further wetland loss and degradation. Encouraging policymakers across all sectors to recognize and take account of multiple wetland values and their interdependencies are essential if wetland-wise use and sustainable development are to be achieved. Effective management of wetlands requires collaboration from many sectors of society, in particular those who make use of the many benefits provided by wetlands, or who can influence their management and conservation. The Global Wetland Outlook sets a baseline to assess progress on the Ramsar Convention's Strategic Plan, 2016-2024, and strengthen the attention given to wetlands in the Sustainable Development Goals, Aichi Biodiversity Targets, Sendai Framework for Disaster Risk Reduction, and the Paris Climate Agreement (López-Calatayudet al 2021). It examines the state and trends of wetlands, identifies knowledge gaps, and looks to potential changes in the future. The Global Wetland Outlook identifies many negative trends but also highlights successes and best practices (Wang et al 2022). The Outlook reviews the drivers of wetland loss and degradation and outlines responses for the wetland community and other sectors.

Wetlands and their associated biodiversity provide a range of ecosystem services (ES) such as regulating climate change, erosion control, and storm protection, provisioning services (food, medicinal plants, honey), supporting services (nutrient cycling and carbon sinks), and cultural services (aesthetics, educational/scientific values, religious cites) Owuor et al (2019; Koundouri et al (2017). Despite their importance, freshwater wetlands continue to face impacts of degradation both from direct and indirect drivers, like conversion of swamps to farming lands and development of aquaculture (land-use changes), climate change, pollution, and unsustainable levels of water abstraction (Kemunto, 2018). Increasing human populations and the need to achieve a developed state in most developing countries exacerbate this situation due to the need for space for infrastructural development, aquaculture, and agricultural production to address food security (Vrebos et al 2015; Owuor et al., 2017; Gentry et al., 2017). These have the effect of reducing the wetland's capacity of the wetlands to provide ecosystem services, thereby affecting livelihood sources of natural resource-dependent communities (Schreckenberg et al., 2018; Owuor et al., 2019; Brander et al., 2012). Besides, the wetlands are partly affected by climate change such as prolonged drought caused by the temporary nature and fluctuating hydrological regimes (Mitchell, 2013).

Economic valuation studies show that the application of an ecosystem-based approaches provides quantitative and monetary estimates for the economic values of different ES (Dorren, and Moos, (2022); Ersoy, (2022). Policy and decision-makers often prefer to work with discrete quantitative estimates of an economic good (Schreckenberg et al., 2018; Davis et al 2016). By measuring the importance of the wetland, economic valuation can be a powerful tool to express the value of wetland goods and services in the monetary unit. This information can help inform policymakers to incorporate the total economic value of the wetland ecosystem in policy formulation.

There are several wetlands found in the Kenyan landscape such as freshwater, marine and Arid and Semi-Arid Lands (ASALS). The Yala swamp wetland is Kenya's largest freshwater wetland and has been recognized for its ecological and socio-economic values but continues to experience resource access and utilization conflicts despite attempts to conserve and protect it (Abila 2002; Okeyo-Owuor et al., 2012; Kemunto, (2018).

One of the main barriers to the successful management of wetlands in Kenya is the lack of recognizing and including values of ecosystem services benefits provided by these ecosystems to local communities into policy and decision-making processes (Odero and Odenyo 2022). Although conservation of the Yala wetland is supported by the Ramsar Convention, Constitution of Kenya 2010, Kenya Wetland Atlas, Kenya Vision 2030, National Land Policy, Nature Kenya, Draft Environment Policy 2013, Siaya and Busia CIDPs and other Conservation Organizations the wetland continues to be threatened by various factors, such as overfishing, chemical pollutant draining from agricultural practices, wetland conversion and encroachment and climate change resulting into persistent and prolonged droughts. All these factors have led to a considerable alteration of the Yala wetlands' habitat and a reduction in their potential in providing ecosystem services. NEMA is the organization in Kenya with the responsibility of protecting the environment. The authority's main responsibilities include environmental law compliance and enforcement, environmental research and planning, and environmental education, awareness, and communication. Poor land-use planning, mandate overlap with lead agencies, and insufficient execution of delegated environmental functions are some areas where there have been policy gaps. Some of the interventions for these gaps include the following:

• Encourage county government policymakers to prioritize environmental functions by advocating on their behalf;

• Build the capacity of local CECs to carry out environmental functions;

• Integrate devolved environmental functions into CIDPs.

1.2 Statement of the Problem

Wetlands provide numerous ecosystem goods and services that are important to the development and survival of humans. Through maintaining the wetlands, biodiversity is protected, and there is sustainable use and management of natural resources. The current scarcity of information about wetland functions and economic values often leads to the ill-informed decision of wetlands management leading to unnecessary resource access and use conflicts. This is, in part, due to poorly defined and poorly assigned property rights.

Yala swamp possesses various attributes of values, making it an essential contributor to the hydrological function, habitat quality, education, and research of ecosystems. The diversity of vegetation, bird's species, and other wildlife and the beauty of the landscape found within the wetland provide humans with tourism and recreational opportunities. The goods and services provided by Yala swamp are not priced in the market, and their value is not immediately apparent. The absence of clearly defined value of wetlands often results in wetlands being undervalued in decisions about their use.

By measuring the importance of the wetland, economic valuation can provide managers with information that can redress the policy failures to improve the wise use and management of wetland goods and services. This study, therefore, attempted to estimate the economic value of ecosystem goods and services provided by the Yala swamp ecosystem wetland as a first step towards providing an economic base of promoting sustainable utilization and formulation of other evidence-based policies to promote environmental conservation in the Yala swamp wetland for inclusive sustainable development.

1.3 Objectives of the Study

The general objective of this study is to undertake the economic valuation of ecosystem services in Yala Swamp wetland, Kenya using a deliberative choice experiment approach.

1.3.1 The Specific Objectives are;

i. To determine the household's preferences for ecosystem services in Yala Swamp Kenya.

ii. To estimate the mean willingness to pay level for the conservation of the Yala swamp ecosystem.

1.4 Research Questions

i. What are the household's preferences for ecosystem services of the Yala Swamp Kenya?

ii. How much is the local community willing to pay for the Yala wetland ecosystem improvement?

1.5 Justification of the study

Estimates of environmental values potentially have a role to play in supporting more informed decision-making in these cases and making decisions more transparent to stakeholders (Elsawah et al 2020). Although intuitively such resources may be significant, this may not be enough to ensure their prudent use and subsequent conservation. Resources in the environment are composite and multifunctional, and it is not apparent how the various goods and services provided by these resources affect human welfare.

First, valuation can provide information that can directly inform conservation policies, such as payment levels for payments for environmental services (PES) policies, or entrance fees for protected areas (Wright et al 2022). Second, and perhaps more important, valuation studies can be used in a general sense to demonstrate that the conservation of nature can result in tangible economic benefits to people consistent with contemporary conservation for development paradigm.

Findings from this study focus on communities and the Yala Swamp wetland benefiting from the ecosystem services (ES). The local community could benefit from the incomes they derive from the wetland as a tourist attraction center since the wetland is an Important Bird Area (IBA) and is home to endangered animal species like the *Sitatungas* (*Tragecephalus spekii*). The choice as to what use to pursue a given environmental resource, and ultimately whether current rates of resource loss are 'excessive,' can only be made if these gains and losses are properly analyzed and evaluated. This requires that all the values gained and lost under each resource use option are carefully considered. This informs the policymakers to integrate the total economic value of the swamp ecosystem services into their plan on conservation of the wetlands. Although attempts have been made at undertaking economic valuation of the Yala swamp wetland none of the studies (eg. Abila, 2002; Schyut 2005) have employed the Discrete Choice Experiment (DCE) method. Previous economic valuation studies employed simple direct and indirect method of calculating the wetland products. The discrete choice experiment is used since it is a more robust method and have been successfully been used by Owuor et al (2019) to undertake economic valuation of non-market mangrove ecosystem services in Kenya. This study employed the deliberative choice experiment approach a novel economic valuation technique that has recently been employed in mangrove ecosystem studies in Kenya (Owuor et al 2019). The application of this technique in highly threatened Kenya freshwater wetland ecosystem have largely not been tested.

This study contributes to growing literature on ecosystem services. The study further demonstrates how economic valuation of ecosystem services can help design and target conservation policies that maximizes human welfare in tropical wetland communities, thereby contributing to achievement of sustainable development goals (SDGs) eg poverty reduction (SDG 1), zero hunger (SDG 2), provision of clean water (SDG 6), life below water (SDG 14) and life on land (SDG 15).

1.6 Scope and limitations of the study

The study was restricted to the Yala swamp wetland and only to five selected sub-location. The second limitation is related to the choice experiment method (Pearce, 2006). First, there is the issue of cognitive difficulty associated with multiple complex choices between bundles with many attributes and levels. There is a limit as to how much information respondents can handle while making a decision. Increased complexity usually leads to increased random errors and irrational choices due to inherent learning and fatigue effects. Second, the total economic value of a wetland management option was calculated by summing up the values of the component attributes. This assumes that the value of the whole is equal to the sum of the parts but this assumption raises two potential problems. There may be additional attributes of the good that are not included in the design but that generate utility. Besides, the value of the whole may not be necessarily additive this way. Some evidence in transport research literature suggests that whole bundles of improvement are valued less than the sum of component values. Like with all other stated preference methods, the study was limited by the choice of study design. Welfare estimates are sensitive to study design e.g., choice of attributes, levels used and the way choices are communicated to respondents. Effects of translation on the interpretation of information also arose as limitation to the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents literature review of the study. It begins with the theoretical models that were applied in this study. Then a methodological review including a review of economic valuation techniques and literature on relevant choice experiment studies. The chapter is concluded with a conceptual framework which lets the envisaged the relationship between independent and dependent variables.

2.2 Theoretical Literature

The critical steps of ecosystem conservation and sustainability service integrate ecological science and economics into decision-making (Castro and Lechthaler 2022). Ecosystem resources either directly or indirectly supply goods and services to society (Agaton and Collera 2022). Environmental goods and services, despite not having market value its flow is an important insight to environmental economics. Conversely, this introduces two problems; conceptualizing and estimating values theoretically and empirically. Formulation of research on ecosystem service within the economic theory gives way to more structured engagement between policy, biophysical science and research in social sciences. Ecosystem services' essential values can be expressed in diverse ways, which include; social-cultural values, ecological values and finally, economic values. Socio-cultural values are the importance that humans give to the ecosystem service, their cultural identity and the extent to which they relate to ecosystem services. Ecological values are recognized as the health state of the system, which is distinguished with ecological indicators. Lastly, economic value comprises non-use and use-values of the ecosystem services.

According to economists, there is a varied definition of value on rationality and consumer sovereignty. Individuals know what they need and want and are best able to choose according to their welfare. One is willing to pay money to secure the improvement where the change in environmental service is a prospect that is believed to change in a better form somehow progress in environmental service influences one's willingness to pay. Economists would like to estimate these measures of values so that non-market goods and services and environmental services can be included in policy decisions to allocate and prioritize public resources and monies.

Figure 2. 1: preference, utility, and consumers' surplus

Figure 2.1 shows how researchers think of valuing non-market goods and services. The theoretical bases for economic value are based on the rational choice that includes preference set, utility function and the consumer surplus (Brennan, 2018). Economists assume that an individual has many preferences over goods and services that can be ordered consistently and logically. After selection, it is followed by a utility function; this is a representation of choices. The utility function allows us to express the highly preferred consumption bundle by the highest utility level (Kolmar, 2022). If a policy is imposed in such a way that utility increases, then this change is measured as consumer surplus by economists. This is the money metric of the unobservable utility function. This consumer surplus is the willingness to pay measures. With a well-formulated utility function, an individual's desire to make a change or desire to pay for it in environmental services is highly based on rational choice theory. This is considered to have consistency in the estimate of preference.

Three categories of economic valuation include; Stated Preference (SP), Benefit Transfer (BT), and Revealed Preference (RP). Benefit Transfer relies on estimates from Stated Preferences and Revealed Preferences. The revealed preference approach infers the value indirectly by observing individuals' behaviour in simulated or actual markets (Blow and Blundell 2018).

The stated preference economic valuation category attempts to directly elicit environmental values by asking the respondents about preferences for certain ecological goods and services. To estimate the total monetary value, economists currently use only stated preference methods by determining the use and non-use values of environmental goods and services (McFadden 2017).

In contrast, revealed preference methods are solely restricted to estimating values. Assignment of monetary values to non-marketed goods, assets, and services is referred to as economic valuation, where money values have precise and a particular meaning. If wealth is measured in terms of money, the estimated benefit is willing to pay to secure the advantage.

Diverse economic approaches have been developed for placing individual ecosystem services with a monetary value, including circulation of economic damage and cost of social and determination of willingness to pay (Hanley et al 2019). A variety of non-market valuation techniques have been evolved in environmental valuation literature. Each of these have their characteristics, capabilities and shortcomings. When choosing the preferences, the primary choice is between Choice Modelling (CM) and Contingent Valuation Method (CVM); both which share a common theoretical framework (Abate et al 2020). A choice model should be chosen when the valuation of individual environmental attributes is required. Contingent Valuation Method is chosen when the valuation of ecological goods and services in total is required. When information is needed in relative value for different environmental goods and services, Choice Model are used (Abate et al 2020). This study adopted the discrete choice experiment (DCE).

Not all Choice Model techniques are consistent with welfare theory, also the choice model is more recent than the Contingent Valuation Method (CVM). Choice experiments are preferable when a consistent welfare estimate is required. More responses are obtained for each individual with CM than with CVM; hence CM offers more efficient sampling than CVM. According to environmental valuation studies, respondents' face choice can be framed in the format of willingness to pay. The National Ocean and Atmospheric Administration (NOAA) recommends the willingness to pay over willingness to accept format (Zhang et al 2019). From this recommendation, there has been evidence that CM can elicit willingness to accept values successfully. Much focus on willingness to pay will underestimate values for willingness to accept situations. Information from both the functioning and structure of an ecosystem, complexity, and varied roles of the ecosystems in supporting human welfare is revealed in valuation studies at a micro-level (Obeng et al 2018).

Various researchers have tried to address the concern on differences in preferences between individuals acting in self-interest and those operating in the collective interests (Zahariadis, 2019). Values are affected by social choices or framed by an individual (Homar and Cvelbar 2021). The elicited values from a perspective of the individual may not be considered valid in social decision-making. CVM and CM valuation output are meaningful results if the environmental change is small in spatial scale, which is a reversible process-it takes place within a short period. Respondents jointly account for the change in nature or the environment.

Environmental services valuation should play an essential role in ecosystem-based management and conservation planning. There has been confusion among academics from all disciplines and decision-makers about the implication and validity of ecosystem service valuation. To ensure the relevance of the valuation results, economists employ and integrate a multidisciplinary approach to the studies that contribute to environmental services valuation.

2.1.1 Random Utility Theory.

The theoretical grounding for a choice experiment method is the Lancaster 1966 model of consumer choice with the random utility model being its econometrics basis (Mekonnen et al

2020). The argument by Lancaster is that a consumer can generate his or her utility from goods and services derived from attributes of an ecosystem (Birol et al 2006b). To reveal the factors influencing a choice this method depends on experiments. To integrate behavior with an economic valuation in the choice experiment technique random utility is used, this describes the discrete choices in the utility maximization outline (Mao et al 2020; Holmes et al 2017).

The environmental resource is defined in terms of its attributes and their level in different states of the world. To estimate the value of other attributes in the ecosystem by eliciting the willingness to pay the cost of an attribute is used. (Mao et al 2020); Birol et al 2006a). The random utility theory, assumes that the utility function U_n has of two parts

A_n=B_n+e_n ……………………………………………………………. 2.1

Where B_n is the systematic and observable component of the latent utility for option *n* and ε_n is the random or unexplained component. Because of the random component, the research can never expect to predict choices perfectly. Considering a respondent's choice for a wetland ecosystem, the utility is assumed that it depends on choices made from a set D which includes all the possible wetland ecosystem alternatives. The utility function is restated in the form.

A_{nm}= B (Y_m,T_n) +e_{nm})…………………………………………………. …...2.2

Where for any respondent *n* a given level of utility was associated with any wetland the ecosystem alternative m, utility derived from any alternatives and ecosystem alternative depends on the attributes Y_m of the wetland, the socioeconomic characteristics of the respondents T_n and the stochastic element e_{nm} which represents unobservable influences on individual choice. With the Lancaster's model of consumer's choice, the respondent utility function A_{nm} for individual n and alternative m can be expanded to this form;

A_{nm}= B (Y_m,T_n) + e(Y_m,T_n)……………………………………………………2.3

The presence of the random component permits to make of probabilistic statements about respondent's behavior. Choices made between alternatives will be a function of the probability that utility associated with particular option m is higher than other alternatives (Holmes et al 2017). An individual n will choose option m over some option k, A_{nm}>A_{nk} m$\neq k$, this leads to the expression for the probability of choice:

P_{nm}= P (B_{nm}+e_{nm}>B_{ik}+e_{nk}); $\forall k$ ∈D ……………………………………………2.4

Where k is any option in a given choice set,

When there is a difference in assumption about the distribution of the random error different models are yielded. The above model that's equation 2.4 can be estimated using a conditional logit (CL) model, which assumes that using Weibull distribution the random (error) components are distributed Independent and Identically Distributed (IID) and choices are consistent with the Independence of Irrelevant Alternatives (IIA) property (Paleti, 2019). The IIA property states that with the introduction or removal of any alternatives, the probabilities of two options let's say options 1 and 2 being chosen are not affected (Okumu and Muchapondwa 2017). This makes the conditional logit model to be estimated for the probability of an individual n for choosing particular option m takes the following form:

$P_{nm} = \frac{exp(B(Y_{nm},T_n))}{\sum_{h\in C} \exp\,(B(Z_{nh},T_n))}$ ……………………………………………………………...2.5

Where h is one of the possible options in wetland ecosystem alternatives in choice set D. h∈D, the conditional indirect utility function is generally estimated as;

B_{nm}= α_0+$\alpha_1 Y_1$+$\alpha_2 Y_2$+………$\alpha_q Y_q$+$\delta_1 T_1$+………$\delta_2 T_2$+$\delta_r T_r$…………………………...2.6

Where;

α_0 = alternative specific constant (ASC) which includes the effects on utility of any attributes not included in choice specific attributes.

q = wetland ecosystem attributes considered and the number of

r= socioeconomic characteristics of wetland

the vectors of coefficients,

α_1 to α_q and δ_1 to δ_r = these are vectors of the coefficients of attributes Y

T= are the vectors of socioeconomic characteristics.

Since the respondents' characteristics are homogenous across alternatives, socio-economic characteristics can't be introduced into the model, they can be introduced as interactions terms (Bronnmann and Asche 2017). Random parameter logit (RPL) or mixed logit (MXL) model are used in discrete choice since they don't require the IIA property, this is to avoid the biased results of the conditional logit model when the IIA property is violated.

The current study used a mixed logit model since it accounts for choice heterogeneousness and does not have IIA property. It also accounts for relationships in unobserved utility. The mixed logit model is given as;

A_{nm} = B ($Y_{nm}(\alpha_i+\tau_n)$,T_n) + $e(Y_j,T_n)$ ……………………………………………………….2.7

The utility is decomposed into a deterministic component B and an error term e. the assumption is that the indirect utility is a function of the choice attributes Y_n with parameters α_n , which due to heterogeneousness in choices may differ by a random component τ_n and of the socio-economic characteristics of the respondents T_n across various respondents, this translates equation 2.5 as:

P_{nm}=$\frac{\exp\ (B(Y_{nm}(\alpha+\tau_n),S_n))}{\sum_{h\in C}\exp\ (B(Y_h(\alpha+\tau_n),S_n))}$ ……………………………………………………………….2.8

Since the mixed logit model is not restricted by the IIA assumption, the stochastic part of the utility may be correlated among alternatives and across the sequence of choices via the common influence of τ_n. Treating preference parameters as random variables requires estimation by simulated maximum likelihood (Czajkowski and Budziński 2019). The randomly distributed parameters are assumed constant across the choice situations for each individual. This reflects underlying assumptions of stable preference structure for all individuals over the choice experiments. It has been argued that the meaning of the unlabeled violated when alternative specific constants (ASCs) are included in the model and that the correct way to proceed would be to exclude constant terms for all unlabeled experiments (Xin et al 2022). However, when excluding an ASC, the remainder of the model parameter would attempt to capture the effect of unobserved factors on respondents' choice resulting in biased parameter estimates. Hence it has been argued that ASCs are important in order to interpret the preferences of the individuals (Ashim, 2018). Although our experiment was generic, we included ASCs that allowed to vary with choice sets in order to test, whether any factors other than the attributes affected the respondents' choices (Sever et al 2018). Once the parameter estimates have been obtained, a compensation variation (CV) or welfare measure in CE studies which confirms to demand theory can be estimated (Dekker & Chorus 2018). A welfare measure can be estimated using the formula;

$$W = \alpha_y^{-1} \ln \left\{ \frac{\sum_{j \in D} \exp\,(B_m^1)}{\sum_{j \in D} \exp\,(B_m^0)} \right\} \qquad \ldots 2.9$$

Where;

W= is the welfare measure

B_m^0 and B_m^1 = the indirect utility functions before and after the discretionary changes in the wetland ecosystem.

α_y =this is the marginal utility of income.

The ratio of coefficients represents the marginal change in value of an attribute of the ecosystem, where equation 2.9 can be re-written as:

MWTP = -1($\frac{\alpha_{attribute}}{\alpha_{cost}}$)……………………………………………………………….2.10

Where these ratios show the MWTP for a change in any of the attributes to improve wetlands ecosystem. By comparing the implicit prices of various attributes drives some understanding to the respondent's thus policy makers are able to develop resource use design and alternatives, they also understand the impact of policy changes.

2.2 Empirical Literature

Willingness to pay (WTP)has been employed to undertake economic valuation of various natural resources such as national parks, wetlands, forests, agricultural lands and marine resources in Kenya and globally. Kemunto and Gathiaka (2021) used an application of discrete choice experiment to determine the willingness to pay (WTP) for the restoration of Nairobi national park attributes. The focus was on the characteristics of (i) wildlife population and diversity of species, (ii) wildlife movement in dispersion and migration areas, (iii) vegetation density and diversity, (iv) security of wildlife and people, and (v) environmental safety and quality. A price attribute in the form of an increase in gate fee was included to elicit WTP estimates. The results of the study using multinomial logit regression estimates indicated that respondents were WTP for the restoration of all the attributes except attribute (iv). Attributes (i) and (ii) elicited the highest WTP and could be the most affected by the two projects.

Oliveira et al (2020) employed the choice experiment approach to determine local community preferences for coastal zone erosion management in the Praia da Amorosa, Brazil where coastal erosion is a complex and increasingly important problem, largely due to its effects and management strategies. The results show that respondents prefer some interventions to mitigate the problem rather than no action, and prefer lighter intervention (palisades, gangways) to heavy infrastructures (rockflls, seawalls, groynes). Moreover, the results show the presence of preference heterogeneity and thus the need to use more flexible and complex models. Based on the results obtained, it is possible to drive some policy implications. First, the do-nothing option is not viable from the population's standpoint, secondly although some types of coastal erosion protection is demanded by the general population, the preferred approach is for light forms, contrary to the policy adopted in the last century, and still overwhelmingly present in the territory.

To determine the market worth of the Simpson Bay Lagoon in Saint Martin's Eastern Caribbean, Duijndam et al. (2020) used a choice experiment. This is a result of intensive development, sewage pollution, and overexploitation of Caribbean coastal ecosystems. The choice experiment was embedded in a larger household survey among residents of Saint Martin along the Caribbean coastal ecosystem. The findings of the choice experiment reveal that the Simpson Bay Lagoon in its current environmental state is worth US$12.1 million per year to the residents of Saint Martin. Besides an economic valuation, the research also scrutinized the welfare benefits of improved environmental management. Two environmental management scenarios are evaluated: the installation of a sewage treatment plant and mangrove restoration. The installation of a sewage treatment plant would enhance the annual economic value to US$16.5 million, mangrove restoration to US$23.0 million, and the implementation of both measures to US$26.3 million. Hence, ameliorating the ecological integrity of the Simpson Bay Lagoon through improved environmental management proves to be a promising venture for the environment, society, and economy of Saint Martin.

In a study of valuing diversification benefits through intercropping in Mediterranean agroecosystems, Alcona et al (2020) used a choice experiment approach to assess social demand for more welfare-improving agricultural cropping systems. The study demonstrated a strong social preference for crop diversification concerning all the benefits considered in the experiment. The total economic value for non-market goods and services provided by intercropping ranges from 900 to 1400 €/ha/year, for some crops might be potentially higher than cropland financial benefits. These results highlight the social support for a change in the agricultural model to reach sustainable agroecosystems, which is essential to ensure the success of agrarian and rural development policies.

In a study to value mangrove biodiversity and ecosystem services in Mida Creek, Kenya Owuor et al (2019) used a deliberative choice experiment to value non-market mangrove ecosystem services (ES). The attributes assessed include "shoreline erosion protection," "biodiversity richness and abundance," "nursery and breeding ground for fish," and "education and research." Unpaid labour (volunteer time) for mangroves conservation was used as the payment mechanism to estimate willingness to pay (WTP). Results suggest that respondents were willing to volunteer: 5.82 h/month for pre- serving the mangrove nursery and breeding ground functions to gain an additional metric ton of fish; 21.16 h/ month for increasing biodiversity richness and abundance; 10.81 h/month for reducing shoreline erosion by 1 m over 25 years; and 0.14 h/month for gaining 100 student/researcher visits/month. The estimation of WTP for mangrove ES provides valuable insights into the awareness of local communities about the contribution of mangrove forests to ES delivery. This knowledge could assist decision-making for the management and conservation of mangroves in Mida Creek and its environs.

In an economic valuation of Green Island, Taiwan, Han-Shen Chen, et al (2019) used a choice experiment method to evaluate ecological security and ecosystem services which is now a core issue in the field of natural and environmental resources. This study investigated the preferences of residents and tourists regarding Green Island and estimates willingness-to-pay (WTP) values for island ecosystem services. The results indicate significant differences between the preferences of residents and tourists regarding island environmental resources.

Therefore, based on the multiple attributes and ecosystem services, this study formulated three assessment schemes: “environmental protection,” “recreational development,” and “integrated operation and management”. Based on the analysis of the problems reflected in the valuation mentioned above, the study recommended that policymakers refer to environmental attribute preferences to create statements or advertisements targeting relevant audiences when planning island development. This paper contributes to the literature by demonstrating how the economic valuation of island ecosystem services can help design and target island conservation policies to maximize human welfare.

Renato et al (2019) undertook a study on economic valuation of recreational attributes using a choice experiment approach in Galapagos Islands, Galápagos Province of Ecuador. Despite the increasing number of visitors to Galapagos National Park, the tourism industry pays little attention to the distinct preferences of tourists toward park attributes, including both its natural resources and managerial emphasis. To “monetize” the benefits of these attributes requires utilizing nonmarket valuation techniques. The study used stated preference questionnaire to estimate the economic value of the park’s recreational attributes. The following five attributes were selected: endangered species, prevalence of garbage, site infrastructure, air quality, and entrance fees. The results of this study demonstrate that tourists place the highest willingness to pay values on increased protection of animal species (US$26.9) and garbage reduction (US$111.2). These results highlight the economic contributions for park management, with a potential for value improvement of US$38.1 per tourist if the park’s combined attributes are upgraded from the present condition to the optimum condition.

In a study on economic valuation of grazing management practices in Tana River County Kenya, Luttaa et al (2019) used discrete choice modeling; to estimates the economic contribution of grazing management practices in rural systems by specifically undertaking an economic analysis of pastoralists’ preferences for grazing management practices and the economic value pastoralists place on these practices. The results show that pastoral communities derive positive utility in connected systems that enable reciprocal access to resources in both wet and dry seasons. Pastoralism adapts to spatial-temporal variability of pasture and water through herd mobility; hence the positive utility derived from practices that contribute to adequate water and range across the seasons. These findings provide empirical evidence on the social and economic net benefits of rangeland management practices that should be enhanced to promote sustainable management of rangeland resources.

Chepkwony et al (2019) undertook a study on total economic value of Kingwal wetland to the surrounding community, Nandi County using choice experiment. The objective of the study was to evaluate the estimated economic value of Kingwal wetland and was meant to help policy makers and conservationists develop effective measures to conserve the wetland, especially in preservation of the rare *Sitatunga* antelopes whose numbers are reported to be decreasing due to the increasing human activities within the wetland. Results from the study showed that the mean household willingness-to-pay per annum for Kingwal wetland was Ksh. 549,442 (US $5494.42). Direct benefits contribute the highest monetary value (Ksh. 292,010) as compared to indirect (Ksh.112,561), option (Ksh. 62,649), bequest (Ksh. 26,125) and existence values (Ksh. 56,097). The study showed that Kingwal wetland has an economic value of Ksh. 549,442 (US $5494.42) and those direct benefits (Ksh. 292,010) contribute the highest monetary value. The study recommended that there is a need to raise awareness regarding the economic worth of the benefits of wetlands to the people.

In a study to value the environmental improvements in coastal wetland restoration of Ximen Island Special Marine Protected Area in China, Yonghua (2018) used choice experiment to estimate the welfare changes of providing different coastal wetland restoration scenarios. Respondents were randomly selected for data collection through face-to-face interviews and 201 individuals were interviewed in the experiment. Both conditional logit model and random parameters logit model were employed in this study to estimate the individual utility associated with the wetland attributes. The results suggested that people valued the positive benefits of coastal wetland restoration, as it could improve the levels of mangrove area, water quality, and biodiversity. The mangrove area was the most important attribute which need to be considered in the restoration strategy design, as it had the highest marginal willingness to pay value. The compensating surplus of specified wetland restoration scenarios were calculated, and the values increased from modest coastal wetland restoration scenario to ambitious coastal wetland restoration scenario. The information derived from the study could be helpful to policymakers in determining coastal wetland restoration strategy for the Ximen Island Special Marine Protected Area.

Matthews et al (2017) estimated preferences in discrete choice experiment for alternative coastal area management options in the Coromandel Peninsula, New Zealand, where the following 3 attributes were considered (1) erosion protection, (2) headland development, and (3) expense. Two conflicting views were reported: that of property owners, who argued for complex coastal defense structures, and the position of the local government, who argued for the protection of natural landscape and recreation activities. The results show willingness to pay (WTP) values for different attributes. Nevertheless, the results were unresponsive to the scale of beach attributes, and the random parameter logit models suggest significant preference heterogeneity in the sample.

Oduor et al (2016) undertook a study on estimation of willingness to pay for conservation of Nyando wetlands in Lake Victoria basin, Kenya. The wetland is faced with multiple pressures from different anthropogenic activities within the wetlands and its catchment. These are bound to intensify as population pressure increases. The study used contingent valuation survey method to estimate the willingness to pay and its determinants, by use of the Tobit model. The results show that nearly all the local people were aware of the economic benefits from the wetland with about 96% of the respondents agreeing that the benefits were being degraded. About 83% of the respondents were willing to pay to the payment vehicle, Conservation Trust Fund. The aggregated WTP for the wetland conservation was about KES 38 million (US$ 0.4 Million) per year. Tobit model revealed that gender of household head; age; household size; and education were the determinants of WTP. The study suggests policies towards gender empowerment, family planning and awareness creation to conserve the wetland.

Remoundou et al (2015) used a DCE to ascertain residents' preferences for coastal risk management caused by climate change in Santander, Spain. The study considered two types of effects of climate change: sea level rise, high tides, and extreme wave events (causing foods and coastal erosion) and rising sea temperatures, increasing the likelihood of jellyfsh booms and changing local bio-diversity. The attributes are based on the climate change effects on marine biodiversity, effects on health due to exposure to jellyfsh, and effects on beaches' size due to sea-level rise and erosion. The study used random parameter logit model. The results illustrate clear significance of willingness to pay values to accept mitigation measures that reduce the harmful effects on health and nature. Mitigation measures comprised beach nourishment and improvement in the existing structures to protect the beach.

Gachoki (2010) employed the choice experiment to undertake both use and non – use valuation and public choice of wetland attributes of Olbolosat wetland in Nyandarua County in Central Kenya. Most studies in Kenyan wetlands have focused mainly on the direct and indirect use values. Non – use valuation captures important characteristics of the wetland. The objectives of this study were to identify and assess factors that determine households' valuation of Lake Olbolosat; and to generate and estimate non-use values of Lake Olbolosat. The survey tool used was an elicitation questionnaire that presented the respondents with the four wetland alternatives to choose from. A Multinomial Logit model (MNL) was estimated to determine how the explanatory variables (attributes and socio-economic characteristics) influenced the dependent variable (choice). The results show farm size, and distance from the wetland, were significant determinants of choice of wetland alternative 1 and status quo respectively, while household income and the level of education of the household head were significant determinants of choice of wetland alternative 3. From policy perspective, these findings are fundamental and point to certain policy implications that include co-management practices with resident community in wetland management, regulation of land sizes around fragile ecosystems such as wetland and community education and awareness, to appreciate the benefits from the Lake Olbolosat wetland socio-ecological system.

Birol et al (2008) used the choice experiment method to inform river management in Poland. The objective of the study was to value benefits from the reduction in flood risk in Europe and estimate the value of biodiversity and the local household's demand for recreational activities. The results reveal that all households derive the highest benefits from reducing flood risk to a low level, followed by recreational activities and biodiversity conservation in the area, respectively. These results have significant implication for the design of efficient and effective river management projects and policies in the area.

2.3 Environmental benefits of wetlands

Many benefits have been derived from wetlands by riparian communities who heavily depend on them for their livelihoods; thus, wetlands have been widely recognized as valuable. Wetlands support different varieties of species of flora and fauna. Services derived from these wetlands play an essential role in sustaining life on earth. Availability of wetlands reduces the emerging poverty incidences and equally improves the quality of life for the population in the rural areas (Das et al 2022)

Wetland provide direct and indirect goods and services, wetlands ecosystem services are generally broadly classified as supporting, regulating, provisioning and cultural services

(Mandishona & Knight 2022). These wetlands support human wellbeing by controlling soil erosion and floods, source of fish, provide fertile land for agriculture and source of building material and many other benefits.

2.3.1 Provisional service

Provisional services have a crucial role in preserving basic human needs and eradicating poverty. These wetlands provide domestic water, fish, and firewood, as well as building materials, cattle feed, and a source of medicinal herbs (Abila, 2005). They also provide building materials and firewood. For instance, fish like tilapia and Nile perch come from Lake Victoria. The populace of the coast uses the mangroves present in the coastal marshes as building materials. Papyrus reeds, on the other hand, are used to create handcraft items like woven chairs, mats, and tables. Additionally, it provides grazing for the local animals and wildlife.

2.3.2 Regulating service

Through the natural management of the diversified wetland ecosystem process by humans, regulation service is gained. These services include groundwater recharge and outflow, nutrient retention, climate regulation and water purification. Additionally, this ecosystem is crucial for evapotranspiration, precipitation and carbon sequestration (Abila, 2002). Wetlands have a crucial role in replenishing the soil in areas with greater topography. Toxins and nutrients are absorbed by vegetation in wetlands to purify the water, which stops eutrophication. As Yala Swamp is susceptible to non-point pollution from pesticides and fertilizers coming from surrounding cultivations, papyrus vegetation is essential in retaining nutrients in this swamp. The vegetation in wetlands and their extensive roots aid in reducing soil erosion. When the fertile topsoil is retained by the thick roots, the swamp becomes more conducive to cultivation.

2.3.3 Supporting service

Supporting service keeps up the hydrological cycles, nutrient recycling, and soil building that the wetlands give to the ecosystem. This will have an impact on the crucial functions that these wetlands supply when interfered with. For instance, when the supportive services offered by wetlands are disrupted, food production is impacted due to a decline food production, which then has an impact on those who depend on the environment (Chepkwony, et al 2020). Additionally, vegetation that grows in wetlands holds onto soil that has been eroded or carried by runoff water, helping to preserve nutrients. The creation of soil and the cycling of nutrients are crucial elements in agriculture because they guarantee food security for the riparian community. Naturally, productive soil doesn't require fertilizers, which eventually lowers the likelihood of soil, water and air pollution.

2.3.4 Cultural service

In Kenya, wetlands are an important resource for a variety of leisure activities, such as boating, hunting, and bird viewing. For instance, the visual significance and attractiveness of Kenya's Lake Nakuru, Lake Bogoria, Lake Naivasha and Lake Elementaita make them significant tourist destinations. Being a popular tourist destination helps the economy of the country by bringing in a lot of foreign currency. Indigenous people and riparian communities have a history of identifying with these ecosystems (Kondowe et al 2022). The environment of the wetlands has had a significant impact on these nations' traditional arts, food varieties, medicinal herbs, and religious rituals. The fishing communities' choice of lifestyle has also been influenced by wetlands. Additionally, these wetlands have been the subject of some scientific investigation. For instance, experts conduct their studies on wetlands like Lake Nakuru and Lake Bogoria to examine the dynamic migration of birds.

2.4 Natural threats of wetlands

Wetlands are among the most threatened ecosystems in the world (Moomaw et al 2018). These ecosystems often encounter naturally severe threats such as floods, storms, soil erosion and subsidence arising from inevitable naturally occurred processes that have the potential to damage wetland environments. (Moomaw et al 2018). The main natural threats to wetlands are discussed in subsequent sub sections. The threats to wetlands are mainly as a result of increasing human populations anthropogenic activities and climate change.

2.4.1 Flooding

Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater, and floodwaters. Trees, root mats, and other wetland vegetation also slow down floodwaters' speed and distribute them more slowly over the floodplain. Virtually all wetlands, primarily coastal and estuarine wetlands, are subject to some flooding measure, although their frequency, depth, and velocity differ significantly (Balwan and Kour 2021). Internationally, wetlands have been recognized as a necessity in reducing surge elevation, high wave, and flood control. An increase in annual floodwaters due to climate change and torrential rains and the destruction of wetlands vegetation in the upper reaches is out of a usual wetland potential and may cause those wetlands losses their ability in flood storage (Balwan and Kour 2021).

2.4.2 Soil Erosion

Soil erosion is the removal of soil particles by wind, water, and other forces of nature. This naturally occurring process is accelerated in areas where the soil has been disturbed by human activities (Issaka and Ashraf 2017). Lands used for new crop production are particularly susceptible to soil erosion. Soil particles in the leaved disturbed sites are carried by run-off to areas of lower elevation as long as the water flow is sufficient to transport them. When water velocity decreases, a portion of the sediment being carried is deposited. Sedimentation is the result of soil erosion. While natural processes may fill wetlands with sediment, anthropogenic influences have great potential in accelerating erosion, prematurely fill wetlands and degrade wetland functions (Philemon, 2017).

2.4.3 Drought

Drought as a climatic event refers to the occurrence and persistence of below-normal rainfall (Ford and Labosier, 2017). Drought is considered one of the most threatening challenges wetlands faces and occurs due to climate change and global warming. Drought impacts on the environment can last a long time, maybe forever. Drought is likely to affect wetlands, including wetland soil microorganisms that drive soil biogeochemical cycling (Sithole, 2017). During the drought, because of the increase in temperature and high evaporation rate, aquatic plants' need for water would escalate (Sithole, 2017). On the other hand, a substantial drop in river flow and surface water resources decreased their ability to purify pollutants. Consequently, it results in a considerable decline in water quality.

2.5 Human (Anthropogenic) Threat to Wetlands

Natural ecosystems, especially freshwater ecosystems in the inland flood plain, are undergoing profound and extensive disturbances by humans worldwide. Key indicator of these disturbances is that humans extensively reclaim natural wetlands to expand their economic benefits. Therefore, most habitats of natural ecosystems have been changed into farms or urban areas rapidly and continuously (Widdows and Downs, 2015). The pressure being put on wetlands is as a result of the increasing human population and the increase in demand of food and food production (Reid et al 2019). Human activities pose greatest threat to the well-being of wetlands this is at the global level. Wetland loss is defined as “the loss of wetland area due to conversion of wetlands to non-wetland areas as a result of human activity”, whereas wetland degradation is “the impairment of wetland functions as a result of human activities (Reid et al 2019).

2.5.1 Unsustainable Ecotourism

Ecotourism plays a considerable role in the world economy. Nevertheless, it is an intensive human activity that can damage protected areas and disturb the ecological balance of wetlands.

The growing numbers of tourists in wetland areas can contribute to and improve the welfare of local people in these areas, but at the same time, can cause severe damages to wildlife and biodiversity (Choi et al 2021)

The impacts of tourism on the ecological functions of wetlands derive from tourism-related constructions of transport and other infrastructure projects, construction, maintenance and use of tourist facilities, use of water and treatment of wastewater, pollution of groundwater, pressures on land use due to urbanization, and more intensive agriculture, the presence and activities of tourists in wetland areas, illegal hunting or fishing (Akbulut et al 2022). Tourists using the same trail repeatedly trample the vegetation and soil, eventually causing damage that can lead to loss of biodiversity and other impacts. Such damage can be even more extensive when visitors frequently stray off established trails.

2.5.2 Discharge of Hazardous Wastes

Discharge of urban and industrial wastewater, agricultural activities, combustion of fossil fuels, mining and smelting operations, processing and manufacturing industries, waste disposal including dumping, etc., are primary anthropogenic sources of pollution (Singh and Singh 2017). Using pesticides and herbicides for agriculture can affect wetlands and their flora and fauna in different ways. Pollution of wetlands by agricultural pesticides can cause different types of damage, from altering the growth of aquatic plants to reducing waterfowl reproduction (Nayak and Bhushan 2022).

2.5.3 Wetland Conversion and encroachment

High human populations, increasing at an annual rate of around 3%, have been a major impetus for increased and intensified agricultural activities and higher wood fuel consumption rates in the Yala wetland. This has led to increased deforestation, soil erosion, soil and water contamination and reclamation of wetlands for example in the Yala swamp ecosystem (Abila, 2002).

Providing reliable economic valuations of wetlands to policy-makers is a necessary step in the process of finding solutions to ecological problems (Ghanian et al., 2022). Economic valuations provide a means for measuring and comparing the various benefits of wetlands and, of course, the costs associated with preservation. Hence, economic valuation can be a powerful tool to aid and improve wise use and wetland management (Dorren and Moos, (2022); Ersoy, (2022). However, economic valuation is often derived from survey research which requires a large budget and time and, sometimes, local people might not feel comfortable enough to respond to questionnaires.

2.6 The Yala Swamp Wetland

The Yala swamp is one of the few wide-ranging wetlands found in Kenya. The wetland covers an area of 17,500 ha and contains three freshwater lakes, Kanyaboli, Sare, and Namboyo. The swamp vegetation is mainly papyrus (*Cyperus papyrus*) and Phragmites reeds. This wetland is nationally important in that it is one of the few habitats where the threatened *Sitatunga* antelope is found in Kenya. The associated lakes contain some critically endangered fish species some of which are no longer found in Lake Victoria. Yala swamp possesses various attributes of values, making it an essential contributor to the hydrological function, habitat quality, education and research of ecosystems. The diversity of vegetation, bird species, and other wildlife and the beauty of the landscape found within the wetland provide humans with tourism and recreational opportunities.

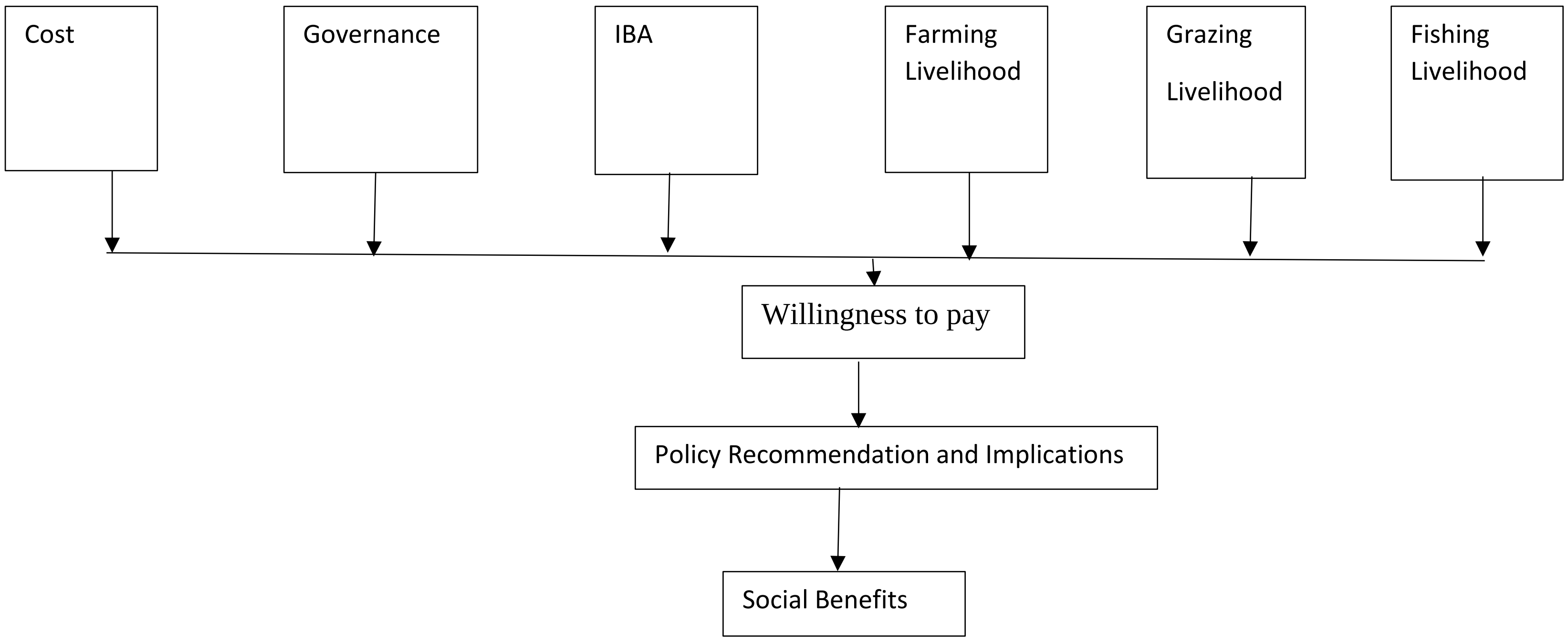
2.7 Summary of Literature Review

According to the evaluated empirical literature, preserving the environment is the main goal of every study that demonstrates the need to assess the ecosystem. In the empirical review of household’s preferences and willingness to pay for the ecosystem services, most studies were carried out using the Contingent Valuation Method (CVM). Contingent valuation method is used when the valuation of ecological goods and services in total is required, this study chooses Choice Modelling (CM) because choice model should be chosen when the valuation of individual environmental attributes is required. When information is needed in relative value for different environmental goods and services, the Choice Model is used. Choice experiments are more preferable when a consistent welfare estimate is required. More responses are obtained for each individual with CM than with CVM; hence CM offers more efficient sampling than CVM. According to environmental valuation studies, respondents' face choice can be framed in the format of willingness to pay. The National Ocean and Atmospheric Administration (NOAA) recommends the willingness to pay over willingness to accept the format (Zhang et al 2019). From this recommendation, there has been evidence that CM can elicit willingness to pay values successfully. The current study employed deliberative discrete choice experiment methodology to measure the WTP for different attributes in the study area. Most studies have studied the mean WTP for the conservation of the wetlands and ecosystems, this study intends to establish the factors affecting the respondents' willingness to pay for the ecosystem. It employed choice modeling rather than the CVM because in using the CM more response is obtained and is more efficient. From a past economic valuation study of the Yala swamp the direct economic values were calculated from fisheries, water transportation, agriculture, building materials, fuelwood, grazing, hunting, mat making, salt licks and tourism (Abila, 2002). Indirect values include medicinal plants, vegetables, flood control and wildlife habitats. The wetland also has existence and option values, which will be lost if the swamp is converted. Comparing these values with the short-term gains, and the cost of conversion, it is suggested that the wetland provides valuable economic resources to support the population, and should not be converted. Instead, traditional sustainable uses of the wetland should be promoted for the benefit of the local people. The current study builds on the findings of this study, where the methodology choice experiment is it elicits the willing to pay values successfully and thus economic valuation of the ecosystem. By using the previous studies on economic valuation of Yala swamp as the grounding of the current study that is using a robust technique (discrete choice experiment) to get the value of the wetland. This study seeks to informs the policymakers to integrate the total economic value of the swamp ecosystem services into their plan on conservation of the wetlands and thus resulting to tangible economic benefits to people consistent with contemporary conservation for development paradigm.

2.8 Conceptual Framework

Figure 2.2 is the conceptual framework guiding the study, the environmental attributes are among the factors that affect the household preferences on willingness to pay which is the dependent variable in this study. The payment vehicle(cost) and one of the factors affecting willingness to pay, the WTP was high when the cost associated with the conservation of various attributes is low. With the absence of governance as a factor affecting the individual WTP, the WTP level is higher than the presence of governance. The IBA affects the individual WTP in such a way that, with the knowledge about the important bird area the WTP is higher than when the respondents don't have that knowledge about the IBA. The fishing livelihood affects the level of willingness to pay, it is expected that acting in their own self-interest, fisher folks favoured alternative promoting increase in fishery abundance and richness. Farming livelihood it is expected that acting in their own self-interest, crop farmers favoured alternative allocating more land for crop farming this affects the dependent variable that's the individual's willingness to pay which led to the expected outcome which is the economic valuation of the wetland ecosystem. Lastly in the grazing livelihood affects the WTP in the sense that respondents chose choices with small grazing area since they will only pay low WTP as compared to choices that had large grazing area.

Figure 2.2: Conceptual Framework
Source: Authors computation 2022



CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the study area and the research methodology that was adopted for the study. Specifically, it describes the research design and methods used to collect and analyze the data.

3.2 Study Area

The study was conducted in the Yala swamp wetland (Fig. 3.1). Yala Swamp ecosystem (Latitude (N) + 0.046396; Longitude (E) + 34.042866) is Kenya's largest freshwater wetland and covers some 175 km^2 of papyrus (*Cyperus papyrus* L) and phragmites (*Phragmites mauritianus*) and other hydrophytic vegetation such as *Ceratophyllum, and Utricularia, Hydrilla, Vallisneria, Potamogeton, Limnophylla heterophylla, Typha, Sagittaria* along the northern shores of Lake Victoria and contains three small lakes Kanyaboli (10km^2), Sare 5 km^2 and Namboyo 2 km^2 (Abila et al., 2004, Barasa et al., 2014, 2017). The lakes have been shown to contain indigenous Lake Victoria cichlid fish species, and 'lost' Lake Victoria genetic variations and are thus important 'genetic reservoirs' for this genetic diversity and Evolutionary Significant Units (ESUs) (Abila et al., 2004, 2008). Yala swamp is bordered to the north by River Nzoia and to the south by river Yala and spans Kenya's administrative counties of Siaya and Busia. The wetland is home to five species of papyrus endemic birds namely Papyrus Gonolek (*Laniarius mufumbiri*), Papyrus Yellow warbler (*Calamonastides gracilirostris*), Carruthers's Cisticola (*Cisticola Carruthers*), Papyrus Canary (*Crithagra koliensis*), and the White-winged warbler (*Xenoligea Montana*) (Birdlife International, 2020) and the wetland has been recognized and designated as an important bird area (IBA) (Birdlife International, 2016). The swamp wetland is also home to the endangered swamp antelope *Sitatunga* (*Tragecephalus spekii*).

Yala swamp ecosystem has historically been a source of livelihood to surrounding communities (Abila, 2002, Thenya and Ngecu 2017). However, since the country's independence, several attempts have been made at extensive land-use conversion into large-scale agriculture, including the controversial leasing of land to an American agro-industrial firm in 2003, which converted nearly 10,000 ha of land to commercial rice, fish, and banana farming before exiting in 2018 (Odhiambo, 2018). This resulted in the loss of the local community's sources of livelihood, including grazing land and public access to the wetland, as well as ecological changes in the wetland, including changes in limnology of Lake Kanyaboli (Kondowe et al 2022).

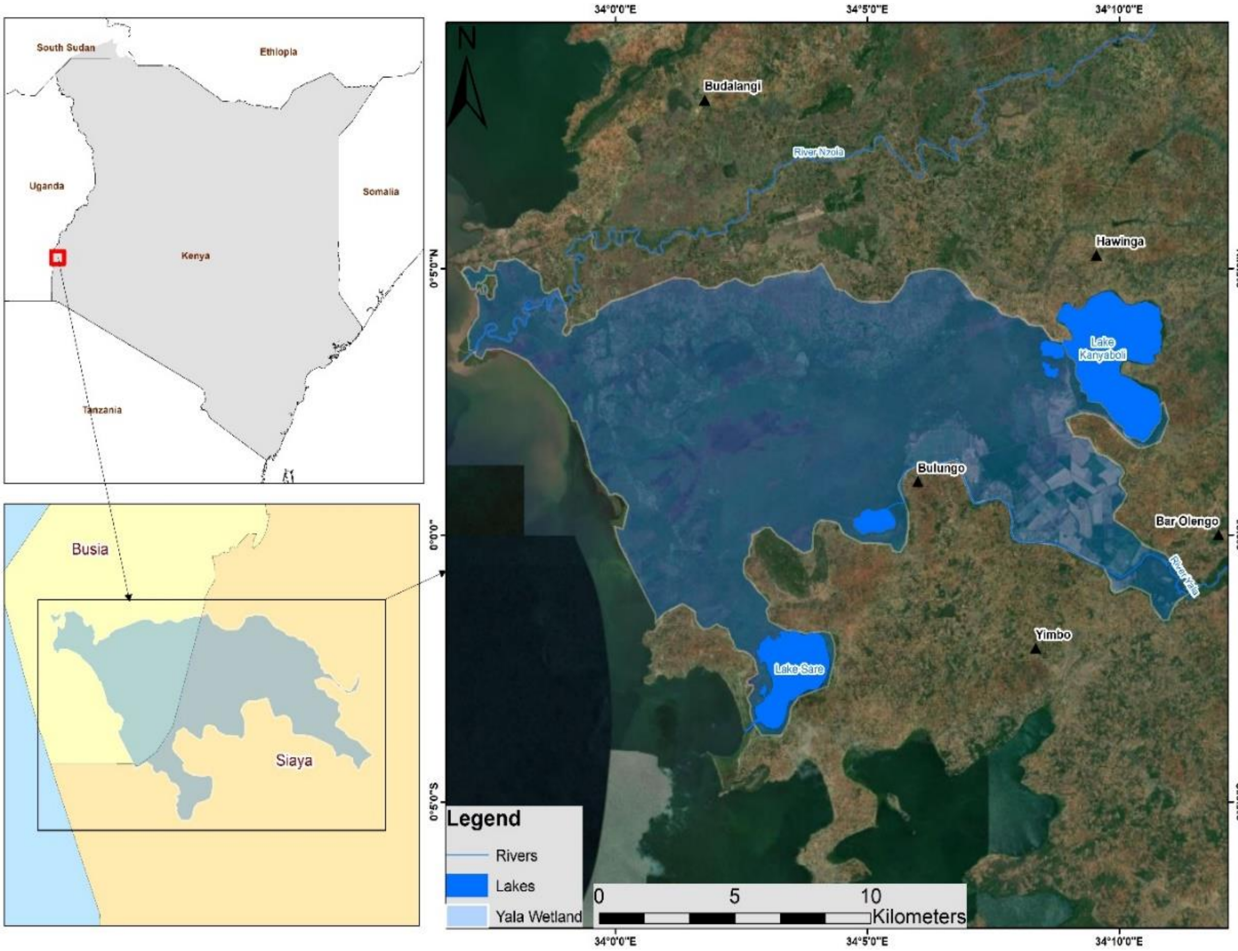


Figure 3. 1: Yala swamp wetland, East Africa (Source, Githiora et al., 2022)

3.3 Research Design

This study used experimental design which is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Experimental designs minimize confounding variables, which can offer alternative explanations for the experimental results. It also allows one to make inferences about the relationship between independent and dependent variables. Experimental design reduces variability, to make it easier for you to find differences in results. Experimental design is a systematic collection of data that focuses on the design itself rather than the results, planning changes to independent variables and the effect on dependent variables or response variables, and ensuring results are valid, easily interpreted, and definitive.

Through accurate and precise empirical measurement and control an experimental design increases a researcher's ability to determine causal relationships and state causal conclusions.

By using this design, the attributes and their levels were used to develop the alternatives so that a variety of different hypothetical scenarios arise. After identification of the attributes and levels, the next step involves the combination of the attribute levels to raise alternative scenarios. To achieve this objective, the study used a fractional factorial design to identify the combinations of attributes and options in a choice set using the dcreate STATA command to ensure orthogonality, while at the same time reducing the D-error and increasing model efficiency to attain a good level of D-optimality.

The final design had 64 paired choice profiles that were randomly blocked into eight sets of four choice tasks. Each respondent was randomly assigned to one of the eight choice sets and asked to choose the most preferred option in each choice task. Each choice task had three alternatives A and B and C the baseline status quo depicting the conditions as they were without any interventions. The D-efficiency converged with an optimal value was 3.88.

3.4 Data Type and Data Collection Procedure

Systematic random sampling was applied to population size in the five sub locations surrounding the swamp, namely: Nyamonye, Kadenge, Bar Olengo, Hawinga in Siaya county, and Rugunga in Busia county. This is because the use of systematic random sampling helps the researcher select samples in a quicker and efficient way. The samples selected are unbiased since each character in the study area are given equal chance of being selected but with a constant interval. Finally, simple random sampling within each of the five population was undertaken so as to get the sample size.

3.4.1 Target population and sample size

The total household population in the selected areas is 5785, the sampling unit in this study was the households residing around Yala swamp. The determination of sample size followed a proportionate to size sampling methodology as specified by Johnson and Orme (1996) formula.

$$n \geq \frac{500C}{t \times a}$$

Where; n is the number of respondents

t is the number of tasks (4) per respondent,

a is the number of alternatives per task (3),

c is the number of analysis cells which is equal to the most significant number of levels for any one attribute (6).

Hence the number of samples was 250 households, as shown in table 3.1

Table 3. 1: Sampled Sub locations and Sample sizes

S/n	Sub-location	Projected size of the Population	Number of respondents	Number Workshops
i	Nyamonye	1940	80	4
ii	Hawinga	1140	50	4
iii	Rugunga	574	24	3
iv	Bar Olengo	804	36	3
v	Kadenge	1327	60	6
	Total	**5785**	**250**	**20**

The respondents were engaged in a deliberation workshop before filling the questionnaires individually at the venue. A team of research assistants were hired to recruit respondents within the identified sub-locations through transect movement and recruit every 20th household head or spouse using a consent form that detailed the purpose of the study and the venue of the workshops. Participants were recruited a week before the meeting, and follow-up calls were made a day before workshop days.

3.5 Design of the choice experiment method

Execution of a choice experiment study follows five stepwise processes which entail identification of attributes and their levels, experimental design, construction of choice sets, and questionnaire development and data collection, and estimation procedure as discussed in the next subsections (Greiner et al., 2014; Holmes et al., 2017).

3.5.1 Identification and Selection of Attributes and their Levels

This is the first stage of designing a choice experiment study and it entails identification of a range of ecosystem functions and or services of a particular ecosystem of interests relevant and especially those that can be potentially impacted by policy change. Aside from the ecosystem services as the attributes, a monetary measure (the inclusion makes estimation of willingness to pay possible) is also included as one of the attributes (Kløjgaard et al., 2012). The identification of the attributes and their levels was aided by a review of the recently developed land use plan on the Yala swamp wetland developed by stakeholders. The land use plan established a baseline condition of the status of the wetland in terms of spatial extend of the various land use activities taking place within the such as farming, grazing, fishing, conservation, among others and the size of land available for each land use type. The land use plan also has scenarios for conservation and intensification of agricultural activities. To establish the attributes, explore attribute levels, with particular interest on the monetary attribute in terms of the most suitable numeraire and its ranges, three focus group discussions were conducted by 30 households. Six attributes with various levels were considered. However, the levels other than status quo were later reviewed when during analysis of pretested (n=63) it turned out for three attributes (grazing, farming, and costs) the participants did not take them seriously, the ranges for farming and grazing lands appeared too close to each other, while the initial costs also appeared low and close.

3.5.2 Questionnaire development

A semi-structured questionnaire was used for this study. The study questionnaire consisted of four sections. The first section was the consent form that informed the respondents about the purpose of the study and seek their permission to engage in the study; the second section comprised warm-up questions that ensured familiarity with the Yala swamp ecosystem and the services it provides. The third section included the choice experiment; and the fourth section contained debriefing questions aimed at establishing the reasoning behind the choices. The questionnaire concluded with questions about the socio-demographic attributes of the participants. It also contained ethical guidelines which informed respondents that participation in the study is not presenting any risk or benefit to them. This information is necessary given that participants were encouraged to provide honest responses.

3.5.3 Generation of choice of cards

After selecting the attributes and their levels, attributes and levels combination were generated as how they would appear in choice cards (Owuor et al 2019). Such choice cards were generated through efficient designs since they aim to yield standard errors that are as low as possible during the estimation of parameters (Walker et al 2018). During a pilot study to obtain efficient design, 30 respondents were interviewed (n = 30) using efficient design choice cards generated with the software package Ngene (Walker et al 2018). The final selection for the full 30 choice cards were designed to survey 250 participants with each respondent limited to six choice tasks to avoid exhaustion. Choice sets were blocked into five sub-samples to attain the six choice tasks. However, nine of the thirty cards that were generated had dominant alternatives. Johnson and Orme (1996) suggest that it is important to exclude implausible and dominant alternatives by including constraints at the design stage of the choice tasks. These constraints enable information on trade-off preferences as respondents normally prefer a dominant alternative, regardless of their preference (Rakotonarivo et al 2017).

Choice Experiment Responses

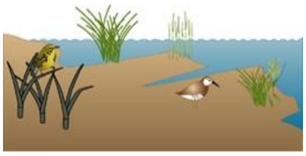
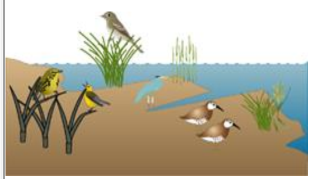
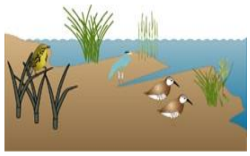
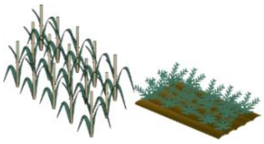
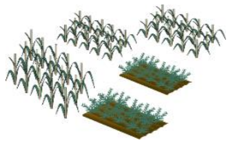
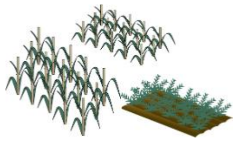
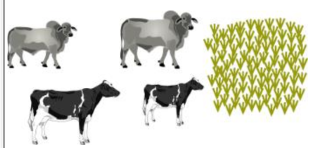
ATTRIBUTE	OPTION A	OPTION B	STATUS QUO
Fish diversity & abundance	Increasing 	Stable 	Declining 
Important bird area	8,000 ha 	16,000 ha 	13,000 ha 
Farming Area	2,000 ha 	10,000 ha 	5,000 ha 
Grazing Area	400 ha 	1,600 ha 	800 ha 
Governance Framework	Sub-location based community management 	NGO 	County Government 
Payment vehicle (Yearly donation of sack (s) of Maize)	5 	10 	0
Choice Made			

Figure 3.2: Example of Choice card used in the study

The final levels of the attributes and the specific attributes are shown in table 3.2 below.

Table 3. 2: Attributes and attributes levels

Variable	**Description**	**Levels/Measures**
Fish diversity & abundance	Population structure of some of (endemic) and (rare) fish species around the land Lake Victoria in terms of species richness and the abundance of the individual species.	Stable Increasing **Declining**
IBA (Important Bird Area)	Area representing extended fully protected area where there is no harvesting of papyrus and reclamation of the land. It represents area preserved for protecting the area as an Important Bird Area (IBA)	16000 hectares 8000 hectares **13000 hectares**
Farming	Amount of land (in hectares) in the wetland used for growing of crops	2000 hectares 10000 hectares **5000 hectares**
Grazing	Amount of land in the wetland that is available for communal gazing of livestock	1600 hectares 400 hectares **800 hectares**

Governance Framework	The institutional framework upon which Yala swamp is preferred to be managed under.	Sub-location-based community based Non-Governmental organization **County Government**
Payment vehicle	Cost to respondents in terms of maize commodity that they provided towards conservation and restoration of the Yala swamp on annual basis.	**0**,5,10 bags of maize

3.6 Data analysis

The collected data was cleaned then coded for easy of data entry. Random utility model that's Conditional and Mixed logit models were used to answer objective one of determining the household's preferences for ecosystem services for the ecosystem resources. Mixed logit model was used to answer objective two of estimating the WTP level for conservation of Yala swamp.

3.6.1 Objective one: Household's preferences for ecosystem services for the ecosystem services

The Lancaster's theory (Lancaster, 1966) of value and McFadden's random utility theory (McFadden, 1974) was adopted for the Yala Swamp ecosystem valuation. Lancaster's theory of value proposes that all goods be broken up into attributes. The random utility theory argues is that all decision-makers are utility maximisers and thus will choose the alternative that maximizes their overall utility (Hess et al 2018).

A_n=B_n+e_n ………………………………………………………………………….3.0

Where A_n is the systematic and observable component of the latent utility for option n and e_n is the random or unexplained component. Because of the random component the research can never expect to predict choices perfectly. The utility may also depend on a set of individual socio-economic characteristics of the respondent n. However, since these characteristics are constant across choices for any given individual, they can only be entered as interaction terms with specific attributes Latinopoulos, (2014); Mao et al., (2020). Recalling equation 2.2, the utility function is restated as;

A_{nm}= B (Y_m,T_n) +e_{nm})……………………………………………….…...3.1

Where for any respondent n a given level of utility will be associated with any wetland ecosystem alternative m, utility derived from any of the wetland ecosystem alternative depends on the attributes Y_m of the wetland, the socioeconomic characteristics of the respondents T_n and the stochastic element e_{nm} which represents unobservable influences on individual choice. With the Lancaster's model of consumer's choice, the respondent utility function A_{nm} for individual n and alternative m can be expanded to this form;

A_{nm}= B (Y_m,T_n) + $e(Y_m,T_n)$…………………………………………………3.2

The presence of the random component permits to make probabilistic statements about respondent's behavior. Choices made between alternatives will be a function of the probability that utility associated with particular option m is higher than other alternatives (Holmes et al 2017). An individual n will choose option m over some option k, U_{ij}>U_{ik} $j\neq k$, this leads to the expression for the probability of choice:

P_{nm}= P (B_{nm}+e_{nm}>B_{ik}+e_{nk}); $\forall k$ ∈D …………………………………………3.3

Where k is any option in a given choice set, different models are yielded due to difference in assumption about the distribution of the random error term. The model in equation 3.4 can be estimated using a conditional logit (CL) model. The conditional logit model assumes the random (error) components are distributed Independent and Identically Distributed (IID) with a Weibull distribution and choices are consistent with the Independence of Irrelevant Alternatives (IIA) property (Paleti, 2019). The IIA property states that the relative probabilities of two options being chosen are unaffected by the introduction or removal of other alternatives (Okumu and Muchapondwa 2017). This makes the conditional logit model to be estimated for the probability of an individual i for choosing particular option j takes the following form:

$$P_{nm} = \frac{exp(B(Y_{nm}, T_n))}{\sum_{h \in C} \exp{(B(Z_{nh}, T_n))}} \ldots\ldots 3.4$$

Where h is one of the possible options in wetland ecosystem alternatives in choice set D. h∈C, the conditional indirect utility function is generally estimated as;

$$B_{nm} = \alpha_0 + \alpha_1 Y_1 + \alpha_2 Y_2 + \ldots\ldots \alpha_q Y_q + \delta_1 T_1 + \ldots\ldots \delta_2 T_2 + \delta_r T_r \ldots\ldots 3.5$$

Where α is the alternative specific constant (ASC) which captures the effects on utility of any attributes not included in choice specific attributes Iqbal (2020). The number of wetland ecosystem attributes considered is q and the number of socioeconomic characteristics of wetland *r*, the vectors of coefficients, α_1 *to* α_n *and* δ_1 *to* δ_m are attached to the vectors of wetland ecosystem attributes (Y) and the vectors of socioeconomic characteristics (T) that influence utility respectively. If the IIA property is violated then the conditional logit model result will be biased and hence a discrete choice that does not require IIA property should be applied such as heteroskedastic extreme value (HEV) model and random parameter logit (RPL) or mixed logit (MXL) model.

In this study a mixed logit model was used since it accounts for preference heterogeneity and does not exhibit the IIA property and explicitly accounts for correlations in unobserved utility over repeated choices by each respondent. The random utility function in the mixed logit model is given in this form;

A_{nm} = B ($Y_{nm}(\alpha_i$+τ_n),T_n) + $e(Y_j$,T_n) ……………………………………………….3.6

In the mixed logit model, utility is also decomposed into a deterministic component B and an error term. Indirect utility is assumed to be a function of the choice attributes T_j with parameters α_i which due to preference heterogeneity may vary across respondents by a random component τ_i and of the socio-economic characteristics of the respondents Ti, this translates equation 3.6 as:

$$P_{nm}=\frac{\exp\,(B(Y_{nm}(\alpha+\tau_n),S_n))}{\sum_{h\in C}\exp\,(B(Y_h(\alpha+\tau_n),S_n))}$$ ……………………………………………………………3.7

3.6.2 The Model specification

The study adopted Owuor et al (2019) and Ombok et al (2016) discrete choice experiment method of valuing mangrove biodiversity and ecosystem in Kenyan coastal and valuation of Kakamega forest medicinal plants respectively where the attributes and characteristics were nursery and breeding ground for fish, biodiversity richness and abundance, shoreline erosion protection and education and research and herbal medicine consumption, pharmaceutical consumption, price of herbal medicine and conventional medicine and medical insurance cover respectively. This study adds on the following variables as attributes farming, grazing, papyrus area, organisation, cost and fish.

$$\Pr(Y=K_i) = \frac{e^{B_{ij}}}{1+e^{B_{ij}}}$$ ……………………………………...………………3.8a

Where;

$$B_{ij} = \alpha_0 \text{ASC} + \alpha_1 \text{FISH}_{\text{ih}} + \alpha_2 \text{PAPYRUS}_{\text{ih}} + \alpha_3 \text{FARMING}_{\text{ih}} + \alpha_4 \text{GRAZING}_{\text{ih}} + \alpha_5 \text{ORGANISATION}_{\text{ih}} + \alpha_6 \text{COST}_{\text{ih}} \quad \ldots\ldots 3.8b$$

A statistically significant and positive partial coefficient of the interaction between the variables in the study and α_0 shows the probability that respondents chose the improved policy options. In contrast, a negative partial coefficient shows a higher likelihood that respondents determined the *status quo* (Wang & Gao, 2018).

3.6.3 Objective two: To estimate the willingness to pay for the conservation of the Yala Swamp ecosystem

The CE method is consistent with utility maximization and demand theory (Holmes et al., 2017); therefore, if a cost attribute is included in the choice set, welfare estimates can be derived. For the specific case of a CL model, compensating surplus (CS) welfare estimates can be obtained from the following formula (Latinopoulos, 2014):

$$CS = \frac{ln \sum_i \exp{(B_i^1)} - ln \sum_i \exp{(B_i^0)}}{a} \ldots\ldots 3.9a$$

Where a is the marginal utility of income (represented by the coefficient of the cost attribute) and B_i^0 , B_i^1 represent the utility functions at initial level (status quo) and after the change levels, respectively. When money is used as the standard to measure welfare, then the measure of benefit is the willingness to pay (WTP) to secure that benefit (Musafili et al 2022). The marginal value of a change in one attribute is measured through the ratio of the two coefficients and this gives the willingness to pay as shown in equation 3.9b

$$mwtp = -\frac{\beta_{Attribute}}{\beta_{cost}} \ldots\ldots 3.9b$$

Moreover, given the linear utility function as specified in equation 3.5, the WTP for a marginal change in the level of provision of each environmental attribute is obtained by divided by the quality by the coefficient of the cost attribute (Xin et al 2022). The main effects model and the segmented model for both conditional logit and mixed logit were used to estimate the total mean willingness to pay for the wetland's ecosystem services.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents study findings, results and discussions. The chapter is organized as follows; the descriptive results, ordered as follows; source of income, age of respondents, household size, land size, monthly income of respondents, length of stay, harvests per seasons, education level of respondents and gender. Objective one was answered using the Random utility model output which seeks to determine the household's preferences for ecosystem services. Discrete choice experiment models were used to answer objective two that's determining the mean WTP for the various attributes.

4.2 Demographic and socio-economic characteristics of the study population

During the study, data was collected on the following socio-economic variables source of income, age of respondents, household size, land size, monthly income of respondents, length of stay, harvests per seasons and education level of respondents. Table 4.1 gives a summary of the data.

Table 4.1: Descriptive Statistics of Demographic and Socio-economic variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	3000	52.25	13.53	24	80
Household size	3000	5.73	2.14	1	16
Land Size(ha)	3000	3.25	2.35	0	12
Ln Income	2988	3.78	1.01	3.44	4.60
Length of stay	3000	43.40	16.80	4	80
Harvests per season	3000	5.23	3.79	0	25
Education (no of yrs.)	3000	8.46	3.73	0	16

4.2.1 Gender

From the information on the gender distribution of the respondents 116 out of 250 were female which is 46.40% while male respondents were 53.60%.

4.2.2 Age

The mean age of the respondents is 52.248 with the minimum age of the respondents being 24 and the oldest being 80 years. The standard deviation of the respondents age is 13.525. Most of the respondents are in active age bracket and thus they are responsible for the labour source in their respective farms and those of hired labour.

4.2.3 Household size

The household size has a mean of 6 people per homestead with the minimum number being 1 and the maximum number being 16. The mean is slightly above the county's average household size which is 4 (KNBS 2019). This high number is responsible for labour force in farming, fishing, businesses and other economic activities around the ecosystem. The standard deviation of household size is 2.135.

4.2.4 Education

The average years respondents have spent in education is 8.45 years with the highest being 16 years that's until one gets a bachelor's degree. With a mean of the mean of 8.45, this shows that most of respondents have basic education. The standard deviation is 3.732.

4.2.5 Length of stay in Yala Swamp area

The average years one has stayed in the area of study is 43.392, with the minimum number of years one has stayed in the area being 4 while the maximum years one has stayed in the area being 80. This shows that the respondents have rich history about the Yala Swamp since they have been observing the positive and negative changes to the ecosystem.

4.2.6 Land size

The average land size responsible for farming is around 3.248 ha with the highest size of land being 12ha. The standard deviation of the land size is 2.348.

4.2.7 Harvests

The average number of bags of maize harvested per hectare per season is 5.226 while the highest harvest per season is 25 bags of maize with a standard deviation of 3.786. The national average bags per hectare of maize is 20, the gap in the average is as a result of the constraints which are associated high cost of production and low fertility and pest and diseases.

4.2.8 Income

The average monthly income of the respondents is Ksh 6057 with the higher limit being Ksh 40000 this is explained by the respondents having different sources of income. The standard deviation of income is 6985

4.2.9 Source of Income

The respondents were asked about their source of income and the table 4.2 shows their response where 16.40% said their source of income is from fishing, 24.80% stated that their source of income is from crop farming, 16.40% source of income came from animal keeping, 10.80% source of income comes from businesses they are involved in, 5.60% stated that their source of income comes from salary whereas 14.80% source of income comes from wages whether weekly or daily and lastly 11.20% source of income comes from remittances.

Table 4.2: Income Sources for the respondents in the study area

Income Source	Freq.	Percent	Cum.
Fishing	492	16.40	16.40
Crop farming	744	24.80	41.20
Animal keeping	492	16.40	57.60
Businesses	324	10.80	68.40
Salaries	168	5.60	74.00
Wages	444	14.80	88.80
Remittances	336	11.20	100.00
Total	3000	100.00	

4.3 Household's preferences for ecosystem services.

4.3.1 Conditional logit results

To measure willingness to pay for the different attributes in Yala Swamp ecosystem, the study used the Discrete Choice Experiment (DCE) methodology to assess households' preferences for different attributes using the Conditional Logit (CL) model. To estimate the willingness to pay level for the conservation of the Yala swamp ecosystem.

The coefficient of IBA attribute is positive and significant at 95% level as shown in table 4.3, this means that there is significant difference in choice of different options as a result of IBA. This shows that respondents were influenced by the area of IBA in respect to choosing of different options. The respondents chose options with more IBA. The positive sign of the IBA attribute is consistent with results of other valuation studies e.g. (Ashim, 2018; Zarandian et al 2017).

The coefficient of grazing as an attribute is negative but significant at 95% level as shown in table 4.3, this shows that the higher the grazing area the lower the choice option by respondents, they were less likely to choose higher choices because they be needed to pay more for the conservation of the ecosystem. This reduces the probability of this attribute being chosen by the households thus not a household preference. The negative sign of the grazing attribute is consistent with results of other valuation studies e.g. (Greiner, 2016, Li and Bennett 2019).

The coefficient of farming attribute is positive and significant at 95% level as shown in the 4.3. The positive sign implies that an increase in the level of this attribute increases the probability of choosing improved choice. The respondents gave more weight on choices with more farming, they choose options with more land for farming. The positive sign of the farming attribute is consistent with results of other valuation studies e.g. (Ceschi et al 2018; Oehlmann et al 2017).

The coefficient of governance as an attribute is negative and significant at 95% confidence level, this is shown in the table 4.3. This shows that the three governance levels (community, County government and NGO's) have no influence on the respondent's choice of options to the swamp ecosystem. Thus, governance is not a household's preferences for ecosystem services.

The coefficient of cost attribute is negative and significant at 95% level as shown in table 4.3. The negative sign implies that the respondents made choices towards the option that has less payment vehicle in the conservation of the environment. The respondents gave more weight on choices with cost that's the willingness to pay for the conservation of the ecosystem. The negative sign of the cost attribute is consistent with results of other valuation studies e.g. (Daziano et al 2017; Börger et al 2021).

The three (stable, declining or increasing) types of fisheries levels don't affect the respondent's choice of the options because as shown in table 4.3 the fishery factor has a positive coefficient and insignificant at 95% confidence level.

Table 4.3: Conditional Logistic regression on the Household preferences

Choice	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
Fishery	0.116	0.098	1.190	0.234	-0.075	0.308	
IBA	0.000	0.000	2.520	0.012	0.000	0.000	**
LnFarming	0.246	0.063	3.910	0.000	0.123	0.370	***
lnGrazing	-0.319	0.073	-4.380	0.000	-0.462	-0.177	***
Governance	-0.210	0.099	-2.120	0.034	-0.405	-0.016	**
Cost	-0.053	0.014	-3.750	0.000	-0.081	-0.025	***

Mean dependent var	0.333	SD dependent var	0.471
Pseudo r-squared	0.310	Number of obs	3000
Chi-square	66.302	Prob > chi2	0.000
Akaike crit. (AIC)	3310.711	Bayesian crit. (BIC)	3346.750
Log likelihood =	-968.4573		
LR	271.25		

**** p<.01, ** p<.05, * p<.1*

Source: Authors computation 2022

It is important to note that the failure of the IIA assumption in CL models can lead to misspecification, to check and ascertain that this misspecification was not present, the Hausman and McFadden (1984) test for the IIA property was conducted. The likelihood ratio tests were conducted for all the four distinct subsets of all the choice alternatives (choice sets) in order to check whether IIA holds. From the tests, it was found that IIA only holds for alternative 2 (61.38 and p=0.05), while it does not hold for alternative 1 (-4.54) and alternative 3 (-7.23) where in both cases it was found to be negative implying a violation of the IIA assumption. In order to overcome the violation of the IIA assumption the study applied the Random Parameters Mixed Logit Model (MXL) with 50 random draws to address the limitations of the CL model regarding the IAA assumption. The results of MXL model are shown in the table 4.4

4.3.2 Mixed logit model

The coefficient of IBA attribute is positive and not significant at 5% level as shown in table 4.4, this means that there is no significant difference in choice of different options as a result of IBA. This shows that respondents won't be influenced by the area of IBA in respect to choosing of different options.

In table 4.4 the coefficient of grazing as an attribute is negative but significant at 5% level, this shows that the higher the grazing area the lower the choice option by respondents, they were less likely to choose higher choices because they be needed to pay more for the conservation of the ecosystem. The negative sign shows that households have lower probability of choosing option one as compared to options two and three. The negative sign of the grazing attribute is consistent with results of other valuation studies e.g. (Greiner, 2016, Li and Bennett 2019).

The coefficient of farming attribute is positive and significant at 5% level, this is shown in table 4.4. The positive sign implies that an increase in the level of this attribute increases the probability of choosing improved choice. This increases the probability of households choosing option one other than options two and three. The respondents gave more weight on choices with more farming. The positive sign of the farming attribute is consistent with results of other valuation studies e.g. (Ceschi et al 2018; Oehlmann et al 2017).

The coefficient of governance as an attribute is positive and significant at 95% confidence level, as shown in table 4.4. This shows that the three governance levels (community, County government and NGO's) to the swamp ecosystem influences the respondent's choice options, thus willingness to pay since it has a positive coefficient and the p value at 95% confidence level is significant.

In table 4.4 the coefficient of cost attribute is negative and significant at 5% level. The negative sign implies that the respondents made choices towards the option that has less payment vehicle in the conservation of the environment. The respondents gave more weight on choices with cost that's the willingness to pay for the conservation of the ecosystem. The cost attribute does affect willingness to pay for the conservation of the ecosystem. The negative sign of the cost attribute is consistent with results of other valuation studies e.g. (Daziano et al 2017; Börger et al 2021, Mwaura, 2021).

As shown in table 4.4 the fisheries (stable, declining or increasing) have a positive coefficient but insignificant at 5% confidence level. This doesn't affect the willingness to pay and isn't a household's preferences for ecosystem services. The positive sign of the coefficient shows that households have a higher probability of choosing option one rather than options one rather than options two and three.

It is assumed that the null hypothesis in the Wald statistics is that there are specified individual parameters that are significant at 5% confidence level. Since the Wald (chi) measures goodness of fit of the model and joint significance of the parameters. In this study we reject the null hypothesis for Wald statistics and take the alternative hypothesis since at least one parameter is significant, (p value 0.0000).

The results of the mixed logit model reveal that the standard errors are significant for the coefficients of the six attributes, these significant standard errors indicate that the different households in the Yala swamp ecosystem have varied preferences over IBA, Grazing, Farming, Cost, Fishery, Governance, at a 5% significance level. Also, the household heterogeneous preferences are shown by significant standard deviations at 5% significance level. The random parameter mixed logit model shows that these four attributes (farming, grazing, cost and governance) were highly significant at 5%(p=0.05) as a shown by the significant standard deviation of the attribute's coefficients.

Table 4.4: Mixed logit choice model results on the Household preferences

Choice Option	Coef.	Std.Err.	Std. dev	z	P>z	[95%Conf.	Interval]
IBA	0.000	0.000	-0.234	1.120	0.263	-0.000	0.000
lnFarming	0.211	0.064	0.319	3.290	0.001	0.085	0.338
lnGrazing	-0.218	0.060	0.543	-3.640	0.000	-0.335	-0.100
Cost	-0.037	0.012	0.395	-3.170	0.002	-0.059	-0.014
Fishery	0.063	0.080	-0.451	0.780	0.433	-0.094	0.219
Governance	0.113	0.082	0.554	1.370	0.001	0.273	0.048
2_cons	-0.778	0.078	0.352	-9.990	0.000	-0.931	-0.626
3_cons	-1.669	0.198	0.214	-8.450	0.000	-2.056	-1.282

Integration points:	0	Wald chi2(6) =	41.63
Log likelihood =	-933.83932	Prob > chi2 =	0.0000
Akaike crit. (AIC)	3140.251	Bayesian crit. (BIC)	3286.501
LR =	240.72		

4.4 Mean willingness to pay level for the conservation of the Yala swamp ecosystem.

4.4.1 Mean WTP for the different attributes

The average implicit payment vehicle of the different ecosystem attributes is shown below. The Krinsky and Robb (1986) bootstrapping procedure was conducted to evaluate the attribute prices and the respective 95% confidence intervals.

From the tabulated output the mean WTP of fisheries is around two bags of maize for the improvement of fisheries. This is because the communities living around the wetland draws most of the income from the fishing activity by creation of jobs and sales obtained from this attribute. The households were willing to pay compensation of around three bags of maize when the attribute is not preserved as the lower limit while willing to pay around six bags of maize for the improvement of this attribute as the upper limit. The households were willing to pay 0.04 bags of maize from the improvement of the IBA (important bird area), this is because of the revenue they get from tourist who are attracted by the birds in the area. The respondents were willing to accept 0.03 bags of maize as compensation for not improving this attribute, this is the lower limit while the same household were willing to pay for the conservation and improvement of the ecosystem 0.11 bags of maize as the upper limit.

From the tabulated output as shown in table 4.5, its evident that household's places high value on governance, through the MXL model the mean WTP of around three bags of maize for the improvement of governance. This is the institutional framework upon which Yala swamp is preferred to be managed under if there were any change in the governance. The respondents were willing to accept around two bags of maize as the lower limit while willing to pay for around eight bags of maize for the improvement of governance as an attribute for the upper limit.

The households were willing to pay 0.17 bags of maize for the improvement of the farming attribute this is because of the revenues and products derived from the farming around the ecosystem, with the lower limit as 0.12 bags and 0.22 bags of maize as the upper limit. Further the respondents were willing to pay 0.12 bags for improving the grazing attribute with the lower limit as 0.10 bags and upper limit as 0.14 bags of maize.

Table 4.5: Mean WTP for the different attributes in the wetland

	Fisheries	IBA	Governance	Farming	Grazing
Mean Wtp	1.71	0.04	3.07	0.17	0.12
Ll	-2.64	-0.03	-1.55	0.12	0.10
Ul	6.06	0.11	7.69	0.22	0.14

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The discussions, debates, results, and recommendations are all presented in this chapter. It begins with a discussion of the first goal, which is to determine the household preferences for ecological services in Yala Swamp, Kenya. The second goal is to estimate the average willingness to pay for the conservation of the Yala swamp ecosystem. The study's conclusions are presented next, and the chapter concludes with policy, legislation, and sustainable management recommendations. Finally, the chapter concludes with research recommendations.

5.2 Discussions

In this discussion, the findings from the study are compared to those from other, related studies to see whether the findings are in agreement or disagreement with other studies. The coefficient of the IBA attribute is positive and not significant, this means that there is no significant difference in the choice of different options as a result of IBA. This shows that respondents won't be influenced by the area of IBA in respect to the choice of different options. this finding corroborates the low WTP for IBA (biodiversity conservation) and is an indication that the local community do not prioritize biodiversity conservation due to not receiving financial gains. Yala swamp wetland is world biodiversity hotspot. There is therefore need for development of community based and community led conservation programmes that provides financial benefits to the local community. This study is contrary to Scridel et al (2020) and Areeyapat et al (2020) where the coefficient estimates for bird species richness are positive and significant for the conservation of biodiversity and the endangered species.

The coefficient of grazing as an attribute is negative but significant. This shows that the higher the grazing area the lower the choice option by respondents, they were less likely to choose higher choices because they are needed to pay more for the conservation of the ecosystem. The negative sign of the grazing attribute is consistent with results of other valuation studies e.g. (Greiner, 2016); Han-Shen (2019); Li and Bennett (2019). These findings are also consistent with Mombo et al (2011) where the grazing area had a negative coefficient and states that a decrease in the grazing area will lead to a reduction in the number of livestock an individual has thus affecting the livelihood of residents. A win-win situation will result from the establishment of grazing area conservation levies since it will raise the condition of pasture lands, which will boost livestock productivity and enhance income for livestock keepers. Additionally, by preserving grazing lands, farmers and livestock keepers in the study area will have less frequent confrontations. This is because livestock keepers frequently invade farmers' land in quest of greener pastures for their herd.

The coefficient of the farming attribute is positive and significant; the positive sign implies that an increase in the level of this attribute increases the probability of choosing an improved choice. The respondents gave more weight to choices with more farming. The positive sign of the farming attribute is consistent with results of other valuation studies e.g., Ceschi et al (2018); Oehlmann et al (2017); Han-Shen et al (2019) and Mwaura (2021). Similarly, Previous studies have also shown households' preference for farming, in a study by Anteneh et al. (2019), has the highest positive and significant coefficient of farming thus the households hold more preference for farming. Also, in a study on Wei River Shaanxi province China by Saddique et al (2019) where the coefficient of water improvement was highly significant to improve farming output. Farmers are encouraged to expand their agricultural activities in wetland areas by the high income that can be generated from crop production in study areas of the research area. Farmers are inspired to develop more fertile land as a result. This is due to the common misconception among farmers that the more they cultivate in flood plain areas, the more food and cash crops they will produce and, consequently, the more money they will make from selling those crops (the WTP value), which is a proxy for the benefits they would receive if the areas were conserved. The proclaimed value for ecological benefit (for preserving flood plain areas) is too low to deter farmers from farming these areas, and it is insufficient to make up for or replace the advantages farmers gain from destroying the wetlands.

The coefficient of governance as an attribute is positive and significant. This shows that the three-management level (community, County government, and NGOs) to the swamp ecosystem influences the respondent's choice options, thus willing to pay. The coefficient of cost attribute is negative and significant, the negative sign implies that the respondents made choices towards the option that has fewer payment vehicles in the conservation of the environment. The respondents gave more weight to choices with cost that's the willingness to pay for the conservation of the ecosystem. The cost attribute does affect willingness to pay for the conservation of the ecosystem. The negative sign of the cost attribute is consistent with results of other valuation studies e.g., Areeyapat et al (2020); Daziano et al (2017); Börger et al (2021), Mwaura, (2021), which their studies found out that the payment vehicle is consistent with the economic theory that makes it less preferred by respondents.

The 3 types of fisheries levels don't affect the respondent's choice of the options whether to choose option 2 or 3. The fisheries have a positive coefficient but insignificant. This doesn't affect the willingness to pay for the conservation of the ecosystem. Because they anticipate that the proposed policy to improve the fisheries by reducing fishing frequency will influence their existing consumption and income from the resource, they are not prepared to pay for the attribute of the fishery. Another factor that may necessitate government and/or other nonprofit organizations implementing programs to raise public awareness of the importance of the resource is a lack of understanding of its value. This is contrary to the study by Dee Lee (2014) where the coefficients were positive and significant in a study to estimate the WTP for controlling excessive recreational fishing demand at Sunday River, South Africa. The results state that an increase in the fish stock would increase the probability of choosing an option. Also, it is consistent with a study by Bulo and Mekonnen (2020) on the valuation of wetland attributes in Lake Koka, Ethiopia using a choice experiment. Where the findings are that respondents are not willing to pay for the improvement of fish stock, because there is an assumption that, limiting the amount of fishing will reduce their current consumption.

In this study the mean willingness to pay for governance is the highest at three bags of maize this, demonstrates that governance is an important issue among the local communities and needs to be resolved if meaningful wetland-based development is to take place. Findings from this study can inform community-based and community-led conservation education programs (school programs and citizen science programs), wetland development, and land use policies such as zoning of the wetland where certain areas are set aside for grazing during drought season, certain areas for farming. Secondly, by the development of land use policies it will avoid physical confrontations amongst the users of community trust lands where grazing was shared also to avoid serious conflict with the host community which was caused by use of water resource from river Yala by the dominion farm for paddy irrigation. These findings are support the proposals that are contained in the CIDP (County Integrated Development Plan) of Siaya county where there is need to establish environmental management plan (EMP) and establishment of land use plan (LUP) (Barasa, & Nyaga, 2021) have) have been identified. The mean willingness to pay for IBA (Important bird area) was the lowest this was attributed by the fact the locals feel they are not involved in the local tourism, thus the willingness to pay level is low.

5.3 Conclusions

The study was carried out to conduct an economic valuation of the Yala swamp ecosystem. The study aimed at addressing two specific research objectives. First was to determine the household’s preferences for ecosystem services. Secondly to estimate the willingness to pay level for the conservation of the Yala swamp ecosystem. The respondents for the study were obtained through stratified sampling, where 250 households were sampled. Study data were collected through semi-structured questionnaires administered by trained enumerators.

These are the conclusions of the study:

i) The results shows where farming, grazing, governance and cost (payment vehicle) factors affects households preferences since they were significant, while fishery and IBA (important bird area) preferences were found not to be significant thus doesn't affect the respondent's willingness to pay for the conservation of the Yala ecosystem.

ii) In estimating the willingness to pay level for the conservation of the Yala swamp ecosystem the results show that households placed a high value on the governance and would pay a mean WTP of three bags of maize for its improvements. The study demonstrates that governance is an important issue among the local communities and needs to be resolved if meaningful wetland-based development is to take place. Further, households would be willing to pay 0.04 bags of maize for the improvement of IBA (Important Bird Area), lack of involvement of local community members may explain the perceived low WTP for improvement of IBA and other biodiversity conservation activities. The households would also be willing to pay a further 0.17 bags of maize for the improvement of the farming attribute. On fisheries attribute, households would also be willing to pay around two bags of maize for its improvement in the ecosystem. Finally, households were willing to pay 0.12 bags of maize for the improvement of the grazing attribute. A total of 5.11 bags of maize was the willingness to pay value for the conservation of Yala swamp wetland. This represents nearly 98% of a household’s annual maize harvests.

5.4 Policy, Legislation and Sustainable Management Recommendations

The results of the study have shown that society’s welfare can be improved by organizing managing and distributing of resources both sufficiently and efficiently.

First, according to the research findings, particular interventions in the Yala swamp could be targeted with market-based conservation strategies that aim to improve the delivery of ecosystem services by rewarding ecosystem service providers. This can be maintained by encouraging public involvement in the design and execution of all development projects. Additionally, taking into account recipient preferences for alternative interventions in ecosystem service payment schemes enables remuneration to change. Therefore, when developing and implementing market-based conservation schemes, policymakers should take into account the diversity in preferences for collective and individual intervention as well as the livelihood strategies of the potential ecosystem service providers. This will improve the welfare of the local population and preserve the area's natural resources.

Secondly, implementation of other environmentally sustainable compatible low technology livelihood activities such as papyrus product industries, apiculture, raising tree seedlings, and finger pond aquaculture, cage aquaculture and promotion of other sustainable farming practices including strengthening local fisher groups.

Thirdly, governance issues can be addressed through implementation of the Yala wetland land use plan which clearly designated swamp areas for use by local communities and formulation of land governance and ownership policies which should include among others policy on conflict management.

Lastly, adoption of implementation of guidelines and regulation regarding large scale agricultural activities in the Yala swamp wetland including requirement for robust environmental and social impact assess (ESIAs) and continued monitoring of all development activities within the wetland.

5.5 Recommendations for Further Research

Further research should reveal the change in economic benefits of the people surrounding caused by a change of the Yala Swamp ecosystem services improvement.

Secondly, the development of a more explicit and detailed mapping between ecosystem services as typically conceived by ecologists and the services that people value (and hence to which economic valuation approaches or methods can be applied).

Further a study on improved understanding of the spatial and temporal thresholds for various ecosystems, and development of methods to assess and incorporate into valuation the uncertainties arising from the complex dynamic and non-linear behavior of many ecosystems and improvements in the methods for assessing and incorporating uncertainty and irreversibility into valuation studies.

Lastly future studies should involve detailed analysis of influence of gender, age, household size, education and income on preferences and WTP in Yala swamp wetland. Such information may inform targeted approaches to wetland communities.

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APPENDIX

APPENDIX I

ECONOMIC VALUATION OF THE YALA SWAMP ECOSYSTEM

SURVEY INSTRUMENT (1)

CONSENT STATEMENT

(The following statement must be read to every respondent)

May I have a minute of your time?

The National Geographic Society is conducting a study on economic values of the Yala swamp ecosystem. It is, therefore, important to obtain information from the communities living around the swamp like you. The information is being collected for academic purposes only and there are no personal benefits or risks to your participation.

The information you give will be treated with confidentiality and will not be shared to third parties. The interview takes approximately 45 minutes. You may terminate the interview at any point if you do not wish to proceed.

Consent Granted: YES: Proceed with interview

NO: Thank the person and look for next respondent. You are required to keep this questionnaire whether the respondent agreed to participate or not.

SECTION A: QUESTIONNAIRE IDENTIFICATION

County…………………Sub-County……… ……………Sub-location………………………………

Village………………………………Date……………………………

SECTION B: HOUSEHOLD CHARACTERISTICS

I would like to ask you some questions about yourself. This will help us understand why respondents' opinions may differ. ***Please be assured that your answers are anonymous and all information collected is confidential***

Question 1	
Age in years	
Years you have lived in the village/area	
Question 2 What is your gender?	
01. Male	
02. Female	
Question 3 How many people live in your household, including yourself? (Please count separately the number of adults and children)	
01. Adults	
02. Children (below 18 years)	
Question 4 Level of education in years (until now)?	

01. Never went to school	
02. Primary	Class…….
03. Secondary	Form…….
04. Certificate	Years ………
05. Diploma	Years……….
06. University degree	Years…………
07. Post-graduate degree	Years …………

Question 5

Are you a member or employee of any environmental, developmental/social group or organisation?

Yes………

No……………

if yes then tick the category below

01. Environmental group	
02. Fishing group	
03. Tourism group	
04. Farmers group	
05. Business group	

Question 6

What is your main source of income? (Tick one only)

01. Fishing	
02. Crop farming	
03. Animal keeping	

04. Business	
05. Salary	
06. Wages	
07. Remittance	
08. Other (specify) ………………...	
Question 7 What size of your land is under maize farming and what is the average bags of maize do you harvest per season	Size of land in acres…………. No of bags per season………...
Question 8 Which of the following is a rough estimate of your monthly income in Ksh.	
Less than 2800	
Between 2801 to 5000	
Between 5001 to 10000	
Between 10001 to 20000	
Between 20001 to 30000	
Between 30001 to 40000	
Between 40001 to 50000	
Above 50000	

SECTION B: KNOWLEDGE OF THE YALA SWAMP

Question 9:

Which of the following best describe how far you live from the Yala swamp (tick one only)

0-1	
1-2	
2-3	
3-4	
4-5	
5-6	
6-7	

Question 10:

Which of the following statements do you think is true about Yala swamp

	Yes	Not sure	No
01. Yala swamp is an Important Bird Area			
02. Yala Swamp is the home to some of the fish that are no longer found in Lake Victoria, and some animals that are globally rare			
03. Yala swamp is used for farming by the surrounding community			
04. Yala swamp is used as a grazing ground by the surrounding community			
05. Yala swamp's papyrus is used for making mats			

Question 11

a. Are you aware that the following list of fish, birds and other animals are either found only in Yala swamp or are globally rare

	Yes	No
Ningu		
Monye		
Duche		
Papyrus Gonolek		
Warbler species		
Cisticola species		
Sitatunga		

b. Do you agree that birds serve the following ecological functions that are useful to man

	Yes	No	Not Sure
1. They help in biological control of pests, and harmful reptiles			
2. They help in spreading nutrients (Guano)			
3. They scavenge on dead animals hence help in waste disposal			
4. They help in seed dispersal			
5. Helps with pollination			
6. They are used as food			

7. They help with communication e.g., as signs of rain			

Question 12a.

Do you take part in the conservation of rare and endemic animals found in Yala swamp?

Yes ……………

No………….

Question 12b.

If Yes which of the following do you do

	Yes	No
01. Tree planting		
02. Bird watching		
03. Not burning papyrus		
04. Not taking part in *Sitatunga* hunting		
05. Using correct fishing gears		

Question 13 If given a chance which of the following activities, would you undertake in Yala swamp	Yes	Not Sure	No
Expand agricultural farm in the swamp			
Burn papyrus			
Hunt *Sitatunga*			
Use mosquito nets as fishing gear			
Question 14a	Yes ……	Not Sure	No ………

Do you support protection of the Yala swamp as an Important Bird Area		…….	
Question 14b. If yes, which of the following strategies do you prefer (tick one only)			
Restoration of the entire papyrus area			
Reclamation of the entire papyrus area for farming			
Allocating half of the papyrus area for farming			
Other (please specify) ……………………………………………………………...			

SECTION C: CHOICE EXPERIMENT METHODS

The Yala swamp provides the functions and services listed earlier such as nursery, breeding ground and habitat for fish no longer found in Lak Victoria, it also provides habitat for hundreds of birds some of which are threatened globally, it provides pasture for animals especially during drought, and it also has potential for farming especially during drought. In order for the community to continue enjoying these and more of the Yala swamp ecosystem functions, there is need for the community and other stakeholders to increase their commitment towards increasing the quality and in some cases the quantity of these ecosystems' functions and services.

Question 15: Choice Experiment

In this section I will show you a sequence of cards. Each card has three options, A, B and BAU. Each option has the amount of land size in Yala swamp allocated for the provision of five ecosystem functions and a governance framework and the cost you are required to contribute so that those functions are provided for the benefit of the society including you as a potential beneficiary.

Remember that BAU (*Business as usual option does not change in each set of cards*).

Consider the details on the cards to be able to understand the services better.

[Show the overview card and explain the attributes and their levels]

You will be first shown an example card.

[Show the respondent the example card and explain the process.]

On this card you see Management options A, B and BAU (business as usual) in which their different levels size of land allocations for:

01. Size of land allocated for habitat for the endemic and rare fish species
02. Size of land allocated for the papyrus or IBA
03. Size of land allocated for farming (both commercial and subsistence combined)
04. Size of land allocated for grazing of animals
05. The lead institutional arrangements proposed for the management of the swamp
06. The cost in form of bags of maize that you will be required to give as contribution for the enhancing the management of swamp.

Choice Experiment Responses

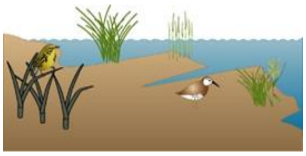
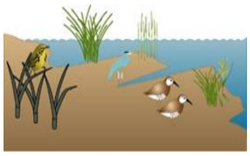
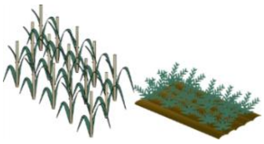
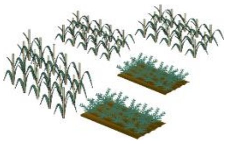
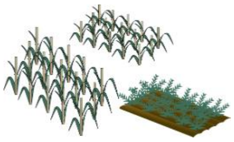
ATTRIBUTE	OPTION A	OPTION B	STATUS QUO
Fish diversity & abundance	Increasing 	Stable 	Declining 
Important bird area	8,000 ha 	16,000 ha 	13,000 ha 
Farming Area	2,000 ha 	10,000 ha 	5,000 ha 
Grazing Area	400 ha 	1,600 ha 	800 ha 
Governance Framework	Sub-location based community management 	NGO 	County Government 
Payment vehicle (Yearly donation of sack (s) of Maize)	5 	10 	0
Choice Made			

Figure **3.3**: Example of Choice card used in the study

Question 16a

When answering question 15, did you choose BAU always

Yes, all the time…………………...

Yes, only in some cases………….

No I did choose BAU at all……….

Question 16b

If you chose BAU, which of the following best captures your decision for doing so? **(Please tick only one)**

09. I am not the only one who will benefit from the swamp	
10. I have never benefited from the swamp	
11. I don't believe that those ecosystem services are important hence not worth conserving	
12. We should continue to use the swamp as is currently used without interventions	
13. I don't believe that I should make any contribution towards the management of the swamp even if I were to benefit from it	
14. Other (specify) ………………...	

THANK YOU SO MUCH FOR YOUR TIME AND COOPERATION

APPENDIX II: Lake Kanyaboli in Yala Swamp Wetland

APPENDIX III: Administration of discrete choice experiment

APPENDIX IV: Research permit

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